Casualty
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Estimating Unpaid Claims Using Basic Techniques

Jacqueline Friedland, FCAS, FCIA, MAAA, FCA
KPMG LLP

With significant contributions by Rachel Dutil, FCAS, FCIA and Edward Lam, FCAS
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Acknowledgments

It has been a true honor and privilege to prepare this new text titled Estimating Unpaid Claims Using Basic Techniques for the Casualty Actuarial Society (CAS). Special thanks go to my KPMG colleagues Rachel Dutil and Edward Lam. Rachel read, proofed, critiqued, modified, and ultimately improved each and every draft version of this text. Her contributions were tremendous at every step of the process. Edward Lam prepared all of the supporting exhibits and assisted with much of the research required for the text. He also reviewed most, if not all, of the draft versions. This text could not have been completed in such a timely manner without their invaluable input.

I also want to thank my KPMG colleagues in Toronto and the United States who assisted in reviewing various versions of the text. Each member of the KPMG Toronto Actuarial Practice was involved at one point or another in reviewing this text. Thanks to members of the CAS Task Force for their input and feedback. Finally, I want to acknowledge the significant contributions of Ralph Blanchard, Edward Y. Yao, Wynand Viljoen, and Eugene van der Westhuizen. Their international experience and knowledge was particularly valuable in ensuring that the text will have relevance for actuaries practicing throughout the world.

The objective of the CAS in creating a new text that addressed the estimation of unpaid claims was to replace a number of readings that existed on the syllabus of basic education as of 2007 with a single educational publication. Thus, candidates preparing for the actuarial exam addressing the estimation of unpaid claims using basic techniques would be able to replace numerous papers, which were written over a 30-year period, with a single text. Two major benefits of one educational publication are (1) consistent definitions of terms and (2) examples that are used with multiple estimation techniques. The CAS specified that the new text would focus on the learning objectives contained within the syllabus as of spring 2007. Furthermore, the CAS specifically requested that the new educational publication be written in a way as to be valuable to actuaries operating around the world.

In preparing Estimating Unpaid Claims Using Basic Techniques, I relied extensively on the following papers:

Adler, M.; and Kline, C.D. Jr., “Evaluating Bodily Injury Liabilities Using a Claims Closure Model,” *Evaluating Insurance Company Liabilities*, Casualty Actuarial Society *Discussion Paper Program*, 1988, pp. 1-66.

Berquist, J.R.; and Sherman, R.E., “Loss Reserve Adequacy Testing: A Comprehensive, Systematic Approach,” *Proceedings of the Casualty Actuarial Society* (PCAS) LXIV, 1977, pp. 123-184. Including discussion of paper: Thorne, J.O., *PCAS* LXV, 1978, pp. 10-33.

Bornhuetter, R.L.; and Ferguson, R.E., “The Actuary and IBNR,” *PCAS* LIX, 1972, pp. 181-195. Including discussions of paper: Cooper, W.P., *PCAS* LX, 1973, pp. 161-164; and White, H.G., *PCAS* LX 1973, pp. 165-168.

Casualty Actuarial Society, *Statement of Principles Regarding Property and Casualty Loss and Loss Adjustment Expense Reserves*, May 1988.

Fisher, W.H.; and Lange, J.T., "Loss Reserve Testing: A Report Year Approach," *PCAS* LX, 1973, pp. 189-207. Including discussions of paper: Skurnick, D., *PCAS* LXI, 1974, pp. 73-83; and authors' response, *PCAS* LXI, 1974, pp. 84-85.

Fisher, W.H.; and Lester, E.P., "Loss Reserve Testing in a Changing Environment," *PCAS* LXII, 1975, pp. 154-171.

Mack, T. "Credible Claims Reserve: The Benktander Method," *ASTIN Bulletin*, 2000, pp. 333-337.

Pinto, E.; and Gogol, D.F., "An Analysis of Excess Loss Development," *PCAS* LXXIV, 1987, pp. 227-255. Including discussions of paper: Levine, G.M., *PCAS* LXXIV, 1987, pp. 256-271; and Bear, R.A., *PCAS* LXXIX, 1992, pp. 134-148.

Wiser, R.F.; Cockley, J.E; and Gardner A., "Loss Reserving," *Foundations of Casualty Actuarial Science* (Fourth Edition), Casualty Actuarial Society, 2001, Chapter 5, pp. 197-285.

Throughout this text, I typically refer to these papers and other actuarial papers by the author, publication source, and year of publication.

It is important to recognize that learning objectives can change over time. To the extent that the CAS determines that new or different topics are appropriate for actuarial candidates studying basic estimation techniques for unpaid claims, it is anticipated that this text will need to be modified accordingly.

I have a request of readers of this text. Every effort has been made to ensure that all references and calculations are accurate. If we have inadvertently missed something, please contact me or the CAS so that future editions of the text can be corrected.

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PART 1 – INTRODUCTION

CHAPTER 1 – OVERVIEW

Importance of Accurately Estimating Unpaid Claims

Accuracy in estimating unpaid claims is critical to insurers. Unlike manufacturers, insurers may not know the true cost of goods sold during a financial reporting period until several years later. An insurer sells its promise to pay the policyholder or an injured party on behalf of the policyholder in the event of an occurrence covered by the insurance policy. For some insured events, the insurer is able to quantify the exact costs of settlement quickly and with great precision. For other insured events, the insurer may not know the ultimate cost for years, and possibly decades. Nevertheless, the insurer must report its financial results on a regular basis. Claim reserves (also known as technical provisions in some parts of the world) represent the insurer's estimate of its current liabilities for claims that occurred on or prior to the financial statement reporting date but that have not yet been paid. Actuaries around the world work with insurers and self-insurers to quantify, evaluate, and monitor estimates of unpaid claims.

We can look at the importance of accurately estimating unpaid claims from three viewpoints:

- Internal management
- Investors
- Regulators

Internal Management

From an internal management perspective, accuracy in the estimation of unpaid claims is essential for proper decision-making in virtually every area of an insurance company's operations including, but not limited to, pricing, underwriting, strategic, and financial decisions. An accurate estimate of unpaid claims is particularly important in pricing insurance products as inaccurate estimates could threaten the financial condition of an insurer. For example, an inadequate estimate of unpaid claims could drive an insurer to reduce its rates not realizing that the estimated unpaid claims were insufficient to cover historical claims. In this situation, the new lower rates would likely be insufficient to pay the claims that will arise from the new policies. The problem could be exacerbated if the insurer gains market share as a result of the lower rates, which ultimately would prove to be inadequate to cover future claims. This chain of events could eventually lead to a situation where the future solvency of the insurer is at risk.

We can also envision the reverse situation where an excessive estimate of unpaid claims could be a factor in inappropriate pricing decisions that could put the future financial condition of the insurer at risk. A redundant estimate of unpaid claims may drive an insurer to increase rates unnecessarily. The increased rates could lead to loss of market share, resulting in a loss of premium revenue to the insurer. A significant loss of revenue could negatively impact the financial strength of the insurer.

An inaccurate estimate of unpaid claims can also lead to poor underwriting, strategic, and financial decisions. Financial results often influence an insurer's decision-making process regarding where to increase business and whether to exit a market that is underperforming. If the financial results are misstated due to an excessive estimate of unpaid claims, an insurer may inappropriately choose to exit a particular line of business or region; such a decision could ultimately have a negative impact on the organization's future financial strength. In addition, an inaccurate estimate of unpaid claims can have a negative impact on the insurer's decisions regarding its reinsurance needs as well as its claims management procedures and policies. Finally, the accuracy of the unpaid claims estimate is also important for financial decision-making such as capital management, i.e., which lines of business get a larger proportion of allocated capital.

Investors

From the investors' perspective, accuracy in reserves is also essential to the decision-making process. Inaccurate reserves may lead to misstated balance sheets and income statements for the insurer. If reserves are incorrect, key financial metrics used by investors could be misleading. An insurer with insufficient reserves may present itself in a stronger position than it truly is. Conversely, an insurer with excessive reserves may show a weaker position than its true state. This could affect investors' decisions related to the insurer.

Regulators

Finally, insurance regulators rely on the financial statements of an insurer to carry out their supervisory role. Inaccurate reserves could result in a misstatement of the true financial position of an insurer. If a financially struggling insurer is masking its true state with inadequate reserves, a regulator may not become involved until too late in the process to help the insurer regain its strength.

Further Requirements for Accurate Reserves

State Law

Proper estimating of unpaid claims is more than just a necessity for managing, investing in, and regulating insurers – it is required by law. As early as the 1960s, the New York insurance law specified:

> … every insurer shall maintain reserves in an amount estimated in the aggregate to provide for the payment of all losses or claims incurred on or prior to the date of settlement whether reported or unreported which are unpaid as of such date and for which such insurer may be liable, and also reserves in an amount estimated to provide for the expenses of adjustments or settlement of such claims.

Today, many jurisdictions directly tie the legal requirements for accurate estimation of unpaid claims to the responsibilities of the actuary. The role of the Appointed Actuary has been created through insurance legislation in countries around the world.

National Association of Insurance Commissioners (NAIC)[1]

In the mid-1970s, due to the increasingly litigious environment in the U.S. and in reaction to the insolvencies of a number of property and casualty[2] (P&C) insurance companies, many of which involved inadequate claim reserves, the NAIC recommended that companies include claim reserve opinions (originally called certification of loss reserves) with their annual statements. The first opinion requirements emanated in 1980 from a limited number of state regulations.

In 1990, the NAIC began requiring that most P&C insurers in the U.S. obtain a Statement of Actuarial Opinion signed by a qualified actuary. The statement contains the qualified actuary's opinion regarding the reasonableness of the carried statutory loss and loss adjustment expense (LAE) reserves as shown in the statutory annual statement. In 1993, qualified actuaries signing statements of opinion started using the title of Appointed Actuary because the NAIC required that they must be appointed by the Board of Directors or its equivalent.

Other U.S.-Regulated Entities

Other U.S. non-NAIC regulated entities also require actuarial opinions. For example, many state insurance departments require opinions for captive insurers, self-insurers, and self-insurance pools as well as some underwriting pools and associations.[3]

Canada

In Canada, the Insurance Companies Act requires all federally regulated insurers to have an Appointed Actuary. The first responsibility of the Appointed Actuary, as set out in the Insurance Companies Act, is to value the actuarial and other policy liabilities of the company at the end of a financial year. The Appointed Actuary's valuation must be in accordance with generally accepted actuarial practice, which means complying with the rules and the standards set by the Canadian Institute of Actuaries (CIA). Further responsibilities, including the specific requirements of the Appointed Actuary's report on policy liabilities, are set forth by the Office of the Superintendent of Financial Institutions Canada (OSFI). Most provinces have adopted legislation similar to the federal insurance act, which defines the major responsibilities of the Appointed Actuary; thus, most provincial insurers also have an Appointed Actuary.

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[1] As the organization of insurance regulators from the 50 states, the District of Columbia, and the five territories, the NAIC promotes the development of uniform policy when uniformity is appropriate. State insurance regulators created the NAIC in 1871 to address the need to coordinate the regulation of multi-state insurers.

[2] Property and casualty insurance is a term used most frequently in the U.S. and Canada; the terms non-life and general insurance are often used in other countries.

[3] There are many different types of captive insurers operating around the world. Generally, a captive is a limited purpose, licensed insurance company, the main business purpose of which is to insure or reinsure the risks of the captive's owners. Self-insurance describes a wide range of risk financing arrangements through which organizations pay all or a significant portion of their own losses. Underwriting pools and associations are created in some jurisdictions to provide coverage for specific exposures, such as residual market automobile or aviation, across the insurance industry.

Other Examples – Australia and Slovenia

We offer two additional examples of countries that have enacted insurance legislation that requires an actuary to be involved in the process of developing unpaid claim estimates. Insurance legislation in Australia requires insurance companies to have an Appointed Actuary. According to the Amendment of the Insurance Act (1973), the signed actuary's report must contain a statement of the actuary's opinion about each of the following:

- The adequacy of all or part of the amount specified in the general insurer's accounts in respect of its liabilities, and the amount that the actuary considers would be adequate in the circumstances

- The accuracy of any relevant valuations made by the actuary

- The assumptions used by the actuary in making those valuations

- The relevance, appropriateness, and accuracy of the information on which those valuations were based

- Any other matter in respect of which the prudential standards require a statement of the actuary's opinion to be included in the report

The Insurance Act of Slovenia specifies that every company that is authorized to perform insurance operations is obliged to appoint a certified actuary. The insurance legislation defines the tasks of the certified actuary as follows:

> A certified actuary shall be obliged to examine whether premiums are calculated and technical provisions set aside in accordance with the regulations, and whether they are calculated or set aside so as to ensure the long-term meeting of all the insurance underwriting's obligations arising from the insurance contracts. … A certified actuary shall be obliged to submit to the supervisory boards and boards of directors, together with the opinion on the annual report, a report on the findings of the certified actuary with regard to the supervision carried out in the preceding year pursuant to the first paragraph hereunder. The said report must, in particular, include the reasons for issuing a favorable opinion, an opinion with a reservation or an unfavorable opinion of a certified actuary on the annual statements.

These examples demonstrate the important role of actuaries in determining and opining on claim reserves for insurers around the world.

Organization of This Book

This book focuses solely on the estimation of unpaid claims for P&C insurers, reinsurers, and self-insured entities. It is an introduction to the topic for actuarial candidates who should only consider this text as the beginning of their learning. There is a vast array of literature on the estimation of unpaid claims available throughout the international actuarial community. We direct actuaries who want to expand their knowledge of the topic beyond the scope of this text to:

- Casualty Actuarial Society (CAS) seminars such as the Reserve Variability Limited Attendance Seminar and the Casualty Loss Reserve Seminar

- CAS publications including the *Proceedings of the Casualty Actuarial Society* (PCAS), *Forum*, *Discussion Paper Program*, and *Variance*

- International actuarial organizations such as The Institute of Actuaries of Australia and The Institute of Actuaries / The Faculty of Actuaries (UK)

We organize this book in the following four parts:

- Part 1 – Introduction
- Part 2 – Information Gathering
- Part 3 – Basic Techniques for Estimating Unpaid Claims
- Part 4 – Estimating Unpaid Claim Adjustment Expenses

We also include three appendices following Part 4 that contain the CAS Statement of Principles and specific actuarial Standards of Practice promulgated by the American Academy of Actuaries (Academy), which are related to unpaid claim estimate analysis.

In Part 1, we take a detailed look at the process for estimating unpaid claims from the perspective of the claims department. We follow a claim from its first report to the insurer, through the establishment of an initial case outstanding, to partial payments and changes in the case outstanding, and finally to ultimate claim settlement.

We dedicate Part 2 to the topic of information gathering. Before actuaries can delve into quantitative analysis of unpaid claims, they must gather information. This information includes detailed statistics summarizing the historical claims and exposure experience of the insurer as well as a thorough knowledge of the insurer's environment. We describe the types of data actuaries use and methods for organizing the data. We discuss the importance of meetings with those involved in the claims and underwriting processes and provide extensive details of the types of information the actuary should seek from such meetings. The development triangle is one of the most common tools used by actuaries to evaluate the performance of an insurer and to determine estimates of unpaid claims. In Part 2, Chapter 5, we describe how to create and use development triangles.

In Part 3, we explore basic techniques for estimating unpaid claims. We generally rely on examples based on the actual experience of insurers in the U.S. and Canada. (See further description regarding examples later in this chapter.) We use similar portfolios of insurance in successive chapters to allow a comparison of the results from different techniques. A changing environment, such as an increase in claim ratios, a shift in the strength of case outstanding, and a change in product mix, can have a pronounced effect on the accuracy of the estimation technique. In this part, we demonstrate through detailed examples the impact of various changes on each of the methodologies for estimating unpaid claims. We conclude Part 3 with an evaluation of all the methods presented in the previous chapters. In the final chapter for this part, we also discuss on-going monitoring of unpaid claim estimates.

The purpose of Part 4 is to present techniques for estimating unpaid claim adjustment expenses. Claim adjustment expenses are the costs of administering, determining coverage for, settling, or defending claims even if it is ultimately determined that the claim is invalid. Some claims produce very little adjustment expenses; an example of such a claim is a house fire that is settled with only a few phone calls. Other claims, such as an asbestos claim, may revolve around complex legal and medical issues and may involve many interested parties. Claim adjustment expenses for an asbestos claim often involve litigation which can lead to high defense costs and expert fees and thus, very high expenses. In some cases, the claim adjustment expenses for asbestos claims may be significantly greater than the indemnity payment itself.

Historically, insurers categorized claim adjustment expenses as allocated loss adjustment expenses (ALAE) and unallocated loss adjustment expenses (ULAE).[4] ALAE correspond to those costs the insurer is able to assign to a particular claim, such as legal and expert witness expenses – thus, the name allocated loss adjustment expense. ULAE, on the other hand, is not easily allocated to a specific claim. Examples of ULAE include the payroll, rent, and computer expenses for the claims department of an insurer.

While actuaries in Canada still separate claim adjustment expenses into ALAE and ULAE, the NAIC promulgated two new categorizations of adjustment expenses (effective January 1, 1998) for U.S. insurers reporting on Schedule P[5] of the P&C statutory Annual Statement: defense and cost containment (DCC) and adjusting and other (A&O). Generally, DCC expenses include all defense litigation and medical cost containment expenses regardless of whether internal or external to the insurer; A&O expenses include all claims adjusting expenses, whether internal or external to the insurer.

The material in the appendices addresses some of the key professional obligations of U.S. and Canadian actuaries that are related to the estimation of unpaid claims as promulgated by the CAS and the Academy. The CAS Code of Professional Conduct states:

> It is the professional responsibility of an Actuary to observe applicable standards of practice that have been promulgated by a Recognized Actuarial Organization for the jurisdictions in which the Actuary renders Actuarial Services and to keep current regarding changes in these standards.

The Actuarial Standards Board (ASB) is a U.S. actuarial organization associated with the Academy that promulgates the standards of practice for the U.S. actuarial profession. Because the Academy is a "Recognized Actuarial Organization" and it issues standards of practice with respect to actuarial practice in the U.S., CAS members are required to observe the Academy's standard if they practice in the U.S. The controlling jurisdiction is the one in which the actuary renders the actuarial services. Therefore, CAS members who do not practice in the U.S. are not required to observe the Academy's standards but would instead be required to observe the standards set by any other recognized actuarial organization for the jurisdiction in which they practice (e.g., the CIA in Canada or the Institute/Faculty of Actuaries in the United Kingdom). The requirements for most of these organizations come in the form of standards of practice, educational notes, statements of principles, and other professional guidelines. In the

[4] In Canada, ULAE is also referred to as internal loss adjustment expense (ILAE).

[5] Schedule P is an important section of the U.S. P&C statutory Annual Statement. In his paper "Completing and Using Schedule P," (*CAS Forum*, 2002) Sholom Feldblum states: "Schedule P is the actuarial portion of the Annual Statement and is critical to monitoring the solvency of insurers." Schedule P includes a ten-year summary, by line of insurance, of earned premiums, claim and claim expense payments, and unpaid claims and expenses; it also contains claim development schedules (also by line of insurance) for incurred net claims, paid net claims, and net bulk and incurred but not reported (IBNR) reserves.

appendices to this book, we provide, in their entirety, selected CAS and Academy documents related to the estimation of unpaid claims.

Ranges of Unpaid Claim Estimates

Throughout the book, we focus on obtaining point estimates for unpaid claims and claim-related expenses. We demonstrate the potential difficulty in obtaining one single estimate of the claims liability through numerous examples applied to the same line of business for the same experience period. Each of the methods presented results in a different value of the unpaid claim estimate. Furthermore, we recognize that, to the extent that we are dealing with the estimation of the mean of a stochastic process, the actual unpaid claims will almost always differ from the estimate.

Clearly, a range of estimates of the unpaid and a statement of our confidence that the actual unpaid claims (as proven at final development) will be within the stated range are valuable to management, regulators, policyholders, investors, and even the general public. However, the insurer's balance sheet requires the insurer to record a point estimate of the unpaid claims.[6]

Actuarial Standard of Practice No. 43 (ASOP 43) adopted in June 2007 by the ASB defines the *actuarial central estimate* as an estimate that represents an expected value over the range of reasonably possible outcomes. It is beyond the scope of this book to address ranges of unpaid claim estimates. We refer the reader to the wealth of material published by the CAS and various other international actuarial organizations on the subject of ranges for unpaid claim estimates.

Background Regarding the Examples

Differences in Coverages and Lines of Business Around the World

There are significant differences in the types of P&C insurance offered around the world. There are also differences in the names that are used for similar coverages throughout the world. For example, in the U.S. and Canada, insurers use the name "automobile insurance" to refer to the P&C coverage for automobiles and trucks; insurers from the U.K. call this coverage "motor insurance"; insurers conducting business in India refer to this coverage as "car insurance"; and in South Africa, insurers use both "car insurance" and "motor insurance." Similarly, the name of the coverage protecting personal homes and possessions is "homeowners insurance" in the U.S. and Canada, "home insurance" in India, and "home insurance" or "homeowners insurance" in Australia. In South Africa, some insurers differentiate between "household content" and "household building" insurance.

Some of the major coverages for U.S. P&C insurers, such as workers compensation or medical malpractice, may not exist at all in other countries, or if they exist, they may operate in a very different way. For example, in Canada, workers compensation insurance is not categorized as a P&C insurance coverage and is not sold by insurers. Instead, Canadian workers compensation coverage is provided by monopolistic provincial funds; pension and life (not P&C) actuaries typically provide actuarial services to the provincial workers compensation funds.

[6] In a number of countries (e.g., Australia, Singapore, the United Kingdom, and South Africa), insurers are required to hold provisions (i.e., the estimate of unpaid claims) at the 75% confidence level.

Since this text was written with the hope that it would be used by actuaries throughout the world, the differences in both the names of the coverages and the coverages themselves presented a challenge in creating meaningful examples. There was an even greater challenge in finding sources of data representative of the wide range of claims behavior that often exists in different P&C coverages. Due to limitations in readily available global data sources, we rely on claim development data contained in *Best's Aggregates & Averages Property/Casualty United States & Canada – 2008 Edition* (*Best's Aggregates & Averages*)[7] for many of our examples. We also rely on actuarial colleagues at Canadian insurers who volunteered data from their organizations. This data has been disguised through the use of multipliers and adjustments to protect the privacy of the organizations.

While the names of the particular coverages and the patterns inherent in the data used in our examples may be unique to the U.S. or Canadian insurance environments, we believe that actuaries can apply the approaches, issues, and methodologies within the P&C (i.e., general or non-life) insurance market of any country around the world.

Description of Coverages Referred to in This Book

As noted above, we refer to and use examples for U.S. and Canadian lines of insurance. To assist the reader in understanding these types of coverage, we briefly describe each P&C coverage referred to in the text. The insurance *coverages* (also referred to as *lines of business*) listed below are in alphabetical order.

— *Accident benefits* is a Canadian no-fault automobile coverage that provides numerous benefits following a covered accident including: medical and rehabilitation expenses, funeral benefits, death benefits, and loss of income benefits. Because this is a no-fault coverage, it is payable by the insured's insurer regardless of fault for the accident.

— *Automobile property damage* is a subcoverage of automobile liability insurance and provides protection to the insured against a claim or suit for damage to the property of a third-party arising from the operation of an automobile.

— *Collision* is a subcoverage of automobile physical damage coverage providing protection against claims resulting from any damages to the insured's vehicle caused by collision with another vehicle or object. Collision is a first-party coverage and responds to the claims of the insured when he or she is at fault.

— *Commercial automobile liability* is a coverage that provides protection from the liability that can arise from the business use of owned, hired, or borrowed automobiles or from the operation of an employee's automobiles on behalf of the business.

— *Crime insurance* protects individuals and organizations from loss of money, securities, or inventory resulting from crime, including but not limited to: employee dishonesty, embezzlement, forgery, robbery, safe burglary, computer fraud, wire transfer fraud, and counterfeiting.

[7] *Best's Aggregates & Averages* is a comprehensive reference with current and historical statistics on the U.S. and Canadian P&C insurance industries. It provides industry-wide aggregates and long-term statistical studies. It also provides a complete financial overview of the P&C industry based on consolidated industry performance.

— *Direct compensation* is a Canadian automobile coverage that provides for damage to, or loss of use of, an automobile or its contents, to the extent that the driver of another vehicle was at fault for the accident. It is called direct compensation because, even though someone else caused the damage, the insured person collects directly from his or her insurer instead of from the person who caused the accident.

— *General liability* in the U.S. and Canada covers a wide array of insurance products. The principal exposures covered by general liability insurance are: premises liability, operations liability, products liability, completed operations liability, and professional (i.e., errors and omissions) liability.

— *Medical malpractice* is also known as medical professional liability insurance. This coverage is often further separated into hospital professional and physician/surgeon professional liability insurance. Medical malpractice coverage responds to the unique general liability exposures present for insureds (both individuals and organizations) offering medical care and related professional services. We use an example from a pivotal paper, "Loss Reserve Adequacy Testing: A Comprehensive, Systematic Approach" by James R. Berquist and Richard E. Sherman.[8] While the data for the medical malpractice example is obviously very dated, the methodology, approach, and conclusions remain applicable today.

— *Personal automobile insurance* is also known as private passenger automobile insurance. Automobile insurance (either personal or commercial) can provide a variety of coverages, including first-party and third-party coverages; the available coverages are dependent upon the jurisdiction in which the insurance is written.

— *Primary insurance* refers to the first layer of insurance coverage. Primary insurance pays compensation in the event of claims arising out of an insured event ahead (first) of any other insurance coverages that the policyholder may have.

— *Private passenger automobile liability* provides third-party liability protection to the insured against a claim or suit for bodily injury or property damage arising out of the operation of a private passenger automobile.

— *Private passenger automobile physical damage* is a personal lines coverage providing protection against damage to or theft of a covered private passenger automobile.

— *Property insurance* provides protection against most risks to property, such as fire, theft, and some weather damages. There are many specialized forms of property insurance including fire insurance, flood insurance, earthquake insurance, home insurance, and boiler and machinery insurance.

— *Umbrella and excess insurance* typically refers to liability types of coverage available to individuals and companies protecting them against claims above and beyond the amounts covered by primary insurance policies or in some circumstances for claims not covered by the primary policies.

[8] *PCAS*, 1977.

— *U.S. workers compensation* provides coverage for the benefits the insured (i.e., the employer) becomes legally responsible for due to workplace injury, illness, and/or disease. The complete name for this U.S. coverage is workers compensation and employers liability insurance. U.S. workers compensation also covers the cost to defend against, and possibly pay, liability claims made against the employer (i.e., the insured) on account of bodily injury to an employee.

Key Terminology

We generally use *italics* for the first reference and definition of a new term. Throughout this text, we strive to use definitions contained within Standards of Practice and Statements of Principles of the CAS and the Academy. We indicate where definitions of the CAS or Academy differ from the Standards of Practice of the CIA. We also strive to clearly identify wherever we deviate from definitions of the U.S. and Canadian professional actuarial organizations.

At the end of each chapter, we present exhibits, some of which include multiple sheets, in Roman numeric order. On all these exhibits, we include detailed footnotes supporting the calculations.

Insurer

Throughout this book, we use the term *insurer* to represent any risk bearer for P&C exposures, whether an insurance company, self-insured entity, or other. There are certain situations where a different approach or different factors within a technique may be more appropriate for insurance companies (including reinsurance companies) than self-insurers (including organizations with funded self-insured programs, captive insurers, pooling associations, etc.). When this happens, we clearly identify the appropriate course of action for the specific type of risk bearer.

Reserves

The term *reserves* itself is tricky. The financial statements of insurers in the U.S. and Canada contain many different types of reserves including: case reserves, loss reserves, bulk and IBNR reserves, case LAE reserves, unearned premium reserves, reserves for bad debts, reserves for rate credits and retrospective adjustments, general and contingency reserves, and earthquake reserves. The primary focus of this text, however, is estimating unpaid claims and claim adjustment expenses.

ASOP 43 limits the term reserve to its strict definition as an amount booked in a financial statement. ASOP 43 defines the term *unpaid claim estimate* to be the actuary's estimate of the obligation for future payment resulting from claims due to past events. ASOP 43 further defines *unpaid claim estimate analysis* to be the process of developing an unpaid claim estimate.

In this text, we strive to use terminology consistent with ASOP 43. We acknowledge that many actuaries and the professionals they work with are more familiar with the term reserves than unpaid claim estimate; similarly, the term reserving is more frequently used today than estimating unpaid claims. Nevertheless, we predominantly use the terminology of ASOP 43, in an attempt to be consistent with more recent CAS developments aimed at improving communication and an effort to use terminology that is consistent with actuarial standards of practice throughout the world.

We differentiate between *unpaid claim estimate* and *carried reserve*. The unpaid claim estimate is the result of the application of a particular estimation technique. For the same line of business and the same experience period, different estimation techniques will likely generate different unpaid claim estimates. In addition, the unpaid claim estimate will likely change from one valuation date to another for the same portfolio. The carried reserve for unpaid claims is the amount reported in a published statement or in an internal statement of financial condition.

The unpaid claims estimate includes five components: case outstanding on known claims, provision for future development on known claims, estimate for reopened claims, provision for claims incurred but not reported, and provision for claims in transit (i.e., claims reported but not recorded). We use the terms *case outstanding* or *unpaid case* to refer to the estimates of unpaid claims established by the claims department, third-party adjusters, or independent adjusters for known and reported claims only; case outstanding do not include future development on reported claims. Actuaries refer to the sum of the remaining four components (i.e., provision for future development on known claims, estimate for reopened claims, provision for claims incurred but not reported, and provision for claims in transit) as the broad definition of *incurred but not reported* (*IBNR*).

IBNR claims are often further separated into two components:

- Incurred but not yet reported claims (pure IBNR or narrow definition of IBNR)
- Incurred but not enough reported (IBNER, commonly referred to as development on known claims)

One of the most important reasons for separating IBNR into its components is to test the adequacy of case outstanding over time. This can be an important management tool and a useful tool for the actuary when determining which methods are most appropriate for estimating unpaid claims.

Throughout this book, unless specifically noted otherwise, we use the broad definition of IBNR. We also use the terms *IBNR* and *estimated IBNR* interchangeably.

In Part 2, Chapter 3, we discuss the importance of the actuary completely understanding the different types of data provided for the purpose of estimating unpaid claims. The actuary must understand whether or not the data include or exclude: IBNR, estimates of unpaid claim adjustment expenses, recoverables from salvage and/or subrogation, reinsurance recoveries, and policyholder deductibles.

Claims, Losses, and Claim Counts

The terms *claims* and *losses* are used interchangeably in this text. We purposefully use the term claims rather than losses since claims is used more frequently in standards of practice of the U.S. and Canadian actuarial organizations as well as other international actuarial organizations. The term claims is also more frequently used for financial reporting purposes of insurers. We recognize that the current practice within many U.S. and Canadian insurance organizations is still to use the term losses – particularly when referring to ultimate losses, expected losses, loss ratios, and loss adjustment expenses. Nevertheless, we have specifically selected to use the term claims. Thus, in this text, we refer to ultimate claims, expected claims, claim ratios, and claim adjustment expenses.

We differentiate between claims (dollar values) and *claim counts (*or *number of claims*).

Reported Claims

In this text, we use the term *reported claims* instead of incurred claims (or incurred losses). While the term incurred losses is used by many throughout the P&C insurance industry, it can be misunderstood as to whether or not it includes IBNR. Many actuaries use the labels *case incurred* or *incurred on reported claims* to specifically note that the losses do not include IBNR. For consistency and simplicity throughout this book, we choose the term *reported claims*. Reported claims (both in the text and exhibits of this book) generally refer to the sum of cumulative paid claims and case outstanding estimates at a particular point in time. In certain methods or discussions, which are clearly defined in the text, we will refer to incremental instead of cumulative reported claims.

Ultimate Claims

Ultimate claims represent the total dollar value after all claims are settled and closed without any chance of reopened claims.[9] For some *short-tail* lines of insurance, such as some lines of property insurance and automobile physical damage, insurers generally know the value of ultimate claims within a relatively short period of time, often within one or two years after the end of the accident period. However, for *long-tail* lines of insurance, such as U.S. general liability and workers compensation, it may take many years, and in some situations even decades, before the insurer knows the value of ultimate claims.

A key step in the actuarial process of estimating unpaid claims is the projection of ultimate claims. In this book we present numerous techniques for estimating unpaid claims. While you can mathematically manipulate many of the methods to simply derive the unpaid claim estimate, wherever possible we first present the projection of ultimate claims. Using the projected ultimate claims, we then calculate the estimate of unpaid claims for IBNR and the total unpaid claim estimate (i.e., the sum of IBNR and case outstanding). We believe that the projected ultimate claims are valuable for the purpose of evaluating and selecting the final unpaid claim estimate and for determining the accuracy of the prior estimate of unpaid claims. We address the evaluation of numerous estimation techniques in detail in the last chapter of Part 3.

Claim-Related Expenses

In this text, we use the terms *claim adjustment expenses* and *claim-related expenses* to refer to total claim adjustment expenses (i.e., the sum of ALAE and ULAE, or the sum of DCC and

[9] Some accounting approaches estimate ultimate claims on a policy year basis in a manner that includes losses yet to be incurred. In this book, we address only losses incurred through a specified point in time.

A&O). We continue to use the terms ALAE and ULAE because of their wide-spread use and acceptance. In our examples, unless specifically noted, claims include ALAE and exclude ULAE.

Experience Period

We use the term *experience period* to refer to the years included in a specific technique for estimating unpaid claims.

Emergence

In this book, the term *emergence* is used to refer to the reporting or development of claims and claim counts over time. In Canada, many actuaries use the term emergence to refer to the rate of payment of ultimate claims, particularly in the context of calculating estimates of discounted claim liabilities.

CHAPTER 2 – THE CLAIMS PROCESS

Overview

The financial condition of a P&C insurer cannot be assessed accurately without sound estimates of unpaid claims. But what are unpaid claim estimates and where do they come from? Claim and claim adjustment expense reserves (as reported on an insurer's financial statements) represent an insurer's liability for unpaid claims as of a particular point in time. Both claims professionals and actuaries have responsibilities related to the unpaid claim estimate of an insurer. As previously noted, there are five elements comprising the total unpaid claim estimate:

- Case outstanding
- Provision for future development on known claims
- Estimate for reopened claims
- Provision for claims incurred but not reported
- Provision for claims in transit (incurred and reported but not recorded)

Claims professionals are responsible for estimating case outstanding on claims that are reported to the insurer; these estimates are also known as "unpaid case" and "case estimates." According to consolidated claim development data for the U.S. insurance industry as a whole, unpaid case, net of reinsurance, represent less than 50% of total unpaid claims and claim expenses.[10] (The proportion of unpaid case to total unpaid claims varies tremendously by line of business and from insurer to insurer.) While claims professionals typically estimate case outstanding, actuaries are responsible for estimating the remaining components of total unpaid claims.

In this chapter, we focus on the unpaid claim estimate from the perspective of the claims professional. As we will see in later chapters, actuaries rely on the historical variations in the case outstanding generated by claims professionals as a base for determining the remaining components of total unpaid claims. Therefore, it is important for the actuary to understand the entire claims process. The actuary must understand why the estimated value of a reported claim could vary over time and how changes in case outstanding are processed by an insurer.

Claims Professionals

The claims professional, who is often referred to as a claims examiner or claims adjuster, can be an employee of the insurer or an employee of an organization external to the insurer. Large commercial insurers generally maintain internal claims departments with many claims adjusters managing the claims. Small to mid-sized commercial insurers and self-insurers often hire third-party claims administrators (TPAs) to handle a specific book of claims. TPAs frequently handle the claims from beginning to end (i.e., from the initial report to the final payment). Insurers usually require the TPA to report details of the claims on a predetermined basis (e.g., monthly or quarterly). In certain circumstances, a TPA manages all the claims of an insurer, and the insurer only has a minimal number of claims personnel reviewing the activities of the TPA. The compensation for services of a TPA is generally based on a contract for the entire book of business and not by individual claim, though compensation varies among TPAs.

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[10] The source of data is *Best's Aggregates & Averages* (2008 Edition), consolidated annual statement data for the U.S. insurance industry.

An insurer may hire an independent adjuster (IA) to handle an individual claim or a group of claims. The insurer, who may have an active claims department, may need an IA to handle a specific type of claim or a claim in a particular region where the insurer does not have the necessary expertise. Also when a disaster occurs, such as a hurricane or earthquake, the insurer may hire a number of IAs (or a firm of IAs) to handle the large volume of claims. The compensation for the services of IAs is generally based on a fee per claim.

A Claim is Reported

The estimation process for unpaid claims begins when an insured first reports a claim, or notice of an event, to the insurer. Insureds may report claims in several ways, including but not limited to: telephone (often to a call center), Internet (the insurer's Web site), e-mail, in person at an insurer's branch office, notice to an insurance intermediary (such as an insurance agent or broker), or a lawyer's letter with a formal statement of claim. A claims professional of the insurer then reviews the initial claim report.

The first decision a claims adjuster, either internal or external to the insurer, encounters is whether or not the reported claim is covered under the terms of a valid policy. To determine whether the reported incident represents a covered claim and to assist in the establishment of an initial case outstanding estimate, claims professionals generally review the following:

- Effective dates of the policy
- Date of occurrence
- Terms and conditions of the policy
- Policy exclusions
- Policy endorsements
- Policy limits
- Deductibles
- Reinsurance or excess coverage
- Reporting requirements
- Mitigation of loss requirements
- Extent of injury and damages
- Extent of fault
- Potential other parties at fault
- Potential other sources of recovery

Once the claims professional recognizes that a liability exists, or may exist, for a covered incident, he or she will establish an initial case outstanding. For some types of claims, insurers may rely on a formula or tabular value[11] as the basis of the initial case outstanding. For example, an insurer may initially set all automobile physical damage glass claims at $500. For U.S. workers compensation claims, the insurer may use a tabular system where the type of injury dictates the initial case outstanding value. For other types of claims, a claims professional may

[11] Tabular estimates of unpaid claims are used for some lines of insurance whereby initial case outstanding values are set based on specific predetermined formula, which take into account characteristics of the injured party and the insurance benefits. The use of tabular values would be most common for accident benefits and U.S. workers compensation insurance. Not all insurers, however, writing these coverages use tabular systems.

analyze the specific details of the insured event to generate an independent estimate of the initial case outstanding.

It is important to recognize that claims professionals generally estimate case outstanding based on the information known at that time. As additional information about a claim becomes available, the estimated value of the claim will likely change. (We demonstrate this point later in the chapter with a detailed example.)

There are several different approaches commonly used by insurers to set case outstanding. These different approaches may best be understood with an example. Assume a claim is reported under a medical malpractice policy with a policy limit of $1 million. One of the most common approaches is to establish the case outstanding based on the best estimate of the ultimate settlement value of such a claim including consideration of future inflationary forces. Other insurers may set the case outstanding based on the maximum value, which would be the policy limit of $1 million. Another approach is for the claims adjuster to seek the advice of legal counsel. Assume that the legal counsel estimates that there is an 80% chance that the claim will settle without any payment and a 20% chance of a full policy limit claim. Some insurers may then set the case outstanding based on the mode, which would be $0; and others may set the case outstanding based on the expected value calculation or $200,000 [(80% x $0) + (20% x $1 million)].

Insurers differ in their practices with respect to the establishment of case outstanding for claim adjustment expenses. While some insurers establish case outstanding for the estimated claim amount only; others establish case outstanding for the estimated claim amount and all claim-related expenses. Even for those insurers who do establish total estimated claim amount and claim adjustment expense case outstanding, there are differences in whether or not the case outstanding for estimated claim amount and claim-related expenses are recorded and tracked separately. Some insurers may establish case outstanding for ALAE (or DCC) only and other insurers for ULAE (or A&O) only.

There are also different practices for the establishment of case outstanding for salvage and subrogation recoveries. Some insurers set up specific case outstanding based on an estimate of the salvage or subrogation recovery that the insurer expects to receive (i.e., the case outstanding is net of expected salvage and subrogation recoveries). Many insurers, however, simply track the actual salvage and subrogation recoveries but do not establish case outstanding for these types of recoveries.

For many insurers, determining the case outstanding for reinsurance recoveries is a fairly straight-forward exercise. When the reinsurance is proportional (i.e., quota share), insurers determine the ceded case outstanding based on the reinsurer’s share of the total case outstanding. If the reinsurance is excess of loss, the reinsurance ceded case outstanding for a claim that exceeds the insurer’s retention is simply the total case outstanding estimate (provided that the claims adjuster estimates the case outstanding on a total limits basis) less the insurer’s retention.

The Life of a Claim

One single insurance claim may have a life that extends over a number of years. We will use the example of an automobile insurer who issued a policy effective for a one-year term beginning on December 1, 2007 and ending on November 30, 2008. Assume an accident occurred on November 15, 2008, and the insurer did not receive notice of the claim until February 20, 2009, more than two months after the end of the policy year. Starting on February 20, 2009 (the report date of the claim), a claims professional will record a number of transactions related to this claim.

The different types of claim transactions over the life of the claim could include:

- Establishment of the initial case outstanding estimate
- Notification to the reinsurer if the claim is expected to exceed the insurer's retention
- A partial claim payment to injured party
- Expense payment for independent adjuster
- Change in case outstanding estimate
- Claim payment (assumed to be final payment)
- Takedown of case outstanding and closure of claim
- Reopening of the claim and establishment of a new case outstanding estimate
- Partial payment for defense litigation
- Final claim payment
- Final payment for defense litigation
- Closure of claim

We summarize the details for our sample claim in the following table. (We use the abbreviation case O/S for case outstanding in the following table.)

Table 1 – Claim Fact Summary

Policy Period	December 1, 2007 to November 30, 2008
Date of Accident	November 15, 2008
Date of Claim Report	February 20, 2009

Claim Transactions

Date	Transaction	Reported Value of Claim to Date	Cumulative Paid to Date
February 20, 2009	Case O/S of $15,000 established for claim only	$15,000	$0
April 1, 2009	Claim payment of $1,500 – case O/S reduced to $13,500 (case O/S change of -$1,500)	$15,000	$1,500
May 1, 2009	Expense payment to IA of $500 – no change in case O/S	$15,500	$2,000
September 1, 2009	Case O/S for claim increased to $30,000 (case O/S change of +$16,500)	$32,000	$2,000
March 1, 2010	Claim thought to be settled with additional payment of $24,000 – case O/S reduced to $0 and claim closed (case O/S change of -$30,000)	$26,000	$26,000
January 25, 2011	Claim reopened with case O/S of $10,000 for claim and $10,000 for defense costs	$46,000	$26,000
April 15, 2011	Partial payment of $5,000 for defense litigation and case O/S for defense costs reduced to $5,000 – no change in case O/S for claim	$46,000	$31,000
September 1, 2011	Final claim payment for an additional $12,000 – case O/S for claim reduced to $0 (case O/S change of -$10,000)	$48,000	$43,000
March 1, 2012	Final defense cost payment for an additional $6,000 – case O/S for defense costs reduced to $0 and claim closed (case O/S change of -$5,000)	$49,000	$49,000

As explained in Chapter 1, case outstanding represent the sum of the values assigned to specific known claims whether determined by claims adjusters or set by formula. In our example, case outstanding refers to the estimates, for claim and claim-related expenses (e.g., IA and defense costs), for the one claim that occurred on November 15, 2008. The initial case outstanding is the adjuster's estimate of the total amount the insurer will pay on this individual claim at the time of first notice to the insurer (i.e., February 20, 2009).

The example in Table 1 illustrates a number of important characteristics of insured claims. First, claim activity typically extends over a period of time – more than three years for this particular claim. Second, the estimated value of a claim can change over the life of the claim and is not ultimately established until the claim is finally closed. In our example, the insurer initially closes the claim on March 1, 2010, but then reopens it almost one year later on January 25, 2011, with an increase to the case outstanding. The estimated case outstanding value can turn out to be too high or too low, although it is reasonable in light of the information available at the time when the claims professional sets the estimate.

A third characteristic is that an insured claim can have many different types of payments associated with it. In our example, the insurer makes an initial claim payment to the injured party on April 1, 2009. This claim payment provides for out-of-pocket medical expenses reported by the claimant. Since the insurer questioned the validity of the claim, they hired an IA; as a result, there was a payment of $500 for the IA's services on May 1, 2009. (Insurers in the U.S. would classify this type of expense as A&O; in Canada, they would categorize this expense as ALAE.) On March 1, 2010, the insurer makes another payment of $24,000 to the claimant for lost wages and additional medical expenses. At this time, the insurer assumes this to be the final payment. Roughly one year later, a claims professional reopens the claim. Over the course of the following year, the insurer makes further payments for defense litigation, additional lost wages, and medical expenses.

A fourth characteristic of insured claims is that there are many dates associated with each claim:

— *Policy effective date* is the date the insurer issues the insurance policy (December 1, 2007)

— *Accident date*, or date of loss, is the date the covered injury occurs (November 15, 2008)

— *Report date* is the date the insurer receives notice of the claim (February 20, 2009)

— *Transaction date* is the date on which either a case outstanding transaction takes place or a payment is made (see all the dates in the preceding table)

— *Closing dates* are the dates on which the claim is initially closed (March 1, 2010) and finally closed (March 1, 2012)

— *Reopening date* is the date the insurer reopens the claim (January 25, 2011)

This example clearly does not cover every combination of transactions possible. Some claims open and close on the same day with a single payment. Such claims would have only one transaction and would likely never show a case outstanding value. In our example, when the partial payment occurs on April 1, 2009, the insurer reduces the case outstanding estimate by exactly the same amount as the claim payment. However, this chain of events may not happen for all claims. As an insurer makes a specific payment, it may choose to reduce the case outstanding more than the payment, less than the payment, not reduce it at all, or even increase it, depending on the exact circumstances of the particular claim.

The payments on a specific claim are the amounts paid through a given date or over some specified time period. Therefore, when referring to paid claims, it is important to clearly state whether the claims are cumulative or incremental. Cumulative paid claims refer to the sum of all claim payments through the valuation date. Incremental paid claims refer to the sum of all claim payments made during a specified time interval.

In the above example, the cumulative paid claims including claim-related expenses are:

- $1,500 at April 1, 2009
- $2,000 at May 1, 2009
- $26,000 at March 1, 2010
- $31,000 at April 15, 2011
- $43,000 at September 1, 2011
- $49,000 at March 1, 2012

The incremental paid claims during calendar year 2009 (January 1, 2009 to December 31, 2009) are $2,000; the incremental paid claims during calendar years 2010, 2011, and 2012 are $24,000, $17,000, and $6,000, respectively.

The case outstanding is the estimated amount of future payments on a specific claim at any given point in time. In our example, the initial case outstanding recorded on the report date of the claim is $15,000. This amount varies over the life of the claim; just before the claim initially closes in March 2010, the case outstanding is $30,000. When the claim is reopened in January 2011, a new case outstanding is established for both claim amount and defense costs. Ultimately, the claim settles for a greater amount than the case outstanding for both claim amount and defense costs.

Similar to paid claims, it is important to define the time period when referring to reported claims. Generally, when looking at a specific claim, we use the term "reported claims" (or case incurred) to mean the sum of cumulative claim payments through a specific date and the case outstanding at the same point in time. Using the example above, the reported claims are:

- $15,000 at the time of first report (i.e., February 20, 2009)

- $15,500 at May 1, 2009 after a payment of $500 to an IA

- $32,000 at September 1, 2009, when the insurer increases the case outstanding to $30,000 ($2,000 cumulative paid claims + $30,000 case outstanding)

- $26,000 upon initial closing on March 1, 2010 ($26,000 cumulative paid claims + $0 case outstanding)

- $46,000 upon reopening on January 25, 2011 ($26,000 cumulative paid claims + $10,000 claims and $10,000 defense costs case outstanding)

- $48,000 at September 1, 2011 after final claim payment ($43,000 cumulative paid claims and LAE + $5,000 case outstanding for defense costs)

- $49,000 at March 1, 2012 after final defense costs payment ($49,000 cumulative paid claims and LAE + $0 case outstanding)

For a particular claim, we calculate the reported claims over a period of time as the reported claims at the end of the period minus the reported claims at the beginning of the period. Mathematically, this is equivalent to adding the incremental paid claims over the period to the change in case outstanding (ending case outstanding minus beginning case outstanding). In our example, the reported claims for the period beginning on January 1, 2009 and ending on December 31, 2009 are $32,000. As of January 1, 2009, the claim was not yet reported and thus there are $0 reported claims for the claim. The incremental claim payments during 2009 are $2,000 and the change in case outstanding is $30,000 ($30,000 ending case outstanding minus $0 beginning case outstanding). The reported claims over the period January 1, 2010 to December 31, 2010 are -$6,000. The incremental claim payments in 2010 are $24,000 and the change in case outstanding is -$30,000 (ending case outstanding of $0 minus beginning case outstanding of $30,000). You can use similar calculations to derive the reported claims during 2011 and 2012.

As indicated above, we use the term "reported claims" under two contexts, incremental and cumulative, and it is important to look at the time period involved to differentiate between these two contexts. For a particular claim or the aggregate of a group of claims, we can summarize reported claims at a specific point in time. In such a context, reported claims are equal to the sum of cumulative paid claims through a specific date and case outstanding as of that same date. Many actuarial projection techniques rely on this definition of reported claims.

Reported claims can also refer to the claim activity over an interval of time. An example of reported claims used in this context is the insurer's income statement. As previously mentioned, we define the reported claims over a period of time using the following formulae:

Reported claims = reported claims at end of period – reported claims at beginning of period

Reported claims = paid claims during period + case outstanding at end of period
– case outstanding at beginning of period

Further Claim Examples

In Table 2 (on the following page), we present additional illustrations of how claim transactions can affect reported claims. (We use the abbreviation case O/S to refer to case outstanding in Table 2.)

Table 2 – Examples of Changes in Reported Values

	At December 31, 2007			Transactions During 2008			At December 31, 2008		
Example Number	**Cumulative Paid Claims**	**Case O/S**	**Reported Claims**	**Paid Claims**	**Change in Case O/S**	**Reported Claims**	**Cumulative Paid Claims**	**Case O/S**	**Reported Claims**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	-	-	-	100	-	100	100	-	100
2	200	-	200	50	-	50	250	-	250
(Making payments where there had been no previous case outstanding increases reported claim.)									
3	-	-	-	-	1,000	1,000	-	1,000	1,000
(Establishing a case outstanding increases reported claim by the amount of the case outstanding.)									
4	-	1,000	1,000	100	(100)	-	100	900	1,000
(Payment with offsetting case outstanding reduction has no effect on reported claim.)									
5	500	5,000	5,500	200	(1,000)	(800)	700	4,000	4,700
(If case outstanding is reduced by a larger amount than the claim payment, the impact is a reduction to reported claim.)									
6	5,000	10,000	15,000	12,000	(10,000)	2,000	17,000	-	17,000
(If payment on closing exceeds case outstanding, reported claim transaction is positive.)									
7	5,000	10,000	15,000	6,000	(10,000)	(4,000)	11,000	-	11,000
(If payment on closing is less than case outstanding estimate, reported claim transaction is negative.)									
8	5,000	15,000	20,000	4,500	-	4,500	9,500	15,000	24,500
(Claim payment with no change in case outstanding increases the reported claim.)									
9	3,000	10,000	13,000	-	(4,000)	(4,000)	3,000	6,000	9,000
(No payment and decrease in case outstanding decreases the reported claim.)									
10	2,000	10,000	12,000	1,000	5,000	6,000	3,000	15,000	18,000
(Payment and increase in case outstanding result in increase in reported claim.)									

Columns (4) and (10) of the above table show reported claims as of year-end 2007 and 2008, respectively. Reported claims at a point in time (i.e., year-end 2007 and 2008) are equal to the cumulative claim payments plus the case outstanding at that point in time. However, reported claims shown in Column (7) represent the incremental reported value during the period of time running from January 1, 2008 to December 31, 2008. Reported claims over the year are equal to sum of the payments during the year (Column (5)) and the changes in case outstanding (Column (6)).

The transactions presented in Table 2 vary with respect to the impact on total reported claims. In the first two examples, there are payments made in 2008 on claims where there was no prior existing case outstanding at December 31, 2007; thus total reported claims for both of these claims increase. Such payments could occur when the insurer reopens a claim. In a situation where the payment made during the year is offset by an equal reduction in the case outstanding, there is no change to reported claim (Example Number 4). If the payment is larger than the reduction in case outstanding, then the reported claim will increase (Example Number 6). If the payment is smaller than the reduction in case outstanding, then the reported claim will decrease (Examples Number 5 and 7). A change in case outstanding without any associated payment will also impact the reported claim (Examples Number 3 and 9).

While the reported claims in the interval can be positive or negative, the reported claims at a point in time are rarely negative. Remember that we define the reported claims at a point in time to equal cumulative payments plus case outstanding at that point in time.

PART 2 – INFORMATION GATHERING

INTRODUCTION TO PART 2 – INFORMATION GATHERING

In the chapter "Loss Reserving" in the *Foundations of Casualty Actuarial Science* (2001), Ronald Wiser describes a four-phase approach to the process of estimating unpaid claims:

— Exploring the data to identify its key characteristics and possible anomalies. Balancing data to other verified sources should be undertaken at this point.

— Applying appropriate techniques for estimating unpaid claims.

— Evaluating the conflicting results of the various methods used, with an attempt to reconcile or explain the different outcomes. At this point, the projected ultimate amounts are evaluated in contexts outside their original frame of analysis.

— Monitoring projections of claim development over subsequent calendar periods. Deviations of actual development from projected development of counts or amounts are one of the most useful diagnostic tools in evaluating the accuracy of unpaid claim estimates.

In Chapters 3 through 6 of this book, we focus on Mr. Wiser's first phase, the exploratory analysis of the data. The process for collecting and understanding the data and other relevant information is so critical that we devote four chapters to the topic. We begin Chapter 3 with a description of the types of data that actuaries use for estimating unpaid claims and present various options for organizing the data.

Equally important to collecting quantitative data is developing an understanding of the environment in which the insurer operates. In Chapter 4, we discuss the importance of meeting with the management of both the claims and underwriting departments to gain a more complete understanding of the environment in which the insurer operates. We provide a list of possible questions for actuaries to use in their meetings with management. Changes in the insurer's internal operations as well as changes in the external setting can affect the results of the various techniques for estimating unpaid claims in different ways. (In Part 3, Chapters 7 through 15, we review numerous examples of changing environments and examine the result of such changes on alternative techniques for estimating unpaid claims.)

The development triangle is one of the actuary's most important tools for displaying and analyzing data; it is an important component of many claims projection techniques. In Chapter 5, we describe in depth how to create a development triangle. The development triangle is also a critical tool in the evaluation of the influence of operational and environmental changes on claims. In Chapter 6, we present a detailed example of how actuaries can use development triangles as a diagnostic tool, allowing examination of the consequences of operational and environmental changes on historical claims.

CHAPTER 3 – UNDERSTANDING THE TYPES OF DATA USED IN THE ESTIMATION OF UNPAID CLAIMS

The availability of appropriate data and information is essential for accurately estimating unpaid claims. We can classify data as originating from either internal or external sources.

Sources of Data

Large insurers are usually able to generate the detailed claims and exposure data required by actuaries for the estimation of unpaid claims from their own management information systems. Thus, actuaries working for large insurers often rely solely on data produced internally.

Smaller insurers, however, may be more limited in the internal data that they can generate. The data may be limited in its volume and thus its credibility to the actuary, or the data may be unavailable due to systems limitations of the organization. Such situations may force actuaries to turn to external sources of data. Large insurers who recently entered a new line of insurance or a new geographical region (e.g., a new territory, state, or province) may also need to turn to external sources of information when developing estimates of unpaid claims.

The sources of readily available external data vary by jurisdiction and by product line. The following are examples of external sources of information available in certain jurisdictions:

United States
- Insurance Services Office, Inc. (ISO)
- National Council on Compensation Insurance (NCCI)
- Reinsurance Association of America (RAA)
- The Surety & Fidelity Association of America (SFAA)
- A.M. Best Company (Best)
- NAIC Annual Statement data

Canada
- Best
- General Insurance Statistical Agency (GISA)
- Insurance Bureau of Canada (IBC)
- Reinsurance Research Council (RRC)
- Market-Security Analysis & Research Inc. (MSA)

Many insurers (of all sizes) use a combination of internally-generated data and external industry benchmarks. External information can be particularly valuable when selecting tail development factors, trend rates, and expected claim ratios (i.e., expected loss ratios). We address all of these topics in Part 3 of this book. Incorporating external information can also be useful when the actuary evaluates and attempts to reconcile the results of the various estimation methods in order to make a final selection of ultimate claims and unpaid claim estimate.

It is important that actuaries recognize the potential shortcomings in the use of data generated from external sources. The International Actuarial Association (IAA) strongly believes that entity-specific data is far preferred over external data. There is a risk that external data may be misleading or irrelevant due to differences relating to: insurance products, case outstanding and settlement practices, insurers' operations, coding, geographic areas, and mix of business and product types. Thus, the actuary must carefully evaluate the relevance and value of external data.[12]

Homogeneity and Credibility of Data[13]

Different lines of insurance exhibit different claim behaviors. For example, claims from insurance policies sold to businesses generally do not have the same characteristics as claims from insurance policies sold to individuals, even when the insurance coverages are identical. Likewise, claims for umbrella and excess insurance are different from claims for primary insurance. Even within a single line of insurance, the characteristics of claims by subcoverage can differ significantly. For example, claims involving only property damage for automobile liability policies are generally reported and paid very quickly and have a relatively low severity (i.e., average settlement value). On the other hand, claims arising from automobile accidents involving catastrophic spinal injuries may take years to settle in some jurisdictions and could ultimately cost millions of dollars.

It is often possible to improve the accuracy of estimating unpaid claims by subdividing experience into groups exhibiting similar characteristics, such as comparable claim experience patterns, settlement patterns, or size of claim distributions. As a result, when separating data into groups for an analysis of unpaid claims, actuaries focus on the following key characteristics:

- Consistency of the coverage triggered by the claims in the group (i.e., group claims that will generally be subject to the same or similar laws, policy terms, claims handling, etc.)
- Volume of claim counts in the group
- Length of time to report the claim once an insured event has occurred (i.e., reporting patterns)
- Ability to develop an appropriate case outstanding estimate from earliest report through the life of the claim
- Length of time to settle the claim once it is reported (i.e., settlement, or payment, patterns)
- Likelihood of claim to reopen once it is settled
- Average settlement value (i.e., severity)

[12] The Academy's Risk Management & Financial Reporting Council, Financial Reporting Committee argued to the International Actuarial Standards Board (IASB) that, in general, external data is typically used (and most appropriately used) only as a fallback where internal data is not sufficiently credible.

[13] The following section borrows from the CAS Statement of Principles Regarding Property and Casualty Loss and Loss Adjustment Expense Reserves, issued in May 1988.

Actuaries strive to group claims by lines and sublines of business which display similar traits with respect to the characteristics listed above. They may also group claims by policy limits to achieve similar claims attributes within a block of business.

The goal for the actuary is to divide the data into sufficiently homogeneous groupings without compromising the credibility of the data. Credibility refers to the predictive value given to a group of data. Increasing the homogeneity of the group of data or increasing the volume of data in the group tends to increase credibility. If the actuary divides the data into too many homogeneous groupings, however, there is a risk that the volume of data in the individual groups may become insufficient to perform a reliable analysis. This is a frequent challenge for the actuary. In "An Introduction to Credibility Theory," Longley-Cook states:

> We may liken our statistics to a large crumbly loaf cake, which we may cut in slices to obtain easily edible helpings. The method of slicing may be chosen in different ways – across the cake, lengthwise down the cake, or even in horizontal slices – but only one method of slicing may be used at a time. If we try to slice the cake more than one way at a time, we shall be left with a useless collection of crumbs.[14]

Consider automobile accident benefits coverage[15] as an example of how actuaries must decide how to divide the cake. Options include analyzing the claims in total or breaking out the claims into the individual components (e.g., medical/rehabilitation, disability income, death benefits, funeral services, and supplementary benefits). Certainly, the claims behavior is very different for funeral services claims than it is for medical/rehabilitation claims. There are differences in claims reporting patterns, settlement patterns, severity of claims, and frequency of claims between these subcoverages. However, if there is insufficient data by subcoverage, a detailed analysis may not produce a more accurate estimate of unpaid claims than the analysis based on the combined data for all of the accident benefits components. Further considerations for the actuary are efficiency and time and resource requirements of separate versus combined analyses. The funeral benefits may represent a stable portion of the total accident benefit claims and thus may not justify the time and resources required for independent analysis.

We can raise similar questions with regards to many other lines of insurance with a combination of coverages or benefits under one policy. For example, is it preferable to analyze claims for bodily injury and property damage separately or on a combined basis for general liability, or for automobile liability insurance?

Another consideration regarding the homogeneity and the grouping of data relates to changes in the portfolio. In some circumstances, it may be appropriate to combine personal automobile and commercial automobile data even though these lines typically exhibit different underlying claims patterns. However, if the relative volume of business is changing between these two lines of insurance, the grouping may not be appropriate. In Part 3, we present an example of the effect on various projection techniques of analyzing a portfolio where the volume of personal automobile is increasing at 5% per year while the commercial automobile volume is increasing at 30%. We will

[14] *PCAS*, 1962.

[15] As described in Chapter 1 – Overview, accident benefits coverage provides for the medical needs of the driver and passengers arising from an automobile accident. Insurers in the U.S. call this coverage automobile no-fault.

see that the consequence of the changing proportion on the various estimation techniques can be significant.

Types of Data Used by Actuaries

Claims and Claim Count Data

Actuaries rely on many different types of data in the establishment and testing of unpaid claim estimates for an insurer. Some of the most common types of data include:

- Incremental paid claims
- Cumulative paid claims
- Paid claims on closed claims
- Paid claims on open claims
- Case outstanding
- Reported claims (i.e., sum of cumulative paid claims plus case outstanding)
- Incremental reported claims
- Reported claim counts
- Claim counts on closed with payment
- Claim counts on closed with no payment
- Open claim counts
- Reopened claim counts

We can use all of the above data types with claims only (i.e., losses only), claim-related expenses, or claims and claim-related expenses combined.

Claim-Related Expenses

The actuary needs to know how the insurer handles expenses before using the data. Where the claim data and policy limits include claim adjustment expenses, many actuaries combine historical claims and ALAE experience when conducting analyses of unpaid claims. Unless otherwise indicated, we use the term claims to denote both claims and ALAE combined. When the claim analysis includes only ALAE and not ULAE, the actuary needs to perform a separate analysis to evaluate the unpaid ULAE estimate.

There are multiple ways to classify claim-related expenses, not just the one generic ALAE/ULAE split. As mentioned in Chapter 1 – Overview, in the U.S., for statutory reporting purposes, insurers categorize LAE as either *defense and cost containment* (DCC) or as *adjusting and other* (A&O). The DCC versus A&O split depends on the function of the expenses. A&O includes all claim adjuster costs regardless of whether or not they are attributable to internal adjusters (which may be viewed as overhead and difficult to attribute to an individual claim) or external independent adjusters (which are generally easily attributable to an individual claim). Various other reporting requirements may place different demands on how insurers categorize claims expenses. Insurers may also use their own internal approach to categorizing claim expenses, suitable to their own internal claim management processes. It is therefore sometimes necessary for the actuary to investigate which claim expenses are included in the data being used and how the terms are defined. For example, different people working for the same insurer may define the term ALAE in different ways: one way by financial reporting systems so as to meet external reporting requirements and another way to meet internal claim management needs.

Multiple Currencies

Claims data for some insurers may exist in the information systems in different currencies. Depending on the volume of claims in differing currencies, the actuary may need to adjust the data prior to the analysis. One approach is to separate the data by currency and then combine it after translating it using the appropriate exchange rates at a common point in time. For example, assume that claims data are in Euros, pounds sterling, and U.S. dollars; if the actuary is conducting an analysis that requires a final unpaid claim estimate in Euros, the actuary could then convert all amounts to Euros using current exchange rates.

Large Claims

When conducting analyses of unpaid claims, it is important for actuaries to be aware of how *large claims* influence the various estimation techniques. As we will see in a later part of this book, the presence of unusually large claims can distort some of the methods used for estimating unpaid claims. In these situations, the actuary may choose to exclude the large claims from the initial projection and then, at the end of the unpaid claims analysis, add a case specific projection for the reported portion of large claims and a smoothed provision for the IBNR portion of large claims. In Part 3, we discuss alternative approaches that the actuary may use to adjust the estimation techniques for large claims.

The determination of the size criteria of a large claim is not a precise science. It may vary by line of business, by geographic region, and even between analyses of unpaid claims. Actuarial judgment is critical in determining how to adjust the analyses for large claims. Actuaries consider the following in establishing the large claim threshold:

- Number of claims over the threshold each year
- Size of claim relative to policy limits
- Size of claim relative to reinsurance limits
- Credibility of internal data regarding large claims
- Availability of relevant external data

One starting point for the actuary is large claims reports from the insurer’s claims department. Claims departments often maintain reports that routinely track the individual experience of claims exceeding a certain threshold. The definition of a large claim, however, may differ between the claims department and the actuary. For example, the claims department may have set up internal controls that require monthly reporting on all claims greater than $100,000. However, to the actuary, a large claim may be any claim with a reported value (i.e., the sum of cumulative paid claims plus the current estimate of unpaid case) greater than $1 million. The actuary can also seek advice from the reinsurance department when deciding upon the large claim threshold.

Recoveries

There are numerous types of recoveries available to insurers that could affect an insurer's net claims experience. *Deductibles* are one of the most common types of insurer recoveries, and it is important for the actuary to understand how the insurer processes claims with respect to deductibles. For some lines of insurance, such as automobile physical damage, claim payments to insured policyholders are typically reduced due to the application of the deductible. Since this line of insurance is a first-party coverage, it is reasonable to apply the deductible before issuing payment to the insured. However, for general liability, insurers usually make claim payments before the application of the deductible. Since general liability is a third-party line of insurance, the injured party is not the insured party. The insurer normally issues a payment to the injured party and then, following the payment, seeks recovery of the deductible from the insured. Insurers differ in their practices with respect to case outstanding for deductibles. Some insurers establish a case outstanding net of the deductible while other insurers do not consider the deductible in the establishment of the case outstanding. Even within the same insurer, practices may vary between lines of insurance.

Salvage and *subrogation* are two other common forms of recoveries for insurers. When an insurer pays an insured for a claim considered to be a total loss, the insurer acquires the rights to the damaged property. Salvage represents any amount that the insurer is able to collect from the sale of such damaged property. Subrogation refers to an insurer's right to recover the amount of claim payment to a covered insured from a third-party responsible for the injury or damage. It is important for the actuary to understand the insurer's practices with respect to both salvage and subrogation. The actuary needs to know whether the insurer records paid claims net or gross of these recoveries. Questions to consider include:

- Are salvage and subrogation recoveries tracked separately from claim payments?
- Are claim payments only recorded net of salvage or subrogation recoveries?
- Is data for salvage and subrogation recoveries available to the actuary?

Claim operations may separate the responsibilities associated with a claim, such that people other than those responsible for claim adjustment and settlement are involved with the investigation, analysis, and pursuit of potential recoveries. This may have implications to the data the actuary is using.

Reinsurance

It is vital that the actuary understands the reinsurance program of the insurer and the effect of reinsurance on claims when conducting an analysis of ceded or net unpaid claims. Understanding the insurer's reinsurance program may be dictated by statute.[16]

Current and previous reinsurance plans and retentions directly affect an insurer's estimates of unpaid claims. Therefore, the actuary may need to analyze claims both gross and net of reinsurance recoveries (i.e., both before and after taking into account the reinsurance recoveries). Some actuaries separately analyze gross claims and ceded claims (i.e., claims ceded to reinsurers) and then determine the estimate of net unpaid claims as the difference between estimated gross unpaid claims and estimated ceded unpaid claims. Other actuaries separately analyze gross claims and net claims (i.e., gross claims minus claims ceded to reinsurers) and then determine the estimate of ceded unpaid claims as the difference between estimated gross unpaid claims and estimated net unpaid claims. In either situation, the actuary must review the implied net or ceded unpaid claim estimate for reasonableness. For insurers who do not cede claims to a reinsurer, there is no difference between claims net and gross of reinsurance, and in these situations separate analyses are not necessary.

One area that requires the actuary's close attention is the treatment of ALAE in excess of loss reinsurance contracts. Generally, there are three possible treatments of ALAE:

- Included with the claim amount in determining excess of loss coverage (which is the most common treatment today)

- Not included in the coverage

- Included on a pro rata basis; the ratio of the excess portion of the claim to the total claim amount determines coverage for ALAE

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[16] The requirements for actuaries providing Statements of Actuarial Opinion in both the U.S. and Canada demonstrate the importance for the actuary to understand the reinsurance program. According to the NAIC's "Quarterly and Annual Statement Instructions for the year 2007, Property/Casualty," the Appointed Actuary must provide "RELEVANT COMMENT" paragraphs to address the specific topic of reinsurance. The Instructions state:

> RELEVANT COMMENT paragraphs should address retroactive reinsurance, financial reinsurance and reinsurance collectibility. Before commenting on reinsurance collectibility, the actuary should solicit information from management on any actual collectibility problems, review ratings given to reinsurers by a recognized rating service, and examine Schedule F for the current year for indications of regulatory action or reinsurance recoverable on paid losses over 90 days past due. The comment should also reflect any other information the actuary has received from management or that is publicly available about the capability or willingness of reinsurers to pay claims. The actuary's comments do not imply an opinion on the financial condition of any reinsurer.

OSFI, the Canadian regulator for federally registered insurance companies, requires the Appointed Actuary's Report (i.e., the report on policy liabilities) to contain a description of the insurer's reinsurance arrangements during the experience period used in the report. Specifically, the Appointed Actuary is required to report on:

- Types of arrangements
- Significant terms and conditions
- Order of application of treaties
- Changes in the arrangements, including changes in retentions or limits

Appointed Actuaries for Canadian insurers are also required to report on how any changes in reinsurance arrangements were taken into account in the development of unpaid claims for the insurer.

The treatment of ALAE will likely have an effect on data requirements, organization, and potentially the methodology selected for estimating unpaid claims.

Exposure Data

Some techniques used for estimating unpaid claims require a measure of the insurer's *exposure* to claims. Earned premium may be the most common type of exposure used in estimation techniques for both insurers and reinsurers. Other types of exposures used by insurers may include: written premium, policies in force, policy limits by region (for the early estimation of unpaid claims related to a natural catastrophe), the number of vehicles insured (for personal automobile insurance), and payroll (for workers compensation).

It is often valuable for actuaries to adjust historical premiums to current rate levels (i.e., on-level premiums). There are two ways in which actuaries typically derive on-level premiums. The first method essentially requires a re-rating of historical exposures at current rates. This is a computer-intensive exercise and may not be feasible in all situations. A second method is to use a summary of rate level changes over the experience period and adjust the premiums in the aggregate for historical rate changes. There are many instances, however, when the actuary is unable to collect reliable information regarding rate changes and must use the premium data from the insurer on an unadjusted basis.

Self-insured organizations do not generally collect premiums in the same way that an insurance company does. As a result, actuaries working with self-insurers generally use other readily observable and available exposure bases that they believe are closely related to the risk and thus the potential for claims.

The following table summarizes, by line of business, examples of the types of exposures that actuaries often use for the analysis of self-insurers' unpaid claims.

Table 1 – Examples of Exposures for Self-Insurers

Line of Insurance	**Exposure**
U.S. workers compensation	Payroll
Automobile liability	Number of vehicles or miles driven
General liability for public entities	Population or operating expenditures
General liability for corporations	Sales or square footage
Hospital professional liability	Average occupied beds and outpatient visits
Property	Property values
Crime	Number of employees

Exposures are important not only as an input to certain techniques used for estimating unpaid claims but also for evaluating and reconciling the results of the various techniques. We address this further in Part 3, Chapter 15.

Insurer Reporting and Understanding the Data

We cannot emphasize strongly enough how critical it is for the actuary to fully understand the types of data generated by the insurer's information systems. Different insurers, TPAs, IAs, or even different departments within the same organization may use the same term to mean different things. The actuary must know the true meaning of the types of claims data contained in the insurer's claims reports and information systems.

"Incurred loss" is an example of a term that the actuary may initially assume is used fairly consistently throughout the insurance industry. Upon closer examination, however, we see that incurred losses means different things to different people. To someone in the finance department, incurred losses usually refer to the transactional losses incurred during a defined period, usually a calendar (or fiscal) quarter or year. Thus, the incurred losses to someone in finance usually refer to the sum of payments made during the time period plus the change in total unpaid claims. Furthermore, finance departments usually include IBNR in their definition of incurred loss. To an actuary wanting to build an incurred claim development triangle, incurred losses are typically the cumulative claim payments through a valuation date plus the case outstanding at the same valuation date.[17] Some actuaries refer to these losses as case incurred or incurred on reported claims. We have also seen the term incurred losses used in TPA loss reports to refer to case outstanding only. To avoid any confusion, we use the term "reported claims" throughout this book to refer to case incurred losses. (Cumulative and incremental reported claims are introduced in Chapter 2 and are explored further in Chapter 5.)

The terms "unpaid claims" and "reserves" are other examples of terminology that have many different meanings. In a report from the finance department, unpaid claims (or reserves) generally refer to the estimate of total unpaid claims including both case outstanding and IBNR. For the claims department, however, reports showing unpaid claims (or reserves) generally refer to case outstanding only. Some TPA reports use the term reserves in detailed claims listings to represent the total reported value of the claims (i.e., cumulative payments plus current case outstanding estimates). In this situation, the actuary would need to subtract cumulative paid claims from the reserves in order to determine the value of unpaid case. The actuary also needs to understand if the unpaid claim estimate is net or gross of deductibles or other types of recoveries, including salvage, subrogation, and reinsurance recoveries, and where in the claims process those recoveries are included. Finally, the actuary needs to know whether or not case outstanding include claim-related expenses. Some insurers record case outstanding and payments for claim-related expenses separately from claim only case outstanding and payments; other insurers record expense payments separately (from claim payments) but do not carry case outstanding for expense.

Another example of differences in the use of the term "reserves" can be found in the actuarial and accounting professions in South Africa and the United Kingdom. It is typical for accountants in these countries to distinguish between provisions (i.e., unpaid claim estimates) and reserves; actuaries usually use the term "reserves" to refer to the unpaid claim estimates and do not distinguish between different types of reserves.

[17] In the U.S., the National Council on Compensation Insurance has Financial Data Calls that require incurred losses by accident year that include IBNR. Similarly, the incurred loss triangles in Schedule P of the U.S. statutory annual statement include IBNR. Hence, actuaries also prepare incurred loss triangles that do include IBNR. These provide further examples of why an actuary must seek a full understanding of the data prior to conducting any analysis or drawing any conclusions.

Even paid claims can mean different things to different people. The actuary must understand whether the paid claims are cumulative or incremental, whether they include or exclude claim-related expenses (and what kind of claims expenses), and whether they are net or gross of recoveries.

The actuary must also understand how the insurer's system tracks claim counts. The number of claims is an important type of data for several techniques used to estimate unpaid claims. Claim counts are also critical to several diagnostic analyses that may be appropriate to undertake upon commencing an analysis of unpaid claims. Claim counts may also be important at the conclusion of the estimation process when the actuary evaluates and selects a final value for the unpaid claim estimate. The actuary needs to understand whether the insurer counts an automobile accident with payments for multiple coverages (e.g., bodily injury liability and physical damage) or to multiple parties (i.e., claimants) as one claim or multiple claims. Another important consideration for the actuary is how reopened claims are treated and whether they are considered a new claim. Reopened claims can be particularly important for some lines of business, such as U.S. workers compensation and accident benefits coverages.

It is absolutely essential to the development of appropriate estimates of unpaid claims that actuaries clearly identify the specific data that exists and that they are requesting from the insurer, and that they fully understand the data that they receive.

Verification of the Data

An analysis based on incorrect or incomplete data can produce erroneous results. Therefore, while not requiring a formal audit of the data, actuarial standards of practice generally do require that actuaries establish suitable procedures to verify that the data utilized is reliable and sufficient for the intended purpose. This data review may include the following components:

— *Consistency with financial statement data* – Can the actuary reconcile the data with financial statement data (that may be subject to some form of external audit)?

— *Consistency with prior data* – Is the current data consistent with the data used in the prior analysis? If not, why?

— *Data reasonableness* – Are there certain values that appear questionable, such as large negative paid claims or apparent inconsistencies between data elements? Questionable values are not always incorrect values, but the actuary should generally investigate questionable values before using them, especially if material to the analysis.

— *Data definitions* – Does the actuary know how each of the data items is defined? The actuary should make a reasonable effort to determine the definition of each data element used in the analysis rather than assuming a certain definition given the label or name assigned to the element. As discussed earlier, similar labels do not always imply similar definitions. The actuary may also need to know what the default values are for certain items. If the default is used too often in the absence of true information for that element, the data element may not be sufficiently reliable for analysis purposes.

While data verification is essential to any actuarial analysis, proper documentation of the verification process and findings should also be part of the process. This can include discussions with external auditors and, at times, reliance on their work regarding data verification.

Organizing the Data

Key Dates

Having identified the types of data that actuaries use in determining unpaid claim estimates, we now discuss how to organize the data. Key dates for the organization of the claim data include:

- Policy effective dates
- Accident date
- Report date
- Accounting date
- Valuation date

The *policy effective dates* are the beginning and ending dates of the policy term (i.e., the period for which the policy triggered by the claim was effective). Some systems only capture the policy year (i.e., the year that the policy became effective). Reinsurers refer to the policy date as the underwriting date (or year).

The *accident date* is generally the date that the accident or event occurred that triggered the potential policy coverage. Some systems only capture the accident year (i.e., the year that the triggering event occurred). This term can be ambiguous with regard to certain policies such as claims-made policies. With claims-made policies, the accident date may be defined as the date that the claim was reported as this is the date of the event that triggered coverage. Alternatively, some may define the accident date for a claims-made policy as the date that an injury occurred with the injury not covered by the policy unless the resulting claim was reported during the policy period.

The *report date* is the date on which the claim was reported to the insurer and recorded in its claims system. Some databases may split this into two dates: report date and record date. There is even a potential for a third date – a *notification date*. The notification date is generally defined as the date that the insurer is put on notice that an event occurred that may result in a claim. For example, an insured motorist may notify their insurer that they got in an accident (but that they are not filing a claim); this is the notification date. A week later, the insurer may receive a claim from the other party in the accident; this is the report date, or the date on which the claim was reported. The following day, the claims department records the claim into their system; this is the record date. Notification dates are not commonly used in many actuarial analyses.

The *accounting date* is the date that defines the group of claims for which liability may exist, namely all insured claims incurred on or before the accounting date. The accounting date may be any date selected for a statistical or financial reporting purpose, but generally must follow a date for which the history is frozen in time, such as a month, quarter, or year-end (with the latter two being the more common accounting dates used).

An example may assist in understanding how claim activities relate to the accounting date. Assuming an accounting date for an occurrence-based policy of December 31, 2008, the total unpaid claim estimate as of this accounting date must provide for all incurred claims, whether reported or not, as of December 31, 2008. An insured loss that occurred on December 30, 2008, for a policy written on December 15, 2008, would be included in the estimate of unpaid claims for the accounting date December 31, 2008, regardless of when the claim is reported to the insurer. However, an insured loss that occurred on January 5, 2009, for the same policy that was written on December 15, 2008, would not be included in the unpaid claim estimate for the accounting date December 31, 2008, because this accident occurred after the accounting date.

The *valuation date* is the date through which transactions are included in the database used in the evaluation of the liability, regardless of when the actuary performs the analysis. A valuation date may be prior to, coincident with, or subsequent to the accounting date. Actuaries typically use claims data at month-end, quarter-end, half-year-end, or year-end valuation dates.

Again, examples may assist in understanding the concept of valuation date. To determine total unpaid claims at December 31, 2008, actuaries may use data valued as of December 31, 2008. In this example, the valuation date and the accounting date are the same. For some insurers, however, internal financial reporting requirements at year-end are such that the actuary does not have time to wait for the December 31, 2008 data to be available. In such circumstances, actuaries often use data at an earlier valuation date to estimate what the requirement for unpaid claims at the accounting date of December 31, 2008 will be. For example, some insurers used data as of September 30, 2008 to estimate unpaid claims as of December 31, 2008. In this example, the valuation date is September 30, 2008, and the accounting date is December 31, 2008.

In certain situations, an actuary may conduct an analysis of unpaid claims where the valuation date is later than the accounting date. For example, assume that the actuary wants to re-estimate what the claim liabilities were at December 31, 2006, taking into account the actual experience of 2007 and 2008. The actuary can use a December 31, 2008 valuation date and thus include actual paid and reported claims experience through 2007 and 2008. When estimating the unpaid claims at December 31, 2006 (the accounting date), the actuary subtracts the actual payments at December 31, 2006 from the projected ultimate claims that he or she derives using data through December 31, 2008 (the valuation date).

Aggregation by Calendar Year

Calendar year data is transactional data. For example, calendar year 2008 paid claims refer to the claim payments made by the insurer between January 1, 2008 and December 31, 2008. Similarly, calendar year 2008 reported claims are the 2008 payments plus the change in case outstanding (ending case outstanding at December 31, 2008 minus beginning case outstanding at January 1, 2008[18]). Reported claim counts for the 2008 calendar year represent those claim counts reported during the January 1, 2008 to December 31, 2008 period; and closed claim counts represent the number of claims closed during the year.

The primary uses of calendar year data for the actuary are the aggregation of exposures and diagnostic testing when analyzing accident year claims data. Calendar year 2008 written premium is simply the sum of all written premium reported/recorded in the accounting systems during

[18] The actual accounting equation uses ending case outstanding at December 31, 2007, but this is generally synonymous with beginning reserves at January 1, 2008.

2008. The following formula defines calendar year earned premium:

Written Premium + Beginning Unearned Premium Reserve – Ending Unearned Premium Reserve

Advantages of Calendar Year Data

A major advantage of calendar year data is that there is no future development. The value remains fixed and does not change as time goes by as do claims and exposures aggregated based on accident year, policy year, and even report year bases. Another advantage of calendar year data is that it is readily available. Most insurers conduct financial reporting on a calendar year basis, thus data by calendar year is typically easily accessible to the actuary.

Disadvantages of Calendar Year Data

The fixed nature of calendar year data also presents a disadvantage. The inability to address the critical issue of development is a disadvantage of calendar year statistics. Very few techniques for estimating unpaid claims are based on calendar year claims. Calendar year exposures, on the other hand, are frequently used in estimation techniques along with accident year claims.

Aggregation by Accident Year

Aggregation by accident year is, by far, the most common grouping of claims data for the actuarial analysis of unpaid claims. *Accident year data* refers to claims grouped according to the date of occurrence (i.e., the accident date or the coverage triggering event). For example, accident year 2008 consists of all claims with an occurrence date in 2008.

Caution must be exercised when working with self-insurers' accident year data as their fiscal year ends may not coincide with the calendar year-end. For example, accident year 2008 may be defined to coincide with a self-insurer's August 1, 2007 to July 31, 2008 fiscal year or may include claims occurring during the January 1, 2008 to December 31, 2008 calendar year period. Again, the important message for the actuary is to understand the data, including how it is organized and presented.

Insurers compile claims data according to a variety of accident periods including accident month, accident quarter, accident half-year, and accident year. The insurer groups together all claims with accident dates within the particular time period.

Various financial reporting schedules and statistical organizations for insurers in the U.S. and Canada require claim information by accident year. In some areas, such as Lloyds of London, financial reporting by underwriting year is more common than accident year.

As indicated previously, actuaries often use calendar year exposures with accident year claims. Calendar year earned premiums provide an approximate matching of the claims that occur during the year with the insurance premiums earned by an insurer during the year in which the insurance coverage is effective. We will see below that claims and exposures aggregated by policy year provide an exact match. For self-insurers, however, calendar year exposures do represent an exact match with the accident year claims.

Advantages of Accident Year Aggregation

In many respects, accident year aggregation has become the accepted norm for P&C insurers in the U.S. and Canada. Accident year grouping is easy to achieve and easy to understand. It represents claims occurring over a shorter time frame than for the policy year or underwriting year aggregation, implying that ultimate accident year claims should become reliably estimable sooner than those for a policy or underwriting year. There are numerous industry benchmarks available to actuaries based on accident year experience. Finally, tracking claims by accident year is valuable when there is change due to economic or regulatory forces (such as inflation or law amendments) or major claim events (such as atypical weather or a major catastrophe) which can influence claims experience.

Disadvantages of Accident Year Aggregation

The most significant disadvantage of accident year aggregation is the potential mismatch between claims and exposures for insurers. It also includes claims from policies underwritten and priced at more varied times than policy or underwriting year aggregation. For self-insureds with high deductibles, accident year data can mask changes in retention levels and/or changes in insurers that could have an effect on claim development patterns.

Aggregation by Policy Year or Underwriting Year

Claims can also be grouped according to policy year. For *policy year data*, the actuary sorts claims according to the year in which the policy was written. Policy year aggregation directly matches the premiums and claims arising from a given block of policies.[19] The grouping of claims by policy year for insurers is similar to the grouping of claims by underwriting year frequently used by reinsurers. *Underwriting year data*, which is frequently used by reinsurers, refers to claims data grouped by the year in which the reinsurance policy became effective.

Claims arising from a policy year or underwriting year can extend over a 24-month calendar period if the policy is of a 12-month duration. For example, policy year 2008 refers to all policies with beginning effective dates between January 1, 2008 and December 31, 2008. For annual policies with a January 1, 2008 beginning effective date, covered claims will have accident dates between January 1, 2008 and December 31, 2008. However, claims for annual policies with a beginning effective date of December 31, 2008 will have occurrence dates between December 31, 2008 and December 30, 2009.

[19] The actuary should be aware of the insurer's treatment of multi-year policies. Insurers differ in their practices as to how such policies are coded in the information systems. Some insurers split the single multi-year policy into annual pieces and code this type of policy as multiple annual policies. Other insurers may follow different practices. The important point is that the actuary must understand the process for recording premium and claims associated with multi-year policies (to the extent such policies exist in the insurer's portfolio).

Advantages of Policy Year Aggregation

The greatest advantage of policy year (or underwriting year) aggregation is a true match between claims and exposures (e.g., premiums). Policy year experience can be very important when underwriting or pricing changes occur, such as a shift from full coverage to large deductible policies, a new emphasis on certain classes of business, or an increase/decrease in the price charged leading to a change in expected claim ratios and possibly a change in the type of policyholder insured. Policy year aggregation is particularly useful for self-insureds where only one policy may apply.

Disadvantages of Policy Year Aggregation

The primary disadvantage of policy year (or underwriting year) aggregation is the extended time frame. As seen in our previous example, a policy year can extend over a 24-month time period, generally resulting in a longer time until all the claims are reported and a longer time until the ultimate claims can be reliably estimated. Policy year data can also make it difficult to understand and isolate the effect of a single large event, such as a major catastrophe or a major court ruling, which changes how the insurance contracts are interpreted.

Aggregation by Report Year

For some lines of insurance, such as medical malpractice, products liability, errors and omission, and directors' and officers' liability, coverage may be dependent on the date on which the claim is reported to the insurer (i.e., claims-made coverage). For these lines of business, actuaries often prefer to use *report year data* for developing estimates of unpaid claims. Report year refers to grouping claims according to the date of report to the insurer. For example, report year 2008 consists of all claims with report dates in 2008. Actuaries use this grouping to estimate the ultimate value of known claims. Aggregation of claims by report year can also be used to test the adequacy of case outstanding on known claims over time.

Once again, we highlight that the actuary must understand the systems and procedures for the insurer. For some insurers, the accident date is the date that triggers coverage, which may be the claim report date for some claims-made policies. For some claims-made policies, the notification date rather than the report date triggers the coverage. Also, some claims-made policies have extended reporting endorsements that may not be coded as a new policy, and hence development beyond 12 months may be possible even for annual policies. An actuary must not only determine how to aggregate the data but must truly understand how the data enters and is tracked in the insurer's systems.

Advantages of Report Year Aggregation

A unique feature of report year claims data is that the number of claims is fixed at the close of the year (other than for claims reported but not recorded). As a result, a report year approach will generally result in more stable data and more readily determinable development patterns than an accident year approach in which the number of claims is subject to change at each successive valuation. The report year approach substitutes a known quantity (i.e., the number of reported claim counts) for an estimate.

Disadvantages of Report Year Aggregation

Estimation techniques based on claims aggregated by report year only measure development on known claims and not pure IBNR; and pure IBNR is frequently the more difficult part of the total unpaid claims estimate to determine. Other methods for developing unpaid claim estimates are required to derive the pure IBNR when using report year data.

CHAPTER 4 – MEETING WITH MANAGEMENT

This chapter discusses the interaction between the actuary and those involved with the processes that underlie the data. The dynamics of this interaction will frequently vary based on whether the actuary is an employee of the insurer or an outside consultant. For example, while an actuarial employee may be able to just call or walk over to meet those involved in the insurer's claims operation when a question arises, a consultant may have to go through a more formal process, such as scheduling a meeting with company management involved in the relevant processes. To simplify the discussion, this chapter is written predominately from the perspective of an outside consultant, using the term *management* when referring to discussions with those involved in the underlying claims and underwriting processes.

Understanding the Environment

Before applying mathematical models to develop estimates of unpaid claims for an insurer, the actuary must first understand the dynamics of the environment in which the insurer operates. This includes both the specific circumstances existing within the insurer's organization as well as the economic, social, legal, and regulatory environments that will also affect the liabilities of the insurer. Without a sound understanding of the environment, both internal and external to the insurer, an actuary may not be able to correctly interpret patterns and changes in the data.

There are countless changes that influence the claims experience of an insurer. Claims reporting and payment patterns, frequency, and severity can all be altered by changes in:

- Classes of business written or geographical focus
- Policy provisions such as policy limits and deductibles
- Reinsurance arrangements including limits and attachment points
- Claims management philosophy that often occur when managerial changes occur
- Claims processing lags that may occur when a new technology is implemented within an insurer or department staffing is disrupted, such as in the event of a merger or a major catastrophe that temporarily overwhelms the claim department's capacity
- Legal and social environment such as the introduction of no-fault automobile insurance, back-logs in the court systems, new court rulings, and implementation of tort reform[20] measures
- Economic environment such as an increase in the inflation rate or a decrease in the interest rate

[20] Tort reform refers to legislation designed to reduce liability costs through limits on various kinds of damages and/or through modification of liability rules.

The collection of data and information does not necessarily proceed in a sequential order as presented in this text. Not all actuaries start by gathering data, then meeting with management, and end with conducting an actuarial diagnostic review of the data. Generally the information gathering is an ongoing process with much back-and-forth dialogue between the actuary and management.

For actuaries responsible for estimating unpaid claims who work as employees of an insurer, the information gathering process will likely be continual and ongoing. Conversations with colleagues in various departments (such as claims, underwriting, reinsurance, and systems) may take place on a routine basis. These conversations may be formal through regular monthly or quarterly meetings, or informal and unscheduled. For actuaries who work as independent consultants, the communication with the insurer's employees in various departments tends to be less frequent. Often the consultant will schedule formal meetings at least once a year to review the departments' key activities that can have a significant influence on the estimation of unpaid claims.

There is no one right or wrong approach for the actuary to collect data and information. What is critically important, however, is that the process includes both a review of quantitative data and discussions with key members of the insurer's claim and underwriting departments. Both of these components will assist the actuary in selecting the appropriate techniques for estimating unpaid claims. Discussions with management will help the actuary understand anomalies in the data. The review of the data will help direct the actuary to ask management specific questions concerning issues that manifest themselves in the data. Such questions will help the actuary gain a better understanding of the organization and the specific circumstances of particular books of business, and thus guide the actuary to the most appropriate methodologies for determining unpaid claim estimates.

In 1977, J.R. Berquist and R.E. Sherman published the paper "Loss Reserve Adequacy Testing: A Comprehensive, Systematic Approach."[21] Among the paper's many valuable contributions was an appendix with a list of possible interview questions for the various departments of an insurer. Actuaries throughout the world have used this list as part of the annual information gathering process in support of the analyses of unpaid claims. In a session entitled "Updating the Berquist-Sherman Paper – Thirty Years Later" presented at the CAS 2007 Casualty Loss Reserving Seminar, Mr. Sherman suggested some additional questions for department executives. We include below a copy of Appendix B from the original Berquist and Sherman paper, updated to incorporate the additional questions presented in 2007.

It is important to recognize that the following questions are presented primarily from the perspective of a consultant interviewing insurance company management. Some changes to these questions would be required for actuaries working with self-insurers as well as for internal actuaries working at insurance and reinsurance companies.

Sample Questions for Department Executives

Questions for a Claims Executive

1) What specific objectives and guidelines does your department have in setting unpaid case? Are unpaid case established on the basis of what it would cost to settle the case today, or has a provision for inflation between now and the estimated time of settlement of the claim been included in the case outstanding?

[21] PCAS, 1977.

2) Have there been any significant changes in the guidelines for setting and reviewing unpaid case during the last five years?

3) Have there been any changes in the definitions of or rules for establishing bulk or formula reserves for reported claims in the last five years?

4) Are any special procedures or guidelines applied in the reserving of large or catastrophic claims? If so, please describe.

5) Has the size of the caseload of the average claims adjuster changed significantly in the past several years?

6) When, in the sequence of events, is a claim file established?

7) Is a claim file established for each claimant or for each accident? What procedures are followed when there are multiple claimants from the same accident? Is a claim file established for each coverage or for all coverages combined?

8) What procedures are followed in recording reopened claims? Are such claims coded to the report date of the original claim or to the date of reopening? How will the reopening of a claim affect aggregate data for paid, open or reported claims and paid, outstanding or incurred losses?

9) Have there been any noticeable shifts in the reporting or non-reporting of very small or trivial claims? In the procedures for the recording of such?

10) Has there been any shift in emphasis in settling large versus small claims? In the relative proportion of such claims? In attitudes in adjusting such claims?

11) Have there been any changes in the guidelines on when to close a claim? For example, is a P.D. (property damage) claim kept open until the associated B.I. (bodily injury) claim is closed, or only until the P.D. portion is settled?

12) Have there been any noticeable changes in the rate of settlement of claims recently?

13) Has there been any shift from the employment of company adjusters to independent adjusters? Or vice versa? If so, how has this affected the operations of the claims department?

14) Has there been any change in the timing of the payment of allocated loss adjustment expenses? For example, are such payments made as these expenses are accrued (or incurred) or when the claim is closed?

15) Has there been any change in the definition and limit for one-shot or fast-track claims in recent years? What is that limit?

16) What safeguards against fraudulent claims are now employed? Are any special procedures followed in the event of the filing of apparently questionable or non-meritorious claims? Have these safeguards changed in recent years?

17) Have there been any shifts toward (or away from) the more vigorous defense of suits in recent years?

18) Could you provide copies of all bulletins to the field issued in the last five years in which details of the changes in claims procedures are provided?

19) Could you provide copies of recent claim audits?

20) For workers compensation, what mortality table was used (year and general population or disabled lives table) to set the unpaid case for permanently disabled claimants?

21) For large open claims, has there been any revision in the reserve since the latest evaluation date of the claims experience?

22) Are unpaid case set at an expected level, the most likely settlement amount, or the minimum possible amount (or some other standard)?

Questions for an Underwriting Executive

1) What significant changes have occurred in your company's book of business and mix of business in the past five to seven years? How are the risks insured today different from those of the past?

2) Do you underwrite any large risks which are not characteristic of your general book of business?

3) Have any significant changes occurred in your underwriting guidelines in recent years?

4) Has the proportion of business attributable to excess coverages for self-insurers changed in recent years? Can a distribution of such business be obtained by line, retention limit, class, etc.? Is a record of self-insured losses and claims available?

5) For how many different programs or types of risk are premium and claims experience tracked and compiled into claim ratio runs?

6) Are there any available summaries of the details of excess policies, such as attachment points, exclusions, per occurrence, sunset clauses, aggregate caps, etc.?

7) What is the frequency of availability of such experience summaries? How far back are these available?

8) How are the new programs priced? If you are relying on another insurer's filings, how similar are the underlying books of business?

Questions for a Data Processing or Accounting Executive

1) Has there been any change in the date on which the books are closed for the quarter? the year?

2) How are claim payments handled for claims which have already been paid, but which have not yet been processed to the point where they can be allocated to accident quarter? Are they excluded from the loss history until they are allocated to accident quarter or are they loaded into an arbitrary quarter?

3) Have new data processing systems been implemented in recent years? Have they had a significant impact on the rate of processing claims or on the length of time required from the reporting to the recording of a claim?

4) To what extent have each of the data sources supplied been crosschecked and audited for accuracy and for balancing to overall company statistics? Comment on the degree of accuracy with which each kind of statistic has been properly allocated to accident quarter, to line of business, to size of loss, etc.

5) Have there been any changes in coding procedures which would affect the data supplied?

6) Would it be possible for partial payments to exceed the case outstanding on a claim? In such an event, what adjustments are made? Are unpaid case taken down by the amount of partial payments?

7) How far back can the claims data be actively re-compiled by various key criteria?

8) What data elements are available for each claim? For each risk?

9) By what key criteria could the historical claims data be freshly compiled? Examples of criteria: size of loss breakdowns, type of claim breakdowns (e.g., liability vs. property for commercial multi-peril or homeowner multi-peril), separate compilations by policy limit, or deductible, or type of claim, or state.

10) Can data be compiled either by claimant or occurrence, if multiple claims are established for one occurrence?

Questions for Actuaries Specializing in Ratemaking

1) Have there been any changes in company operations or procedures which have caused you to depart from standard ratemaking procedures? If so, please describe those changes and how they were treated.

2) What data which is currently used for ratemaking purposes could also be used in testing unpaid claims?

3) Have you noted any significant shifts in the composition of business by type of risk or type of claim within the past several years?

4) Do you have any of the following sources of information which may be of value in reserve testing:

   a) External economic indices,
   b) Combined claims data for several companies (e.g., data obtainable from bureau rate filings),
   c) Special rating bureau studies,
   d) Changes in state laws or regulations, and
   e) Size of loss or cause of loss studies?

5) Could we obtain copies of recent rate filings?

6) Were there any changes in statues, court decisions, extent of coverage that necessitated some reflection in the rate analysis?

7) How are new programs priced? If you are relying on another insurer's filing, how similar are the underlying books of business?

Questions for In-House Actuaries

1) Could we obtain copies of any and all actuarial studies done by consultants, auditors or internal actuaries?

2) What areas of disagreement are there between these different studies?

3) What specific background information did you take into account in making your selections?

Additional Questions

In addition to the questions identified in the Berquist and Sherman paper, we recommend that the following questions be added for meetings with senior management of the insurer.

Questions for Those Managing Reinsurance

— Please provide details of reinsurance treaties and of reinsurance agreements in general, regarding both assumed and ceded business.

— Please provide details of all reinsurance ceded treaties including:

- Retention level or quota share percentage
- Reinsurers involved including participation
- Details of any sliding scale premium, commission, or profit commission including currently booked amounts
- Any problems or delays encountered in collecting reinsurance

- Please provide details of any internal or sister company reinsurance agreements that were not included above (cover notes, relevant amounts, and by-line breakdowns).

- Have you secured the continuation of your reinsurance program for next year? If so, under what terms?

Questions for Senior Management

Please provide a brief description of the company's operations including:

- An organization chart with recent changes highlighted
- Details of ownership
- Description of types of business written including all special programs
- Description of marketing (i.e., direct writer, independent agent, etc.)

CHAPTER 5 – THE DEVELOPMENT TRIANGLE

A *development triangle* is a table that shows changes in the value of various cohorts over time. For example, we create a table that summarizes how the cumulative amounts paid by insurance companies (the values) for claims arising out of automobile accidents that occurred during 2006, 2007, and 2008 (the cohorts) increased from year-end 2006 to year-end 2007 to year-end 2008.

Table 1 – Paid Claims and Expenses ($US Billions)
by Year-End Accounting Date

Accident Year	Year-end 2006	Year-end 2007	Year-end 2008
2006	100	150	170
2007		110	161
2008			115

We define the *development* for any of these cohorts (i.e., the accident year claims mentioned above) as the change in the value for the cohort over time. For example, the paid claims and expense for accident year 2006 in the above triangle were $100 billion through year-end 2006, and increased to $150 billion through year-end 2007; the change from $100 billion to $150 billion is the *development* in this quantity.

Actuaries are frequently interested in the typical development for a cohort over time. This is generally easier to observe by looking at the age (or maturity) of the cohort rather than the accounting date for the cohort. The above triangle reformatted to reflect this approach is presented in Table 2 below.

Table 2 – Paid Claims and Expenses ($US Billions)
by Age

Accident Year	12 Months	24 Months	36 Months
2006	100	150	170
2007	110	161	
2008	115		

The age (or maturity) is generally measured in terms of the time from the start of the cohort period. For example, the age of the 2006 accident year valued at year-end 2006 is 12 months (from the start of the accident year). Similarly, the age of the 2006 accident year valued at year-end 2007 is 24 months (from the start of the accident year).

Both of the above formatting approaches result in data in a triangle shape, hence the term development triangle. However, in the second triangle it is easier to see how the volume (or scale) of the accident year cohort changes from one accident year to the next and how the value of cumulative paid claims for an accident year changes from age to age.

We can show and analyze many different values through the use of development triangles, including but not limited to: reported claims, paid claims, claim-related expenses, and reported claim counts.

Development can be either positive or negative. For example, the number of claims associated with claims occurring in a particular accident year will often increase from one valuation point to another until all claims are reported. There are circumstances, however, when the number of claims decreases from one valuation point to another. In Chapter 11, we use an example with data for private passenger automobile collision coverage organized by accident half-year. The claim count data excludes claims closed without payment. In this particular example, we will observe that the number of claims decreases at successive valuations. Reported claim development can also show downward patterns if the insurer settles claims for a lower value than the case outstanding estimate or if the insurer includes recoveries with the claims data.

The development triangle is one of the most common tools that actuaries use to organize data in order to identify and analyze patterns in historical data. Actuaries use development triangles to quantify historical development. Development patterns are critical inputs to many techniques used to estimate unpaid claims. In this chapter, we demonstrate how to build development triangles for paid claims, case outstanding, reported claims, and reported claim counts. We use payment and case outstanding information for a sample of 15 claims over a four-year time horizon. Our example is not representative of any particular line of insurance. Its sole purpose is to demonstrate how to build development triangles based on detailed claims information.

Rows, Diagonals, and Columns

Table 3 contains a sample reported claim triangle for an organization that began operations in 2005.

Table 3 – Reported Claim Triangle

Accident	Reported Claims as of (months)			
Year	12	24	36	48
2005	1,500	2,420	2,720	3,020
2006	1,150	1,840	2,070	
2007	1,650	2,640		
2008	1,740			

There are three important dimensions in a development triangle:

- Rows
- Diagonals
- Columns

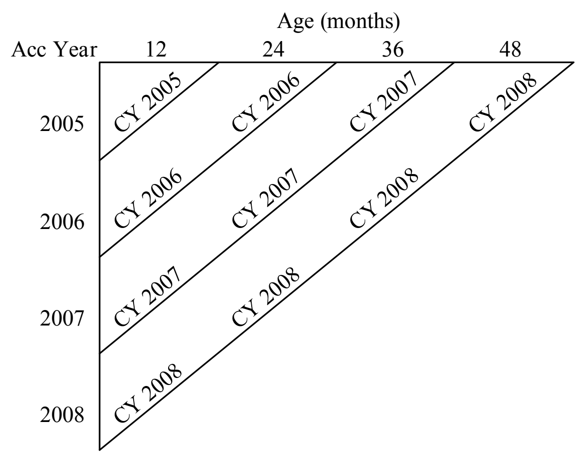
Each row in the triangle above represents one accident year. As we discuss in Chapter 3, organizing data by accident year refers to grouping claims according to the date of occurrence (i.e., the accident date). By grouping the data into accident years, each row consists of a fixed group of claims. In our example, the reported claim development triangle includes the reported claims for accident years 2005 through 2008. The first row of the triangle represents claims occurring in 2005; the second row, claims occurring in 2006; the third row, claims occurring in 2007; and the final row, claims occurring in 2008.

Each subsequent diagonal in the reported claim triangle represents a successive valuation date. There are four diagonals in the triangle shown in Table 3:

- The first diagonal (which is a single point) is the December 31, 2005 valuation
- The next diagonal is the December 31, 2006 valuation for accident years 2005 and 2006
- The next diagonal is the December 31, 2007 valuation for accident years 2005 through 2007
- The last diagonal is the December 31, 2008 valuation for accident years 2005 through 2008

The diagonals and corresponding valuation dates are shown pictorially in Table 4 below. (CY in the diagram below refers to calendar year.)

Table 4 – Diagonals of the Reported Claim Triangle Example



The first diagonal, which starts in the upper left corner of the triangle, is at the December 31, 2005 valuation date and represents accident year 2005 at 12 months of maturity. Again, the standard nomenclature is to count from the beginning of the accident year to the valuation date. Thus accident year 2005, which begins on January 1, 2005, is 12 months old at December 31, 2005.

The second diagonal in the triangle is at the December 31, 2006 valuation date. At December 31, 2006, accident year 2005 is 24 months old and accident year 2006 is 12 months old. To determine these ages, we again count the number of months from the beginning of each accident year (i.e., January 1, 2005 and January 1, 2006) to the valuation date of December 31, 2006. The third diagonal continues in a similar manner.

Concluding our example, the last diagonal of the triangle, at a valuation date of December 31, 2008, represent claims for accident year:

- 2005 as of 48 months (counting from the start of the accident year, January 1, 2005, to the valuation date of December 31, 2008)

- 2006 as of 36 months (counting from January 1, 2006 to December 31, 2008)

- 2007 as of 24 months (counting from January 1, 2007 to December 31, 2008)

- 2008 as of 12 months (counting from January 1, 2008 to December 31, 2008)

Each column in the claim development triangle represents an *age* (or *maturity*) and is directly related to the combination of accident year (row) and valuation date (diagonal) used to create the triangle. In our example, we present accident year data using annual valuations, and thus the ages in the columns are 12 months, 24 months, 36 months, and 48 months. Different valuations can be used by the actuary (e.g., 6 months, 12 months, 18 months, etc.).

Alternative Format of Development Triangles

Throughout this book, we present development triangles with the rows corresponding to the experience period[22] (e.g., accident year in the previous example) and the columns representing the maturity ages.[23] This is by far the most common presentation of development triangles. Some insurers, however, reverse this orientation and present accident years (or policy or underwriting years) as the columns and the maturity ages as the rows. Prior to commencing the analysis of unpaid claims, it is important for the actuary to understand the way in which the insurer aggregates the data and reports the data in the development triangle.

Detailed Example of Claim Development Triangles

Understanding the Data

To better understand how to create a claim development triangle, we turn our attention to the individual claims detail that underlies the reported claim triangle shown in Table 3. In our example, we demonstrate how to integrate the claims amounts shown in the claims listing below into the cells of the various claim development triangles. (In the table below, we use the abbreviation case O/S to mean case outstanding.)

Table 5 – Detailed Example – Claims Transaction Data

			2005 Transactions		2006 Transactions		2007 Transactions		2008 Transactions	
Claim ID	Accident Date	Report Date	Total Payments	Ending Case O/S	Total Payments	Ending Case O/S	Total Payments	Ending Case O/S	Total Payments	Ending Case O/S
1	Jan-5-05	Feb-1-05	400	200	220	0	0	0	0	0
2	May-4-05	May-15-05	200	300	200	0	0	0	0	0
3	Aug-20-05	Dec-15-05	0	400	200	200	300	0	0	0
4	Oct-28-05	May-15-06			0	1,000	0	1,200	300	1,200
5	Mar-3-06	Jul-1-06			260	190	190	0	0	0
6	Sep-18-06	Oct-2-06			200	500	0	500	230	270
7	Dec-1-06	Feb-15-07					270	420	0	650
8	Mar-1-07	Apr-1-07					200	200	200	0
9	Jun-15-07	Sep-9-07					460	390	0	390
10	Sep-30-07	Oct-20-07					0	400	400	400
11	Dec-12-07	Mar-10-08							60	530
12	Apr-12-08	Jun-18-08							400	200
13	May-28-08	Jul-23-08							300	300
14	Nov-12-08	Dec-5-08							0	540
15	Oct-15-08	Feb-2-09								

[22] Also referred to as "origin period."

[23] Also referred to as "development periods."

Table 5 contains detailed information for 15 claims that occurred in accident years 2005 through 2008. The first column of the table is a claim ID number. The next two columns are the accident date and the report date. The accident date is necessary for determining the appropriate row of the triangle. The report date is important for determining when the information about the claim first enters the triangle. The table includes claim payments made in the year and the ending case outstanding value. It is important to recognize that the claim payments in the table do not represent the cumulative paid values but the transactional payments made during the year. The case outstanding values contained in the table are the ending case outstanding values; they are not the transactional change in case outstanding that occurred during the year.

It is absolutely critical when constructing claim development triangles that the actuary fully understands the data available. The information systems used by different insurers vary tremendously. Thus, the types and format of data available to actuaries vary significantly from insurer to insurer. Defining and understanding the available data must be the first step in any actuarial analysis.

Step-by-Step Example

We now demonstrate, step by step, how to create the paid claims, case outstanding, reported claims, and reported claim count triangles. We begin with the incremental paid claim development triangle. Table 6 below summarizes the payment transactions presented in our example. This table is simply an excerpt of Table 5.

Table 6 - Detailed Example – Claims Transaction Paid Claims Data

			Incremental Payments in Calendar Year			
Claim ID	**Accident Date**	**Report Date**	**2005**	**2006**	**2007**	**2008**
1	Jan-5-05	Feb-1-05	400	220	0	0
2	May-4-05	May-15-05	200	200	0	0
3	Aug-20-05	Dec-15-05	0	200	300	0
4	Oct-28-05	May-15-06		0	0	300
5	Mar-3-06	Jul-1-06		260	190	0
6	Sep-18-06	Oct-2-06		200	0	230
7	Dec-1-06	Feb-15-07			270	0
8	Mar-1-07	Apr-1-07			200	200
9	Jun-15-07	Sep-9-07			460	0
10	Sep-30-07	Oct-20-07			0	400
11	Dec-12-07	Mar-10-08				60
12	Apr-12-08	Jun-18-08				400
13	May-28-08	Jul-23-08				300
14	Nov-12-08	Dec-5-08				0
15	Oct-15-08	Feb-2-09				

Using the above data, we create a triangle of incremental payments showing the amounts paid in each 12-month calendar period for the fixed group of claims in our example. For claims that occurred during 2005, the insurer paid a total of $600 during the first 12-month period (2005), $620 during the second 12-month period (2006), and $300 in each of the following two 12-month periods (2007 and 2008). For claims that occurred during 2006, the insurer paid $460 during 2006 and 2007 and $230 during 2008. We use the same approach for each accident year grouping of claims to derive the following triangle of incremental paid claims.

Table 7 – Incremental Paid Claim Triangle

Accident	Incremental Paid Claims as of (months)			
Year	**12**	**24**	**36**	**48**
2005	600	620	300	300
2006	460	460	230	
2007	660	660		
2008	700			

The incremental paid claim triangle is important for diagnostic purposes and for some frequency-severity techniques. However, actuaries tend to use cumulative paid claim triangles more often than incremental paid claim triangles. We can readily create the following cumulative paid claim triangle from the incremental paid claim triangle.

Table 8 – Cumulative Paid Claim Triangle

Accident	Cumulative Paid Claims as of (months)			
Year	**12**	**24**	**36**	**48**
2005	600	1,220	1,520	1,820
2006	460	920	1,150	
2007	660	1,320		
2008	700			

We derive the cumulative paid claim triangle by simple arithmetic from the incremental paid claim triangle. The first column in both triangles, age 12 months, is the same for both paid claim triangles (i.e., incremental paid claims are equal to cumulative paid claims at the first maturity age). To derive the second column of the cumulative paid claim triangle, we add the second column (i.e., age 24 months) of the incremental paid claim triangle to the first column of either triangle. The cumulative paid claims at 36 months are equal to the cumulative paid claims at 24 months plus the incremental paid claims at 36 months. Finally, the cumulative paid claims at 48 months are equal to the cumulative paid claims at 36 months plus the incremental paid claims at 48 months.

Before moving on to the other development triangles (e.g., case outstanding, reported claims, and reported claim counts), we stop to explain where the payments in the original summary appear in the cumulative paid claim development triangle. We now describe how to create numerous cells of the cumulative paid claim triangle using the original detailed paid claims information summarized in Table 6 as an alternative to simply cumulating the incremental paid triangle.

The first cell of the accident year cumulative paid claim development triangle is accident year 2005 at a valuation date of December 31, 2005. Actuaries refer to this point in the triangle as accident year 2005 at 12 months. In the claims detail presented in Table 6, we note that there are four claims that occurred in 2005 (Claim IDs 1, 2, 3, and 4). The first three claims (Claim IDs 1, 2, and 3) all occurred and were reported to the insurer during 2005. The last claim (Claim ID 4) occurred on October 28, 2005, but was only reported on May 15, 2006. Thus, when we calculate the value of accident year 2005 paid claims at 12 months, we do not include Claim ID 4 since this claim was not yet reported as of the December 31, 2005 valuation date. We also note that Claim ID 3 did not have any payments as of December 31, 2005. Thus, the $600 paid claims which appear in the first cell of the triangle represent payments for Claim IDs 1 and 2 during the year 2005.

We now construct the second diagonal of the cumulative paid claim triangle; this is the December 31, 2006 valuation. The second diagonal of the triangle contains two points: accident year 2005 at 24 months and accident year 2006 at 12 months. Continuing along the first row, we first calculate the value of paid claims at 24 months for accident year 2005. Total payments made during 2006 for Claim IDs 1, 2, 3, and 4 are $620 ($220 + $200 + $200 + $0). Cumulative claim payments for accident year 2005 through December 31, 2006 are equal to the sum of the payments made during 2005 and the payments made during 2006 for a total of $1,220.

The second point along the December 31, 2006 diagonal is accident year 2006 at 12 months. In the table we observe three claims with 2006 accident dates. However, only Claim IDs 5 and 6 were reported in 2006. Thus, we do not include Claim ID 7 in the calculation for the December 31, 2006 valuation[24]. The paid claims for accident year 2006 as of December 31, 2006 are equal to the sum of claim payments ($260 + $200) for Claim IDs 5 and 6.

Our example continues with the third diagonal, the December 31, 2007 valuation, which is also known as the 2007 diagonal. The third diagonal consists of three points:

- Accident year 2005 at 36 months
- Accident year 2006 at 24 months
- Accident year 2007 at 12 months

We follow a similar procedure of cumulating claim payments made through December 31, 2007. For accident year 2005, there are additional claim payments of $300 made during 2007. Thus, cumulative claim payments for accident year 2005 as of December 31, 2007 are $1,520. For accident year 2006, we cumulate the claim payments ($460 in 2006 plus $460 in 2007) for a total cumulative paid claims of $920. Similar to other accident years in our example, there is one claim for accident year 2007 that is not reported by year-end. Thus, the paid claims for accident year 2007 at 12 months only include Claim IDs 8, 9, and 10. We note that there is no payment for Claim ID 10 as of December 31, 2007. Thus, the paid claims value entered in the triangle is the sum of claim payments for Claim IDs 8 and 9 ($200 + $460).

We leave it to the reader to calculate the final diagonal of the cumulative paid claim triangle.

[24] In some applications, it may be far easier to just include Claim 7 as a zero value than to write programming logic to exclude it from the application.

Case Outstanding Triangle

In the following table, we summarize the detailed case outstanding from our 15-claim example. Table 9 is simply an excerpt from Table 5 presented earlier in this chapter.

Table 9 – Detailed Example – Claims Transaction Ending Case Outstanding Data

			Ending Case Outstanding			
Claim ID	**Accident Date**	**Report Date**	**2005**	**2006**	**2007**	**2008**
1	Jan-5-05	Feb-1-05	200	0	0	0
2	May-4-05	May-15-05	300	0	0	0
3	Aug-20-05	Dec-15-05	400	200	0	0
4	Oct-28-05	May-15-06		1,000	1,200	1,200
5	Mar-3-06	Jul-1-06		190	0	0
6	Sep-18-06	Oct-2-06		500	500	270
7	Dec-1-06	Feb-15-07			420	650
8	Mar-1-07	Apr-1-07			200	0
9	Jun-15-07	Sep-9-07			390	390
10	Sep-30-07	Oct-20-07			400	400
11	Dec-12-07	Mar-10-08				530
12	Apr-12-08	Jun-18-08				200
13	May-28-08	Jul-23-08				300
14	Nov-12-08	Dec-5-08				540
15	Oct-15-08	Feb-2-09				

We use the table above to create the case outstanding development triangle below.

Table 10 – Case Outstanding Triangle

Accident	Case Outstanding as of (months)			
Year	**12**	**24**	**36**	**48**
2005	900	1,200	1,200	1,200
2006	690	920	920	
2007	990	1,320		
2008	1,040			

The first value in the case outstanding development triangle is accident year 2005 at 12 months. We add the ending case outstanding values for Claim IDs 1, 2, and 3 to derive the case outstanding value of $900. We do not include Claim ID 4 since it is not reported until May 15, 2006. Case outstanding for accident year 2005 at 24 months (i.e., valuation date December 31, 2006) are equal to the case outstanding values for Claim IDs 3 and 4 or $1,200 ($200 + $1,000). Case outstanding for Claim IDs 1 and 2 are both $0 at December 31, 2006. For accident year 2005 at 36 months and 48 months, only Claim ID 4 has an ending case outstanding value. For both these valuation dates, December 31, 2007 and December 31, 2008, the ending case outstanding is $1,200.

For accident year 2006 at 12 months (i.e., valuation date December 31, 2006), the case outstanding value of $690 is equal to the sum of the ending case outstanding for Claim IDs 5 and 6 ($190 + $500). Case outstanding at 24 months (i.e., valuation date December 31, 2007) is equal to the sum of case outstanding on all three accident year 2006 claims ($0 + $500 + 420). The final value in the triangle for accident year 2006 is at 36 months (i.e., valuation date December 31, 2008). Claim IDs 6 and 7 have ending case outstanding values of $270 and $650, respectively. Thus, total case outstanding for accident year 2006 at 36 months is $920.

You can continue in a similar manner to build the remainder of the case outstanding development triangle.

Reported Claim Development Triangle

We define reported claims to be equal to cumulative paid claims through the valuation date plus case outstanding at the valuation date. Thus, we are able to build the reported claim development triangle by adding the cumulative paid claim triangle to the case outstanding triangle. Table 11 below presents the reported claim triangle for our sample 15 claims.

Table 11 – Reported Claim Development Triangle

Accident	Reported Claims as of (months)			
Year	12	24	36	48
2005	1,500	2,420	2,720	3,020
2006	1,150	1,840	2,070	
2007	1,650	2,640		
2008	1,740			

It is interesting to return to the original data and observe what happened to accident year 2005 claims over time. Claim ID 1 occurred early in 2005 and was reported shortly thereafter. Through December 31, 2005 (i.e., the first year of development), there were $400 in claim payments and the insurer established a case outstanding of $200. In the following year, this claim settled for slightly more than the case outstanding value. A claim payment of $220 was made during 2006 and the case outstanding was reduced to $0. There was no further activity on this claim through year-end 2008.

Claim ID 2 occurred in May 2005 and was also reported in May 2005. The insurer made a claim payment of $200 in 2005 and established a case outstanding of $300 by year-end 2005. During 2006, the insurer settled Claim ID 2 for $200, which was less than the $300 case outstanding. Thus, on this claim there was a saving from the initial case outstanding estimate.

The final settlement for Claim ID 3, however, was higher than the initial estimate. When the insured reported the claim near the end of 2005, the claims adjuster established an initial case outstanding of $400. During 2006, the insurer made a payment of $200 and reduced the case outstanding to $200. Thus, the reported claim estimate for this particular claim did not change during 2006; the payment of $200 offsets a similar reduction of $200 in the case outstanding. During 2007, there was a final settlement for Claim ID 3 of $300. The final incurred value for this claim was $500, or $100 more than the reported claim estimates at year-ends 2005 and 2006.

We continue looking at the activity of accident year 2005 claims during 2008. There was no activity on Claim IDs 1 through 3. However the reported claim for Claim ID 4 continues to increase. This was a late-reported claim. At December 31, 2006, the case outstanding was $1,000 for this claim. By December 31, 2007, the case outstanding had increased to $1,200. There were no payments in either 2006 or 2007. In 2008, claim payments were $300 but there was no change in the ending case outstanding. Thus, the reported claim for this particular claim increased by $300 during 2008 from $1,200 (the sum of cumulative claim payments through December 31, 2007, $0, and ending unpaid case at December 31, 2007, $1,200) to $1,500 (the sum of cumulative claim payments through December 31, 2008, $300, and ending unpaid case at December 31, 2008, $1,200).

A similar review can take place with the claims experience of each accident year.

Reported Claim Count Development Triangle

We also use the data in Table 5 to build a reported claim count triangle.

Table 12 – Reported Claim Count Development Triangle

Accident	**Reported Claim Counts as of (months)**			
Year	**12**	**24**	**36**	**48**
2005	3	4	4	4
2006	2	3	3	
2007	3	4		
2008	3			

We describe how to build the claim count development triangle by using accident years 2005 and 2008 as examples. Based on the data in Table 5, we note that while there are 4 claims for 2005, only 3 of the claims were reported as of December 31, 2005. Thus, the first cell in the reported claim count triangle which represents accident year 2005 as of December 31, 2005 shows 3 claims reported. By December 31, 2006, all four claims were reported. No further claims were reported for accident year 2005, and thus the number of reported claims remains unchanged at 4 for ages 36 months and 48 months.

The final row of the reported claim count triangle is for accident year 2008 as of December 31, 2008. As of 12 months, there were 3 claims reported for accident year 2008. Claim ID 15 was not reported until 2009 and thus is not included in the triangle.

Other Types of Development Triangles

As mentioned earlier, actuaries use development triangles with a wide variety of data. The first step in creating triangles is to determine the time interval for organizing the data. The time interval represents the rows of the triangles. In our previous example, we use accident year. Other common intervals include:

- Report year
- Underwriting year

- Treaty year[25]
- Policy year
- Fiscal year

By far, accident year is the most common organization of claims data actuaries in the U.S. and Canada use when creating development triangles. Actuaries also often rely on report year development triangles for the analysis of claims-made coverages such as U.S. medical malpractice and errors and omissions liability. Reinsurers often organize claims data by underwriting year. Policy year is a similar concept to underwriting year.

For self-insurers, the policy year, fiscal year, and accident year are often the same. For example, a self-insured public entity with a fiscal year April 1 to March 31 may issue documents of coverage to covered departments and agencies with an April 1 to March 31 coverage period; such entity may also arrange excess insurance with a policy year of April 1 to March 31. Finally, this public entity may aggregate development triangles using accident year periods of April 1 to March 31.

Claims can be categorized by time intervals other than annual intervals. Actuaries also use monthly, quarterly, and semi-annual data for developing estimates of unpaid claims. When selecting the time interval, important considerations for the actuary include the credibility of the experience or the stability of development or both.

There are numerous possibilities for the types of claims data that are presented in development triangles. Common types of data include:

- Reported claims
- Case outstanding
- Cumulative total paid claims
- Cumulative paid claims on closed claim counts[26]
- Incremental paid claims
- Reported claim counts
- Claim counts on closed with payment
- Claim counts on closed with no payment
- Total closed claim counts
- Outstanding claim counts

Actuaries also use the data types listed previously to create triangles of ratios and average claim values. Examples of these triangles include:

- Ratio of paid-to-reported claims

- Ratio of total closed claim counts-to-reported claim counts

- Ratio of claim counts on closed with payment-to-total closed claim counts

- Ratio of claim counts on closed without payment-to-total closed claim counts

[25] *Treaty year* is defined as a period of twelve months covered by a reinsurance treaty or contract.

[26] These values may be problematic to obtain in cases where interim or pre-closing payments are possible.

- Average case outstanding (case outstanding divided by outstanding claim counts)

- Average paid on closed claims (cumulative paid claims on closed claims divided by claim counts closed with payment)[27]

- Average paid (cumulative total paid claims divided by total closed claim counts)

- Average reported (reported claims divided by reported claim counts)

The triangles of ratios and average values provide useful insight into the relationships that exist between the various types of data at different points in time during the experience period. In Chapter 6, we explain how actuaries use these types of triangles as diagnostic tools.

For some insurers, the actuary analyzes LAE data independently of claims only. In such situations, the actuary may also create development triangles with the ratios of paid LAE-to-paid claims only and the ratios of reported LAE-to-reported claims only.

In our discussion so far, we have not mentioned how many development periods the actuary needs to evaluate. Is it necessary to analyze development through the 3rd maturity year, the 5th maturity year, the 10th or the 20th maturity year? If possible, the actuary should analyze development out to the point at which the development ceases (i.e., until the selected development factors are equal to 1.000). The number of development periods required generally varies by line, jurisdiction, and also by data type. For example, paid claims typically require a greater number of development periods than reported claims, and reported claims often require a greater number of development periods than reported claim counts. Also, automobile physical damage claims settle much more quickly than general liability claims, and therefore an analysis of unpaid claims for automobile physical damage requires fewer development periods than a similar analysis for general liability.

In the following chapters, we use the development triangle both as a diagnostic tool and as the primary input for numerous estimation techniques for unpaid claims.

Naming Convention for Examples

In our examples, we use the terms “reported claims” to refer to cumulative reported claims and “paid claims” to refer to cumulative paid claims. Similarly, we use the terms “reported claim counts” and “closed claim counts” to refer to cumulative reported and closed claim counts, respectively. For some examples in Chapters 11 through 13, we use incremental values of claims and claim counts. Any development triangles containing incremental values, of claims or claim counts, are specifically labeled as incremental.

[27] As noted on the previous page, cumulative paid claims on closed claim counts may be difficult to obtain. In such cases, actuaries may determine that interim or pre-closing payments are immaterial enough to justify the inexact match from including all payments, even those from open claims, divided by closed claim counts.

CHAPTER 6 – THE DEVELOPMENT TRIANGLE AS A DIAGNOSTIC TOOL

Part 2 of this book is about information gathering. We begin Chapter 3 with a description of the types of data and how data is organized. In Chapter 4, we discuss the importance of meeting with those involved with the operations and processes underlying the data (labeled in this text as management) and understanding the environment in which the insurer operates – both the internal and external environments. In Chapter 5, we construct development triangles. We conclude Part 2 with Chapter 6 in which we combine the knowledge we obtain by analyzing the development triangles with the information we receive during meetings with the insurer's claims and underwriting departments. In this chapter, we use the development triangles as a tool to further understand how changes in an insurer's operations and the external environment can influence the claims data. This is the final step before we delve into specific techniques for estimating unpaid claims.

It is very important for the actuary to communicate with the insurer's management if the changes that management reports to have implemented are not supported by the data. It is quite common for an insurer's management to report significant changes in both the claims settlement area and the strength (i.e., adequacy) of its case outstanding. Insurers may try to accomplish such changes through new policies, procedures, and/or information systems. Many times actuaries do see evidence of operational change in the quantitative data that they are reviewing. However, in some situations, the best intentions of senior claims management may not have worked through the organization as planned; in these situations a direct effect on the claims data may not be evident to the actuary. Sometimes, it is just a matter of time before signs of the operational changes start to show in the claims data. Other times, there may be cultural blocks within the organization that are resisting the intended changes. Through open discussions with claims management and staff as well as a detailed review of the claims data, the actuary should be able to gain a clear understanding of the situation and then choose the best technique(s) to match the particular situation at hand.

Detailed Example – Background Information

In the following example, we demonstrate how to use development triangles for diagnostic review. For this purpose, we use the experience of an insurer's private passenger automobile portfolio in one geographic region (e.g., a single state or a province). Specifically, we look at the historical claims experience for automobile bodily injury liability over the 2002 to 2008 experience period. In this chapter and throughout Part 3, we refer to this example as XYZ Insurer.

The purpose of our example is not to raise every possible question or to identify every possible issue that may exist for XYZ Insurer. Instead, our goal is to teach you how to look at relationships and how to begin to develop your own observations and questions.

In this example, we assume that meetings with various members of the insurer's operations have already taken place. At these meetings, we were told that there were significant changes within the claims department over the last several years, including changes at the most senior levels of management. The new Senior Vice President – Claims told us that one of her main priorities is to carry adequate case outstanding. Management insists that the strength of current case outstanding is much greater than in prior years. During our meetings, we also learned that the insurer implemented new information systems in the past three years for the purpose of speeding up the claims reporting and settlement processes. Management at XYZ Insurer believes very strongly in the saying "a good claim is a closed claim" and has instituted policies and procedures to expedite the claim settlement process.

In addition to the changing environment within the insurer's operations, we know that there were significant changes to the automobile insurance product in this geographic region. Major tort reforms were implemented in 2006 resulting in caps on awards as well as pricing restrictions and mandated rate level changes for all insurers operating in the region. As a result of these reforms, management decided to reduce its presence in this market.

Having met with management, it is now time to begin our diagnostic review of the data. One goal of such a review is to determine if we can observe the effect of the changes implemented by management in the claims data provided by the insurer. We expect that our review will likely lead to further questions and result in more discussions with members of the management team. We also hope that based on our diagnostic review, we will be able to determine what types of data and which techniques will be most appropriate to estimate unpaid claims for XYZ Insurer under its current circumstances.

Premium History

In Table 1 below, we summarize earned premium as well as XYZ Insurer's historical rate changes for this line of business. XYZ Insurer provided the earned premium and rate level changes by year. We calculate the cumulative average rate level and annual change in exposures from year to year.[28]

Table 1 – Summary of Earned Premium and Rate Changes

Calendar Year	Earned Premiums ($000)	Rate Changes	Cumulative Average Rate Level	Annual Exposure Change
2002	61,183		0.0%	
2003	69,175	+5.0%	5.0%	7.7%
2004	99,322	+7.5%	12.9%	33.6%
2005	138,151	+15.0%	29.8%	21.0%
2006	107,578	+10.0%	42.8%	-29.2%
2007	62,438	-20.0%	14.2%	-27.5%
2008	47,797	-20.0%	-8.6%	-4.3%

(To simplify the analysis in this chapter and in Part 3, assume that the rate changes in the above table represent the average earned rate level for the year. For further information about

[28] The average rate level is calculated by successive multiplication of the annual rate changes. For example, for 2004, the cumulative average rate level is equal to {[(1.00 + 5.0%) x (1.00 + 7.5%)] – 1.00}, or 12.9%. Similarly, the average rate level change for 2007 is equal to {[(1.00 + 42.8%) x (1.00 – 20.0%)] – 1.00}, or 14.2%. The annual exposure change is equal to the annual change in earned premiums divided by the rate change in the year. For example, the annual exposure change for 2003 is equal to {[(69,175 / 61,183) / (1 + 5.0%)] – 1.00}, or 7.7%. For 2008, the annual exposure change is equal to {[(47,797 / 62,438) / (1 – 20.0%)] – 1.00}, or -4.3%.

adjustments for rate level changes, we refer the reader to C. L. McClenahan, "Ratemaking," Chapter 3 in *Foundations of Casualty Actuarial Science,* Fourth Edition, CAS, 2001.)

The Reported and Paid Claim Triangles

Reported and paid claim development data are the two most common types of data actuaries have access to. Tables 2 and 3 below present the reported and paid claim development triangles, respectively, for XYZ Insurer.

Table 2 – Reported Claim Development Triangle

Accident	Reported Claims ($000) as of (months)						
Year	12	24	36	48	60	72	84
2002	12,811	20,370	26,656	37,667	44,414	48,701	48,169
2003	9,651	16,995	30,354	40,594	44,231	44,373	
2004	16,995	40,180	58,866	71,707	70,288		
2005	28,674	47,432	70,340	70,655			
2006	27,066	46,783	48,804				
2007	19,477	31,732					
2008	18,632						

Table 3 – Paid Claim Development Triangle

Accident	Paid Claims ($000) as of (months)						
Year	12	24	36	48	60	72	84
2002	2,318	7,932	13,822	22,095	31,945	40,629	44,437
2003	1,743	6,240	12,683	22,892	34,505	39,320	
2004	2,221	9,898	25,950	43,439	52,811		
2005	3,043	12,219	27,073	40,026			
2006	3,531	11,778	22,819				
2007	3,529	11,865					
2008	3,409						

When conducting a diagnostic review with claim development triangles, the actuary is generally looking down the columns of the triangle. The actuary is looking at the experience of different accident years at the same age of development (i.e., same maturity age). In a stable environment, the actuary expects to see stability in the claim experience down each column.

We combine the premium data with the claim data and calculate two more diagnostic triangles: the ratio of reported claims to earned premium (also known as the reported claim ratio) and the ratio of reported claims to on-level earned premium. We calculate the on-level premium using the average rate level changes by year and restating the earned premium for each year as if it was written at the 2008 rate level.

Table 4 – Ratio of Reported Claims to Earned Premium

Accident	Ratio of Reported Claims to Earned Premium as of (months)						
Year	12	24	36	48	60	72	84
2002	0.209	0.333	0.436	0.616	0.726	0.796	0.787
2003	0.140	0.246	0.439	0.587	0.639	0.641	
2004	0.171	0.405	0.593	0.722	0.708		
2005	0.208	0.343	0.509	0.511			
2006	0.252	0.435	0.454				
2007	0.312	0.508					
2008	0.390						

Table 5 – Ratio of Reported Claims to On-Level Earned Premium

Accident	Ratio of Reported Claims to On-Level Earned Premium as of (months)						
Year	12	24	36	48	60	72	84
2002	0.229	0.364	0.477	0.674	0.794	0.871	0.862
2003	0.160	0.282	0.504	0.674	0.735	0.737	
2004	0.211	0.500	0.732	0.892	0.874		
2005	0.295	0.488	0.723	0.726			
2006	0.393	0.679	0.709				
2007	0.390	0.635					
2008	0.390						

A thorough review of the above triangles, leads us to the following questions/observations:

— What happened in accident year 2003? Why are the reported claims so low after 12 and 24 months of development? When comparing the changes in claims by year to the changes in premiums by year, we need to first consider the rate level history for the insurer. According to Table 1, we know that the insurer had a 5% higher rate level in 2003 than 2002. Thus, it appears that the insurer experienced an exposure growth of approximately 8% in 2003 ([(($69,175 / 1.05) / $61,183) – 1.00]). Knowing that the insurer actually increased its exposure base, it is surprising to see a 25% drop in reported claims for 2003 after 12 months of development. For the 36-, 48-, and 60-month valuations, reported claims for accident year 2003 appear to return to levels similar to those experienced in 2002. What led to the lower level of reported claims for the first 24 months? Was there a change in systems? Were paid claims or case outstanding driving the decrease in reported claims? If we look at the paid claim triangle for accident year 2003, we observe that paid claims are also down at 12 and 24 months of development and that the reduction is roughly of the same magnitude as for the reported claims.

— What happened in accident year 2004, particularly at and after the 24-month valuation? While we observe that earned premiums are up 44% over 2002 and 34% over 2003 (after adjustment for rate changes), the reported claims for 2004 after 24 months of development are up by 97% [($40,180 / $20,370) – 1.00] over 2002 and 136% [($40,180 / $16,995) – 1.00] over 2003. Are large claims or more claim counts or both driving the increase? Was there a change in case outstanding adequacy that had an effect on the December 31, 2005 valuation? (Remember that the 24-month valuation for accident year 2004 corresponds to the December 31, 2005 valuation.)

- What happened in accident years 2005 and 2006 to drive reported claims up so much at 12 months of development? A quick look at the higher volume of earned premiums for these two years provides some of the explanation for the increase. However, we observe that, at the 12-month valuation, reported claims are again increasing at a rate that is greater than the increase in exposures and our knowledge of the inflationary environment. For example, we compare reported claims between accident years 2004 and 2005:

  $[(AY_{2005} / AY_{2004}) - 1.00] = [(\$28{,}674 / \$16{,}995) - 1.00] = 69\%$

  The 69% increase observed in reported claims between 2004 and 2005 is greater than the increase in exposures between these years, which is 21%. Similarly, we compare reported claims between accident years 2004 and 2006:

  $[(AY_{2006} / AY_{2004}) - 1.00] = [(\$27{,}066 / \$16{,}995) - 1.00] = 59\%$

  The 59% increase observed in reported claims between 2004 and 2006 is greater than the change in exposures between these years, which is actually a decrease of 14%.

- If we look down the 24-month column, we observe unusually large volumes of reported claims for accident years 2004 through 2006. For each of these years, reported claims are greater than $40 million, and the on-level reported claim ratios are greater than 0.40. For these same three accident years, we see that XYZ experienced larger volumes of paid claims with values of approximately $10 million for 2004 and $12 million for 2005 and 2006. We also note that, at 24 months, accident year 2007 reported claims are lower than the preceding three accident years. Could the lower claims in 2007 be a result of the tort reforms introduced during 2006?

- When we analyze the experience for accident year 2006, we should keep in mind that the insurer experienced a significant reduction in exposures during the year. Earned premiums dropped from $138,151 in 2005 to $107,578 even with a 10% rate increase. This indicates a drop in exposures of almost 30%. However reported claims after 12 months of development differ from 2005 by less than 6% [($27,066 / $28,674) – 1.00] and at 24 months of development by less than 2% [($46,783 / $47,432) – 1.00]. After 36 months, we do see a significant difference between claims for accident years 2005 and 2006.

- Now turning our attention to accident years 2007 and 2008, we see that reported claims are significantly lower than for 2005 and 2006 though the claim ratios are not. We can determine the change in exposures based on the given premium information. While there was another reduction of approximately 30% in the exposures during 2007 (from 2006), the change in earned premiums between 2007 and 2008 was primarily due to the rate change and not due to changes in exposure volume. The volume of reported claims at 12 months for accident years 2007 and 2008 is consistent with the earned premium information.

At this point it is valuable for the actuary to analyze additional development triangles to look for answers to some of the questions raised in this initial review of the claims data.

The Ratio of Paid-to-Reported Claims

There are many situations under which reported and paid claim development triangles are the only triangles available to the actuary. Using these two triangles the actuary can calculate a ratio of the paid claims-to-reported claims (also known as the paid-to-reported ratio). Building a triangle using such ratios allows the actuary to analyze the evolution of this relationship over the experience period.

As a diagnostic tool, this ratio examines the consistency of paid claims relative to reported claims. It is an important tool for testing whether there might have been changes in case outstanding adequacy or in settlement patterns. Since we are analyzing a ratio, we need to investigate further any changes observed to determine if the change is occurring in paid claims (i.e., the numerator) or in the case outstanding, which are a critical component of the reported claims (i.e., the denominator). However, if we do not observe changes in the ratio of paid-to-reported claims, it does not necessarily mean that changes are not occurring. There could be offsetting changes in both claim settlement practices and the adequacy of case outstanding that result in no change to the ratio of paid-to-reported claims.

In our example, claims department management believes that the new claims settlement practices resulted in a speed-up in claims closure. Based on this information, we would expect paid claims to be increasing along the latest diagonals relative to prior years. Management also reported that the new policies related to case outstanding are resulting in stronger unpaid case than in prior years. Therefore, reported claims should also be increasing along the latest diagonals of the triangle. With both paid claims and reported claims increasing, the ratio of paid-to-reported claims may be unchanged along the latest diagonals when compared with prior years' diagonals.

Now, we look at the triangle summarizing the historical ratios of paid-to-reported claims for XYZ Insurer.

Table 6 – Ratio of Paid Claims-to-Reported Claims

Accident	Ratio of Paid Claims-to-Reported Claims as of (months)						
Year	12	24	36	48	60	72	84
2002	0.181	0.389	0.519	0.587	0.719	0.834	0.923
2003	0.181	0.367	0.418	0.564	0.780	0.886	
2004	0.131	0.246	0.441	0.606	0.751		
2005	0.106	0.258	0.385	0.567			
2006	0.130	0.252	0.468				
2007	0.181	0.374					
2008	0.183						

We continue to look down each column and to compare the experience from accident year to accident year. Based on the experience in Table 6, it is difficult to discern changes in this ratio. While the ratio was decreasing at 12 months for accident years 2004 through 2006, it has returned to historical levels for accident years 2007 and 2008. Similar observations can be made at 24 months.

We recall that since we are reviewing a ratio, we need to look at the potential for changes in both the numerator and the denominator. A downward trend in the ratio of paid-to-reported claims could be the result of decreasing paid claims or of increasing case outstanding adequacy. We understand from our discussions with management of the claims department that the rate of claims settlement has increased. Is the change in case outstanding adequacy masking the changes in the settlement process? We also ask if the type of claims reported is changing. Different types of claims have different settlement and reporting characteristics. This could have an effect on both paid and reported claims.

The Ratio of Paid Claims to On-Level Earned Premium

Next, we decide to review the ratio of cumulative paid claims to on-level earned premium. We hope that a review of this diagnostic triangle will provide insight as to whether there was a speed-up in claims payment or possibly deterioration in underwriting results.

Table 7 – Ratio of Cumulative Paid Claims to On-Level Earned Premium

Accident	Ratio of Cumulative Paid Claims to On-Level Earned Premium as of (months)						
Year	**12**	**24**	**36**	**48**	**60**	**72**	**84**
2002	0.041	0.142	0.247	0.395	0.571	0.727	0.795
2003	0.029	0.104	0.211	0.380	0.573	0.653	
2004	0.028	0.123	0.323	0.540	0.657		
2005	0.031	0.126	0.278	0.412			
2006	0.051	0.171	0.331				
2007	0.071	0.238					
2008	0.071						

There does appear to be evidence of a possible speed-up in payments, particularly at 12 and 24 months. The question still remains as to whether or not there has been a shift in the type of claim settled at each age. At this point, we request additional data (reported and closed claim counts) and create new development diagnostic triangles for further review.

Claim Count Triangles

Just as we review the reported and paid claim triangles above, we also review the triangles of reported and closed claim counts.

Table 8 – Reported Claim Count Development Triangle

Accident	Reported Claim Counts as of (months)						
Year	**12**	**24**	**36**	**48**	**60**	**72**	**84**
2002	1,342	1,514	1,548	1,557	1,549	1,552	1,554
2003	1,373	1,616	1,630	1,626	1,629	1,629	
2004	1,932	2,168	2,234	2,249	2,258		
2005	2,067	2,293	2,367	2,390			
2006	1,473	1,645	1,657				
2007	1,192	1,264					
2008	1,036						

Table 9 – Closed Claim Count Development Triangle

Accident	Closed Claim Counts as of (months)						
Year	12	24	36	48	60	72	84
2002	203	607	841	1,089	1,327	1,464	1,523
2003	181	614	941	1,263	1,507	1,568	
2004	235	848	1,442	1,852	2,029		
2005	295	1,119	1,664	1,946			
2006	307	906	1,201				
2007	329	791					
2008	276						

Before commencing the analysis of the claim count development triangles, it is important that the actuary understand the types of data contained within such triangles. How does the insurer treat reopened claims? Are they coded as a new claim or is a previously closed claim re-opened? If the insurer treats reopened claims in the latter, there could potentially be a decrease across a row in the closed claim count development triangle. Does the insurer include claims closed with no payment (CNP) in the reported and closed claim count triangles? How are claims classified that have only expense payments and no claim payment?

XYZ Insurer indicated that the closed claim count development data excludes CNP claim counts. The reported claim count development data is based on the sum of closed claim counts (excluding CNP) and claims with case outstanding values; thus, the reported claim count development triangle also excludes CNP counts.

Our review of these triangles leads to the following observations and questions:

- At 12 months, we see that the reported claim counts experienced an increase of 40% [(1,932 / 1,373) – 1.00] and closed claim counts had an increase of 30% [(235 / 181) – 1.00] between accident years 2003 and 2004. Over this same time period, we observe a 76% increase in reported claims. Similarly, the increases in claim counts at 24 months for accident year 2005 [(2,293 / 2,168) – 1.00 = 5.8%] are not as significant as the increases in reported claims [($47,432 / $40,180) – 1.00 = 18.0%]. Why are claims increasing so much more than the number of claims? Could large claims be driving the increases?

- Reported claim counts for accident years 2004 and 2005 stand out as the highest values at all ages. This is generally consistent with the experience shown in the reported claim triangle. However, we do not observe a similar increase in the closed claim count triangle where 2006 and 2007 are highest at 12 months. At 24 months, the highest closed claim count values are for accident years 2005 and 2006. Are the higher closed claim counts due to the new systems implemented at the insurer?

- The decrease in reported claim counts for 2006 and 2007 is consistent with the decrease in exposures for these years. We do not see a similar decrease in closed claim counts, however. Perhaps, this is due to the speed-up in claims settlement processes that management discussed in our meetings. It is worth investigating this issue further.

- For accident year 2008, reported and closed claim counts are lower than we would expect given reported claims, paid claims, and the relative steady-state of exposures between 2007 and 2008. This leads us to further investigation of why the number of claims is down for the latest year.

Ratio of Closed-to-Reported Claim Counts

If the actuary suspects that there are changes in the settlement rate of claims, either based on information gained from meetings with management or changes observed in the ratio of paid-to-reported claims, the ratio of closed-to-reported claim counts is an important diagnostic tool to review. Many factors can have an effect on the reporting and closing of claims. For example, a large catastrophic storm, such as a hurricane, has the potential to temporarily limit an insurer's operations with telephone and computer system shutdowns. In such a situation, there may be a one-time blip with a decrease in the ratio of closed-to-reported claim counts. Other forces that could result in a change in the ratio of closed-to-reported claim counts include:

- Change in the guidelines for the establishment of a claim

- Decrease in the statute of limitations, which often accompanies major tort reform

- Delegation of a higher limit for settlement of claims to a TPA

- Restructuring of the claim field offices, such as through the merging of existing offices or the addition of new offices

- Introduction of a new call center to handle claims (This could affect both reported and closed claim counts and thus the actuary would need to further investigate whether changes were affecting the numerator, closed claim counts, the denominator, reported claim counts, or both.[29])

Management at XYZ Insurer told us that they implemented a new claims processing system and that claims are now settling much more quickly than in the past. Management indicated that the new system is having an effect on the entire portfolio of outstanding claims not just claims from the latest accident year. With respect to the ratio of closed-to-reported claim counts, we would then expect to see greater ratios for the latest diagonals than for prior years.

[29] Changes in claims handling procedures can result in decreases and increases in the rate of claim payments. Sometimes, a change in procedures results in a temporary increase in closing patterns, such as when a claim department makes an extra effort to get the backlog as low as possible before making a transition to a new system. Sometimes, the speed-up is due to faster processing under the new system. Sometimes the new system leads to a slowdown in closing, due to a learning curve necessary before the new system is fully operational.

We generate the following triangle based on the claims information presented earlier for XYZ Insurer.

Table 10 – Ratio of Closed-to-Reported Claim Counts

Accident	Ratio of Closed-to-Reported Claim Counts as of (months)						
Year	12	24	36	48	60	72	84
2002	0.151	0.401	0.543	0.699	0.857	0.943	0.980
2003	0.132	0.380	0.577	0.777	0.925	0.963	
2004	0.122	0.391	0.645	0.823	0.899		
2005	0.143	0.488	0.703	0.814			
2006	0.208	0.551	0.725				
2007	0.276	0.626					
2008	0.266						

Change is clearly evident in this diagnostic triangle. For the first four years in the experience period (2002 through 2005) at 12 months of development, the ratio of closed-to-reported claim counts was roughly 0.14. For each of the last three years (at 12 months), the ratio is in excess of 0.20; and for the latest year it is 0.266. We observe the same type of increases for the 24-month through 48-month development periods. At 24 months, the ratio of closed-to-reported claim counts for the latest accident year, 2007, is 0.626 and for the earliest year, 2002, is 0.401; at 36 months, the ratio for the latest accident year, 2006, is 0.725 and for the earliest year, 2002, is 0.543.

The experience of closed and reported claim counts is consistent with management's report of greater emphasis on settling claims faster. After concluding that management's efforts have indeed had an effect on the claims settlement patterns, the actuary must then consider the consequences of such a change. Generally, insurers are able to close the less complicated and less expensive claims the quickest. The closure of more complicated claims, which tend to involve litigation and expert witnesses, are often less in the control of the insurer since third parties play a significant role in the claims settlement process. If the insurer's greater focus on closing claims is having its greatest influence on the settlement of smaller claims, there will likely be a shift in the type of claims closed or open at any particular age in the claim development triangle. We discuss this further in the next section on average claims.

Average Claims

We use the reported and paid claim development triangles as well as the reported and closed claim count triangles to calculate various average values. For XYZ Insurer, we calculate the following:

Table 11 – Definitions of Average Values

Average Value	Definition
Average reported claim	Reported claim triangle / reported claim count triangle
Average paid claim	Paid claim triangle / closed claim count triangle
Average case outstanding	$\dfrac{\text{Reported claim triangle – paid claim triangle}}{\text{Reported claim count triangle – closed claim count triangle}}$

Before summarizing the observations from XYZ Insurer, we highlight two important issues related to average values. First, it is important for the actuary to have a clear understanding of the definition of closed and reported claim counts. Some insurers include claims with no payment (CNP) in the definition of closed claim counts and other insurers exclude CNP. Similarly, some insurers include claims with no case outstanding and no payments in the definition of reported claim counts, and other insurers define reported claim counts as only those claims with a case outstanding greater than $1 or with a claim payment. The result of including CNPs in closed claim count statistics or claims with no case outstanding or payments in reported claim counts is a much lower average value. For the actuary, what is most important is that he or she knows what definition the insurer uses and that the insurer is consistently using the same definition throughout the experience period. A change in the definition of claim counts can have a significant consequence on the results of diagnostic analyses using claim counts and on estimation techniques that rely on the number of claims. It is also important that the actuary is aware of differences between the insurer's definition of claim counts and any external benchmarks that would be used for comparison purposes.

Second, large claims, both the presence and absence of such claims, can have a distorting effect on average claims. Actuaries may remove unusually large claims from the database before conducting both ratio and average value calculations and handle the unpaid claim estimate required for such large claims separately. Another alternative is to prepare development triangles using limited claims. For example, claims can be limited to $500,000 or $1 million per occurrence in the reported and paid claim development triangles. The determination of the claim limit is a matter of significant actuarial judgment and is beyond the scope of this book. (See previous discussion of determining a large claims threshold in Chapter 3.)

Policy deductibles can also cause a distorting effect on the analysis of average values. Again, the actuary must understand what is included and excluded from the data source, in terms of claims, recoverables, and claim counts. Retentions can also distort severities.

For XYZ Insurer, closed claim counts exclude claims closed without any payment; similarly, reported claim counts exclude claims in which there are no case outstanding and no payments. Paid claims, for XYZ Insurer, include partial payments as well as payments on closed claims. Thus, our average paid claim triangle will be a combination of payments on settled claims as well as payments on claims that are still open.

We present the average reported claim triangle for XYZ Insurer in the following table. The average reported claim triangle is frequently used to detect possible changes in case outstanding adequacy. It is not quite as valuable as the average case outstanding triangle since reported claims include both paid claims and unpaid case. As we discussed previously, changes in paid claims have the potential to mask changes in case outstanding adequacy. However, for some insurers, open claim counts are not available in triangular format and the average reported claim triangle may be all that the actuary has available for diagnostic purposes.

Table 12 – Average Reported Claim Development Triangle

Accident	Average Reported Claims as of (months)						
Year	**12**	**24**	**36**	**48**	**60**	**72**	**84**
2002	9,546	13,455	17,219	24,192	28,673	31,379	30,997
2003	7,029	10,517	18,622	24,966	27,152	27,239	
2004	8,796	18,533	26,350	31,884	31,129		
2005	13,872	20,686	29,717	29,563			
2006	18,375	28,440	29,453				
2007	16,340	25,104					
2008	17,985						

When reviewing triangles of average values for a stable insurer, we expect to see changes down the columns limited to inflationary forces only. As we look down the columns of the average reported claim triangle in our example above we observe changes that are greater than the annual inflation (assumed to be 5% for this region's automobile bodily injury liability).[30] We do not know, however, if the increases are due to greater levels of payments or stronger case outstanding.

In Table 13, we show the average paid claim triangle. We remind you that there is a mismatch in the average paid claim triangle since the numerator (cumulative paid claims) includes partial claim payments and the denominator (closed claim counts) represents only claims with final settlement. We must consider this limitation when drawing any conclusions from this particular diagnostic triangle.

Table 13 – Average Paid Claim Development Triangle

Accident	Average Paid Claims as of (months)						
Year	**12**	**24**	**36**	**48**	**60**	**72**	**84**
2002	11,417	13,067	16,436	20,290	24,073	27,752	29,178
2003	9,631	10,163	13,478	18,125	22,896	25,077	
2004	9,452	11,673	17,996	23,455	26,028		
2005	10,315	10,920	16,270	20,569			
2006	11,502	13,000	19,000				
2007	10,726	15,000					
2008	12,351						

In this diagnostic triangle, we observe that the average values along the latest diagonal are generally the highest value in each column (particularly at 12 to 36 months). Based on the knowledge acquired from our meetings with claims department representatives and our review of other diagnostics, we ask whether or not there has been a change in the type of claim that is being closed at these particular ages. This is an important question for the actuary to discuss with management of the claims department as it could affect the actuary's selection of estimation techniques and claim projection factors.

[30] It is important to recognize that there are many factors that have an effect on severity trends for any particular line of business. Examples include changes in: policy limits purchased, geographic mix, type of policyholders insured, definition of claim counts, etc.

The average paid claim triangle appears relatively stable for ages 48 and older. The evidence of change in average paid claims only at 12, 24, and 36 months is consistent with our earlier comment that insurers typically have the greatest control on closure rates of the less complicated and less expensive claims. Closing more complex claims is usually dependent on the actions of third parties that are not within the insurer's control.

Finally, we review the average case outstanding (or average open claim amount) triangle. The average case outstanding triangle is one of the most important diagnostic tools for testing changes in case outstanding adequacy. In this triangle, a decreasing pattern down the column is an indicator of potential weakening in the case outstanding, and an increasing pattern down the column is an indicator of possible strengthening in the case outstanding.

Table 14 – Average Case Outstanding Development Triangle

Accident	Average Case Outstanding as of (months)						
Year	**12**	**24**	**36**	**48**	**60**	**72**	**84**
2002	9,213	13,714	18,151	33,273	56,167	91,729	120,366
2003	6,634	10,733	25,647	48,766	79,718	82,826	
2004	8,706	22,941	41,561	71,204	76,320		
2005	14,464	29,994	61,547	68,983			
2006	20,185	47,368	56,984				
2007	18,480	42,002					
2008	20,031						

Before drawing any conclusions, however, it is important that the actuary understands the dynamics of the insurer. Has there been a change in case outstanding practices, policies, philosophy, staff, or senior management of the claims department? Any of these changes could affect case outstanding adequacy. The average case outstanding could also be changing due to changes in the mix of business in the portfolio that have nothing to do with changes in case outstanding strength.

This is why it is so important that the actuary looks at more than one diagnostic tool before drawing conclusions and that the actuary returns to the insurer's claims department for further input regarding his or her observations.

To analyze the data in the average case outstanding triangle for XYZ Insurer, we look down the columns and compare the average case outstanding at the same age by accident year. For an insurer that is operating in a stable environment, we expect that the average case outstanding would be increasing down the column at the relevant annual inflation rate.[31] A quick look at the average case outstanding in our example tells us that the average case outstanding is generally increasing by more than the 5% inflation in this example.

For the earliest years in our experience period (2002 through 2004), the average case outstanding at 12 months of development was less than $10,000. For two of the latest three accident years at 12 months, the average case outstanding is greater than $20,000. We see similar increases at 24 and 36 months. At 24 months, the average case outstanding for accident years 2002 and 2003 was less than $15,000; for accident years 2006 and 2007 at the same development age, the average case outstanding values are both greater than $40,000. At 36 months, the average case

[31] Note that the relevant annual inflation rate may be something other than the overall inflation rate, as it may reflect a different mix of components than found in the overall economy's inflation.

outstanding for accident years 2002 and 2003 was less than $26,000; for accident years 2005 and 2006 at the same age, the average value is close to $60,000. We also observe increasing values of average case outstanding at 48 and 60 months.

We understand from our meetings with XYZ Insurer management that increased case outstanding strength is a priority. We also know that a review of the average case outstanding shows increasing average values for outstanding claims. However, before accepting that there has been a change in the adequacy of case outstanding, we must ask what effect, if any, is the change in claims settlement having on the average case outstanding. If smaller claims are settling more quickly, we are then left with only the more complex and more expensive claims. This, in and of itself, would lead to an increase down the columns in the average case outstanding. It is very important for the actuary to determine how much of the increase in the average case outstanding is truly due to a systemic change in the overall level of case outstanding adequacy and how much is due to a different mix of claims.

Summary Comments for XYZ Insurer

Clearly XYZ Insurer has experienced change over the recent several years. Management communicated these changes in our last meeting and every claim development diagnostic that we review shows that the changes noted by management are evident. It is now up to the actuary to determine how to incorporate all this information in the development of an unpaid claim estimate to be carried on XYZ Insurer's financial statements. The changing environment will have an effect on the actuary's choice of estimation techniques, types of data, and actuarial factors within the techniques. We continue to use this example in Part 3 as we introduce basic techniques for estimating unpaid claims.

Conclusions

In this chapter we present, as an example, an insurer who has the capability of producing development triangles for many types of data, including claims and claim counts. Many insurers do not have this ability. In these situations, actuaries may be limited to development triangles of reported and paid claims only. Actuaries are then faced with the challenge of finding other sources of data and information to ensure that they have sufficient knowledge of the insurer in order to determine the unpaid claims.

In "Loss Reserving," Mr. Wiser states: "Exploring the data begins by understanding the trends and changes affecting the database. Understanding the data is a prerequisite to estimating sound loss reserves. This exploration will help the analyst select appropriate loss reserving methods and interpret the results of the methods."[32]

The goal of this chapter is to demonstrate that the development triangle is an excellent tool for exploring the data. We discuss how important it is for the actuary to take the information obtained during meetings with management and then seek confirmation in the actual claims experience. The actuary should not simply accept reports of change or reports of no change without confirmation. Without some form of verification, management's assertion of changes in the strength of case outstanding or changes in the rate of claims settlement could lead to inaccurate estimates of unpaid claims by the actuary.

[32] *Foundations of Casualty Actuarial Science*, 2001.

The actuary must be able to question management when they see changes in the data that are not consistent with what management says has occurred, is occurring, or will be occurring. The dialogue between the actuary and those involved with the insurer's operations (especially claims operations) must be ongoing. Understanding the data is a complex process that requires the input of many people and ultimately requires the judgment of the actuary to interpret the findings from both quantitative and qualitative information.

PART 3 – BASIC TECHNIQUES FOR ESTIMATING UNPAID CLAIMS

INTRODUCTION TO PART 3 – BASIC TECHNIQUES FOR ESTIMATING UNPAID CLAIMS

The Components of Ultimate Claims

In Part 3, we present numerous methods for projecting ultimate claims. Ultimate claims are the sum of three components: cumulative paid claims, case outstanding, and IBNR. The relationships among these three components vary tremendously by line of insurance, by jurisdiction, and by time interval being reviewed (e.g., recent accident years versus mature accident years). The relationships also vary from insurer to insurer depending on the insurers' claims management philosophies and procedures.

Paid claims and case outstanding typically represent a high proportion of ultimate claims at early maturities for lines of insurance such as automobile physical damage and property. These lines of insurance are characterized as *short-tail* lines of insurance due to the short period of time associated with the claims reporting and settlement processes. In contrast, medical malpractice occurrence is an example of a line of insurance that is classified in the U.S. as a *long-tail* line of insurance due to the lengthy period of time associated with the reporting and settlement of these types of claims. U.S. workers compensation and general liability, including products liability and errors and omissions, are other examples of long-tail lines of insurance in the U.S.

In the four pie charts on the following page, we compare the split between paid claims, case outstanding, and IBNR for accident years 2006 and 2007 as of December 31, 2007,[33] for the consolidated U.S. industry data for automobile physical damage and for medical malpractice occurrence.[34] While the examples refer to specific U.S. coverages, the intent of the pie charts is to demonstrate the significant differences in the proportions between paid, case outstanding, and IBNR for different accident years, and the differences between short-tail lines and long-tail lines of coverage.

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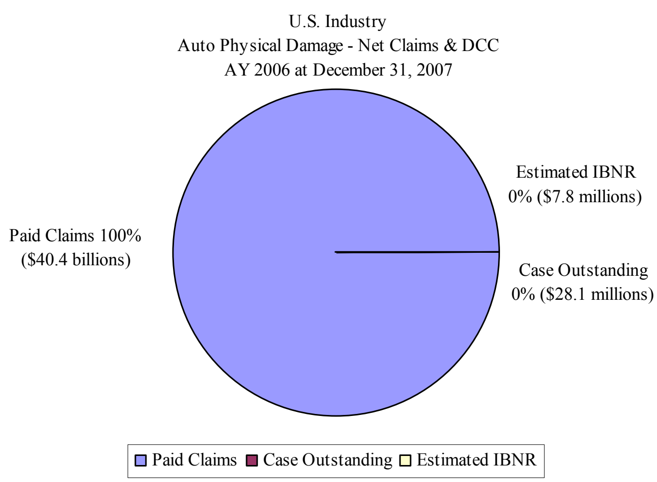
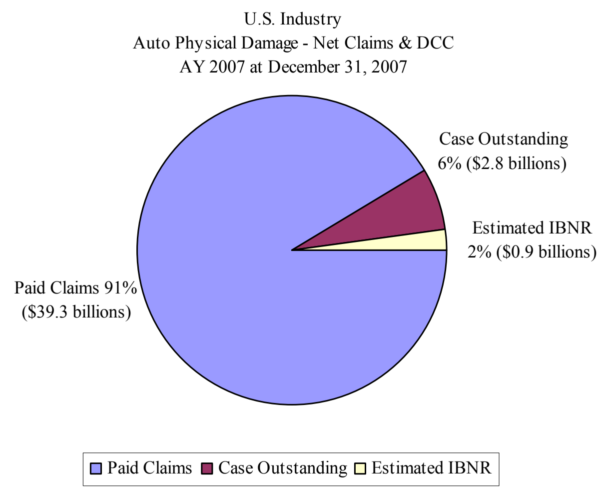
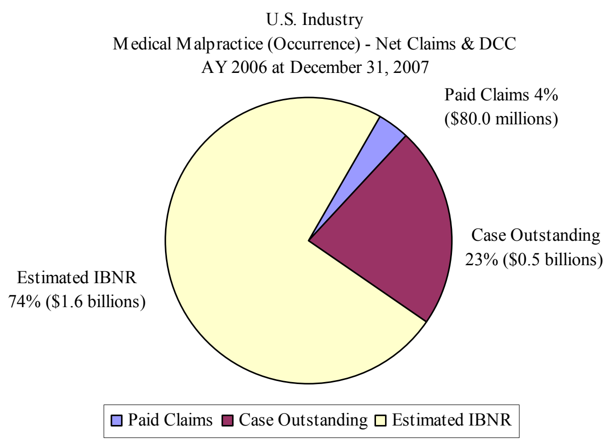
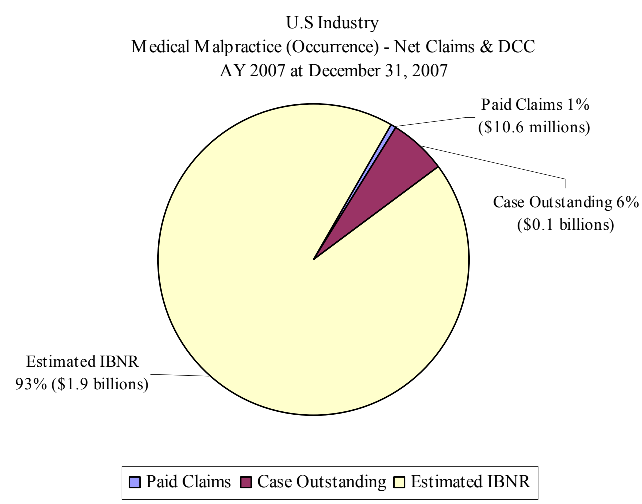
[33] The source of data for the four pie charts in this section is the consolidated U.S. annual statement for the year ending December 31, 2007, Schedule P (a claim development schedule of the U.S. annual statement) contained in *Best's Aggregates & Averages*. The data in the pie charts includes claims and DCC net of reinsurance, gross of salvage and subrogation.

[34] Medical malpractice is the name of the coverage used in *Best's Aggregates & Averages*. This coverage is also known as medical professional liability. In the U.S., there is separate financial reporting for medical malpractice occurrence and medical malpractice claims-made coverages.









Throughout Part 3, we use numerous methods to project ultimate claims. We then derive estimated IBNR as the difference between projected ultimate claims and reported claims as of the valuation date. The total unpaid claim estimate is calculated as the sum of the estimated IBNR and case outstanding; alternatively, we can calculate the estimated total unpaid claims as the difference between projected ultimate claims and cumulative paid claims as of the valuation date.

Actuarial Judgment

In the Berquist and Sherman paper "Loss Reserve Adequacy Testing: A Comprehensive, Systematic Approach,"[35] there is a discussion of the vital role of actuarial judgment in the analysis of unpaid claims. Berquist and Sherman begin their paper with the following:

> While specific guidelines for reserve adequacy testing may be established and specific examples of an actuarial approach to the testing of loss reserves may be offered for particular situations, loss reserving cannot be reduced to a purely mechanical process or to a "cookbook" of rules and methods. The utilization and interpretation of insurance statistics requires an intimate knowledge of the insurance business as well as the actuary's ability to quantify complex phenomena which are not readily measurable. As in the case of ratemaking, while certain general methods are widely accepted, actuarial judgment is required at many critical junctures to assure that reserve projections are neither distorted nor biased.

Berquist and Sherman identify the following specific areas where actuarial judgment is required:

- Determining the optimal combination of the kinds of claims data to be used in the estimation of unpaid claims
- Assessing the effect of changes in an insurer's operations on the claims data that is used in estimating unpaid claims
- Adjusting the claims data for the influences of known and quantifiable events
- Evaluating the strengths and weaknesses of various estimation techniques
- Making the final selection of the unpaid claim estimate

Part 3 – Basic Techniques for Estimating Unpaid Claims addresses all of these areas. Through the use of numerous examples, which span multiple chapters, we examine different combinations of data and use them with a wide range of actuarial projection methods. We study the influence of changes in case outstanding adequacy, settlement patterns, underlying claims experience, and product mix on the various projection methods. When an insurer has experienced significant changes in operations, we seek alternative methods through data reorganization, selection of alternative data types, and quantitative manipulation of existing data. In the final chapter of Part 3, we bring the results of all the various projection methodologies together for evaluation and final selection of ultimate claims and unpaid claim estimate.

[35] *PCAS*, 1977.

The following table summarizes the examples that we use in Part 3 and the chapters in which they can be found. For ease of reference throughout Part 3, we identify each example by an abbreviated name.

Example Number	Example Name	Description	Chapters
1	U.S. Industry Auto	U.S. private passenger automobile insurance as reported in *Best's Aggregates & Averages*	7, 8, 9, 10, 12
2	XYZ Insurer	Private passenger automobile bodily injury liability portfolio for an insurer who has experienced numerous internal changes in operations, management, and claims philosophy as well as external influences from regulatory reform in the insurance product	7, 8, 9, 10, 11, 12, 13, 15
3	U.S. PP Auto Steady-State	U.S. private passenger automobile insurance in a steady-state environment where claim ratios are stable and there are no changes from historical levels of case outstanding strength	7, 8, 9, 10
4	U.S. PP Auto Increasing Claim Ratios	U.S. private passenger automobile insurance in an environment of increasing claim ratios and no change in case outstanding strength	7, 8, 9, 10
5	U.S. PP Auto Increasing Case Outstanding Strength	U.S. private passenger automobile insurance in an environment of stable claim ratios with an increase in case outstanding strength	7, 8, 9, 10
6	U.S. PP Auto Increasing Claim Ratios and Case Outstanding Strength	U.S. private passenger automobile insurance in an environment where there are increases in both claim ratios and case outstanding strength	7, 8, 9, 10
7	U.S. Auto Steady-State	Combined portfolio of U.S. private passenger and commercial automobile insurance in a steady-state environment where there is no change in the product mix	7, 8, 9, 10
8	U.S. Auto Changing Product Mix	Combined portfolio of U.S. private passenger and commercial automobile insurance in an environment where the volume of commercial automobile insurance is increasing at a faster rate than the private passenger automobile insurance	7, 8, 9, 10
9	Auto BI Insurer	Insurer's private passenger automobile bodily injury portfolio in one jurisdiction	8
10	GL Self-Insurer	Self-insurer's general liability program	8
11	Auto Collision Insurer	Insurer's private passenger automobile collision portfolio	11
12	WC Self-Insurer	Self-insurer's U.S. workers compensation program	11
13	GL Insurer	Insurer's occurrence basis general liability insurance portfolio	11
14	Self-Insurer Case Only	Self-insurer with case outstanding only data available for historical years for general liability coverage	12
15	Berq-Sher Med Mal Insurer	Insurer's occurrence basis U.S. medical malpractice insurance portfolio	13, 15
16	Berq-Sher Auto BI Insurer	Insurer's U.S. automobile bodily injury liability insurance portfolio	13, 15
17	Auto Physical Damage Insurer	Salvage and subrogation for auto physical damage insurance portfolio	14
18	DC Insurer	Interim Reporting	15

Readers should be aware that figures in the supporting exhibits for both Parts 3 and 4 are often carried to a greater number of decimals than shown. Thus, totals and calculations may not agree exactly due to rounding differences.

CHAPTER 7 – DEVELOPMENT TECHNIQUE

In Chapter 5, we explain how to create a development triangle. Specifically, we build development triangles for paid claims, case outstanding, reported claims, and reported claim counts based on detailed information for a set of 15 claims observed over a four-year time horizon. In this chapter, we develop estimates of ultimate claims and unpaid claims based on the reported and paid claim development methods. The development technique, also known as the chain ladder technique, is one of the most frequently used methodologies for estimating unpaid claims.

Key Assumptions

The distinguishing characteristic of the development method is that ultimate claims for each accident year are produced from recorded values assuming that future claims' development is similar to prior years' development. In this method, the actuary uses the development triangles to track the development history of a specific group of claims. The underlying assumption in the development technique is that claims recorded to date will continue to develop in a similar manner in the future – that the past is indicative of the future. That is, the development technique assumes that the relative change in a given year's claims from one evaluation point to the next is similar to the relative change in prior years' claims at similar evaluation points.

An implicit assumption in the development technique is that, for an immature accident year, the claims observed thus far tell you something about the claims yet to be observed. This is in contrast to the assumptions underlying the expected claims technique (Chapter 8), the Bornhuetter-Ferguson technique (Chapter 9), and the Cape Cod technique (Chapter 10).

Other important assumptions of the development method include: consistent claim processing, a stable mix of types of claims, stable policy limits, and stable reinsurance (or excess insurance) retention limits throughout the experience period.

Common Uses of the Development Technique

Actuaries apply the development technique to paid and reported claims as well as the number of claims. This technique is used with all lines of insurance including short-tail lines and long-tail lines. In order to use the development method, actuaries organize data in many different time intervals, including:

- Accident year
- Policy year
- Underwriting year
- Report year
- Fiscal year[36]

[36]Actuaries for self-insurers often conduct the actuarial analysis using the organization's fiscal year time frame. For example, for a self-insured public entity with a fiscal year ending March 31, the actuary will likely organize the claim development data by April 1 to March 31 fiscal year.

Actuaries also apply this technique to monthly, quarterly, and semiannual data.

Mechanics of the Development Technique

The development method consists of seven basic steps:

- Step 1 – Compile claims data in a development triangle
- Step 2 – Calculate age-to-age factors
- Step 3 – Calculate averages of the age-to-age factors
- Step 4 – Select claim development factors
- Step 5 – Select tail factor
- Step 6 – Calculate cumulative claim development factors
- Step 7 – Project ultimate claims

To demonstrate these seven steps, we begin with an example based on industry-aggregated accident year claim development data for U.S. private passenger automobile insurance.[37] This example is labeled "U.S. Industry Auto."

Step 1 – Compile Claims Data in a Development Triangle

In Exhibit I, Sheets 1 and 2, we present the cumulative reported and paid claim development triangles, respectively. Each of these sheets contains four parts that follow the first five steps of our description of the development method. Part 1 of each exhibit includes the data triangle. In our example, the data triangles contain reported and paid claim development experience for accident years 1998 through 2007. There are ten diagonals in each triangle with annual valuation dates of December 31, 1998 through December 31, 2007. The reported and paid claims data contained in these exhibits are net of reinsurance and include the defense cost portion of claim adjustment expenses (labeled DCC for U.S. statutory accounting).

Step 2 – Calculate Age-to-Age Factors

The next step is to calculate age-to-age factors. These factors are also known as report-to-report factors or link ratios. They measure the change in recorded claims from one valuation date to the next. In Part 2 of Exhibit I, Sheets 1 and 2, we present the age-to-age factors for U.S. Industry Auto. The standard naming convention for age-to-age factors is *starting month-ending month*. For example, the age-to-age factor for the 12-month period-to-the 24-month period is often referred to as the 12-24 factor (which is read as the 12-to-24 factor) or the 12-24 month factor.

To calculate the age-to-age factors for the 12-month-to-24-month period, we divide the claims as of 24 months by the claims as of 12 months. Therefore, the triangle of age-to-age factors has one less row and one less column than the original data triangle.

[37] The source of data is *Best's Aggregates & Averages*.

Using the reported claims presented in Exhibit I, Sheet 1, we calculate the following:

12-24 factor for accident year 1998

$$= \frac{\text{reported claims at 24 months for accident year 1998}}{\text{reported claims at 12 months for accident year 1998}} = \frac{\$43{,}169{,}009}{\$37{,}017{,}487}$$

= 1.166

We provide a second example for the 36-month-to-48-month factor for accident year 2002:

36-48 factor for accident year 2002

$$= \frac{\text{reported claims at 48 months for accident year 2002}}{\text{reported claims at 36 months for accident year 2002}} = \frac{\$57{,}703{,}851}{\$56{,}102{,}312}$$

= 1.029

We proceed in the same manner down the columns and across the rows of both the reported and paid claim triangles.

Step 3 – Calculate Averages of the Age-to-Age Factors

After completing the triangle of age-to-age factors, our next step is to calculate averages of the age-to-age factors. Actuaries use a wide variety of averages for age-to-age factors. Some of the most common averages include:

- Simple (or arithmetic) average
- Medial average (average excluding high and low values)
- Volume-weighted average
- Geometric average (the n^{th} root of the product of n historical age-to-age factors)

In Part 3 of Exhibit I, Sheets 1 and 2, we present the following averages for U.S. Industry Auto:

- Simple averages for the latest five years and the latest three years
- Medial average for the latest five years excluding one high and one low value (medial latest 5x1)[38]
- Volume-weighted averages for the latest five years and the latest three years
- Geometric average for the latest four years

For reported claims, the 12-24 month simple average of the latest five factors is based on the average of the 12-24 month factors for accident years 2002 through 2006 and is equal to 1.168 ((1.184 + 1.162 + 1.159 + 1.160 + 1.173) / 5). The simple average of the latest three factors is

[38] In the examples in this text, the medial average for two data points is the same as the simple average, and the medial average for one data point is simply the value of the data point.

based on the 12-24 month factors for accident years 2004 through 2006 and is 1.164 ((1.159 +1.160 + 1.173) / 3).

To calculate the reported claims 24-36 month medial average development factor of the latest 5x1, we consider the 24-36 month factors for accident years 2001 through 2005; we exclude the highest value (1.062 for accident year 2001) and the lowest value (1.055 for accident year 2004) and take an average of the remaining three values. The 24-36 month medial average of the latest 5x1 is 1.057 ((1.059 + 1.057 + 1.056) / 3).

The volume-weighted average is the weighted average using the amounts of reported claims (or paid claims) as weights. The formula for this type of average uses the sum of the claims for the specific number of years divided by the sum of the claims for the same years at the previous age. For example, the 36-48 month volume-weighted average of the latest three years is equal to the sum of the reported claims for accident years 2002 through 2004 as of 48 months ($57,703,851 + $57,015,411 + $56,976,657 = $171,695,919) divided by the sum of the reported claims for accident years 2002 through 2004 as of 36 months ($56,102,312 + $55,468,551 + $55,553,673 = $167,124,536), or 1.027.

The geometric average (also known as the geometric mean) for the latest four years is equal to the fourth root of the product of the last four age-to-age factors. For example, the geometric average for the latest four years at 12-24 months is equal to $(1.162 \times 1.159 \times 1.160 \times 1.173)^{.25}$, or 1.164. Similarly, for 48-60 months, the geometric average for the latest four years is equal to $(1.010 \times 1.014 \times 1.011 \times 1.010)^{.25}$, or 1.011.

For U.S. Industry Auto, we present various averages for the more recent diagonals. Actuaries often place greater reliance on the most recent experience as this data most likely reflects the effect of the latest changes in the insurer’s internal and external environments. The circumstances underlying the specific data grouping (including the nature of the line of business, the credibility of the available claims data, and changes in the insurer’s environment) should dictate the number of experience periods to include in the various averages. Similar to many actuarial decisions, there is often a trade-off between stability, which is represented by a greater number of experience periods included in the average values, and responsiveness, where only the most recent experience periods are considered.

Step 4 – Select Claim Development Factors

The selected age-to-age factor (also referred to as the selected claim development factor or selected loss development factor) represents the growth anticipated in the subsequent development interval. When selecting claim development factors, actuaries examine the historical claim development data, the age-to-age factors, and the various averages of the age-to-age factors. It is also common practice to review the prior year’s selection of claim development factors.[39]

[39] A comparison to prior factors is important for several reasons. First, the actuary is able to compare his or her expectations at the prior valuation for development in the interval with actual experience. Second, an actuary is often balancing the conflicting goals of stability and responsiveness. By having the prior selected factors as a reference point, the actuary can consider the extent to which he or she wants to change selected claim development factors. Finally, it is valuable information to understand the effect of changes in development factors alone (or methodology) on the projected ultimate claims versus the effect of changes in the actual claim experience.

When the credibility of the insurer's own historical experience is limited, there may be a need to supplement the insurer's own historical experience with certain benchmarks. One possible benchmark includes experience from similar lines with similar claims handling practices within the insurer. Another source of benchmarks is claim development patterns from the insurance industry when observable and considered to be comparable. Any benchmark must be utilized with caution, as there may be significant differences between the line of business being analyzed and the benchmark with regard to claims practices, policy coverages, underwriting, geographic mix, claim coding, policyholder deductibles and/or limits, legal precedents, etc. Such differences could make the development patterns noncomparable and increase the variability in the estimates of unpaid claims. (For further discussion on the use of industry benchmark experience, see Chapter 3.[40])

When selecting claim development factors, actuaries review the claim development experience for the following characteristics:

— *Smooth progression of individual age-to-age factors and average factors across development periods.* Ideally, the pattern should demonstrate steadily decreasing incremental development from valuation to valuation (i.e., as we move further away from the accident period), especially in the later valuations. For U.S. Industry Auto, we observe decreasing values of age-to-age factors in virtually every interval (moving across the columns) for both reported claims and paid claims.

— *Stability of age-to-age factors for the same development period.* Ideally, there should be a relatively small range of factors (small variance) within each development interval (i.e., down the columns). We look for stability of age-to-age factors and within the various averages for the same development period. In our example, there is considerable stability of factors especially for the factors in age intervals of 24-36 months and later. For both reported and paid claims, we observe the greatest variability in age-to-age factors at the 12-24 month period. This is not unexpected as claims at the earlier ages are at their most immature state, when the claims professional has the least amount of information about the circumstances of the insured event as well as the potential damages and injuries of claimants.

— *Credibility of the experience.* Actuaries generally determine credibility based on the volume and the homogeneity of the experience for a given accident year and age. If the claim development experience of the insurer has limited credibility because of the limited volume of claims, organizational changes, or other factors, it may be necessary to use benchmark development factors from the insurance industry. (See the earlier discussion about the use of industry benchmarks.)

— *Changes in patterns.* Actuaries review the age-to-age factors to identify systematic patterns that may suggest changes in the internal operations or external environment. We address this issue at length in Chapter 6.

— *Applicability of the historical experience.* Actuaries determine the appropriateness of historical age-to-age factors for projecting future claim development based on qualitative information regarding changes in the book of business and insurer operations over time. Actuaries also consider the effect of changes in external factors that have not yet manifested themselves in the reported claims experience.

[40] The Academy is on record for recommending against the reliance and heavy use of insurance industry benchmarks, unless necessary due to low credibility.

In Part 4 of Exhibit I, Sheets 1 and 2, we present our selected claim development factors for each age-to-age interval as well as the selected tail factors. (Tail factors are described in greater detail in the next section.) We use actuarial judgment to select these factors after reviewing all of the age-to-age factors, the various averages, and the prior year's selected factors. In the exhibits, we use the label "To Ult" (i.e., To Ultimate) to designate the tail factor; in the following tables, we label the tail factors "120-Ultimate" (i.e., 120 months-to-ultimate). Both labels are commonly used by actuaries to indicate the selected tail development factor.

We recognize that the selections of development factors are subjective and will likely differ from one actuary to another, perhaps materially, as the selection process involves significant actuarial judgment. When different actuaries apply their own experience and insight to the analysis of the same data, the selected age-to-age factors typically differ – sometimes by a small amount and sometimes by a large amount. It is important to appreciate that there is more than one reasonable selection of age-to-age and tail factors.

Table 1, which is an excerpt from Exhibit I, Sheets 1 and 2, summarizes the selected reported and paid claim development factors by age-to-age interval for U.S. Industry Auto.

Table 1 – Selected Age-to-Age Factors

	12-24	24-36	36-48	48-60	60-72	72-84	84-96	96-108	108-120	120-ultimate
Reported	1.164	1.056	1.027	1.012	1.005	1.003	1.002	1.001	1.000	1.000
Paid	1.702	1.186	1.091	1.044	1.019	1.009	1.005	1.002	1.002	1.002

Step 5 – Select Tail Factor

Earlier in this book we introduced the topic of the number of development periods needed for the analysis of unpaid claims. We asked whether it is necessary to analyze development through the 3rd maturity year, the 5th maturity year, the 10th or the 20th maturity year. If the data is available, the actuary should analyze development out to the point at which the development ceases (i.e., until the selected development factors are equal to 1.000). The number of development periods required generally varies by line, jurisdiction, and data type.

Sometimes the data does not provide for enough development periods. This occurs when the development factors for the most mature development periods available are still significantly greater than 1.000.[41] When this occurs, the actuary will need to determine a tail factor to bring the claims from the latest observable development period to an ultimate value.

For some lines of insurance and some types of claims data, the tail factor can be especially difficult to select due to the limited availability of relevant data. The point of development beyond which no tail factor is required varies tremendously by line of business. For short-tail coverages, insurers generally settle claims within months or a few years of the accident date. However, for long-tail lines of business, such as U.S. medical professional liability and workers compensation, some claims can take more than fifteen years to reach final settlement.

[41] There are some cases in which the development at the end of the triangle is often less than one, such as for a line of business with significant subrogation activity after claims are paid. For these lines of business, the desire is still to have sufficient periods in the development triangle so that non-zero development ceases, but in this case the development factors may approach 1.000 from below.

In 1978, Joseph O. Thorne discussed the potential difficulty in selecting tail factors based on historical data in his review of the Berquist and Sherman paper "Loss Reserve Adequacy Testing: A Comprehensive, Systematic Approach." Mr. Thorne noted:

> Care must be taken in projecting the tail from older accident years to recent accident years. For example, in Workers' Compensation the tail percentage may increase due to trends in cumulative injury, shifts to unlimited medical benefits, and increases in the proportion of pension claims. On the other hand, the percentage may decrease due to trends in settlement practices for lump sum awards of for compromise and release of claims. The effects of certain factors may be quantified by analysis of loss experience (such as claims by size or injury type) or by specific sampling; other factors may require considerable judgment.[42]

Thorne's comments are equally applicable today. The tail factor is crucial as it influences the unpaid claim estimate for all accident years (in the experience period) and can create a disproportionate leverage on the total estimated unpaid claims. The tail factor, or a similar concept, plays an important role not only in the development technique but in almost every technique discussed in Part 3 – Basic Techniques for Estimating Unpaid Claims.

Actuaries use several approaches to evaluate the tail factor. One approach is to rely on industry benchmark development factors. (See previous discussions regarding use of industry benchmarks.) Another common approach is to fit a curve to the selected or observed development factors to extrapolate the tail factors; exponential decay is a common assumption for such curve fitting. A third approach, used for paid development where the comparable reported development is already considered to be at ultimate, is to utilize reported-to-paid ratios at the latest observed paid development period. A more in-depth discussion of this topic is beyond the scope of this text. We recommend that the actuary seek additional information on this topic through the actuarial literature available on the CAS Web Site and the CAS Tail Factors Working Party.

For the U.S. Industry Auto example, we select a reported claim tail factor of 1.000; we also select an age-to-age factor of 1.000 for the 108-120 month interval. This means that we do not expect any further development on reported claims after 108 months. For paid claims, however, we expect future development beyond 108 months; we select a 1.002 age-to-age factor for 108-120 months and a tail factor of 1.002 (based on the typical ratio of reported to paid claims at this age).

Step 6 – Calculate Cumulative Claim Development Factors (CDF)[43]

We calculate cumulative claim development factors by successive multiplications beginning with the tail factor and the oldest age-to-age factor. The cumulative claim development factor projects the total growth over the remaining valuations. Cumulative claim development factors are also known as age-to-ultimate factors and claim development factors to ultimate.

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[42] *PCAS*, 1978.

[43] As noted previously, we specifically choose to use the terminology claims instead of losses in this text. Thus, we use CDF for claim development factor to ultimate. Many actuaries use the term losses and thus LDF to represent the loss development factor to ultimate. In South Africa, actuaries often use LDF to refer to the incremental loss development factor and UDF to refer to the cumulative loss development factor or loss development factor to ultimate. The important message for the actuary is that he or she must understand the terminology, including abbreviations, for any analysis.

Based on the selected age-to-age factors from Step 4 and the tail factor in Step 5, we calculate the following:

Reported CDF at 120 months
= selected tail (120-ultimate) factor
= 1.000

Reported CDF at 108 months
= (selected tail factor) x (selected development factor 108-120 months)
= 1.000 x 1.000
= 1.000

Reported CDF at 96 months
= (selected tail factor) x (selected development factor 108-120 months) x
(selected development factor 96-108 months)
= (CDF at 108 months) x (selected development factor 96-108 months)
= 1.000 x 1.001
= 1.001

And so on, until we get to

Reported CDF at 12 months
= (CDF at 24 months) x (selected development factor 12-24 months)
= 1.110 x 1.164
= 1.292

We calculate cumulative claim development factors for paid claims in the same manner.

Table 2, which is an excerpt from Exhibit I, Sheets 1 and 2, summarizes the cumulative claim development factors based on the selected age-to-age factors.

Table 2 – Cumulative Claim Development Factors

	12	**24**	**36**	**48**	**60**	**72**	**84**	**96**	**108**	**120**
Reported	1.292	1.110	1.051	1.023	1.011	1.006	1.003	1.001	1.000	1.000
Paid	2.390	1.404	1.184	1.085	1.040	1.020	1.011	1.006	1.004	1.002

Tables 1 and 2 demonstrate a typical relationship between reporting and payment patterns for many lines of P&C insurance: cumulative paid claim development factors are usually greater than cumulative reported claim development factors at the same maturity age.

Step 7 – Project Ultimate Claims

Ultimate claims are equal to the product of the latest valuation of claims (the amounts shown on the last diagonal of the claim triangles) and the appropriate cumulative claim development factors. In our example, the latest diagonal of the triangle is the December 31, 2007 valuation. Each accident year has an associated age at December 31, 2007. For example, accident year 2007 as of December 31, 2007 is 12 months old. Accident year 2006 as of December 31, 2007 is 24 months old. Similarly, in this example, the oldest accident year in our experience period is 1998 which, at December 31, 2007, is 120 months old. We determine the appropriate cumulative claim development factor based on the age of each accident year; we then multiply each accident year's reported (and paid) claims at the latest valuation by its age-to-ultimate factor (i.e., cumulative claim development factor).

Detailed calculations are presented in Exhibit I, Sheet 3. The first column of Exhibit I, Sheet 3, is the accident year. Our example for U.S. Industry Auto includes accident years 1998 through 2007. In the second column, we show the age of each accident year as of the latest valuation of claims (i.e., December 31, 2007). Columns (3) and (4) summarize reported and paid claims, respectively, by accident year at December 31, 2007. Column (3) is the last diagonal of the reported claim development triangle in Exhibit I, Sheet 1, and Column (4) is the last diagonal of the paid claim development triangle in Exhibit I, Sheet 2. Columns (5) and (6) are the cumulative claim development factors that are calculated in Step 5. Each cumulative claim development factor refers to a specific age.

Projected ultimate claims based on the reported claim development method are equal to the latest valuation of reported claims multiplied by the cumulative reported claim development factors. (See Column (7) of Exhibit I, Sheet 3.) For example, projected ultimate claims for accident year 1998 are calculated as follows:

> Projected ultimate claims for accident year 1998
> = (reported claims for 1998 as of 12/31/07) x (reported CDF at 120 months)
> = $47,742,304 x 1.000
> = $47,742,304

And for accident year 2007,

> Projected ultimate claims for accident year 2007
> = (reported claims for 2007 as of 12/31/07) x (reported CDF at 12 months)
> = $48,853,563 x 1.292
> = $63,118,803

We perform similar calculations for the projection of ultimate claims using the paid claim development technique (Column (8) of Exhibit I, Sheet 3). For example, projected ultimate claims for accident year 2007 are calculated as follows:

> Projected ultimate claims for accident year 2007
> = (paid claims for 2007 as of 12/31/07) x (paid CDF at 12 months)
> = $27,229,969 x 2.390
> = $65,079,626

Unpaid Claim Estimate Based on the Development Technique

For each technique presented in this text, we derive an unpaid claim estimate. Using the development technique, actuaries calculate the unpaid claim estimate as the difference between projected ultimate claims and actual paid claims. Because we are using accident year data, this value of the unpaid claim estimate represents total unpaid claims including both case outstanding and the broad definition of IBNR. To determine estimated IBNR based on the development technique, we subtract reported claims from the projected ultimate claims. Alternatively, IBNR is equal to the estimate of total unpaid claims less case outstanding.

In Exhibit I, Sheet 4, we summarize the calculations for the unpaid claim estimate based on the example for U.S. Industry Auto. Columns (2) and (3) contain reported and paid claims data as of December 31, 2007, which are the latest diagonals in our claim development triangles. Columns (4) and (5) are the projected ultimate claims, which we developed in Exhibit I, Sheet 3. We summarize case outstanding in Column (6); case outstanding is equal to the difference between reported and paid claims as of December 31, 2007 (Column (2) – Column (3)). Estimated IBNR is equal to projected ultimate claims minus reported claims. Estimated IBNR based on the reported claim development technique is calculated in Column (7), and Column (8) shows the results of the paid claim development technique. The estimate of total unpaid claims is equal to the sum of case outstanding and estimated IBNR. We present the total unpaid claim estimate in Columns (9) and (10) based on the reported and paid claim development techniques, respectively.

Reporting and Payment Patterns

Actuaries describe the reporting pattern of claims as the percentage of ultimate claims that are reported in each year. We can derive implied reporting patterns from the cumulative reported claim development factors.[44] The following table shows the cumulative reported claim development factors and the associated reporting pattern for U.S. Industry Auto.

Table 3 – Reporting Pattern

Age (Months)	Cumulative Reported Claim Development Factors	Cumulative % Reported	Incremental % Reported
12	1.292	77.4%	77.4%
24	1.110	90.1%	12.7%
36	1.051	95.1%	5.0%
48	1.023	97.8%	2.7%
60	1.011	98.9%	1.1%
72	1.006	99.4%	0.5%
84	1.003	99.7%	0.3%
96	1.001	99.9%	0.2%
108	1.000	100.0%	0.1%
120	1.000	100.0%	0.0%

The percentage reported is equal to the inverse of the cumulative claim development factor. For example, at 12 months, the percentage reported is equal to 1.000 divided by 1.292 or 77.4%; in other words, our selected reported claim development factors imply that 77.4% of ultimate claims are reported through 12 months. Similarly at 24 months, the percentage reported is equal to 1.000 divided by 1.110 or 90.1%; the selected reported claim development factors indicate that 90.1% of claims are reported through 24 months.

In the preceding table, we also show the incremental percentage reported. These values are equal to the difference in the cumulative percentage reported at successive ages. For example, the incremental percentage reported for the first 12 months is 77.4%, which is equal to the

[44] In Chapter 15 – Evaluation of Techniques, we present an alternative approach for determining reporting and payment patterns based on a comparison of the reported and paid claim development triangles to selected ultimate claims. This alternative approach is routinely used by actuaries in Canada to determine payment patterns (also known as emergence patterns in Canada) for present value discounting purposes.

cumulative percentage reported at 12 months. The incremental percentage reported for the 12-24 month period is equal to 90.1% minus 77.4%, or 12.7%.

We can also determine an implied payment pattern based on the cumulative paid claim development factors. In the following table, we present the cumulative paid claim development factors and the associated payment patterns (cumulative and incremental) for U.S. Industry Auto.

Table 4 – Payment Pattern

Age (Months)	Cumulative Paid Claim Development Factors	Cumulative % Paid	Incremental % Paid
12	2.390	41.8%	41.8%
24	1.404	71.2%	29.4%
36	1.184	84.5%	13.3%
48	1.085	92.2%	7.7%
60	1.040	96.2%	4.0%
72	1.020	98.0%	1.8%
84	1.011	98.9%	0.9%
96	1.006	99.4%	0.5%
108	1.004	99.6%	0.2%
120	1.002	99.8%	0.2%

In the U.S. Industry Auto example, which contains the aggregated results for U.S. private passenger automobile liability, we observe that the incremental percentages reported and paid in each successive interval are less than or equal to that of the previous age interval. Actuaries often observe such patterns for many lines of P&C insurance, consistent with reasonable expectations for the underlying process of settling a portfolio of claims. Where the underlying development patterns are erratic, actuaries frequently incorporate increased levels of actuarial judgment into the selection process to achieve claim development patterns that exhibit such a steady, decreasing pattern.

It is worthwhile to note that while the above payment and reporting patterns might serve as a reasonable model for the expected payment and reporting of future claims, the development method implies somewhat different patterns for each of the accident years from 1998 through 2007. This is due to the fact that the emerged portion of each accident year does not precisely fit the selected age-to-age factors.

The reporting and payment patterns may be valuable input for other actuarial calculations. They can be used in other techniques for estimating unpaid claims and in monitoring the development of claims during the year. The payment pattern[45] is also often used for present value (i.e., discounting) calculations.

[45] In Canada, actuaries typically refer to an emergence pattern as the payment pattern used for discounting purposes. This is a different terminology from that used by U.S. actuaries who generally use the term emergence to refer to the reporting pattern of either claims or claim counts.

Observations and Common Relationships

Generally, cumulative claim development factors are the greatest for the most recent accident years and the smallest for the oldest accident years. Actuaries refer to the most recent, less-developed accident years as immature and the oldest, most-developed accident years as mature. As a result, it is common to find the highest values of estimated IBNR for the most recent accident years, or the less mature years. As accident years mature and more claims are reported and settled, the estimate of total unpaid claims, which is comprised of case outstanding and estimated IBNR, will gradually approach zero.

Another common phenomenon is that development factors tend to increase as the retention increases. In 1987, E. Pinto and D.F. Gogol published a paper titled "An Analysis of Excess Loss Development."[46] Upon a review of excess claim development experience published by the RAA, they observed:

> Since the data indicates that excess business generally exhibits much slower reporting than that normally associated with primary business, there appears to be a relationship between the layer for which business is written and the resulting development pattern. It is this relationship that we intend to analyze in this paper for both paid and reported losses. Applications to increased limits and excess of loss pricing are also noted.
>
> The protracted development of excess losses reflected in the RAA study suggests that the development is not only caused by late reported claims and increases in the average reported loss per claim but also by changes at successive maturities in the proportion of claims with losses which are large multiples of the average. Thus, the shape of the size of loss distribution changes at successive valuations.

Pinto and Gogol reviewed ISO excess of loss data as well as RAA data, and in both sets of data they observed that claim development increases as the retention increases. They developed a model which illustrates the two influences underlying claim development: the reporting pattern of claims over time and the changing characteristics of the size of claims distribution at successive maturities. Pinto and Gogol noted that without the latter influence, the development factors for claims in excess of different retentions would be identical. They conclude their paper as follows:

> The results that have been produced indicate clearly that loss and ALAE development varies significantly by retention. Accordingly, pricing and reserving estimates incorporating development factors may be substantially in error if this is not taken into account. As this applies to paid as well as reported loss development, recognition of retention is also a major factor in estimating discounted losses using paid development factors.

When the Development Technique Works and When it Does Not

The development technique is based on the premise that we can predict future claims activity for an accident year (or policy year, report year, etc.) based on historical claims activity to date for that accident year. The primary assumption of this technique is that the reporting and payment of future claims will be similar to the patterns observed in the past. When used with reported claims,

[46] *PCAS*, 1987.

there is an implicit assumption that there have been no significant changes in the adequacy of case outstanding during the experience period; when used with paid claims, there is an implicit assumption that there have been no significant changes during the experience period in the speed of claims closure and payment. Thus, the development method is appropriate for insurers in a relatively stable environment. When there are no major organizational changes for the insurer and when there are no major external environmental changes, the development technique is an appropriate method to use in combination with other techniques for estimating unpaid claims.

However, if there are any changes to the insurer's operations (e.g., new claims processing systems; revisions to tabular formulae for case outstanding; or changes in claims management philosophy, policyholder deductibles, or the insurer's reinsurance limits), the assumption that the past will be predictive of the future may not hold true. Environmental changes can also invalidate the primary assumption of the development technique. For example, when a major tort reform occurs (such as a cap on claim settlements or a restriction in the statute of limitations), actuaries may no longer be able to assume that historical claim development experience will be predictive of future claims experience. In such situations, the actuary should consider alternative techniques for estimating unpaid claims, or at the very least, adjust the selected claim development factors.

The development technique requires a large volume of historical claims experience. It works best when the presence or absence of large claims does not greatly distort the data. If the volume of data is not sufficient, large claims could greatly distort the age-to-age factors, the projection of ultimate claims, and finally the estimate of unpaid claims using a development method. As noted in "The Actuary and IBNR" by R.L. Bornhuetter and R.E. Ferguson[47], a strictly fortuitous event such as an unusual large claims should not distort an insurer's estimate of IBNR. There are circumstances, however, such as a large winter storm or other catastrophe, in which the insurer's IBNR should likely increase.

For an insurer entering a new line of business or a new territory, a sufficient volume of credible claim development data may not be available. For some smaller insurers with limited portfolios, historical claim development data may not be sufficiently credible for the actuary to use the development technique. It should be noted that in such situations the development technique is still often used. However, actuaries in these situations typically rely on benchmark patterns (such as from comparable lines of business or available industry data, as discussed earlier) to select claim development factors, which they then apply to the insurer's latest valuation of claims.

The development technique is particularly suitable for high-frequency, low-severity lines with stable and relatively timely reporting of claims, especially where the claims are evenly spread throughout the accident year (or policy year, report year, etc.) – that is, the volume of claims experience is not changing significantly from one year to the next.

Where there is not an even spread of claims throughout the year, the development technique can distort the projected ultimate claims for an accident year. This is a result of the potential for a significant difference in the average claim maturity. To understand why this is the case, it is helpful to think in terms of the individual claims making up the accident year. An accident year includes individual claims that occur throughout the accident year. Some occur in the first month of the year, some in the sixth month, and some in the last month. The average occurrence date of claims (if the exposure is evenly spread throughout the year) occurs in the middle of the year. A cumulative development factor for an accident year at 12 months can be thought of as an average of factors for the January accident month at 12 months, the February accident month at 11

[47] *PCAS*, 1972

months, …, ending with the December accident month at 1 month. If the historic data had an even spread of claims across the months, but the most recent accident year had an uneven spread due to a large storm or other event in the last month or due to an increase in the exposures over the year, the historical data will have an average occurrence date that is not comparable to the most recent accident year.

For long-tail lines of insurance, such as U.S. workers compensation and general liability, the cumulative claim development factors can become very large for the most recent accident years, particularly when using the paid claim development technique. Actuaries often speak of the leveraged effect of claim development factors with high values. For example, if the cumulative reported claim development factor is 4.00, each dollar of reported claims is multiplied by a factor of 4.00 to determine ultimate claims. It is not unusual for long-tail lines of insurance to have cumulative paid claim development factors greater than 10.00. These highly leveraged factors result in projections of ultimate claims that are very sensitive to the current value of paid and reported claims. The presence or absence of large claims as well as any unusual change in the reporting or settlement of claims (or sometimes just a single claim) can result in unreasonable projections of ultimate claims for the most recent accident years. In situations of highly leveraged cumulative claim development factors, actuaries often seek alternative techniques for estimating unpaid claims.

XYZ Insurer

In Exhibit II, Sheets 1 through 4, we continue the example introduced in Chapter 6 for XYZ Insurer. This example is for an insurer of private passenger automobile bodily injury liability in a single jurisdiction that has experienced numerous operational and environmental changes. During meetings, claims department management highlighted changes in the rate of claims settlement and in the strength of case outstanding. During the experience period, this jurisdiction implemented major tort reform aimed at modifying the liability covered by the insurance product. The result of the tort reform was a change in the insurance product as well as a change in the insurer's market presence.

Before we even begin with the calculations, we need to examine whether or not the development technique is appropriate for XYZ Insurer. Again, the underlying premise of the development method is that future claims activity can be projected based on historical claims experience. A primary assumption of the reported claim development method is that there have been no significant changes in the adequacy of case outstanding over the experience period, and a primary assumption of the paid claim development method is that there have been no significant changes in the rate of settlement over the experience period. These methods also assume that the type of claim has not changed during the period and the claim reporting lags (i.e., the time between date of occurrence and date of report) have not changed.

Based on the information we gathered through meetings with management of XYZ Insurer and through our actuarial diagnostic review, we question whether the development technique is in fact appropriate. We know that there have been changes in the case outstanding adequacy as well as changes in the rate at which claims are closed. We also know that there have been changes in the claim environment due to the tort reform. Therefore, the underlying assumptions do not hold true, and we must conclude that some type of adjustment for these changes is necessary for the development technique to be appropriate for XYZ Insurer.

For purposes of demonstration and comparison to other methods that we will present in later chapters, we show the calculations for the development technique in Exhibit II, Sheets 1 through 4, for XYZ Insurer. We organize the exhibits similarly to Exhibit I, Sheets 1 through 4. Exhibit II, Sheets 1 and 2, contain the reported and paid claim development triangles, respectively. The challenge of selecting age-to-age factors is much greater for the actuary in this example than in the prior example. There is significant variability in the age-to-age factors down each column of the triangle. For the reported claim triangle, almost all of the age-to-age factors along the December 31, 2004 diagonal are the highest in each column; the latest diagonal of age-to-age factors is the lowest value in many of the columns. Based on our knowledge of the changing environment, we expect such variability in the age-to-age factors. In our example, we select age-to-age factors based on the volume-weighted average of the latest two years. (Keep in mind other factor selections may also be reasonable.) In a situation of such major change, an actuary would typically need to exercise a higher degree of judgment in selecting the age-to-age factors.

We present projected ultimate claims based on the development technique applied to reported and paid claims in Exhibit II, Sheet 3. In Exhibit II, Sheet 4, we summarize estimated IBNR and the total unpaid claim estimate based on the two development projections. In our first example for U.S. Industry Auto, the estimated IBNR generated by the reported and paid claim development methods differs by approximately 10% and the estimate of total unpaid claims differs by only 4%. In our second example for XYZ Insurer, the estimated IBNR using the paid claim development technique differs by 138% from the reported claims indication; the total unpaid claim estimate differs by almost 50%. These differences suggest that the actuary should review alternative projection methods.

Influence of a Changing Environment on the Claim Development Technique

Changes in Claim Ratios[48] and Case Outstanding Adequacy

To examine the effect of a changing environment on the estimates produced by the development technique, we construct an example based on characteristics seen in the U.S. private passenger automobile example. We use similar reporting and payment patterns as well as a similar ultimate claim ratio. We compare the estimated IBNR generated by the development technique to the "actual IBNR"[49] under the following four scenarios:

- *Scenario 1* is a steady-state environment where claim ratios are stable and there are no changes from historical levels of case outstanding strength (U.S. PP Auto Steady-State)

- *Scenario 2* is an environment of increasing claim ratios and no change in case outstanding strength (U.S. PP Auto Increasing Claim Ratios)

- *Scenario 3* is an environment of stable claim ratios with an increase in case outstanding strength (U.S. PP Auto Increasing Case Outstanding Strength)

- *Scenario 4* is an environment where there are increases in both claim ratios and case outstanding strength (U.S. PP Auto Increasing Claim Ratios and Case Outstanding Strength)

[48] Because we specifically chose to use the term claims instead of losses, we refer to a claim ratio instead of a loss ratio. This claim ratio should be understood to refer to dollars of claims and not claim counts.

[49] See the next section, "Key Assumptions," for description of "actual IBNR."

We will continue to use this example with its four scenarios in Chapters 8, 9, and 10. (Note that Scenarios 1 through 4 are labeled Examples 3 through 6 in the summary table in the Introduction to Part 3 – Basic Techniques for Estimating Unpaid Claims.)

Key Assumptions

In real-life situations, actuaries know neither the “actual” claim development patterns nor the “actual” ultimate claim ratios prior to final settlement and closure for any particular accident year. However, for the purpose of demonstrating the effect of a changing environment, we design a model in which we can calculate the “actual” or “true” IBNR requirement. In developing this example, we use a ten-year experience period, accident years 1999 through 2008. We assume that the earned premium for the first year (i.e., 1999) is $1 million. We then assume a 5% annual premium trend to develop earned premium values for each subsequent year in the experience period.

In Exhibit III, Sheet 1, we summarize the key assumptions and calculate the actual IBNR for each scenario. The actual IBNR is equal to the ultimate claims projection, which is based on the given ultimate claim ratio for each accident year, minus the reported claims as of December 31, 2008.

The following table summarizes the assumed reporting and payment patterns for the steady-state environment.

Table 5 – Key Assumptions
Steady-State Environment
Reporting and Payment Patterns

As of Month	% Reported	% Paid
12	77%	42%
24	90%	71%
36	95%	84%
48	98%	92%
60	99%	96%
72	99%	98%
84	100%	99%
96	100%	99%
108	100%	100%
120	100%	100%

In the steady-state environment, we assume an ultimate claim ratio of 70% for all ten accident years in the experience period (i.e., 1999 through 2008). For the increasing claim ratio scenarios, we assume the following claim ratios by accident year:

Table 6 – Key Assumptions
Increasing Claim Ratio Scenarios

Accident Year	Ultimate Claim Ratio
1999-2003	70%
2004	80%
2005	85%
2006	90%
2007	95%
2008	100%

We use the earned premium and ultimate claim ratios as well as the given reporting and payment patterns to create reported and paid claim development triangles for each of the four scenarios previously described. Claim development triangles are presented in Exhibit III, Sheets 2 through 9.

To simplify the presentation of the various scenarios, we always select reported and paid age-to-age factors based on a five-year volume-weighted average. When selecting age-to-age factors, an actuary would typically review several different types of averages as well as various claims diagnostics. Actuaries incorporate significant judgment when selecting age-to-age factors to respond to changes in the environment, both internal and external. By not responding in our examples to the changes in the environment with judgmental adjustments, we further demonstrate how the development technique reacts to a changing situation.

Scenario 1 – U.S. PP Auto Steady-State

Not surprisingly, the projected ultimate claims are the same for both the reported and paid claim development methods in the steady-state environment. Both methods generate estimated IBNR that is equal to the actual IBNR. We present calculations for the steady-state environment in the top section of Exhibit III, Sheet 10.

Scenario 2 – U.S. PP Auto Increasing Claim Ratios

In the bottom section of Exhibit III, Sheet 10, we present the calculations for the second scenario, increasing claim ratios with no change in case outstanding strength. The first thing we notice when comparing the top and bottom sections of Exhibit III, Sheet 10, is the differences between reported and paid claims in Columns (3) and (4). We can also see similar differences in the claim development triangles. The claim development triangles in Exhibit III, Sheets 4 and 5 (increasing claim ratio scenario) are the same as the triangles in Exhibit III, Sheets 2 and 3 (steady-state) for accident years 1999 through 2003. However, beginning in accident year 2004, the reported and paid claims for all remaining years are higher for the increasing claim ratio scenario than the steady-state scenario. This is consistent with our assumption of increasing claim ratios for accident years 2004 through 2008.

It is important to recognize that since we assume no change in the adequacy of case outstanding, there are no changes in the age-to-age factors. Thus, there are no changes in the cumulative claim development factors between the increasing claim ratio scenario and the steady-state environment. (Compare Columns (6) and (7) in the top and bottom sections of Exhibit III, Sheet 10.) In Exhibit III, Sheet 10, we note that the projected ultimate claims are the same for the reported and paid claim development techniques, and that they are significantly greater for the increasing claim ratio scenario ($10,249,350 for all years combined) than for the steady-state environment ($8,804,525 for all years combined). Since the claim development factors to ultimate are the same, the higher value of projected ultimate claims is solely due to higher values of claims reported and paid as of December 31, 2008. We observe that the estimated IBNR, which is the same for both the reported and paid claim development methods, are equal to the actual IBNR in this scenario. Thus, we can conclude that the development technique is responsive to changes in the underlying claim ratios assuming no changes in the underlying claims reporting or payment pattern.

Scenario 3 – U.S. PP Auto Increasing Case Outstanding Strength

Exhibit III, Sheets 6 and 7 contain the claim development triangles for this scenario; we present detailed calculations for projected ultimate claims and estimated IBNR in the top section of Exhibit III, Sheet 11. In building the reported claim development triangle, we assume that the case outstanding adequacy increased by 6% in 2007 and 25% in 2008 over the steady-state case outstanding (for the latest four accident years only). Thus, the next to last diagonal of the case outstanding triangle is 6% greater in this scenario than the steady-state scenario; and the last diagonal of the case outstanding triangle is 25% greater in this scenario than the steady-state scenario. Since reported claims are comprised of the sum of case outstanding and paid claims, a change in the case outstanding triangle will result in changes to the reported claim triangle. These changes result in changes in the age-to-age factors along the latest two diagonals and changes in the cumulative reported claim development factors.

Before we review the detailed calculations, we can discuss conceptually what we expect to see happen with the projections. The true ultimate claims have not changed from the steady-state environment. Ultimate claims for this scenario are equal to 70% of earned premium for each year in the experience period. We should have higher values of reported claims since we know that case outstanding strength has increased. For example, where case outstanding are $380,075 for accident year 2008 in the steady-state environment, they are now $475,094. Given the same value of ultimate claims with higher values of reported claims at December 31, 2008, the IBNR should decrease. The actual IBNR[50] for the scenario of stable claim ratios and increases in case outstanding strength are $253,336 (for all years combined); these are lower than the actual IBNR of the steady-state, which are $438,638.

We now turn to the detailed calculations in the top section of Exhibit III, Sheet 11. When we compare the projections of Scenario 3 with those of the steady-state environment, we observe several differences. First, for accident years 2005 through 2008, reported claims in Column (3) are greater than the reported claims of the steady-state. We also note that the reported claim development factors to ultimate (Column (6)) are higher for the latest three accident years in Scenario 3 than in the steady-state scenario. Projected ultimate claims based on the reported claim

[50] Recall that we are using the broad definition of IBNR that includes both pure IBNR and case development on known claims (incurred but not enough reported or IBNER). The actual pure IBNR remains the same regardless of changes in the adequacy of case outstanding.

development technique are greater in Scenario 3 than the steady-state projection due to both higher reported claims and higher cumulative claim development factors.

This example brings us to the conclusion that without adjustment, the reported claim development method overstates the projected ultimate claims and thus the IBNR in times of increasing case outstanding strength. There are two forces at play in this scenario. First, the reported claims are greater along the latest diagonal due to the increase in case outstanding adequacy. Second, the age-to-age factors are also higher along the latest two diagonals where the insurer strengthened the adequacy of the case outstanding. Unless the actuary mechanically or judgmentally adjusts for such change, an increase in case outstanding adequacy can lead to higher cumulative claim development factors. (We will discuss some methods that the actuary could use for such adjustments in Chapter 13.) We are then multiplying a higher value of reported claims by a higher cumulative claim development factor. The result is a projected value of ultimate claims that likely overstates the estimate of total unpaid claims.

Looking back at the underlying assumptions of the development technique, we recall that the key assumption of this technique is that claims reported to date will continue in a similar manner in the future. That is, the development technique assumes that the relative change in a given year's claims from one evaluation point to the next is similar to the relative change in prior years' claims at similar evaluation points. In times of changing case outstanding adequacy, this assumption no longer holds true for reported claims. Since case outstanding are now more adequate than they have been historically, we actually need a lower CDF-to-ultimate factor not a higher factor. In order to produce the actual value of ultimate claims, the cumulative claim development factors should be lower than that of the steady-state environment, not higher.

Case outstanding at December 31, 2008 are equal to $977,641, which is the difference between total reported claims and total paid claims, and the actual IBNR for Scenario 3 are $253,336. The true total value of unpaid claims at December 31, 2008 is equal to the sum of the actual IBNR and the case outstanding, or $1,230,997. The difference between the actual unpaid claims and the estimate of unpaid claims resulting from the reported claim development technique is significant. The total unpaid claim estimate based on the reported claim development technique is $1,478,573 (projected ultimate claims in Column (8) minus paid claims in Column (4)) which is 20% greater than the actual unpaid claims. The difference between the actual unpaid claims and the estimated unpaid claims generated by the reported claim development method is $247,596. From a calendar year financial reporting perspective, this adds 16 points to the 2008 calendar year claim ratio ($247,596 divided by the 2008 earned premium of $1,551,328). (This assumes that the insurer reports all of the difference in calendar year 2008.)

Because only the case outstanding are affected in Scenario 3, there are no differences between the paid claim development triangles of Scenario 3 and the steady-state environment. Since there are no differences in the paid claim triangles, the age-to-age factors, claim development factors to ultimate, and projected ultimate claims all remain the same as the steady-state scenario. The estimated IBNR, which is equal to projected ultimate claims less reported claims at December 31, 2008, is lower for this scenario than the steady-state scenario, however, since the latest valuation of reported claims is higher now due to the case outstanding strengthening.

Since there has been no change in the settlement of claims, the primary assumption of the development technique still holds true for paid claims. In times of changing case outstanding adequacy, actuaries often turn to the paid claim development method as an alternative to the reported claim development method. However, one common problem with the paid claim development method is the highly leveraged nature of the cumulative development factor for the most recent years in the experience period, particularly for long-tail lines of insurance.

Scenario 4 – U.S. PP Auto Increasing Claim Ratios and Case Outstanding Strength

We present the fourth scenario in the bottom section of Exhibit III, Sheet 11. The claim ratios are the same as those of the second scenario, and we assume changes in case outstanding strength that are similar to the third scenario. Once again, the paid claim development method produces the actual value for IBNR. The reported claim development method, while responsive to the increasing claim ratios, overstates the estimate of unpaid claims due to the changing case outstanding adequacy. The reported claim development technique produces a total unpaid claim estimate that is more than 20% greater than actual total unpaid claims and adds 22 points to the 2008 calendar year claim ratio.

Changes in Product Mix

In this final example, we focus on the effect of changes in product mix on the development technique. In Chapter 6, we discuss the challenge for the actuary in finding homogeneous groupings of data while maintaining a sufficient volume of claims to be credible. In our final example of this chapter, we look at a portfolio of business in which we combine private passenger and commercial automobile insurance for the purpose of estimating unpaid claims. Typically, these categories of business have different underlying claim development patterns and ultimate claim ratios. We will see that the development technique is an acceptable method for determining estimates of unpaid claims for the combined portfolio as long as there are no changes in the mix of business (i.e., one line of business is not significantly increasing or decreasing in volume relative to the other line of business). However, if the business mix changes over the experience period, the results of the development technique may no longer be appropriate for the determination of the unpaid claim estimate.[51]

Key Assumptions

For the changing product mix example, we review a steady-state environment that has no change in product mix (called U.S. Auto Steady-State) and an environment with a changing product mix (called U.S. Auto Changing Product Mix).

We continue to use a ten-year experience period, accident years 1999 through 2008, for these two final examples. We assume that each of the private passenger and commercial automobile portfolios had $1 million in earned premiums for 1999. For U.S. Auto Steady-State, we assume that the earned premium for both private passenger and commercial automobile is increasing at an annual rate of 5%. For U.S. Auto Changing Product Mix, we assume that the portfolio includes the same private passenger premiums as the steady-state, but commercial automobile insurance premiums increase at 30% instead of 5% per year starting in 2005.

[51] We construct this example for demonstration purposes only. Information regarding product mix is generally available so that the actuary would be able to make modifications to the methodology and/or the key assumptions for the purpose of estimating unpaid claims. Nevertheless, it is important to observe how a change in product mix can affect the results of the various methodologies for estimating unpaid claims presented in this and the following chapters.

We assume that the ultimate claim ratio is 70% for private passenger automobile and 80% for commercial automobile. The following table summarizes reporting and payment patterns for the two categories of business.

Table 7 – Key Assumptions – Product Mix Scenarios
Reporting and Payment Patterns

	Private Passenger Automobile		Commercial Automobile	
As of Month	**% Reported**	**% Paid**	**% Reported**	**% Paid**
12	77%	42%	59%	22%
24	90%	71%	78%	46%
36	95%	84%	89%	67%
48	98%	92%	96%	82%
60	99%	96%	98%	91%
72	99%	98%	100%	95%
84	100%	99%	100%	97%
96	100%	99%	100%	98%
108	100%	100%	100%	99%
120	100%	100%	100%	100%

We create the claim development triangles using the earned premium and ultimate claim ratios by accident year as well as the given reporting and payment patterns. Exhibit IV, Sheets 2 and 3 present reported and paid claim development triangles assuming no change in product mix; the claim development triangles based on a changing product mix are in Exhibit IV, Sheets 4 and 5. Similar to our prior examples, we rely on the five-year volume-weighted averages to select age-to-age factors. We calculate the actual IBNR in Exhibit IV, Sheet 1 for these two final examples.

U.S. Auto Steady-State (No Change in Product Mix)

For this scenario, both the reported and paid claim development techniques produce estimated IBNR that is equal to the actual IBNR. As long as the distribution between the different categories of business remains consistent (and there are no other operational or environmental changes), the claim development method should produce an accurate estimate of unpaid claims. The top section of Exhibit IV, Sheet 6 contains detailed calculations, similar to those presented earlier in this chapter.

U.S. Auto Changing Product Mix

We present the calculations for the scenario with a change in product mix in the bottom section of Exhibit IV, Sheet 6. We note that there are no differences between the two examples until accident year 2005. This is the year in which commercial automobile insurance began to increase at a 30% annual rate instead of the historical 5% rate. We observe higher reported and paid claims for 2005 through 2008. For accident years 2006, 2007 and 2008, we also note higher cumulative claim development factors for both paid and reported claims. However, even with greater claims and higher claim development factors to ultimate, the development technique falls short of the actual IBNR.

If we turn our attention to the claim development triangles in Exhibit IV, Sheets 4 and 5, we notice the critical issue confronting the actuary. What is the correct age-to-age factor when a portfolio is changing its composition? In our example, commercial automobile has a longer reporting pattern than private passenger automobile and thus requires the selection of higher age-to-age factors. Since the proportion of commercial automobile claims is increasing in the portfolio, we see increasing age-to-age factors in our experience. Changing from a five-year volume-weighted average to a three-year volume-weighted average for selecting age-to-age factors would help move the estimated IBNR closer to the actual IBNR, but we would still fall short by a significant amount.

In this situation, the reported claim development method is more responsive than the paid claim development method due to the shorter time frame in which claims are reported versus paid. However, both methods result in estimated IBNR that are significantly lower than the actual IBNR. This example illustrates how changes in the portfolio could result in serious distortions in the development technique. Within a single line of insurance, changes in the types of claims that are occurring could have a similar effect.

PART 1 - Data Triangle

Accident Year	Reported Claims as of (months) 12	24	36	48	60	72	84	96	108	120
1998	37,017,487	43,169,009	45,568,919	46,784,558	47,337,318	47,533,264	47,634,419	47,689,655	47,724,678	47,742,304
1999	38,954,484	46,045,718	48,882,924	50,219,672	50,729,292	50,926,779	51,069,285	51,163,540	51,185,767	
2000	41,155,776	49,371,478	52,358,476	53,780,322	54,303,086	54,582,950	54,742,188	54,837,929		
2001	42,394,069	50,584,112	53,704,296	55,150,118	55,895,583	56,156,727	56,299,562			
2002	44,755,243	52,971,643	56,102,312	57,703,851	58,363,564	58,592,712				
2003	45,163,102	52,497,731	55,468,551	57,015,411	57,565,344					
2004	45,417,309	52,640,322	55,553,673	56,976,657						
2005	46,360,869	53,790,061	56,786,410							
2006	46,582,684	54,641,339								
2007	48,853,563									

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
1998	1.166	1.056	1.027	1.012	1.004	1.002	1.001	1.001	1.000	
1999	1.182	1.062	1.027	1.010	1.004	1.003	1.002	1.000		
2000	1.200	1.061	1.027	1.010	1.005	1.003	1.002			
2001	1.193	1.062	1.027	1.014	1.005	1.003				
2002	1.184	1.059	1.029	1.011	1.004					
2003	1.162	1.057	1.028	1.010						
2004	1.159	1.055	1.026							
2005	1.160	1.056								
2006	1.173									
2007										

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Simple Average										
Latest 5	1.168	1.058	1.027	1.011	1.004	1.003	1.002	1.001	1.000	
Latest 3	1.164	1.056	1.027	1.012	1.005	1.003	1.002	1.001	1.000	
Medial Average*										
Latest 5x1	1.165	1.057	1.027	1.010	1.004	1.003	1.002	1.001	1.000	
Volume-weighted Average										
Latest 5	1.168	1.058	1.027	1.011	1.004	1.003	1.002	1.001	1.000	
Latest 3	1.164	1.056	1.027	1.012	1.005	1.003	1.002	1.001	1.000	
Geometric Average										
Latest 4	1.164	1.057	1.027	1.011	1.004	1.003	1.002	1.001	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Prior Selected	1.160	1.057	1.028	1.012	1.005	1.003	1.001	1.001	1.000	1.000
Selected	1.164	1.056	1.027	1.012	1.005	1.003	1.002	1.001	1.000	1.000
CDF to Ultimate	1.292	1.110	1.051	1.023	1.011	1.006	1.003	1.001	1.000	1.000
Percent Reported	77.4%	90.1%	95.1%	97.8%	98.9%	99.4%	99.7%	99.9%	100.0%	100.0%

*In the examples, the medial average for two data points is the same as the simple average, and the medial average for one data point is simply the value of the data point.

Chapter 7 - Development Technique Exhibit I
U.S. Industry Auto Sheet 2
Paid Claims ($000)

PART 1 - Data Triangle

Accident Year	Paid Claims as of (months) 12	24	36	48	60	72	84	96	108	120
1998	18,539,254	33,231,039	40,062,008	43,892,039	45,896,535	46,765,422	47,221,322	47,446,877	47,555,456	47,644,187
1999	20,410,193	36,090,684	43,259,402	47,159,241	49,208,532	50,162,043	50,625,757	50,878,808	51,000,534	
2000	22,120,843	38,976,014	46,389,282	50,562,385	52,735,280	53,740,101	54,284,334	54,533,225		
2001	22,992,259	40,096,198	47,767,835	52,093,916	54,363,436	55,378,801	55,878,421			
2002	24,092,782	41,795,313	49,903,803	54,352,884	56,754,376	57,807,215				
2003	24,084,451	41,399,612	49,070,332	53,584,201	55,930,654					
2004	24,369,770	41,489,863	49,236,678	53,774,672						
2005	25,100,697	42,702,229	50,644,994							
2006	25,608,776	43,606,497								
2007	27,229,969									

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
1998	1.792	1.206	1.096	1.046	1.019	1.010	1.005	1.002	1.002	
1999	1.768	1.199	1.090	1.043	1.019	1.009	1.005	1.002		
2000	1.762	1.190	1.090	1.043	1.019	1.010	1.005			
2001	1.744	1.191	1.091	1.044	1.019	1.009				
2002	1.735	1.194	1.089	1.044	1.019					
2003	1.719	1.185	1.092	1.044						
2004	1.703	1.187	1.092							
2005	1.701	1.186								
2006	1.703									
2007										

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Simple Average										
Latest 5	1.712	1.189	1.091	1.044	1.019	1.010	1.005	1.002	1.002	
Latest 3	1.702	1.186	1.091	1.044	1.019	1.009	1.005	1.002	1.002	
Medial Average										
Latest 5x1	1.708	1.188	1.091	1.044	1.019	1.009	1.005	1.002	1.002	
Volume-weighted Average										
Latest 5	1.712	1.189	1.091	1.044	1.019	1.010	1.005	1.002	1.002	
Latest 3	1.702	1.186	1.091	1.044	1.019	1.009	1.005	1.002	1.002	
Geometric Average										
Latest 4	1.706	1.188	1.091	1.044	1.019	1.010	1.005	1.002	1.002	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Prior Selected	1.707	1.189	1.091	1.044	1.019	1.010	1.005	1.003	1.001	1.002
Selected	1.702	1.186	1.091	1.044	1.019	1.009	1.005	1.002	1.002	1.002
CDF to Ultimate	2.390	1.404	1.184	1.085	1.040	1.020	1.011	1.006	1.004	1.002
Percent Paid	41.8%	71.2%	84.5%	92.2%	96.2%	98.0%	98.9%	99.4%	99.6%	99.8%

Projection of Ultimate Claims Using Reported and Paid Claims ($000)

Accident Year	Age of Accident Year at 12/31/07	Claims at 12/31/07 Reported	Claims at 12/31/07 Paid	CDF to Ultimate Reported	CDF to Ultimate Paid	Projected Ultimate Claims Using Dev. Method with Reported	Projected Ultimate Claims Using Dev. Method with Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1998	120	47,742,304	47,644,187	1.000	1.002	47,742,304	47,739,475
1999	108	51,185,767	51,000,534	1.000	1.004	51,185,767	51,204,536
2000	96	54,837,929	54,533,225	1.001	1.006	54,892,767	54,860,424
2001	84	56,299,562	55,878,421	1.003	1.011	56,468,461	56,493,084
2002	72	58,592,712	57,807,215	1.006	1.020	58,944,268	58,963,359
2003	60	57,565,344	55,930,654	1.011	1.040	58,198,563	58,167,880
2004	48	56,976,657	53,774,672	1.023	1.085	58,287,120	58,345,519
2005	36	56,786,410	50,644,994	1.051	1.184	59,682,517	59,963,673
2006	24	54,641,339	43,606,497	1.110	1.404	60,651,886	61,223,522
2007	12	48,853,563	27,229,969	1.292	2.390	63,118,803	65,079,626
Total		543,481,587	498,050,368			569,172,456	572,041,099

Column Notes:
(2) Age of accident year in (1) at December 31, 2007.
(3) and (4) Based on Best's Aggregates & Averages U.S. private passenger automobile experience.
(5) and (6) Based on CDF from Exhibit I, Sheets 1 and 2.
(7) = [(3) x (5)].
(8) = [(4) x (6)].

Accident Year	Claims at 12/31/07 Reported	Claims at 12/31/07 Paid	Projected Ultimate Claims Using Dev. Method with Reported	Projected Ultimate Claims Using Dev. Method with Paid	Case Outstanding at 12/31/07	Unpaid Claim Estimate at 12/31/07: IBNR - Based on Dev. Method with Reported	Unpaid Claim Estimate at 12/31/07: IBNR - Based on Dev. Method with Paid	Unpaid Claim Estimate at 12/31/07: Total - Based on Dev. Method with Reported	Unpaid Claim Estimate at 12/31/07: Total - Based on Dev. Method with Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1998	47,742,304	47,644,187	47,742,304	47,739,475	98,117	0	- 2,829	98,117	95,288
1999	51,185,767	51,000,534	51,185,767	51,204,536	185,233	0	18,769	185,233	204,002
2000	54,837,929	54,533,225	54,892,767	54,860,424	304,704	54,838	22,495	359,542	327,199
2001	56,299,562	55,878,421	56,468,461	56,493,084	421,141	168,899	193,522	590,040	614,663
2002	58,592,712	57,807,215	58,944,268	58,963,359	785,497	351,556	370,647	1,137,053	1,156,144
2003	57,565,344	55,930,654	58,198,563	58,167,880	1,634,690	633,219	602,536	2,267,909	2,237,226
2004	56,976,657	53,774,672	58,287,120	58,345,519	3,201,985	1,310,463	1,368,862	4,512,448	4,570,847
2005	56,786,410	50,644,994	59,682,517	59,963,673	6,141,416	2,896,107	3,177,263	9,037,523	9,318,679
2006	54,641,339	43,606,497	60,651,886	61,223,522	11,034,842	6,010,547	6,582,183	17,045,389	17,617,025
2007	48,853,563	27,229,969	63,118,803	65,079,626	21,623,594	14,265,240	16,226,063	35,888,834	37,849,657
Total	543,481,587	498,050,368	569,172,456	572,041,099	45,431,219	25,690,869	28,559,512	71,122,088	73,990,731

Column Notes:
(2) and (3) Based on Best's Aggregates & Averages U.S. private passenger automobile experience.
(4) and (5) Developed in Exhibit I, Sheet 3.
(6) = [(2) - (3)].
(7) = [(4) - (2)].
(8) = [(5) - (2)].
(9) = [(6) + (7)].
(10) = [(6) + (8)].

Summary of Earned Premium and Claim Ratio Assumptions and Actual IBNR

Accident Year	Earned Premium	Ultimate Claim Ratio	Ultimate Claims	Reported Claims at 12/31/08	Actual IBNR	Ultimate Claim Ratio	Ultimate Claims	Reported Claims at 12/31/08	Actual IBNR
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Steady-State				**Increasing Claim Ratios**			
1999	1,000,000	70.0%	700,000	700,000	0	70.0%	700,000	700,000	0
2000	1,050,000	70.0%	735,000	735,000	0	70.0%	735,000	735,000	0
2001	1,102,500	70.0%	771,750	771,750	0	70.0%	771,750	771,750	0
2002	1,157,625	70.0%	810,338	810,338	0	70.0%	810,338	810,338	0
2003	1,215,506	70.0%	850,854	842,346	8,509	70.0%	850,854	842,346	8,509
2004	1,276,282	70.0%	893,397	884,463	8,934	80.0%	1,021,025	1,010,815	10,210
2005	1,340,096	70.0%	938,067	919,306	18,761	85.0%	1,139,081	1,116,300	22,782
2006	1,407,100	70.0%	984,970	935,722	49,249	90.0%	1,266,390	1,203,071	63,320
2007	1,477,455	70.0%	1,034,219	930,797	103,422	95.0%	1,403,583	1,263,224	140,358
2008	1,551,328	70.0%	1,085,930	836,166	249,764	100.0%	1,551,328	1,194,523	356,805
Total	12,577,893		8,804,525	8,365,887	438,638		10,249,350	9,647,366	601,984
		Increasing Case Outstanding Strength				**Increasing Claim Ratios and Case Outstanding Strength**			
1999	1,000,000	70.0%	700,000	700,000	0	70.0%	700,000	700,000	0
2000	1,050,000	70.0%	735,000	735,000	0	70.0%	735,000	735,000	0
2001	1,102,500	70.0%	771,750	771,750	0	70.0%	771,750	771,750	0
2002	1,157,625	70.0%	810,338	810,338	0	70.0%	810,338	810,338	0
2003	1,215,506	70.0%	850,854	842,346	8,509	70.0%	850,854	842,346	8,509
2004	1,276,282	70.0%	893,397	884,463	8,934	80.0%	1,021,025	1,010,815	10,210
2005	1,340,096	70.0%	938,067	933,377	4,690	85.0%	1,139,081	1,133,386	5,695
2006	1,407,100	70.0%	984,970	962,808	22,162	90.0%	1,266,390	1,237,897	28,494
2007	1,477,455	70.0%	1,034,219	979,922	54,296	95.0%	1,403,583	1,329,895	73,688
2008	1,551,328	70.0%	1,085,930	931,185	154,745	100.0%	1,551,328	1,330,264	221,064
Total	12,577,893		8,804,525	8,551,189	253,336		10,249,350	9,901,689	347,660

Column Notes:
(2) Assume $1,000,000 for first year in experience period (1999) and 5% annual increase thereafter.
(3) and (7) Ultimate claim ratios assumed to be known for purpose of example.
(4) = [(2) x (3)].
(5) Latest diagonal of reported claim triangles in Exhibit III, Sheets 2 and 6.
(6) = [(4) - (5)].
(8) = [(2) x (7)].
(9) Latest diagonal of reported claim triangles in Exhibit III, Sheets 4 and 8.
(10) = [(8) - (9)].

Chapter 7 - Development Technique
Impact of Changing Conditions
U.S. PP Auto Steady-State - Reported Claims

Exhibit III
Sheet 2

PART 1 - Data Triangle

Accident Year	Reported Claims as of (months) 12	24	36	48	60	72	84	96	108	120
1999	539,000	630,000	665,000	686,000	693,000	693,000	700,000	700,000	700,000	700,000
2000	565,950	661,500	698,250	720,300	727,650	727,650	735,000	735,000	735,000	
2001	594,248	694,575	733,163	756,315	764,033	764,033	771,750	771,750		
2002	623,960	729,304	769,821	794,131	802,234	802,234	810,338			
2003	655,158	765,769	808,312	833,837	842,346	842,346				
2004	687,916	804,057	848,727	875,529	884,463					
2005	722,312	844,260	891,164	919,306						
2006	758,427	886,473	935,722							
2007	796,348	930,797								
2008	836,166									

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
1999	1.169	1.056	1.032	1.010	1.000	1.010	1.000	1.000	1.000	
2000	1.169	1.056	1.032	1.010	1.000	1.010	1.000	1.000		
2001	1.169	1.056	1.032	1.010	1.000	1.010	1.000			
2002	1.169	1.056	1.032	1.010	1.000	1.010				
2003	1.169	1.056	1.032	1.010	1.000					
2004	1.169	1.056	1.032	1.010						
2005	1.169	1.056	1.032							
2006	1.169	1.056								
2007	1.169									
2008										

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Volume-weighted Average										
Latest 5	1.169	1.056	1.032	1.010	1.000	1.010	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Selected	1.169	1.056	1.032	1.010	1.000	1.010	1.000	1.000	1.000	1.000
CDF to Ultimate	1.299	1.111	1.053	1.020	1.010	1.010	1.000	1.000	1.000	1.000
Percent Reported	77.0%	90.0%	95.0%	98.0%	99.0%	99.0%	100.0%	100.0%	100.0%	100.0%

PART 1 - Data Triangle

Accident Year	Paid Claims as of (months) 12	24	36	48	60	72	84	96	108	120
1999	294,000	497,000	588,000	644,000	672,000	686,000	693,000	693,000	700,000	700,000
2000	308,700	521,850	617,400	676,200	705,600	720,300	727,650	727,650	735,000	
2001	324,135	547,943	648,270	710,010	740,880	756,315	764,033	764,033		
2002	340,342	575,340	680,684	745,511	777,924	794,131	802,234			
2003	357,359	604,107	714,718	782,786	816,820	833,837				
2004	375,227	634,312	750,454	821,925	857,661					
2005	393,988	666,028	787,976	863,022						
2006	413,688	699,329	827,375							
2007	434,372	734,295								
2008	456,090									

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
1999	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010	1.000	
2000	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010		
2001	1.690	1.183	1.095	1.043	1.021	1.010	1.000			
2002	1.690	1.183	1.095	1.043	1.021	1.010				
2003	1.690	1.183	1.095	1.043	1.021					
2004	1.690	1.183	1.095	1.043						
2005	1.690	1.183	1.095							
2006	1.690	1.183								
2007	1.690									
2008										

PART 3 - Average Age-to-Age Factors

Averages	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Volume-weighted Average										
Latest 5	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010	1.000	

PART 4 - Selected Age-to-Age Factors

Development Factor Selection	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Selected	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010	1.000	1.000
CDF to Ultimate	2.381	1.408	1.190	1.087	1.042	1.020	1.010	1.010	1.000	1.000
Percent Paid	42.0%	71.0%	84.0%	92.0%	96.0%	98.0%	99.0%	99.0%	100.0%	100.0%

PART 1 - Data Triangle

Accident Year	Reported Claims as of (months) 12	24	36	48	60	72	84	96	108	120
1999	539,000	630,000	665,000	686,000	693,000	693,000	700,000	700,000	700,000	700,000
2000	565,950	661,500	698,250	720,300	727,650	727,650	735,000	735,000	735,000	
2001	594,248	694,575	733,163	756,315	764,033	764,033	771,750	771,750		
2002	623,960	729,304	769,821	794,131	802,234	802,234	810,338			
2003	655,158	765,769	808,312	833,837	842,346	842,346				
2004	786,189	918,923	969,974	1,000,605	1,010,815					
2005	877,093	1,025,173	1,082,127	1,116,300						
2006	975,121	1,139,751	1,203,071							
2007	1,080,759	1,263,224								
2008	1,194,523									

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
1999	1.169	1.056	1.032	1.010	1.000	1.010	1.000	1.000	1.000	
2000	1.169	1.056	1.032	1.010	1.000	1.010	1.000	1.000		
2001	1.169	1.056	1.032	1.010	1.000	1.010	1.000			
2002	1.169	1.056	1.032	1.010	1.000	1.010				
2003	1.169	1.056	1.032	1.010	1.000					
2004	1.169	1.056	1.032	1.010						
2005	1.169	1.056	1.032							
2006	1.169	1.056								
2007	1.169									
2008										

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Volume-weighted Average										
Latest 5	1.169	1.056	1.032	1.010	1.000	1.010	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Selected	1.169	1.056	1.032	1.010	1.000	1.010	1.000	1.000	1.000	1.000
CDF to Ultimate	1.299	1.111	1.053	1.020	1.010	1.010	1.000	1.000	1.000	1.000
Percent Reported	77.0%	90.0%	95.0%	98.0%	99.0%	99.0%	100.0%	100.0%	100.0%	100.0%

PART 1 - Data Triangle

Accident Year	Paid Claims as of (months) 12	24	36	48	60	72	84	96	108	120
1999	294,000	497,000	588,000	644,000	672,000	686,000	693,000	693,000	700,000	700,000
2000	308,700	521,850	617,400	676,200	705,600	720,300	727,650	727,650	735,000	
2001	324,135	547,943	648,270	710,010	740,880	756,315	764,033	764,033		
2002	340,342	575,340	680,684	745,511	777,924	794,131	802,234			
2003	357,359	604,107	714,718	782,786	816,820	833,837				
2004	428,831	724,928	857,661	939,343	980,184					
2005	478,414	808,748	956,828	1,047,955						
2006	531,884	899,137	1,063,768							
2007	589,505	996,544								
2008	651,558									

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
1999	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010	1.000	
2000	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010		
2001	1.690	1.183	1.095	1.043	1.021	1.010	1.000			
2002	1.690	1.183	1.095	1.043	1.021	1.010				
2003	1.690	1.183	1.095	1.043	1.021					
2004	1.690	1.183	1.095	1.043						
2005	1.690	1.183	1.095							
2006	1.690	1.183								
2007	1.690									
2008										

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Volume-weighted Average										
Latest 5	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Selected	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010	1.000	1.000
CDF to Ultimate	2.381	1.408	1.190	1.087	1.042	1.020	1.010	1.010	1.000	1.000
Percent Paid	42.0%	71.0%	84.0%	92.0%	96.0%	98.0%	99.0%	99.0%	100.0%	100.0%

PART 1 - Data Triangle

Accident Year	Reported Claims as of (months) 12	24	36	48	60	72	84	96	108	120
1999	539,000	630,000	665,000	686,000	693,000	693,000	700,000	700,000	700,000	700,000
2000	565,950	661,500	698,250	720,300	727,650	727,650	735,000	735,000	735,000	
2001	594,248	694,575	733,163	756,315	764,033	764,033	771,750	771,750		
2002	623,960	729,304	769,821	794,131	802,234	802,234	810,338			
2003	655,158	765,769	808,312	833,837	842,346	842,346				
2004	687,916	804,057	848,727	878,745	884,463					
2005	722,312	844,260	897,355	933,377						
2006	758,427	897,702	962,808							
2007	818,067	979,922								
2008	931,185									

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
1999	1.169	1.056	1.032	1.010	1.000	1.010	1.000	1.000	1.000	
2000	1.169	1.056	1.032	1.010	1.000	1.010	1.000	1.000		
2001	1.169	1.056	1.032	1.010	1.000	1.010	1.000			
2002	1.169	1.056	1.032	1.010	1.000	1.010				
2003	1.169	1.056	1.032	1.010	1.000					
2004	1.169	1.056	1.035	1.007						
2005	1.169	1.063	1.040							
2006	1.184	1.073								
2007	1.198									
2008										

PART 3 - Average Age-to-Age Factors

Averages	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Volume-weighted Average										
Latest 5	1.178	1.061	1.034	1.009	1.000	1.010	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

Development Factor Selection	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Selected	1.178	1.061	1.034	1.009	1.000	1.010	1.000	1.000	1.000	1.000
CDF to Ultimate	1.318	1.119	1.055	1.020	1.010	1.010	1.000	1.000	1.000	1.000
Percent Reported	75.9%	89.4%	94.8%	98.1%	99.0%	99.0%	100.0%	100.0%	100.0%	100.0%

Chapter 7 - Development Technique
Impact of Changing Conditions
U.S. PP Auto Increasing Case Outstanding Strength - Paid Claims

PART 1 - Data Triangle

Accident Year	Paid Claims as of (months) 12	24	36	48	60	72	84	96	108	120
1999	294,000	497,000	588,000	644,000	672,000	686,000	693,000	693,000	700,000	700,000
2000	308,700	521,850	617,400	676,200	705,600	720,300	727,650	727,650	735,000	
2001	324,135	547,943	648,270	710,010	740,880	756,315	764,033	764,033		
2002	340,342	575,340	680,684	745,511	777,924	794,131	802,234			
2003	357,359	604,107	714,718	782,786	816,820	833,837				
2004	375,227	634,312	750,454	821,925	857,661					
2005	393,988	666,028	787,976	863,022						
2006	413,688	699,329	827,375							
2007	434,372	734,295								
2008	456,090									

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
1999	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010	1.000	
2000	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010		
2001	1.690	1.183	1.095	1.043	1.021	1.010	1.000			
2002	1.690	1.183	1.095	1.043	1.021	1.010				
2003	1.690	1.183	1.095	1.043	1.021					
2004	1.690	1.183	1.095	1.043						
2005	1.690	1.183	1.095							
2006	1.690	1.183								
2007	1.690									
2008										

PART 3 - Average Age-to-Age Factors

Averages	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Volume-weighted Average										
Latest 5	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010	1.000	

PART 4 - Selected Age-to-Age Factors

Development Factor Selection	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Selected	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010	1.000	1.000
CDF to Ultimate	2.381	1.408	1.190	1.087	1.042	1.020	1.010	1.010	1.000	1.000
Percent Paid	42.0%	71.0%	84.0%	92.0%	96.0%	98.0%	99.0%	99.0%	100.0%	100.0%

Chapter 7 - Development Technique
Impact of Changing Conditions
U.S. PP Auto Increasing Claim Ratios and Case Outstanding Strength - Reported Claims

Exhibit III
Sheet 8

PART 1 - Data Triangle

Accident Year	Reported Claims as of (months) 12	24	36	48	60	72	84	96	108	120
1999	539,000	630,000	665,000	686,000	693,000	693,000	700,000	700,000	700,000	700,000
2000	565,950	661,500	698,250	720,300	727,650	727,650	735,000	735,000	735,000	
2001	594,248	694,575	733,163	756,315	764,033	764,033	771,750	771,750		
2002	623,960	729,304	769,821	794,131	802,234	802,234	810,338			
2003	655,158	765,769	808,312	833,837	842,346	842,346				
2004	786,189	918,923	969,974	1,004,280	1,010,815					
2005	877,093	1,025,173	1,089,645	1,133,386						
2006	975,121	1,154,188	1,237,897							
2007	1,110,234	1,329,895								
2008	1,330,264									

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
1999	1.169	1.056	1.032	1.010	1.000	1.010	1.000	1.000	1.000	
2000	1.169	1.056	1.032	1.010	1.000	1.010	1.000	1.000		
2001	1.169	1.056	1.032	1.010	1.000	1.010	1.000			
2002	1.169	1.056	1.032	1.010	1.000	1.010				
2003	1.169	1.056	1.032	1.010	1.000					
2004	1.169	1.056	1.035	1.007						
2005	1.169	1.063	1.040							
2006	1.184	1.073								
2007	1.198									
2008										

PART 3 - Average Age-to-Age Factors

Averages	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Volume-weighted Average										
Latest 5	1.179	1.061	1.035	1.009	1.000	1.010	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

Development Factor Selection	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Selected	1.179	1.061	1.035	1.009	1.000	1.010	1.000	1.000	1.000	1.000
CDF to Ultimate	1.320	1.120	1.055	1.019	1.010	1.010	1.000	1.000	1.000	1.000
Percent Reported	75.7%	89.3%	94.8%	98.1%	99.0%	99.0%	100.0%	100.0%	100.0%	100.0%

Chapter 7 - Development Technique Exhibit III
Impact of Changing Conditions Sheet 9
U.S. PP Auto Increasing Claim Ratios and Case Outstanding Strength - Paid Claims

PART 1 - Data Triangle

Accident Year	Paid Claims as of (months) 12	24	36	48	60	72	84	96	108	120
1999	294,000	497,000	588,000	644,000	672,000	686,000	693,000	693,000	700,000	700,000
2000	308,700	521,850	617,400	676,200	705,600	720,300	727,650	727,650	735,000	
2001	324,135	547,943	648,270	710,010	740,880	756,315	764,033	764,033		
2002	340,342	575,340	680,684	745,511	777,924	794,131	802,234			
2003	357,359	604,107	714,718	782,786	816,820	833,837				
2004	428,831	724,928	857,661	939,343	980,184					
2005	478,414	808,748	956,828	1,047,955						
2006	531,884	899,137	1,063,768							
2007	589,505	996,544								
2008	651,558									

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
1999	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010	1.000	
2000	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010		
2001	1.690	1.183	1.095	1.043	1.021	1.010	1.000			
2002	1.690	1.183	1.095	1.043	1.021	1.010				
2003	1.690	1.183	1.095	1.043	1.021					
2004	1.690	1.183	1.095	1.043						
2005	1.690	1.183	1.095							
2006	1.690	1.183								
2007	1.690									
2008										

PART 3 - Average Age-to-Age Factors

Averages	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Volume-weighted Average										
Latest 5	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010	1.000	

PART 4 - Selected Age-to-Age Factors

Development Factor Selection	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Selected	1.690	1.183	1.095	1.043	1.021	1.010	1.000	1.010	1.000	1.000
CDF to Ultimate	2.381	1.408	1.190	1.087	1.042	1.020	1.010	1.010	1.000	1.000
Percent Paid	42.0%	71.0%	84.0%	92.0%	96.0%	98.0%	99.0%	99.0%	100.0%	100.0%

Chapter 7 - Development Technique
Impact of Changing Conditions
U.S. PP Auto - Development of Unpaid Claim Estimate

Exhibit III
Sheet 10

Accident Year	Age of Accident Year at 12/31/08	Claims at 12/31/08 Reported	Claims at 12/31/08 Paid	Case Outstanding	CDF to Ultimate Reported	CDF to Ultimate Paid	Projected Ultimate Claims Using Dev. Method with Reported	Projected Ultimate Claims Using Dev. Method with Paid	Estimated IBNR Using Dev. Method with Reported	Estimated IBNR Using Dev. Method with Paid	Actual IBNR	Difference from Actual IBNR Using Dev. Method with Reported	Difference from Actual IBNR Using Dev. Method with Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Steady-State													
1999	120	700,000	700,000	0	1.000	1.000	700,000	700,000	0	0	0	0	0
2000	108	735,000	735,000	0	1.000	1.000	735,000	735,000	0	0	0	0	0
2001	96	771,750	764,033	7,718	1.000	1.010	771,750	771,750	0	0	0	0	0
2002	84	810,338	802,234	8,103	1.000	1.010	810,338	810,338	0	0	0	0	0
2003	72	842,346	833,837	8,509	1.010	1.020	850,854	850,854	8,509	8,509	8,509	0	0
2004	60	884,463	857,661	26,802	1.010	1.042	893,397	893,397	8,934	8,934	8,934	0	0
2005	48	919,306	863,022	56,284	1.020	1.087	938,067	938,067	18,761	18,761	18,761	0	0
2006	36	935,722	827,375	108,347	1.053	1.190	984,970	984,970	49,249	49,249	49,249	0	0
2007	24	930,797	734,295	196,502	1.111	1.408	1,034,219	1,034,219	103,422	103,422	103,422	0	0
2008	12	836,166	456,090	380,075	1.299	2.381	1,085,930	1,085,930	249,764	249,764	249,764	0	0
Total		8,365,887	7,573,548	792,339			8,804,525	8,804,525	438,638	438,638	438,638	0	0
Increasing Claim Ratios													
1999	120	700,000	700,000	0	1.000	1.000	700,000	700,000	0	0	0	0	0
2000	108	735,000	735,000	0	1.000	1.000	735,000	735,000	0	0	0	0	0
2001	96	771,750	764,033	7,718	1.000	1.010	771,750	771,750	0	0	0	0	0
2002	84	810,338	802,234	8,103	1.000	1.010	810,338	810,338	0	0	0	0	0
2003	72	842,346	833,837	8,509	1.010	1.020	850,854	850,854	8,509	8,509	8,509	0	0
2004	60	1,010,815	980,184	30,631	1.010	1.042	1,021,025	1,021,025	10,210	10,210	10,210	0	0
2005	48	1,116,300	1,047,955	68,345	1.020	1.087	1,139,081	1,139,081	22,782	22,782	22,782	0	0
2006	36	1,203,071	1,063,768	139,303	1.053	1.190	1,266,390	1,266,390	63,320	63,320	63,320	0	0
2007	24	1,263,224	996,544	266,681	1.111	1.408	1,403,583	1,403,583	140,358	140,358	140,358	0	0
2008	12	1,194,523	651,558	542,965	1.299	2.381	1,551,328	1,551,328	356,805	356,805	356,805	0	0
Total		9,647,366	8,575,112	1,072,254			10,249,350	10,249,350	601,984	601,984	601,984	0	0

Column Notes:
(2) Age of accident year at December 31, 2008.
(3) and (4) From last diagonal of reported and paid claim triangles in Exhibit III, Sheets 2 through 5.
(5) = [(3) - (4)].
(6) and (7) CDF based on 5-year volume-weighted average age-to-age factors presented in Exhibit III, Sheets 2 through 5.
(8) = [(3) x (6)].
(9) = [(4) x (7)].
(10) = [(8) - (3)].
(11) = [(9) - (3)].
(12) Developed in Exhibit III, Sheet 1.
(13) = [(12) - (10)].
(14) = [(12) - (11)].

Accident Year	Age of Accident Year at 12/31/08	Claims at 12/31/08 Reported	Claims at 12/31/08 Paid	Case Outstanding	CDF to Ultimate Reported	CDF to Ultimate Paid	Projected Ultimate Claims Using Dev. Method with Reported	Projected Ultimate Claims Using Dev. Method with Paid	Estimated IBNR Using Dev. Method with Reported	Estimated IBNR Using Dev. Method with Paid	Actual IBNR	Difference from Actual IBNR Using Dev. Method with Reported	Difference from Actual IBNR Using Dev. Method with Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Increasing Case Outstanding Strength													
1999	120	700,000	700,000	0	1.000	1.000	700,000	700,000	0	0	0	0	0
2000	108	735,000	735,000	0	1.000	1.000	735,000	735,000	0	0	0	0	0
2001	96	771,750	764,033	7,718	1.000	1.010	771,750	771,750	0	0	0	0	0
2002	84	810,338	802,234	8,103	1.000	1.010	810,338	810,338	0	0	0	0	0
2003	72	842,346	833,837	8,509	1.010	1.020	850,854	850,854	8,509	8,509	8,509	0	0
2004	60	884,463	857,661	26,802	1.010	1.042	893,397	893,397	8,934	8,934	8,934	0	0
2005	48	933,377	863,022	70,355	1.020	1.087	951,656	938,067	18,279	4,690	4,690	- 13,589	0
2006	36	962,808	827,375	135,433	1.055	1.190	1,015,302	984,970	52,493	22,162	22,162	- 30,331	0
2007	24	979,922	734,295	245,627	1.119	1.408	1,096,235	1,034,219	116,313	54,296	54,296	- 62,017	0
2008	12	931,185	456,090	475,094	1.318	2.381	1,227,589	1,085,930	296,404	154,745	154,745	- 141,659	0
Total		8,551,189	7,573,548	977,641			9,052,121	8,804,525	500,932	253,336	253,336	- 247,596	0
Increasing Claim Ratios and Case Outstanding Strength													
1999	120	700,000	700,000	0	1.000	1.000	700,000	700,000	0	0	0	0	0
2000	108	735,000	735,000	0	1.000	1.000	735,000	735,000	0	0	0	0	0
2001	96	771,750	764,033	7,718	1.000	1.010	771,750	771,750	0	0	0	0	0
2002	84	810,338	802,234	8,103	1.000	1.010	810,338	810,338	0	0	0	0	0
2003	72	842,346	833,837	8,509	1.010	1.020	850,854	850,854	8,509	8,509	8,509	0	0
2004	60	1,010,815	980,184	30,631	1.010	1.042	1,021,025	1,021,025	10,210	10,210	10,210	0	0
2005	48	1,133,386	1,047,955	85,431	1.019	1.087	1,155,482	1,139,081	22,096	5,695	5,695	- 16,400	0
2006	36	1,237,897	1,063,768	174,129	1.055	1.190	1,305,639	1,266,390	67,742	28,494	28,494	- 39,248	0
2007	24	1,329,895	996,544	333,351	1.120	1.408	1,488,874	1,403,583	158,980	73,688	73,688	- 85,292	0
2008	12	1,330,264	651,558	678,706	1.320	2.381	1,756,504	1,551,328	426,240	221,064	221,064	- 205,176	0
Total		9,901,689	8,575,112	1,326,577			10,595,466	10,249,350	693,777	347,660	347,660	- 346,116	0

Column Notes:
(2) Age of accident year at December 31, 2008.
(3) and (4) From last diagonal of reported and paid claim triangles in Exhibit III, Sheets 6 through 9.
(5) = [(3) - (4)].
(6) and (7) CDF based on 5-year volume-weighted average age-to-age factors presented in Exhibit III, Sheets 6 through 9.
(8) = [(3) x (6)].
(9) = [(4) x (7)].
(10) = [(8) - (3)].
(11) = [(9) - (3)].
(12) Developed in Exhibit III, Sheet 1.
(13) = [(12) - (10)].
(14) = [(12) - (11)].

Chapter 7 - Development Technique Exhibit IV
Impact of Change in Product Mix Example Sheet 1
Summary of Assumptions - Earned Premiums and Claim Ratios

	Earned Premium			Ultimate Claim Ratios			Ultimate Claims			Reported	
Accident	Priv Pass	Comm	Total	Priv Pass	Comm	Total	Priv Pass	Comm	Total	Claims	Actual
Year	Auto	Auto	Auto	Auto	Auto	Auto	Auto	Auto	Auto	at 12/31/08	IBNR
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Steady-State (No Change in Product Mix)											
1999	1,000,000	1,000,000	2,000,000	70.0%	80.0%	75.0%	700,000	800,000	1,500,000	1,500,000	0
2000	1,050,000	1,050,000	2,100,000	70.0%	80.0%	75.0%	735,000	840,000	1,575,000	1,575,000	0
2001	1,102,500	1,102,500	2,205,000	70.0%	80.0%	75.0%	771,750	882,000	1,653,750	1,653,750	0
2002	1,157,625	1,157,625	2,315,250	70.0%	80.0%	75.0%	810,338	926,100	1,736,438	1,736,438	0
2003	1,215,506	1,215,506	2,431,013	70.0%	80.0%	75.0%	850,854	972,405	1,823,259	1,814,751	8,509
2004	1,276,282	1,276,282	2,552,563	70.0%	80.0%	75.0%	893,397	1,021,025	1,914,422	1,885,068	29,354
2005	1,340,096	1,340,096	2,680,191	70.0%	80.0%	75.0%	938,067	1,072,077	2,010,143	1,948,499	61,644
2006	1,407,100	1,407,100	2,814,201	70.0%	80.0%	75.0%	984,970	1,125,680	2,110,651	1,937,577	173,073
2007	1,477,455	1,477,455	2,954,911	70.0%	80.0%	75.0%	1,034,219	1,181,964	2,216,183	1,852,729	363,454
2008	1,551,328	1,551,328	3,102,656	70.0%	80.0%	75.0%	1,085,930	1,241,063	2,326,992	1,568,393	758,599
Total	12,577,893	12,577,893	25,155,785				8,804,525	10,062,314	18,866,839	17,472,204	1,394,634
Changing Product Mix											
1999	1,000,000	1,000,000	2,000,000	70.0%	80.0%	75.0%	700,000	800,000	1,500,000	1,500,000	0
2000	1,050,000	1,050,000	2,100,000	70.0%	80.0%	75.0%	735,000	840,000	1,575,000	1,575,000	0
2001	1,102,500	1,102,500	2,205,000	70.0%	80.0%	75.0%	771,750	882,000	1,653,750	1,653,750	0
2002	1,157,625	1,157,625	2,315,250	70.0%	80.0%	75.0%	810,338	926,100	1,736,438	1,736,438	0
2003	1,215,506	1,215,506	2,431,013	70.0%	80.0%	75.0%	850,854	972,405	1,823,259	1,814,751	8,509
2004	1,276,282	1,276,282	2,552,563	70.0%	80.0%	75.0%	893,397	1,021,025	1,914,422	1,885,068	29,354
2005	1,340,096	1,659,166	2,999,262	70.0%	80.0%	75.5%	938,067	1,327,333	2,265,400	2,193,545	71,855
2006	1,407,100	2,156,916	3,564,016	70.0%	80.0%	76.1%	984,970	1,725,533	2,710,503	2,471,446	239,057
2007	1,477,455	2,803,991	4,281,446	70.0%	80.0%	76.5%	1,034,219	2,243,192	3,277,411	2,680,487	596,924
2008	1,551,328	3,645,188	5,196,516	70.0%	80.0%	77.0%	1,085,930	2,916,150	4,002,080	2,556,695	1,445,385
Total	12,577,893	17,067,173	29,645,066				8,804,525	13,653,738	22,458,263	20,067,179	2,391,084

Column Notes:
(2) Assume $1,000,000 for first year in experience period (1999) and 5% annual increase.
(3) For no change scenario, assume $1,000,000 for first year in experience period (1999) and 5% annual increase thereafter. For change scenario, assume annual increase of 30% beginning in 2005.
(4) = [(2) + (3)].
(5) and (6) Ultimate claim ratios assumed to be known for purpose of example.
(7) = [(10) / (4)].
(8) = [(2) x (5)].
(9) = [(3) x (6)].
(10) = [(8) + (9)].
(11) Latest diagonal of reported claim triangles in Exhibit IV, Sheets 2 and 4.
(12) = [(10) - (11)].

PART 1 - Data Triangle

Accident Year	Reported Claims as of (months) 12	24	36	48	60	72	84	96	108	120
1999	1,011,000	1,254,000	1,377,000	1,454,000	1,477,000	1,493,000	1,500,000	1,500,000	1,500,000	1,500,000
2000	1,061,550	1,316,700	1,445,850	1,526,700	1,550,850	1,567,650	1,575,000	1,575,000	1,575,000	
2001	1,114,628	1,382,535	1,518,143	1,603,035	1,628,393	1,646,033	1,653,750	1,653,750		
2002	1,170,359	1,451,662	1,594,050	1,683,187	1,709,812	1,728,334	1,736,438			
2003	1,228,877	1,524,245	1,673,752	1,767,346	1,795,303	1,814,751				
2004	1,290,321	1,600,457	1,757,440	1,855,713	1,885,068					
2005	1,354,837	1,680,480	1,845,312	1,948,499						
2006	1,422,579	1,764,504	1,937,577							
2007	1,493,707	1,852,729								
2008	1,568,393									

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
1999	1.240	1.098	1.056	1.016	1.011	1.005	1.000	1.000	1.000	
2000	1.240	1.098	1.056	1.016	1.011	1.005	1.000	1.000		
2001	1.240	1.098	1.056	1.016	1.011	1.005	1.000			
2002	1.240	1.098	1.056	1.016	1.011	1.005				
2003	1.240	1.098	1.056	1.016	1.011					
2004	1.240	1.098	1.056	1.016						
2005	1.240	1.098	1.056							
2006	1.240	1.098								
2007	1.240									
2008										

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Volume-weighted Average										
Latest 5	1.240	1.098	1.056	1.016	1.011	1.005	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Selected	1.240	1.098	1.056	1.016	1.011	1.005	1.000	1.000	1.000	1.000
CDF to Ultimate	1.484	1.196	1.089	1.032	1.016	1.005	1.000	1.000	1.000	1.000
Percent Reported	67.4%	83.6%	91.8%	96.9%	98.5%	99.5%	100.0%	100.0%	100.0%	100.0%

PART 1 - Data Triangle

Accident Year	Paid Claims as of (months) 12	24	36	48	60	72	84	96	108	120
1999	470,000	865,000	1,124,000	1,300,000	1,400,000	1,446,000	1,469,000	1,477,000	1,492,000	1,500,000
2000	493,500	908,250	1,180,200	1,365,000	1,470,000	1,518,300	1,542,450	1,550,850	1,566,600	
2001	518,175	953,663	1,239,210	1,433,250	1,543,500	1,594,215	1,619,573	1,628,393		
2002	544,084	1,001,346	1,301,171	1,504,913	1,620,675	1,673,926	1,700,551			
2003	571,288	1,051,413	1,366,229	1,580,158	1,701,709	1,757,622				
2004	599,852	1,103,984	1,434,540	1,659,166	1,786,794					
2005	629,845	1,159,183	1,506,268	1,742,124						
2006	661,337	1,217,142	1,581,581							
2007	694,404	1,277,999								
2008	729,124									

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
1999	1.840	1.299	1.157	1.077	1.033	1.016	1.005	1.010	1.005	
2000	1.840	1.299	1.157	1.077	1.033	1.016	1.005	1.010		
2001	1.840	1.299	1.157	1.077	1.033	1.016	1.005			
2002	1.840	1.299	1.157	1.077	1.033	1.016				
2003	1.840	1.299	1.157	1.077	1.033					
2004	1.840	1.299	1.157	1.077						
2005	1.840	1.299	1.157							
2006	1.840	1.299								
2007	1.840									
2008										

PART 3 - Average Age-to-Age Factors

Averages	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Volume-weighted Average										
Latest 5	1.840	1.299	1.157	1.077	1.033	1.016	1.005	1.010	1.005	

PART 4 - Selected Age-to-Age Factors

Development Factor Selection	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Selected	1.840	1.299	1.157	1.077	1.033	1.016	1.005	1.010	1.005	1.000
CDF to Ultimate	3.191	1.734	1.335	1.154	1.071	1.037	1.021	1.016	1.005	1.000
Percent Paid	31.3%	57.7%	74.9%	86.7%	93.3%	96.4%	97.9%	98.5%	99.5%	100.0%

PART 1 - Data Triangle

Accident Year	Reported Claims as of (months) 12	24	36	48	60	72	84	96	108	120
1999	1,011,000	1,254,000	1,377,000	1,454,000	1,477,000	1,493,000	1,500,000	1,500,000	1,500,000	1,500,000
2000	1,061,550	1,316,700	1,445,850	1,526,700	1,550,850	1,567,650	1,575,000	1,575,000	1,575,000	
2001	1,114,628	1,382,535	1,518,143	1,603,035	1,628,393	1,646,033	1,653,750	1,653,750		
2002	1,170,359	1,451,662	1,594,050	1,683,187	1,709,812	1,728,334	1,736,438			
2003	1,228,877	1,524,245	1,673,752	1,767,346	1,795,303	1,814,751				
2004	1,290,321	1,600,457	1,757,440	1,855,713	1,885,068					
2005	1,505,438	1,879,580	2,072,490	2,193,545						
2006	1,776,491	2,232,389	2,471,446							
2007	2,119,832	2,680,487								
2008	2,556,695									

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
1999	1.240	1.098	1.056	1.016	1.011	1.005	1.000	1.000	1.000	
2000	1.240	1.098	1.056	1.016	1.011	1.005	1.000	1.000		
2001	1.240	1.098	1.056	1.016	1.011	1.005	1.000			
2002	1.240	1.098	1.056	1.016	1.011	1.005				
2003	1.240	1.098	1.056	1.016	1.011					
2004	1.240	1.098	1.056	1.016						
2005	1.249	1.103	1.058							
2006	1.257	1.107								
2007	1.264									
2008										

PART 3 - Average Age-to-Age Factors

Averages	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Volume-weighted Average										
Latest 5	1.252	1.101	1.057	1.016	1.011	1.005	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

Development Factor Selection	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Selected	1.252	1.101	1.057	1.016	1.011	1.005	1.000	1.000	1.000	1.000
CDF to Ultimate	1.503	1.200	1.090	1.032	1.016	1.005	1.000	1.000	1.000	1.000
Percent Reported	66.5%	83.3%	91.7%	96.9%	98.5%	99.5%	100.0%	100.0%	100.0%	100.0%

PART 1 - Data Triangle

Accident Year	Paid Claims as of (months) 12	24	36	48	60	72	84	96	108	120
1999	470,000	865,000	1,124,000	1,300,000	1,400,000	1,446,000	1,469,000	1,477,000	1,492,000	1,500,000
2000	493,500	908,250	1,180,200	1,365,000	1,470,000	1,518,300	1,542,450	1,550,850	1,566,600	
2001	518,175	953,663	1,239,210	1,433,250	1,543,500	1,594,215	1,619,573	1,628,393		
2002	544,084	1,001,346	1,301,171	1,504,913	1,620,675	1,673,926	1,700,551			
2003	571,288	1,051,413	1,366,229	1,580,158	1,701,709	1,757,622				
2004	599,852	1,103,984	1,434,540	1,659,166	1,786,794					
2005	686,001	1,276,601	1,677,289	1,951,435						
2006	793,305	1,493,074	1,983,482							
2007	927,874	1,766,164								
2008	1,097,644									

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
1999	1.840	1.299	1.157	1.077	1.033	1.016	1.005	1.010	1.005	
2000	1.840	1.299	1.157	1.077	1.033	1.016	1.005	1.010		
2001	1.840	1.299	1.157	1.077	1.033	1.016	1.005			
2002	1.840	1.299	1.157	1.077	1.033	1.016				
2003	1.840	1.299	1.157	1.077	1.033					
2004	1.840	1.299	1.157	1.077						
2005	1.861	1.314	1.163							
2006	1.882	1.328								
2007	1.903									
2008										

PART 3 - Average Age-to-Age Factors

Averages	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Volume-weighted Average										
Latest 5	1.870	1.310	1.158	1.077	1.033	1.016	1.005	1.010	1.005	

PART 4 - Selected Age-to-Age Factors

Development Factor Selection	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	To Ult
Selected	1.870	1.310	1.158	1.077	1.033	1.016	1.005	1.010	1.005	1.000
CDF to Ultimate	3.273	1.750	1.336	1.154	1.071	1.037	1.021	1.016	1.005	1.000
Percent Paid	30.6%	57.1%	74.8%	86.7%	93.3%	96.4%	97.9%	98.5%	99.5%	100.0%

Accident Year	Age of Accident Year at 12/31/08	Claims at 12/31/08		Case Outstanding	CDF to Ultimate		Projected Ultimate Claims Using Dev. Method with		Estimated IBNR Using Dev. Method with		Actual IBNR	Difference from Actual IBNR Using Dev. Method with	
		Reported	Paid		Reported	Paid	Reported	Paid	Reported	Paid		Reported	Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Steady-State (No Change in Product Mix)													
1999	120	1,500,000	1,500,000	0	1.000	1.000	1,500,000	1,500,000	0	0	0	0	0
2000	108	1,575,000	1,566,600	8,400	1.000	1.005	1,575,000	1,575,000	0	0	0	0	0
2001	96	1,653,750	1,628,393	25,358	1.000	1.016	1,653,750	1,653,750	0	0	0	0	0
2002	84	1,736,438	1,700,551	35,886	1.000	1.021	1,736,438	1,736,438	0	0	0	0	0
2003	72	1,814,751	1,757,622	57,129	1.005	1.037	1,823,259	1,823,259	8,509	8,509	8,509	0	0
2004	60	1,885,068	1,786,794	98,274	1.016	1.071	1,914,422	1,914,422	29,354	29,354	29,354	0	0
2005	48	1,948,499	1,742,124	206,375	1.032	1.154	2,010,143	2,010,143	61,644	61,644	61,644	0	0
2006	36	1,937,577	1,581,581	355,996	1.089	1.335	2,110,651	2,110,651	173,073	173,073	173,073	0	0
2007	24	1,852,729	1,277,999	574,730	1.196	1.734	2,216,183	2,216,183	363,454	363,454	363,454	0	0
2008	12	1,568,393	729,124	839,269	1.484	3.191	2,326,992	2,326,992	758,599	758,599	758,599	0	0
Total		17,472,204	15,270,788	2,201,416			18,866,839	18,866,839	1,394,634	1,394,634	1,394,634	0	0
Changing Product Mix													
1999	120	1,500,000	1,500,000	0	1.000	1.000	1,500,000	1,500,000	0	0	0	0	0
2000	108	1,575,000	1,566,600	8,400	1.000	1.005	1,575,000	1,575,000	0	0	0	0	0
2001	96	1,653,750	1,628,393	25,358	1.000	1.016	1,653,750	1,653,750	0	0	0	0	0
2002	84	1,736,438	1,700,551	35,886	1.000	1.021	1,736,438	1,736,438	0	0	0	0	0
2003	72	1,814,751	1,757,622	57,129	1.005	1.037	1,823,259	1,823,259	8,509	8,509	8,509	0	0
2004	60	1,885,068	1,786,794	98,274	1.016	1.071	1,914,422	1,914,422	29,354	29,354	29,354	0	0
2005	48	2,193,545	1,951,435	242,111	1.032	1.154	2,262,942	2,251,655	69,397	58,110	71,855	2,458	13,745
2006	36	2,471,446	1,983,482	487,964	1.090	1.336	2,693,735	2,650,749	222,289	179,303	239,057	16,768	59,754
2007	24	2,680,487	1,766,164	914,323	1.200	1.750	3,217,775	3,091,666	537,288	411,179	596,924	59,636	185,746
2008	12	2,556,695	1,097,644	1,459,051	1.503	3.273	3,842,645	3,592,939	1,285,950	1,036,245	1,445,385	159,435	409,141
Total		20,067,179	16,738,684	3,328,495			22,219,966	21,789,878	2,152,787	1,722,699	2,391,084	238,297	668,386

<u>Column Notes:</u>
(2) Age of accident year at December 31, 2008.
(3) and (4) From last diagonal of reported and paid claim triangles in Exhibit IV, Sheets 2 through 5.
(5) = [(3) - (4)].
(6) and (7) CDF based on 5-year volume-weighted average age-to-age factors presented in Exhibit IV, Sheets 2 through 5.
(8) = [(3) x (6)].
(9) = [(4) x (7)].
(10) = [(8) - (3)].
(11) = [(9) - (3)].
(12) Developed in Exhibit IV, Sheet 1.
(13) = [(12) - (10)].
(14) = [(12) - (11)].

CHAPTER 8 – EXPECTED CLAIMS TECHNIQUE

Insurers frequently use the expected claims[52] method when entering new lines of business or new territories. Many actuaries also use this method for estimating unpaid claims for the most immature period(s). Expected claims are a critical component of several other methods including the Bornhuetter-Ferguson and Cape Cod techniques, which we discuss in Chapters 9 and 10.

Key Assumption

The key assumption of the expected claims technique is that the actuary can better estimate total unpaid claims based on an a priori (or initial) estimate than from claims experience observed to date. In certain circumstances, the claims experience reported to date may provide little information about ultimate claims, especially when compared to the a priori estimate.

Common Uses of the Expected Claims Method

Actuaries can use the expected claims method with all lines of insurance. However, this method is more commonly used in lines of business with longer emergence patterns and settlement patterns. The method can be used with data organized by accident year, report year, policy year, underwriting year, and even with calendar year data. The expected claims method is often used when:

- An insurer enters a new line of business or a new territory
- Operational or environmental changes make recent historical data irrelevant for projecting future claims activity for that cohort of claims
- The claim development method is not appropriate for less mature periods since the development factors to ultimate are too highly leveraged
- Data is unavailable for other methods

Mechanics of the Expected Claims Technique

There are numerous ways for actuaries to determine the a priori expected claims. Some of the approaches are mathematically simple and some involve complex statistical modeling. The approach most often used by commercial insurers is relatively simple. Actuaries for commercial insurers frequently apply a claim ratio method, where ultimate claims for an experience period are equal to a selected expected claim ratio multiplied by the earned premium. Such an approach implicitly relies on the accuracy of policy pricing and underwriting. An example of the other end

[52] We again remind the reader that we specifically chose the term claims instead of losses. Many actuaries refer to the method described in this chapter as the expected loss method. These actuaries would use the terms expected loss ratios and expected losses instead of the terms expected claim ratios and expected claims that we selected to use. A critical point for the actuary to remember is that he or she must completely understand the terminology used in any situation.

of the spectrum would be a complex simulation model built to project expected claims for a captive insurer covering the errors and omission liability for potential blood-related diseases. The selection of variables for input to this model may require the opinions of an expert panel of doctors, lawyers, and other practitioners from around the world. The complex stochastic model may also require detailed analyses of the frequency rate of claims and the likely cost of each claim if it were to occur.

In this chapter, we focus only on exposure-based methods for determining expected claims. For further information, we refer students to the CAS Research Working Party on Bornhuetter-Ferguson Initial Expected Losses. The goal of this working party is to produce a paper addressing the topic of expected losses (i.e., expected claims).

In many respects, an exposure-based method of determining expected claims consists of very basic calculations. Actuaries calculate expected claims by multiplying a predetermined exposure base by a selected measure of claims per unit of exposure (known as the pure premium or the loss rate). The unpaid claim estimate is simply the projected expected claims less paid claims.

The two challenges of the expected claims method are to determine the appropriate exposure base and to estimate the measurement of claims relative to that exposure base.

For commercial insurers (and reinsurers), the most common exposure base is earned premium and the most common measurement of claims is the claim ratio. Expected claims are then equal to the product of the earned premium and the expected claim ratio.

Self-insured organizations do not generally collect premiums in the same way that an insurer does. As a result, actuaries working with self-insurers generally use other exposure bases that they believe are closely related to the risk and thus the potential for claims and are readily observable and available. The following table provides examples, by line of insurance, of the types of exposures that actuaries often use for the analysis of self-insurers' unpaid claims.

Line of Insurance	**Exposure**
U.S. workers compensation	Payroll
Automobile liability	Number of vehicles or miles driven
General liability for public entities	Population or operating expenditures
General liability for corporations	Sales or square footage
Hospital professional liability	Average occupied beds and outpatient visits
Property	Property values
Crime	Number of employees

For self-insurers, the expected claims are equal to the product of the exposure and a pure premium per unit of exposure.

As noted above, one of the challenges for actuaries working with either insurers (and reinsurers) or self-insurers is to determine the claim ratio or pure premium, respectively. Actuaries often begin with a review of the historical claims and exposure experience. We present two examples of the expected claims method in Exhibit I, Sheets 1 and 2. In these two examples, we use the expected claims method to estimate unpaid claims for accident year 2008 only. We use historical reported and paid claims data as well as exposure data from each organization for our calculations.

Step-by-Step Example – Auto BI Insurer

In Exhibit I, Sheet 1, we develop an estimate of unpaid claims for an insurer writing private passenger automobile bodily injury in one jurisdiction (Auto BI Insurer). For Auto BI Insurer, we have nine years (2000 through 2008) of historical accident year claims and premium data. We summarize the reported and paid claim development projections in Columns (2) through (7). We first present the latest diagonals of the reported and paid claim triangles, claims as of the December 31, 2008 valuation date (Columns (2) and (3)). Cumulative claim development factors, selected based on Auto BI Insurer's historical experience, are summarized in Columns (4) and (5). We then calculate projected ultimate claims in Columns (6) and (7) using the development technique applied to reported and paid claims, respectively. In this example, we develop an initial (a priori) estimate of ultimate claims in Column (8) based on the average of the reported and paid claim development projections.

Up to this point, the analysis is the same as that described in the previous chapter on the development technique. Now, however, we move into new territory. Our goal is to develop an expected claim ratio for accident year 2008. The claim ratio will be based on historical claims and premiums of Auto BI Insurer. In our calculations, we need both the premiums and claims to be at the cost levels expected in 2008. Our first adjustment is to the premiums. We develop on-level premiums to account for rate changes implemented during the nine-year experience period. We require all premiums for each calendar year 2000 to 2007 to be restated as if 2008 rates were effective in each respective year. Such restated premiums are also known as on-level premiums. Column (9) contains the on-level earned premium for Auto BI Insurer.

Next we adjust historical claims for changes that will influence the claims of accident year 2008. The first adjustment in our example is trend. Actuaries often use the term "trend" to describe inflation and other systematic influences on the claims or premiums or both. In this example, the only trend reflected is inflation in claims. Through the use of trend factors we adjust historical claims to the economic value that would be reported if that same claim occurred in accident year 2008. Another way of looking at the trend adjustment is to say that we are restating the value of the historical claims in 2008 dollars.

In our example we use a 14.5% annual claim trend rate for automobile bodily injury liability claims. This trend incorporates both severity and frequency trends for this particular line of insurance in the particular jurisdiction in which the coverage is written. Trend rates can vary significantly by line of business and by geographic region. Trends can be negative for some lines of business and above 20% for other lines of business. Trends can also vary for different periods of time within the experience period. If the actuary is going to use the historical experience of the insurer to determine an expected claim ratio, it is critical to incorporate the effect of claim trends in the analysis.

The second adjustment in our example for Auto BI Insurer is a tort reform adjustment. It is not uncommon for states and provinces to legislate changes to the legal environment for lawsuits arising out of private passenger automobile accidents. In such situations, historical claims need to be restated as if they occurred in the new legal environment. In our example, there was a significant reform implemented during 2004. When multiplying historical claims by a reform adjustment factor of 0.67, we are removing 33% of the claims for the oldest years in the experience period. In essence we are saying that if the same type of claims that occurred in 2000 through 2003 were to occur in 2008, they would cost 33% less. Since the reform was introduced during 2004, the pro rata adjustment factor for 2004 is only 0.75, a 25% reduction. This example demonstrates the significant effect of both trend (e.g., inflation) and tort reform adjustments on the claim costs.

Returning to Exhibit I, the projected claims in Column (12) are adjusted by both the trend factor and the tort reform adjustment. In Column (13), we present the trended adjusted claim ratios, which are equal to the trended adjusted claims divided by the on-level earned premiums. We then take various averages of the claim ratios in Line (14). We observe that the claim development factors to ultimate for both reported and paid claims are highly leveraged for the most recent accident years. The reported claim development factors to ultimate for accident years 2007 and 2008 are 2.90 and 4.00, respectively; and the paid claim development factors to ultimate for accident years 2007 and 2008 are 15.00 and 90.00. Thus, we look at various averages that do not include the experience of the most recent years. In Line (15) we select a claim ratio of 80% based on a review of the individual projected claim ratios in Column (13) and the averages in Line (14).

The final two steps in our example are to project accident year 2008 expected claims and to determine the unpaid claim estimate. The expected claims of $49.6 million (Line (16)) are equal to the selected claim ratio of 80% multiplied by the earned premium of $62 million. We calculate the estimate of unpaid claims by subtracting paid claims for accident year 2008 from the expected claims. The total unpaid claim estimate includes both case outstanding and the broad definition of IBNR. Estimated IBNR is equal to the expected claims less reported claims.

Step-by-Step Example – GL Self-Insurer

In Exhibit I, Sheet 2, we present a similar calculation for a public entity self-insurer's general liability program (GL Self-Insurer). We begin again with the reported and paid claim development methods, and select an initial estimate of ultimate claims based on the average of the two claim development projections (Column (8)). In this example, we use population as our exposure base; historical values are summarized in Column (9) of Exhibit I, Sheet 2. Had we used an inflation-sensitive exposure base, such as payroll or sales, we would need to consider the effect of inflation over the experience period and possibly introduce an exposure trend to adjust all exposures to the common economic value of 2008 exposures.

For GL Self-Insurer, we assume that the only adjustment to claims is for trend, and that the annual claim trend rate is 7.5%. Again this trend incorporates both severity and frequency trends for the jurisdiction in which coverage is provided. An alternative to trending claims and exposures separately when the exposures are inflation-sensitive is to use a residual pure premium trend rate. For example, in U.S. workers compensation, actuaries frequently use a residual pure premium trend that represents the trend in claims that is in excess of the trend in payroll.

After a review of the trended pure premiums in Column (12) and various averages in Line (13), we select a pure premium for accident year 2008 of $3.50 per person. We calculate expected claims of $2,765,000 by multiplying the selected pure premium of $3.50 by the 2008 population (790,000). The total unpaid claim estimate is equal to expected claims less paid claims, and estimated IBNR is equal to expected claims less reported claims.

Step-by-Step Example – U.S. Industry Auto

In Exhibits II through V, we continue with the examples presented in Chapter 7. Exhibit II contains the expected claims projections for the aggregated results of U.S. private passenger automobile insurance (i.e., U.S. Industry Auto). We rely on the selected reported and paid claim development factors from Chapter 7 to develop an initial selection of ultimate claims. Columns (2) through (7) present detailed calculations for the reported and paid claim development projections. We derive the initial selected ultimate claims in Column (8) based on the average of the reported and paid claim development projections.

We then divide the initial selected ultimate claims by earned premium for each year to develop the estimated claim ratios (Column 10). Since the data in Exhibit II represents the consolidated results for the entire U.S. insurance industry, we do not have detailed information regarding rate changes and thus can not adjust the premium to an on-level basis.

The example in Exhibit II differs somewhat from the prior two examples in this chapter in the time period for which the expected claims method is used. In the first two examples, we use historical experience to select an expected claim ratio and an expected pure premium for the 2008 accident year only. Thus, we adjusted the exposures and claims for each year in the experience period to the 2008 cost level. In the example for U.S. Industry Auto, we are projecting ultimate claims for each year in the experience period based on the expected claims technique. Thus, we require a claim ratio at the cost level expected for each year in the experience period. While it is still advisable for the most recent years to review estimated claim ratios from prior years on a trended and adjusted basis, many actuaries use significant judgment when selecting expected claim ratios. In our example, we select expected claim ratios of 75% for accident years 1998 through 2002 and 65% for accident years 2003 through 2007. We incorporate actuarial judgment by selecting two different claim ratios to reflect the change in experience that is apparent between the older accident years and the more recent accident years. (See Column (10) of Exhibit II, Sheet 1.)

In Exhibit II, Sheet 2, we calculate the estimated IBNR and the total unpaid claim estimate. Estimated IBNR in Column (6) is equal to the expected claims in Column (4) less reported claims in Column (2). We then calculate the total unpaid claim estimate as the difference between expected claims and paid claims or the sum of case outstanding plus IBNR. It is interesting to note that in this example the estimated IBNR is negative for accident years 2000, 2001, and 2003. While negative IBNR is possible, particularly for first-party lines of insurance that are subject to salvage and subrogation recoveries, it is not intuitively likely for U.S. Industry Auto. Remember that the key assumption of the expected claims method is that total claims are a function of an a priori estimate and not actual claims activity to date. At times this is a strength of the expected claims method and at times, such as in this example, it proves to be a weakness of the method.

The negative IBNR suggests that the selected a priori claim ratio may be too low for certain accident years. An alternative approach that avoids a negative IBNR is to use the 65% claim ratio assumption for only accident years 2005 through 2007 and to rely on the estimated claim ratios in Column (10) for all prior years (i.e., accident years 1998 through 2004). In other words, limit the use of the expected claims method to accident years 2005 through 2007. Since the expected claims unreported and unpaid for the older years are relatively low, the claim development methods are likely reliable projection methods. (Note, that for accident year 2004, the percentage of claim unreported at December 31, 2007 is only 2% and the percentage unpaid is 8%.)

XYZ Insurer

In Exhibit III, we present the expected claim ratio technique for XYZ Insurer. In the previous chapter, we point out the potential shortcomings of the claim development method for this particular insurer. The primary assumption of the development technique is that future claims will behave in a similar way as historical claims. Due to the various changes experienced by XYZ Insurer, this assumption does not likely hold true. We have several alternatives for consideration in selecting expected claim ratios for XYZ Insurer. First, we can turn to insurance industry experience for benchmark claim ratios. For this particular jurisdiction and coverage, we know that ultimate claim ratios for the aggregated experience of the insurance industry are approximately 50%. Since XYZ Insurer's undeveloped reported claim ratios (i.e., current value of reported claims prior to development divided by earned premiums) are greater than 70% for six of the seven earliest accident years in the experience period, the use of an industry claim ratio does not appear reasonable.

Another alternative is to use the unadjusted reported and paid claim development methods as a starting point. In Exhibit III, we use the reported and paid development methods to determine an initial estimate of ultimate claims. Columns (2) through (8) present these calculations. For accident years 1998 through 2003, which are the most mature years in the experience period, we select the expected claim ratio based on the average of the estimated claim ratios in Column (10).

For the most recent accident years, 2004 through 2008, we select the expected claim ratios in Exhibit III, Sheet 2. Columns (3) through (7) contain trend factors that adjust for inflation; we assume an annual claim trend rate of 3.425% (derived based on an annual frequency trend of -1.50% and an annual severity trend of 5.00%). We adjust the initial ultimate claims for each year in the experience period through the use of these factors to the cost level for each particular year under examination (i.e., 2004 through 2008). For example, the trend factor of 0.874, which appears at the bottom of Column (3), adjusts accident year 2008 claims to the inflation level expected in accident year 2004 ($1.03425^{(2004-2008)}$). Similarly, the trend factor of 1.070, which appears at the top of Column (3), adjusts accident year 2002 claims to the inflation level expected in accident year 2004 ($1.03425^{(2004-2002)}$).

We incorporate a second type of adjustment to ultimate claims through the tort reform adjustment factors in Columns (8) through (12). These factors adjust the ultimate claims of each accident year in the experience period to the tort environment of the particular accident year.

In addition to adjusting claims, we must adjust earned premiums for rate level changes. In Chapter 6, we summarize earned premiums and the historical rate level changes for XYZ Insurer. In Columns (14) through (18) we present the on-level factors that adjust the earned premiums summarized in Column (13) to the rate level for the particular accident year. In other words, this adjustment restates the premium as if the exposures were written at the rate level that was in effect for each particular year.

In Columns (19) through (23) we present trended and adjusted on-level claim ratios. These claim ratios equal the initial estimate of ultimate claims multiplied by the trend factors and the tort reform adjustment factors divided by the earned premiums adjusted to the appropriate rate level for each year. We examine various averages of the claim ratios by year and select expected claim ratios in Line (25) of Exhibit III, Sheet 2.

In Exhibit III, Sheet 1, expected claims in Column (12) are calculated as the product of selected expected claim ratios in Column (11) and the earned premium in Column (9). Estimated IBNR and estimated total unpaid claims are calculated in Exhibit III, Sheet 3. We compare the results of the expected claims method with the claim development method in Exhibit III, Sheet 4 (projected ultimate claims) and in Exhibit III, Sheet 5 (estimated IBNR).

In later chapters, we discuss other approaches for selecting expected claims for XYZ Insurer.

When the Expected Claims Technique Works and When it Does Not

As indicated previously, the expected claims method is often used when an insurer is entering a new line of business or a new territory. If actual historical claims experience is not available for the insurer, the actuary may be able to turn to insurance industry benchmarks for claim ratios, pure premiums, and claim development patterns. Actuaries also use the expected claims technique for the most recent years in the experience period when the cumulative claim development factors are highly leveraged.

In addition, the expected claims method is often relied upon when an insurer has experienced significant change either due to internal factors or external influences. For example, an insurer may decide to use an expected claim ratio method for the latest year in the experience period after major changes in the legal environment. An increase in the statute of limitations for filing claims or expanded coverage due to recent court decisions are examples of changes in the legal environment that can affect insurers' claims liabilities. Of course an important assumption in using the expected claim ratio method is that the actuary can estimate a reliable value of the expected claim ratio that takes into account such a changing legal environment for the insurance coverage.

Since actual claims do not enter into the calculations, the expected claims technique has the advantage of maintaining stability over time. The ultimate claims estimate does not change unless the exposures or claim ratio (or pure premium) assumptions change. While there is a potential advantage in the stability of the projections, there is a potential disadvantage in a lack of responsiveness to recent experience. Because, the technique ignores actual claims experience as reported, the method is not responsive when the actual claims experience differs from the initial expectations. This is evident in the U.S. Industry Auto example presented earlier in this chapter.

There are times, however, when the actuary will judgmentally adjust the claim ratios based on historical experience due to a belief that either the pricing or underwriting or both are changing. In such a situation, the actuary may be able to adjust the a priori expectation in advance of changes being fully manifest in the data. In this circumstance, the expected claims method could prove to be more responsive than data-dependent methods.

Influence of a Changing Environment on the Expected Claims Technique

In the prior chapter on the development technique, we discuss the performance of the development method during times of change. In this section, we continue with these examples using the expected claims technique.

Scenario 1 – U.S. PP Auto Steady-State Environment

In the example for Scenario 1, we assume that the expected claim ratio is equal to 70%, which is the same as the ultimate claim ratio. Thus, the expected claims technique generates an appropriate estimate of IBNR in a steady-state environment. This is also true of the development technique in a steady-state environment. We present detailed calculations for this scenario in the top section of Exhibit IV, Sheet 1.

Scenario 2 – U.S. PP Auto Increasing Claim Ratios

A weakness of the expected claims method is its lack of responsiveness to actual claims experience. The projected value of ultimate claims will only change if the actuary changes the expected claim ratio assumption. Thus, in Scenario 2, unless the actuary changes the 70% expected claim ratio assumption, the projected ultimate claims will be unchanged from Scenario 1. Since claims are increasing in Scenario 2, the estimated IBNR will be lower than the actual IBNR requirements if the actuary estimates unpaid claims using the expected claims method without a revision in the expected claim ratios. This example is particularly severe and it is highly unlikely that an actuary would proceed with this method without a significant change to the claim ratio.

One simple test to assess the adequacy of the expected claim ratio is to compare the reported claim ratio to date to the selected claim ratio. Such a comparison may have alerted the actuary to the fact that for accident years 2004 through 2008, the reported claim ratios are already greater than the expected claim ratio. This simple test would suggest a higher expected claim ratio for more recent accident years and avoid the negative values for IBNR seen in Column (6) of Exhibit IV, Sheet 1 (bottom section).

Scenario 3 – U.S. PP Auto Increasing Case Outstanding Strength

We present the calculations for Scenario 3 in the top section of Exhibit IV, Sheet 2. The expected claims method produces an accurate estimate of IBNR for this scenario. Changes in the adequacy of case outstanding have no effect on the expected claim ratio method since actual claims experience does not enter the calculation.

Scenario 4 – U.S. PP Auto Increasing Claim Ratios and Case Outstanding Strength

Similar to Scenario 2, IBNR based on the expected claims method for the scenario with increasing claim ratios and case outstanding strength falls short of the actual IBNR requirements, as shown in the bottom section of Exhibit IV, Sheet 2. The actual IBNR and the estimated IBNR differ by the same amount for Scenarios 2 and 4. Without a deliberate change in the expected claim ratio assumption, the expected claims method will not react appropriately to an environment of changing claim ratios.

U.S. Auto Steady-State (No Change in Product Mix)

In the top section of Exhibit V, we summarize the calculations for the example of a combined portfolio of private passenger and commercial automobile insurance with no change in product mix. We assume that we can estimate the expected claim ratio appropriately for the combined portfolio. This is much easier when the proportion of each of the two categories remains consistent over time. We demonstrate in Exhibit V, that the expected claims technique will generate the correct IBNR requirement in times of no change.

U.S. Auto Changing Product Mix

In the final example, we assume that the volume of commercial automobile insurance is increasing at a greater rate than that of private passenger automobile insurance. Since commercial automobile insurance has higher ultimate claim ratios, the actuary will need to modify the expected claim ratio assumption, which is critical to the expected claims technique. The bottom section of Exhibit V demonstrates that without a change in the expected claim ratio, the expected claims technique will produce an inadequate estimate of IBNR.

Accident Year	Claims at 12/31/08 Reported	Claims at 12/31/08 Paid	CDF to Ultimate Reported	CDF to Ultimate Paid	Projected Ultimate Claims Based on Reported	Projected Ultimate Claims Based on Paid	Initial Selected Ultimate Claims	On-Level Earned Premium	Trend at 14.5% to 7/1/08	Adjustment for Tort Reform	Trended Adj. Ultimate Claims	Trended Adjusted Claim Ratio
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
2000	10,000,000	9,500,000	1.005	1.050	10,050,000	9,975,000	10,012,500	24,000,000	2.954	0.670	19,816,540	83.0%
2001	8,000,000	7,200,000	1.020	1.150	8,160,000	8,280,000	8,220,000	18,000,000	2.580	0.670	14,209,092	79.0%
2002	9,400,000	7,600,000	1.030	1.250	9,682,000	9,500,000	9,591,000	19,000,000	2.253	0.670	14,477,710	76.0%
2003	15,600,000	7,800,000	1.100	1.350	17,160,000	10,530,000	13,845,000	23,000,000	1.968	0.670	18,255,463	79.0%
2004	16,500,000	11,200,000	1.200	1.750	19,800,000	19,600,000	19,700,000	32,000,000	1.719	0.750	25,398,225	79.0%
2005	18,500,000	10,200,000	1.400	2.500	25,900,000	25,500,000	25,700,000	47,000,000	1.501	1.000	38,575,700	82.0%
2006	16,500,000	6,000,000	1.800	5.000	29,700,000	30,000,000	29,850,000	50,000,000	1.311	1.000	39,133,350	78.0%
2007	14,000,000	3,000,000	2.900	15.000	40,600,000	45,000,000	42,800,000	57,000,000	1.145	1.000	49,006,000	86.0%
2008	8,700,000	750,000	4.000	90.000	34,800,000	67,500,000	51,150,000	62,000,000	1.000	1.000	51,150,000	83.0%

(14) Average Claim Ratio at 7/1/2008 Cost Level	
Average 2000 to 2005	79.7%
Average 2000 to 2005 Excluding High and Low	79.8%
Average 2001 to 2006	78.8%
Average 2001 to 2006 Excluding High and Low	78.8%
(15) Selected Claim Ratio at 7/1/2008 Cost Level	80.0%
(16) Expected Claims for 2008 Accident Year	49,600,000
(17) Unpaid Claim Estimate for 2008 Accident Year	
Total	48,850,000
IBNR	40,900,000

Column and Line Notes:
(2) and (3) Based on data provided by commercial insurer.
(4) and (5) Based on commercial insurer historical claim development experience.
(6) = [(2) x (4)].
(7) = [(3) x (5)].
(8) Based on average of paid and reported claim projections. (8) = [((6) + (7)) / 2].
(9) Based on data provided by commercial insurer.
(10) Assume 14.5% annual trend in private passenger auto bodily injury liability claims. Trend from midpoint of accident year to 7/1/08.
(11) Adjusts for law reforms in private passenger auto implemented during experience period.
(12) = [(8) x (10) x (11)].
(13) = [(12) / (9)].
(14) Various averages of claim ratios in (13).
(15) Selected based on claim ratios by year in (13) and various averages in (14).
(16) Based on selected claim ratio at 2008 cost level and accident year 2008 earned premiums. (16) = [(15) x (9) for 2008].
(17) Total unpaid claim estimate is equal to expected claims in (16) less paid claims for 2008. IBNR is equal to expected claims in (16) less reported claims for 2008.

Accident Year	Claims at 12/31/08 Reported	Claims at 12/31/08 Paid	CDF to Ultimate Reported	CDF to Ultimate Paid	Projected Ultimate Claims Based on Reported	Projected Ultimate Claims Based on Paid	Initial Selected Ultimate Claims	Population	Trend at 7.5% to 7/1/08	Trended Ultimate Claims	Trended Pure Premium
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1998	900,000	890,000	1.015	1.046	913,500	930,940	922,220	709,000	2.061	1,900,695	2.68
1999	1,200,000	1,170,000	1.020	1.067	1,224,000	1,248,390	1,236,195	724,000	1.917	2,369,786	3.27
2000	1,300,000	1,265,000	1.030	1.109	1,339,000	1,402,885	1,370,943	736,000	1.783	2,444,390	3.32
2001	1,800,000	1,600,000	1.051	1.187	1,891,800	1,899,200	1,895,500	740,000	1.659	3,144,635	4.25
2002	1,450,000	1,200,000	1.077	1.306	1,561,650	1,567,200	1,564,425	750,000	1.543	2,413,908	3.22
2003	1,400,000	1,050,000	1.131	1.489	1,583,400	1,563,450	1,573,425	760,000	1.436	2,259,438	2.97
2004	2,400,000	900,000	1.244	1.749	2,985,600	1,574,100	2,279,850	770,000	1.335	3,043,600	3.95
2005	1,800,000	860,000	1.394	2.274	2,509,200	1,955,640	2,232,420	775,000	1.242	2,772,666	3.58
2006	1,500,000	525,000	1.616	3.183	2,424,000	1,671,075	2,047,538	780,000	1.156	2,366,953	3.03
2007	1,200,000	750,000	1.940	5.093	2,328,000	3,819,750	3,073,875	785,000	1.075	3,304,416	4.21
2008	600,000	170,000	3.104	20.373	1,862,400	3,463,410	2,662,905	790,000	1.000	2,662,905	3.37

(13) Average Pure Premium at 7/1/2008 Cost Level	
Average 2000 to 2005	3.55
Average 2000 to 2005 Excluding High and Low	3.52
Average 2001 to 2006	3.50
Average 2001 to 2006 Excluding High and Low	3.45
(14) Selected Pure Premium at 7/1/2008 Cost Level	3.50
(15) Expected Claims for 2008 Accident Year	2,765,000
(16) Unpaid Claim Estimate for 2008 Accident Year	
Total	2,595,000
IBNR	2,165,000

<u>Column and Line Notes:</u>
(2) and (3) Based on data provided by public entity.
(4) and (5) Based on insurance industry benchmark claim development patterns.
(6) = [(2) x (4)].
(7) = [(3) x (5)].
(8) Based on average of paid and reported claim projections. (8) = [((6) + (7)) / 2].
(9) Based on data provided by public entity.
(10) Assume 7.5% annual trend in general liability claims. Trend from midpoint of accident year to 7/1/08.
(11) = [(8) x (10)].
(12) Pure premium based on population. (12) = [(11) / (9)].
(13) Various averages of pure premium in (12).
(14) Selected based on pure premium by year in (12) and various averages in (13).
(15) Based on selected pure premium at 2008 cost level and accident year 2008 population. (15) = [(14) x (9) for 2008].
(16) Total unpaid claim estimate is equal to expected claims in (15) less paid claims for 2008. IBNR is equal to expected claims in (15) less reported claims for 2008.

Accident Year	Claims at 12/31/07 Reported	Claims at 12/31/07 Paid	CDF to Ultimate Reported	CDF to Ultimate Paid	Projected Ultimate Claims Using Dev. Method with Reported	Projected Ultimate Claims Using Dev. Method with Paid	Initial Selected Ultimate Claims	Earned Premium	Claim Ratio Estimated	Claim Ratio Selected	Expected Claims
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1998	47,742,304	47,644,187	1.000	1.002	47,742,304	47,739,475	47,740,890	68,574,209	69.6%	75.0%	51,430,657
1999	51,185,767	51,000,534	1.000	1.004	51,185,767	51,204,536	51,195,152	68,544,981	74.7%	75.0%	51,408,736
2000	54,837,929	54,533,225	1.001	1.006	54,892,767	54,860,424	54,876,596	68,907,977	79.6%	75.0%	51,680,983
2001	56,299,562	55,878,421	1.003	1.011	56,468,461	56,493,084	56,480,772	72,544,955	77.9%	75.0%	54,408,716
2002	58,592,712	57,807,215	1.006	1.020	58,944,268	58,963,359	58,953,814	79,228,887	74.4%	75.0%	59,421,665
2003	57,565,344	55,930,654	1.011	1.040	58,198,563	58,167,880	58,183,221	86,643,542	67.2%	65.0%	56,318,302
2004	56,976,657	53,774,672	1.023	1.085	58,287,120	58,345,519	58,316,320	91,763,523	63.6%	65.0%	59,646,290
2005	56,786,410	50,644,994	1.051	1.184	59,682,517	59,963,673	59,823,095	94,115,312	63.6%	65.0%	61,174,953
2006	54,641,339	43,606,497	1.110	1.404	60,651,886	61,223,522	60,937,704	95,272,279	64.0%	65.0%	61,926,981
2007	48,853,563	27,229,969	1.292	2.390	63,118,803	65,079,626	64,099,215	95,176,240	67.3%	65.0%	61,864,556

Column and Line Notes:
(2) and (3) Based on Best's Aggregates & Averages U.S. private passenger automobile experience.
(4) and (5) Developed in Chapter 7, Exhibit I, Sheets 1 and 2.
(6) = [(2) x (4)].
(7) = [(3) x (5)].
(8) Based on average of paid and reported claim projections. (8) = [((6) + (7)) / 2].
(9) Based on Best's Aggregates & Averages U.S. private passenger automobile experience.
(10) = [(8) / (9)].
(11) Selected judgmentally based on experience in (10).
(12) = [(9) x (11)].

Chapter 8 - Expected Claims Technique
U.S. Industry Auto
Development of Unpaid Claim Estimate ($000)

Exhibit II
Sheet 2

Accident Year	Claims at 12/31/07 Reported	Claims at 12/31/07 Paid	Expected Claims	Case Outstanding at 12/31/07	Unpaid Claim Estimate Based on Expected Claims Method IBNR	Unpaid Claim Estimate Based on Expected Claims Method Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1998	47,742,304	47,644,187	51,430,657	98,117	3,688,353	3,786,470
1999	51,185,767	51,000,534	51,408,736	185,233	222,969	408,202
2000	54,837,929	54,533,225	51,680,983	304,704	- 3,156,946	- 2,852,242
2001	56,299,562	55,878,421	54,408,716	421,141	- 1,890,846	- 1,469,705
2002	58,592,712	57,807,215	59,421,665	785,497	828,953	1,614,450
2003	57,565,344	55,930,654	56,318,302	1,634,690	- 1,247,042	387,648
2004	56,976,657	53,774,672	59,646,290	3,201,985	2,669,633	5,871,618
2005	56,786,410	50,644,994	61,174,953	6,141,416	4,388,543	10,529,959
2006	54,641,339	43,606,497	61,926,981	11,034,842	7,285,642	18,320,484
2007	48,853,563	27,229,969	61,864,556	21,623,594	13,010,993	34,634,587
Total	543,481,587	498,050,368	569,281,839	45,431,219	25,800,252	71,231,471

Column Notes:
(2) and (3) Based on Best's Aggregates & Averages U.S. private passenger automobile experience.
(4) Developed in Exhibit II, Sheet 1.
(5) = [(2) - (3)].
(6) = [(4) - (2)].
(7) = [(4) - (3)].

Chapter 8 - Expected Claims Technique Exhibit IV
Impact of Changing Conditions Sheet 1
U.S. PP Auto - Development of Unpaid Claim Estimate

Accident Year	Earned Premium	Expected Claim Ratio	Expected Claims	Reported Claims at 12/31/08	Estimated IBNR	Actual IBNR	Difference from Actual IBNR
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Steady-State							
1999	1,000,000	70.0%	700,000	700,000	0	0	0
2000	1,050,000	70.0%	735,000	735,000	0	0	0
2001	1,102,500	70.0%	771,750	771,750	0	0	0
2002	1,157,625	70.0%	810,338	810,338	0	0	0
2003	1,215,506	70.0%	850,854	842,346	8,509	8,509	0
2004	1,276,282	70.0%	893,397	884,463	8,934	8,934	0
2005	1,340,096	70.0%	938,067	919,306	18,761	18,761	0
2006	1,407,100	70.0%	984,970	935,722	49,249	49,249	0
2007	1,477,455	70.0%	1,034,219	930,797	103,422	103,422	0
2008	1,551,328	70.0%	1,085,930	836,166	249,764	249,764	0
Total	12,577,893		8,804,525	8,365,887	438,638	438,638	0
Increasing Claim Ratios							
1999	1,000,000	70.0%	700,000	700,000	0	0	0
2000	1,050,000	70.0%	735,000	735,000	0	0	0
2001	1,102,500	70.0%	771,750	771,750	0	0	0
2002	1,157,625	70.0%	810,338	810,338	0	0	0
2003	1,215,506	70.0%	850,854	842,346	8,509	8,509	0
2004	1,276,282	70.0%	893,397	1,010,815	- 117,418	10,210	127,628
2005	1,340,096	70.0%	938,067	1,116,300	- 178,233	22,782	201,014
2006	1,407,100	70.0%	984,970	1,203,071	- 218,101	63,320	281,420
2007	1,477,455	70.0%	1,034,219	1,263,224	- 229,006	140,358	369,364
2008	1,551,328	70.0%	1,085,930	1,194,523	- 108,593	356,805	465,398
Total	12,577,893		8,804,525	9,647,366	- 842,841	601,984	1,444,824

Column Notes:
(2) Assume $1,000,000 for first year in experience period (1999) and 5% annual increase thereafter.
(3) Assumed equal to 70% for all years.
(4) = [(2) x (3)].
(5) From last diagonal of reported claim triangles presented in Chapter 7, Exhibit III, Sheets 2 and 4.
(6) = [(4) - (5)].
(7) Developed in Chapter 7, Exhibit III, Sheet 1.
(8) = [(7) - (6)].

Chapter 8 - Expected Claims Technique
Impact of Changing Conditions
U.S. PP Auto - Development of Unpaid Claim Estimate

Exhibit IV
Sheet 2

Accident Year	Earned Premium	Expected Claim Ratio	Expected Claims	Reported Claims at 12/31/08	Estimated IBNR	Actual IBNR	Difference from Actual IBNR
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Increasing Case Outstanding Strength							
1999	1,000,000	70.0%	700,000	700,000	0	0	0
2000	1,050,000	70.0%	735,000	735,000	0	0	0
2001	1,102,500	70.0%	771,750	771,750	0	0	0
2002	1,157,625	70.0%	810,338	810,338	0	0	0
2003	1,215,506	70.0%	850,854	842,346	8,509	8,509	0
2004	1,276,282	70.0%	893,397	884,463	8,934	8,934	0
2005	1,340,096	70.0%	938,067	933,377	4,690	4,690	0
2006	1,407,100	70.0%	984,970	962,808	22,162	22,162	0
2007	1,477,455	70.0%	1,034,219	979,922	54,296	54,296	0
2008	1,551,328	70.0%	1,085,930	931,185	154,745	154,745	0
Total	12,577,893		8,804,525	8,551,189	253,336	253,336	0
Increasing Claim Ratios and Case Outstanding Strength							
1999	1,000,000	70.0%	700,000	700,000	0	0	0
2000	1,050,000	70.0%	735,000	735,000	0	0	0
2001	1,102,500	70.0%	771,750	771,750	0	0	0
2002	1,157,625	70.0%	810,338	810,338	0	0	0
2003	1,215,506	70.0%	850,854	842,346	8,509	8,509	0
2004	1,276,282	70.0%	893,397	1,010,815	- 117,418	10,210	127,628
2005	1,340,096	70.0%	938,067	1,133,386	- 195,319	5,695	201,014
2006	1,407,100	70.0%	984,970	1,237,897	- 252,926	28,494	281,420
2007	1,477,455	70.0%	1,034,219	1,329,895	- 295,676	73,688	369,364
2008	1,551,328	70.0%	1,085,930	1,330,264	- 244,334	221,064	465,398
Total	12,577,893		8,804,525	9,901,689	- 1,097,165	347,660	1,444,824

<u>Column Notes:</u>
(2) Assume $1,000,000 for first year in experience period (1999) and 5% annual increase thereafter.
(3) Assumed equal to 70% for all years.
(4) = [(2) x (3)].
(5) From last diagonal of reported claim triangles presented in Chapter 7, Exhibit III, Sheets 6 and 8.
(6) = [(4) - (5)].
(7) Developed in Chapter 7, Exhibit III, Sheet 1.
(8) = [(7) - (6)].

Chapter 8 - Expected Claims Technique
Impact of Change in Product Mix Example
U.S. Auto - Development of Unpaid Claim Estimate

Exhibit V

Accident Year	Earned Premium	Expected Claim Ratio	Expected Claims	Reported Claims at 12/31/08	Estimated IBNR	Actual IBNR	Difference from Actual IBNR
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Steady-State (No Change in Product Mix)							
1999	2,000,000	75.0%	1,500,000	1,500,000	0	0	0
2000	2,100,000	75.0%	1,575,000	1,575,000	0	0	0
2001	2,205,000	75.0%	1,653,750	1,653,750	0	0	0
2002	2,315,250	75.0%	1,736,438	1,736,438	0	0	0
2003	2,431,013	75.0%	1,823,259	1,814,751	8,509	8,509	0
2004	2,552,563	75.0%	1,914,422	1,885,068	29,354	29,354	0
2005	2,680,191	75.0%	2,010,143	1,948,499	61,644	61,644	0
2006	2,814,201	75.0%	2,110,651	1,937,577	173,073	173,073	0
2007	2,954,911	75.0%	2,216,183	1,852,729	363,454	363,454	0
2008	3,102,656	75.0%	2,326,992	1,568,393	758,599	758,599	0
Total	25,155,785		18,866,839	17,472,204	1,394,634	1,394,634	0
Changing Product Mix							
1999	2,000,000	75.0%	1,500,000	1,500,000	0	0	0
2000	2,100,000	75.0%	1,575,000	1,575,000	0	0	0
2001	2,205,000	75.0%	1,653,750	1,653,750	0	0	0
2002	2,315,250	75.0%	1,736,438	1,736,438	0	0	0
2003	2,431,013	75.0%	1,823,259	1,814,751	8,509	8,509	0
2004	2,552,563	75.0%	1,914,422	1,885,068	29,354	29,354	0
2005	2,999,262	75.0%	2,249,446	2,193,545	55,901	71,855	15,954
2006	3,564,016	75.0%	2,673,012	2,471,446	201,566	239,057	37,491
2007	4,281,446	75.0%	3,211,085	2,680,487	530,597	596,924	66,327
2008	5,196,516	75.0%	3,897,387	2,556,695	1,340,692	1,445,385	104,693
Total	29,645,066		22,233,799	20,067,179	2,166,620	2,391,084	224,465

Column Notes:
(2) For no change scenario, assume $2,000,000 for first year in experience period (1999) and 5% annual increase thereafter. For change scenario, assume annual increase of 30% for commercial auto beginning in 2005.
(3) Assumed equal to 75% for all years.
(4) = [(2) x (3)].
(5) From last diagonal of reported claim triangles presented in Chapter 7, Exhibit IV, Sheets 2 and 4.
(6) = [(4) - (5)].
(7) Developed in Chapter 7, Exhibit IV, Sheet 1.
(8) = [(7) - (6)].

CHAPTER 9 – BORNHUETTER-FERGUSON TECHNIQUE

Actuaries rely on the Bornhuetter-Ferguson technique almost as often as they rely on the development method. The Bornhuetter-Ferguson technique is essentially a blend of the development and expected claims techniques. In the development technique, we multiply actual claims by a cumulative claim development factor. This technique can lead to erratic, unreliable projections when the cumulative development factor is large because a relatively small swing in reported claims or the reporting of an unusually large claim could result in a very large swing in projected ultimate claims. In the expected claims technique, the unpaid claim estimate is equal to the difference between a predetermined estimate of expected claims and the actual payments. This has the advantage of stability, but it completely ignores actual results as reported. The Bornhuetter-Ferguson technique combines the two techniques by splitting ultimate claims into two components: actual reported (or paid) claims and expected unreported (or unpaid) claims. As experience matures, more weight is given to the actual claims and the expected claims become gradually less important.

In the 1993 paper "Loss Development Using Credibility,"[53] Eric Brosius described the Bornhuetter-Ferguson method as a credibility weighting between the development method and the expected claims method. In the development method, full credibility (i.e., Z = 1) is given to actual claims experience; and in the expected claims method, no credibility (i.e., Z = 0) is given to actual claims. In the Bornhuetter-Ferguson, credibility is equal to the percentage of claims developed at a particular stage of maturity, which is a function of the cumulative claim development factor (i.e., Z = 1.00 / cumulative development factor). Therefore, more weight is given to the expected claims method in less mature years, and more weight is given to the development method in more mature years of the experience period.

Key Assumptions

The key assumption of the Bornhuetter-Ferguson method is that unreported (or unpaid) claims will develop based on expected claims. In other words, the claims reported to date contain no informational value as to the amount of claims yet-to-be reported. This is different from the development method where the primary assumption is that unreported (or unpaid) claims will develop based on reported (or paid) claims to date.

The reporting and payment patterns used in the Bornhuetter-Ferguson methods are the same as those selected in the development method. However, the application of the development factors differs between the two methods. It is also important to note that the expected claims used in the Bornhuetter-Ferguson method using reported claims are the same as those used in the Bornhuetter-Ferguson method using paid claims.

Common Uses of the Bornhuetter-Ferguson Technique

The Bornhuetter-Ferguson technique is most frequently applied to reported and paid claims, yet it can also be used with the number of claims and with ALAE. Actuaries use this technique with all lines of insurance including short-tail lines and long-tail lines. Similar to the development

[53] *CAS Study Note*, 1993

method, the Bornhuetter-Ferguson method is used with data organized in many different time intervals including:

- Accident year
- Policy year
- Underwriting year
- Report year
- Fiscal year

Actuaries also apply this technique to data organized by month, quarter, or half-year.

Mechanics of the Bornhuetter-Ferguson Technique

As indicated previously, the Bornhuetter-Ferguson technique is a blend of two other methods: the development method and the expected claims method. The following two formulae represent the reported and paid Bornhuetter-Ferguson methods, respectively:

Ultimate Claims = Actual Reported Claims + Expected Unreported Claims
Ultimate Claims = Actual Reported Claims + (Expected Claims) x (% Unreported)

Ultimate Claims = Actual Paid Claims + Expected Unpaid Claims
Ultimate Claims = Actual Paid Claims + (Expected Claims) x (% Unpaid)

Since actual reported and paid claims are both known quantities, the challenge of the Bornhuetter-Ferguson method is to calculate the expected unreported and expected unpaid claims. In order to complete the Bornhuetter-Ferguson method, the actuary must select claim development patterns and develop an expected claims estimate.

In our step-by-step example of the Bornhuetter-Ferguson method, we use the cumulative claim development patterns presented in Chapter 7 and the expected claims developed in Chapter 8.[54] In Exhibit I, Sheet 1, we present both the reported and paid Bornhuetter-Ferguson projections for U.S. Industry Auto.

The second column of Exhibit I, Sheet 1, contains the expected claims developed in Chapter 8 for U.S. Industry Auto. Columns (3) and (4) are the selected cumulative claim development factors described in Chapter 7. We convert the cumulative claim development patterns to percentage unreported and percentage unpaid in Columns (5) and (6), respectively. The percentage reported is equal to the inverse of the cumulative reported claim development factor. Thus, the percentage unreported is equal to 1.00 minus the inverse of the cumulative reported claim development factor. Similarly, the percentage paid is equal to the inverse of the cumulative paid claim

[54] Recall that expected claims are developed in Chapter 8 based on earned premiums and selected claim ratios. We discussed the importance of adjusting premiums to an on-level basis when selecting expected claim ratios. The purpose of adjusting premiums to an on-level basis is to develop a proxy for the underlying exposures in each year of the experience period. An alternative to the use of premiums and claim ratios for developing expected claims is exposures and pure premiums (also referred to as loss rates or loss costs). Many actuaries who work with self-insurers rely on such an approach. Due to enhancements in many insurers' data systems, historical exposures may become more readily available to actuaries and can thus be directly incorporated into the development of expected claims for the Bornhuetter-Ferguson technique.

development factor; and the percentage unpaid is equal to 1.00 minus the inverse of the cumulative paid claim development factor.

Once again, we summarize the selected claim development factors for reported and paid claims as well as the associated reporting and payment patterns in Table 1 below.

Table 1 – U.S. Industry Auto
Selected Reporting and Payment Patterns

	Reported Claims			Paid Claims		
Age (Month)	**CDF to Ultimate**	**% Reported**	**% Unreported**	**CDF to Ultimate**	**% Paid**	**% Unpaid**
12	1.292	77.4%	22.6%	2.390	41.8%	58.2%
24	1.110	90.1%	9.9%	1.404	71.2%	28.8%
36	1.051	95.1%	4.9%	1.184	84.5%	15.5%
48	1.023	97.8%	2.2%	1.085	92.2%	7.8%
60	1.011	98.9%	1.1%	1.040	96.2%	3.8%
72	1.006	99.4%	0.6%	1.020	98.0%	2.0%
84	1.003	99.7%	0.3%	1.011	98.9%	1.1%
96	1.001	99.9%	0.1%	1.006	99.4%	0.6%
108	1.000	100.0%	0.0%	1.004	99.6%	0.4%
120	1.000	100.0%	0.0%	1.002	99.8%	0.2%

The primary assumption of the reported Bornhuetter-Ferguson method is that unreported claims will emerge in accordance with expected claims. Thus, the next step of this method is to calculate the expected unreported claims. In Column (7), we calculate expected unreported claims by accident year. Expected unreported claims are equal to expected claims in Column (2) multiplied by the percentage unreported in Column (5) for each year. Similarly, expected unpaid claims in Column (8) are equal to expected claims from Column (2) multiplied by the percentage unpaid in Column (6).

Returning to our original formulae for the Bornhuetter-Ferguson method,

Ultimate Claims = Actual Reported Claims + Expected Unreported Claims

Ultimate Claims = Actual Paid Claims + Expected Unpaid Claims

We can now calculate the projected ultimate claims. Using the reported Bornhuetter-Ferguson method, projected ultimate claims in Column (11) are equal to the actual reported claims in Column (9) plus the expected unreported claims in Column (7). The projected ultimate claims based on the paid Bornhuetter-Ferguson method are shown in Column (12); they are equal to actual paid claims in Column (10) plus expected unpaid claims in Column (8).

Unpaid Claim Estimate Based on Bornhuetter-Ferguson Technique

We follow a similar procedure for determining the unpaid claim estimate based on the Bornhuetter-Ferguson technique (Exhibit I, Sheet 2) as presented in the prior chapters for the development and expected claims techniques. Estimated IBNR is equal to projected ultimate claims less reported claims[55] and the total unpaid claim estimate is equal to the difference between projected ultimate claims and paid claims.

Exhibit I, Sheet 2, presents the calculations of the unpaid claim estimate for U.S. Industry Auto. Columns (2) and (3) contain reported and paid claims data as of December 31, 2007. The projected ultimate claims, developed in Exhibit I, Sheet 1, are summarized in Columns (4) and (5). Case outstanding, which are equal to the difference between reported claims and paid claims as of December 31, 2007, are presented in Column (6). Estimated IBNR is equal to projected ultimate claims minus reported claims. In Columns (7) and (8), we calculate estimated IBNR based on the reported and paid Bornhuetter-Ferguson techniques, respectively. The total unpaid claim estimate is equal to the sum of case outstanding and estimated IBNR. We present the estimate of total unpaid claims in Columns (9) and (10) based on the reported and paid Bornhuetter-Ferguson techniques, respectively.

When the Bornhuetter-Ferguson Technique Works and When it Does Not

An advantage of the Bornhuetter-Ferguson technique is that random fluctuations early in the life of an accident year (or other defined time interval) do not significantly distort the projections. For example, if several large and unusual claims are reported for an accident year, then the reported claim development technique may produce overly conservative ultimate claims estimates. This situation does not, however, seriously distort the Bornhuetter-Ferguson technique.

Actuaries frequently use the Bornhuetter-Ferguson method for long-tail lines of insurance, particularly for the most immature years, due to the highly leveraged nature of claim development factors for such lines. Actuaries may also use the Bornhuetter-Ferguson technique if the data is extremely thin or volatile or both. For example, when an insurer has recently entered a new line of business or a new territory and there is not yet a credible volume of historical claim development experience, an actuary may use the Bornhuetter-Ferguson technique. In such circumstances, the actuary would likely need to rely on benchmarks, either from similar lines at the same insurer or insurance industry experience, for development patterns and expected claim ratios (or pure premiums). (See previous comments about the use of industry benchmarks.)

In a discussion of when to use the Bornhuetter-Ferguson method in the paper "The Actuary and IBNR," the authors state: "It can be argued that the most prudent course is, when in doubt, to use expected losses, in as much as it is certainly indicated for volatile lines, and in the case of a stable line, the expected loss ratio should be predictable enough so that both techniques produce the same result."[56]

The Bornhuetter-Ferguson technique can be a useful method for very short-tail lines as well as long-tail lines. For very short-tail lines, the IBNR can be set equal to a multiple of the last few months' earned premium; this is essentially an application of the Bornhuetter-Ferguson technique.

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[55] Recall that the formula for the reported Bornhuetter-Ferguson method is:

Ultimate Claims = Actual Reported Claims + Expected Unreported Claims

Thus, for the reported Bornhuetter-Ferguson projection, the expected unreported claims are equal to the estimated IBNR.

[56] *PCAS*, 1972.

The Bornhuetter-Ferguson Method and Cumulative CDFs Less than 1.00

Downward development (i.e., cumulative development factors that are less than 1.00) does occur for some insurers, for some lines of business. Automobile physical damage and property are examples of coverages in which actuaries can observe this type of development experience. For some insurers, salvage and subrogation recoveries lag the reporting and payment of claims, which can result in report-to-report factors that are less than 1.00. For some insurers, a conservative philosophy regarding case outstanding can also result in an observed downward development of reported claims as payments for claims may be less than the case outstanding set by claims adjusters. For those lines of business for which the actuary derives cumulative claim development factors that are less than 1.00, we revisit the original premise of the Bornhuetter-Ferguson method.

At the beginning of this chapter, we refer to Brosius' description of the Bornhuetter-Ferguson method as a credibility-weighting between the development method and the expected claims method. Credibility is concerned with the combination of the projections from these two methods. The basic formula for calculating the credibility-weighted projection is:

$$[(Z) \times (\text{development method})] + [(1 - Z) \times (\text{expected claims method})],$$

where,

$0 \leq Z \leq 1$,
Z is the credibility assigned to the development method, and
$(1 - Z)$ is the complement of credibility assigned to the expected claims method.

As noted earlier, the credibility is equal to the percentage of claims developed at a particular stage of maturity, which is a function of the cumulative claim development factor ($Z = 1.000$ / cumulative development factor).

From a theoretical perspective, the credibility-weighting approach of the Bornhuetter-Ferguson method does not hold true if the cumulative development factor is less than 1.00 since the value assigned to credibility, Z, is then greater than 1.00. For example, if the cumulative development factor is 0.93, then the credibility assigned to the development method is equal to 1.075 (1.00 / 0.93). However, as defined above, credibility must be a value between 0 and 1. Thus, a credibility value of 1.075 is outside of the acceptable range.

While cumulative development factors that are less than 1.00 present a theoretical issue for the use of the Bornhuetter-Ferguson method, in practice, many actuaries continue to use this method with such factors. One solution to address this theoretical challenge is to limit the cumulative development factors to a minimum value of 1.00 when applying the Bornhuetter-Ferguson technique. (We follow this approach for the examples in this text.) Alternatively, and what happens quite frequently in practice, is that the actuary will still calculate the reported Bornhuetter-Ferguson projected ultimate claims using cumulative development factors that are less than 1.00 but will rely on another technique to select ultimate claims for the year(s) in question (i.e., years with cumulative development factors less than 1.00). As noted previously in this chapter, actuaries frequently use the Bornhuetter-Ferguson method for long-tail lines of insurance, particularly for the most immature years. Cumulative development factors for these lines and years are typically much greater than 1.00. Nevertheless, it is worthwhile to note that some actuaries continue to include the Bornhuetter-Ferguson method as part of their analyses even in the presence of cumulative development factors that are less than 1.00.

XYZ Insurer

In Exhibit II, Sheets 1 and 2, we present the results of the reported and paid Bornhuetter-Ferguson methods based on the expected claims developed in Chapter 8 for XYZ Insurer. The presentation and calculations are identical to the previous example for U.S. Industry Auto (Exhibit I). We will not examine the results of this projection in detail because we know that the expected claims estimates underlying the projections are likely inaccurate. Remember that the primary assumption of the development method does not hold true for XYZ Insurer as a result of the operational and environmental changes that took place during the experience period. Nevertheless, we derive the current estimates of expected claims using unadjusted reported and paid claim development methods. We compare the results of the Bornhuetter-Ferguson method with the expected claims method and the development method in Exhibit II, Sheet 3 (projected ultimate claims) and in Exhibit II, Sheet 4 (estimated IBNR). In later chapters, we look at alternative methods that can be used for developing expected claims for use in a revised Bornhuetter-Ferguson method.

Influence of a Changing Environment on the Bornhuetter-Ferguson Method[57]

In Chapters 7 and 8, we discuss the performance of the development technique and the expected claims technique, respectively, during times of change. We continue with these examples using the Bornhuetter-Ferguson technique. Since the Bornhuetter-Ferguson method is a combination of the development method and the expected claims method, we will refer you to these prior chapters for critical input. For example, refer to Chapter 7 for the reported and paid claim development triangles and the selection of age-to-age factors, and refer to Chapter 8 for the calculation of expected claims.

Scenario 1 – U.S. PP Auto Steady-State

For Scenarios 1 through 4, we use an expected claim ratio of 70%. Since the steady-state environment also has a 70% ultimate claim ratio, the Bornhuetter-Ferguson technique generates an accurate estimate of IBNR. We see in Chapters 7 and 8, that the development and expected claims techniques also generate accurate IBNR values in a steady-state environment. Detailed calculations are presented for the Bornhuetter-Ferguson method in the top section of Exhibit III, Sheet 1.

[57] We present the following examples to demonstrate the effect of not changing assumptions on the resulting projections of ultimate claims and the estimate of unpaid claims. We recognize that the examples are not necessarily representative of real-life applications of the Bornhuetter-Ferguson method since we assume that there are no adjustments in expected claims in anticipation of the events that caused higher claim ratios or changes in business mix. Most insurers have a feel for whether a market is getting softer or harder, so they would have a sense as to the direction to adjust the expected claims, if not the absolute amount of adjustment. In addition, actuaries typically use the Bornhuetter-Ferguson technique where development data is sparse and erratic, which is exactly where the development approaches are very weak. Hence, we note that the PP Auto examples are biased against a Bornhuetter-Ferguson approach.

Scenario 2 – U.S. PP Auto Increasing Claim Ratios

The weakness of the expected claims method is also a weakness of the Bornhuetter-Ferguson method. Remember the original formulae for the reported and paid Bornhuetter-Ferguson method:

Ultimate Claims = Actual Reported Claims + Expected Unreported Claims

Ultimate Claims = Actual Paid Claims + Expected Unpaid Claims

While projected ultimate claims are increasing between Scenarios 1 and 2, the increases are due to higher values of actual reported and paid claims and not higher estimates of the expected unreported and unpaid claims. Since the expected claims estimate does not change in this example, the expected unreported and unpaid claims do not change in Scenario 2 from the steady-state values of Scenario 1.

For the reported Bornhuetter-Ferguson technique, the estimated IBNR is identical between the steady-state environment and the environment with increasing claim ratios. Without a deliberate change in the expected claim ratio, this method will not respond to a situation with increasing claim ratios. The paid Bornhuetter-Ferguson performs even worse than the reported Bornhuetter-Ferguson technique for Scenario 2. The estimate of expected unpaid claims is understated to an even greater degree than the expected unreported claims. This is due to the longer-term nature of the payment pattern than the reporting pattern, which implies that the percentage unpaid cannot be less than the percentage unreported at any age. (See Table 5 of Chapter 7, which summarizes the reporting and payment patterns.)

Scenario 3 – U.S. PP Auto Increasing Case Outstanding Strength

We present the calculations for Scenario 3 in the top section of Exhibit III, Sheet 2. The reported Bornhuetter-Ferguson technique produces an estimate of IBNR that is greater than the actual IBNR for this scenario. Similar to the paid claim development technique, the paid Bornhuetter-Ferguson method is unaffected by changes only in case outstanding strength.

In Chapter 7, we saw how increases in case outstanding strength led to increases in age-to-age factors and in cumulative claim development factors. The cumulative claim development factors are an important input to the Bornhuetter-Ferguson method. Thus, if the cumulative claim development factors are changing due to increases in case outstanding strength, it will also have an effect on the Bornhuetter-Ferguson projection. The expected claims, on the other hand, remain unchanged.

The estimated IBNR, in this scenario, based on the reported Bornhuetter-Ferguson method is greater than the actual IBNR requirement. However, the overstatement is less for the reported Bornhuetter-Ferguson method than for the reported claim development method because we did not increase the expected claims. In Chapter 7, we discuss how there are two forces that contribute to the excessive estimate of IBNR in the development technique. First, age-to-age factors increase due to the change in case outstanding adequacy. Second, we then multiply the resulting higher cumulative claim development factors by the latest valuation of reported claims, which contains higher reported values due to the increase in case outstanding strength. There is, in essence, a leveraging effect of higher factors and higher claims in the development technique. In the Bornhuetter-Ferguson method, the higher cumulative claim development factors result in greater percentages of expected unreported claims. However, the same leveraging effect does not exist since expected claims, not actual claims, are the basis for determining unreported claims in the Bornhuetter-Ferguson method, and the expected claims did not change in our example.

Scenario 4 – U.S. PP Auto Increasing Claim Ratios and Case Outstanding Strength

We present the detailed calculations for Scenario 4 in the bottom section of Exhibit III, Sheet 2. We see that the estimated IBNR based on the reported Bornhuetter-Ferguson method is overstated while the paid Bornhuetter-Ferguson projection is understated, absent a change in the expected claims assumption.

For both projections, the expected claims used in the example are too low. This is the reason that the paid Bornhuetter-Ferguson method produces an estimate of IBNR that is $443,260 lower than the actual IBNR. This is the same difference between estimated and actual IBNR that we saw in Scenario 2, where claim ratios increased and case outstanding strength remained stable. Since the payment pattern is unaffected by changes in case outstanding adequacy, there is no effect on the paid Bornhuetter-Ferguson method. The sole reason for the inadequacy of the paid Bornhuetter-Ferguson method is the understatement of expected claims.

In Scenario 2 (increasing claim ratios and stable case outstanding strength), we see that the reported Bornhuetter-Ferguson technique produces an estimated IBNR that is lower than the actual IBNR. In Scenario 3 (stable claim ratio and increasing case outstanding strength), the estimated IBNR based on the reported Bornhuetter-Ferguson method is too high. These two factors work in opposition in Scenario 4, in which both claim ratios and case outstanding strength are increasing. Even though expected claims are too low for Scenario 4, there is more than an offsetting effect from the higher cumulative development factors leading to an estimated IBNR for the reported Bornhuetter-Ferguson technique that is $112,773 higher than the actual IBNR.

In Scenario 4, with increasing claim ratios and case outstanding strengthening, the difference from the actual IBNR using the Bornhuetter-Ferguson method could be positive or negative depending on the extent of case outstanding strengthening and deteriorating claim ratio.

U.S. Auto Steady-State (No Change in Product Mix)

In the last two examples, we present the projections for a combined portfolio of private passenger and commercial automobile. In the top section of Exhibit IV, we summarize the calculations assuming a steady-state (i.e., no change in product mix). Similar to our projections using the claim development and expected claims techniques, we demonstrate in Exhibit IV, that the Bornhuetter-Ferguson technique will generate the correct IBNR requirement if there is no change in the product mix.

U.S. Auto Changing Product Mix

In the final example, we assume that the volume of commercial automobile insurance is increasing at a greater rate than that of private passenger automobile insurance. In the bottom section of Exhibit IV, we quickly observe that both the reported and paid Bornhuetter-Ferguson methods produce estimated IBNR that is lower than the actual IBNR. This is due to the expected claim ratio assumption that is unchanged from the U.S. Auto Steady-State.

Since the commercial automobile segment is growing at a greater rate than the private passenger auto segment, and since commercial automobile has a higher ultimate claim ratio, the actuary needs to modify the expected claim ratio assumption. Without such modification, the estimated IBNR from both the expected claims and the Bornhuetter-Ferguson methods proves inadequate. The reporting and payment patterns also require change. With an increasing proportion of commercial automobile, the reporting and payment patterns lengthen, and thus result in the requirement for a higher IBNR value.

Benktander Technique

An often-cited advantage of the Bornhuetter-Ferguson technique versus the development technique is stability in the presence of sparse data. However, since the estimate of unpaid claims for the most recent accident years using the Bornhuetter-Ferguson technique is heavily dependant on the actuary’s judgment when determining the expected claims, actual claims emergence for these years may be ignored to some extent.

The Benktander method, introduced in 1976, is a credibility-weighted average of the Bornhuetter-Ferguson technique and the development technique. The advantage cited by the authors is that this method will prove more responsive than the Bornhuetter-Ferguson technique and more stable than the development technique. (For further information on the development of the technique and underlying proofs of the methodology, see Thomas Mack’s 2000 *ASTIN Bulletin* paper “Credible Claims Reserves: The Benktander Method.”)

The Benktander method is often considered an iterative Bornhuetter-Ferguson method. The only difference in the two methods is the derivation of the expected claims. As we discuss in Chapter 8 – Expected Claims Technique, most insurers use an expected claim ratio and earned premium to determine expected claims and many self-insurers use pure premiums and exposures. Such expected claims become the input for the Bornhuetter-Ferguson technique. In the Benktander technique, the expected claims are the projected ultimate claims from an initial Bornhuetter-Ferguson projection – thus, the reference to the Benktander method as an iterative Bornhuetter-Ferguson method. It is interesting to note that the Benktander projection of ultimate claims will approach the projected ultimate claims produced by the development technique after sufficient iterations. (See Thomas Mack’s 2000 ASTIN paper for the detailed proof.)

In Exhibits V and VI, we present the Benktander technique using our six examples of changing environments. We follow the same exhibit format that was presented earlier in this chapter for the Bornhuetter-Ferguson technique. The only difference between the Bornhuetter-Ferguson projections in Exhibits III and IV and the Benktander projections in Exhibits V and VI are the expected claims. In the Bornhuetter-Ferguson projections, we derive the expected claims based on the initial expected claim ratio multiplied by the earned premium. In the Benktander projections, the expected claims are based on the Bornhuetter-Ferguson projections (from Exhibits III and IV).

In the following table, we summarize the differences from the true unpaid claims, in thousands of dollars, based on the Bornhuetter-Ferguson technique and the Benktander technique for the six examples related to changing environments.

Example Name	Difference from True IBNR ($000) Using			
	Bornhuetter-Ferguson Method		Benktander Method	
	Reported	Paid	Reported	Paid
U.S. PP Auto Steady-State	0	0	0	0
U.S. PP Auto Increasing Claim Ratios	163	443	29	196
U.S. PP Auto Increasing Case Outstanding Strength	-205	0	-239	0
U.S. PP Auto Increasing Claim Ratios and Case Outstanding Strength	-113	443	-300	196
U.S. Auto Steady-State	0	0	0	0
U.S. Auto Changing Product Mix	223	400	233	498

The Benktander technique is significantly more responsive to changes in the underlying claim ratio but is less responsive to changes in the case outstanding adequacy. The Benktander technique is also less responsive to changes in the product mix than the Bornhuetter-Ferguson technique.

Note that the Benktander method always gives greater credibility to the development technique. Thus, where there are no changes in the underlying claim development patterns, we expect the Benktander method to be more responsive than the Bornhuetter-Ferguson method. Where claim development patterns are changing, the Benktander method may not produce the most appropriate estimate as seen in the examples with changing case outstanding adequacy and changes in product mix. With the changing product mix, the Benktander method would have proven responsive to the changing claim ratio but not to the changes in the underlying development patterns.

Projection of Ultimate Claims Using Reported and Paid Claims ($000)

Accident	Expected	CDF to Ultimate		Percentage		Expected Claims		Claims at 12/31/07		Projected Ultimate Claims Using B-F Method with	
Year	Claims	Reported	Paid	Unreported	Unpaid	Unreported	Unpaid	Reported	Paid	Reported	Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1998	51,430,657	1.000	1.002	0.0%	0.2%	0	102,656	47,742,304	47,644,187	47,742,304	47,746,843
1999	51,408,736	1.000	1.004	0.0%	0.4%	0	204,816	51,185,767	51,000,534	51,185,767	51,205,350
2000	51,680,983	1.001	1.006	0.1%	0.6%	51,629	308,236	54,837,929	54,533,225	54,889,558	54,841,461
2001	54,408,716	1.003	1.011	0.3%	1.1%	162,738	591,984	56,299,562	55,878,421	56,462,300	56,470,405
2002	59,421,665	1.006	1.020	0.6%	2.0%	354,404	1,165,131	58,592,712	57,807,215	58,947,116	58,972,346
2003	56,318,302	1.011	1.040	1.1%	3.8%	612,761	2,166,089	57,565,344	55,930,654	58,178,105	58,096,743
2004	59,646,290	1.023	1.085	2.2%	7.8%	1,341,021	4,672,751	56,976,657	53,774,672	58,317,678	58,447,423
2005	61,174,953	1.051	1.184	4.9%	15.5%	2,968,528	9,506,918	56,786,410	50,644,994	59,754,938	60,151,912
2006	61,926,981	1.110	1.404	9.9%	28.8%	6,136,908	17,819,445	54,641,339	43,606,497	60,778,247	61,425,942
2007	61,864,556	1.292	2.390	22.6%	58.2%	13,981,773	35,979,805	48,853,563	27,229,969	62,835,336	63,209,774
Total	569,281,839					25,609,761	72,517,830	543,481,587	498,050,368	569,091,348	570,568,198

Column Notes:
(2) Developed in Chapter 8, Exhibit II, Sheet 1.
(3) and (4) Developed in Chapter 7, Exhibit I, Sheets 1 and 2.
(5) = [1.00 - (1.00 / (3))].
(6) = [1.00 - (1.00 / (4))].
(7) = [(2) x (5)].
(8) = [(2) x (6)].
(9) and (10) Based on Best's Aggregates & Averages U.S. private passenger automobile experience.
(11) = [(7) + (9)].
(12) = [(8) + (10)].

Chapter 9 - Bornhuetter-Ferguson Technique
U.S. Industry Auto
Development of Unpaid Claim Estimate ($000)

Accident Year	Claims at 12/31/07 Reported	Claims at 12/31/07 Paid	Projected Ultimate Claims Using B-F Method with Reported	Projected Ultimate Claims Using B-F Method with Paid	Case Outstanding at 12/31/07	Unpaid Claim Estimate at 12/31/07: IBNR - Based on B-F Method with Reported	IBNR - Based on B-F Method with Paid	Total - Based on B-F Method with Reported	Total - Based on B-F Method with Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1998	47,742,304	47,644,187	47,742,304	47,746,843	98,117	0	4,539	98,117	102,656
1999	51,185,767	51,000,534	51,185,767	51,205,350	185,233	0	19,583	185,233	204,816
2000	54,837,929	54,533,225	54,889,558	54,841,461	304,704	51,629	3,532	356,333	308,236
2001	56,299,562	55,878,421	56,462,300	56,470,405	421,141	162,738	170,843	583,879	591,984
2002	58,592,712	57,807,215	58,947,116	58,972,346	785,497	354,404	379,634	1,139,901	1,165,131
2003	57,565,344	55,930,654	58,178,105	58,096,743	1,634,690	612,761	531,399	2,247,451	2,166,089
2004	56,976,657	53,774,672	58,317,678	58,447,423	3,201,985	1,341,021	1,470,766	4,543,006	4,672,751
2005	56,786,410	50,644,994	59,754,938	60,151,912	6,141,416	2,968,528	3,365,502	9,109,944	9,506,918
2006	54,641,339	43,606,497	60,778,247	61,425,942	11,034,842	6,136,908	6,784,603	17,171,750	17,819,445
2007	48,853,563	27,229,969	62,835,336	63,209,774	21,623,594	13,981,773	14,356,211	35,605,367	35,979,805
Total	543,481,587	498,050,368	569,091,348	570,568,198	45,431,219	25,609,761	27,086,611	71,040,980	72,517,830

Column Notes:
(2) and (3) Based on Best's Aggregates & Averages U.S. private passenger automobile experience.
(4) and (5) Developed in Exhibit I, Sheet 1.
(6) = [(2) - (3)].
(7) = [(4) - (2)].
(8) = [(5) - (2)].
(9) = [(6) + (7)].
(10) = [(6) + (8)].

Chapter 9 - Bornhuetter-Ferguson Technique
Impact of Changing Conditions
U.S. PP Auto - Development of Unpaid Claim Estimate

Exhibit III
Sheet 1

Accident Year	Age of Accident Year at 12/31/08	Expected Claims	Claims at 12/31/08		CDF to Ultimate		Expected Percentage		Projected Ultimate Claims Using B-F Method with		Estimated IBNR Using B-F Method with		Actual IBNR	Diff from Actual IBNR Using B-F Method with	
			Reported	Paid	Reported	Paid	Unreported	Unpaid	Reported	Paid	Reported	Paid		Reported	Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Steady-State															
1999	120	700,000	700,000	700,000	1.000	1.000	0.0%	0.0%	700,000	700,000	0	0	0	0	0
2000	108	735,000	735,000	735,000	1.000	1.000	0.0%	0.0%	735,000	735,000	0	0	0	0	0
2001	96	771,750	771,750	764,033	1.000	1.010	0.0%	1.0%	771,750	771,750	0	0	0	0	0
2002	84	810,338	810,338	802,234	1.000	1.010	0.0%	1.0%	810,338	810,338	0	0	0	0	0
2003	72	850,854	842,346	833,837	1.010	1.020	1.0%	2.0%	850,854	850,854	8,509	8,509	8,509	0	0
2004	60	893,397	884,463	857,661	1.010	1.042	1.0%	4.0%	893,397	893,397	8,934	8,934	8,934	0	0
2005	48	938,067	919,306	863,022	1.020	1.087	2.0%	8.0%	938,067	938,067	18,761	18,761	18,761	0	0
2006	36	984,970	935,722	827,375	1.053	1.190	5.0%	16.0%	984,970	984,970	49,249	49,249	49,249	0	- 0
2007	24	1,034,219	930,797	734,295	1.111	1.408	10.0%	29.0%	1,034,219	1,034,219	103,422	103,422	103,422	0	0
2008	12	1,085,930	836,166	456,090	1.299	2.381	23.0%	58.0%	1,085,930	1,085,930	249,764	249,764	249,764	0	- 0
Total		8,804,525	8,365,887	7,573,548					8,804,525	8,804,525	438,638	438,638	438,638	0	0
Increasing Claim Ratios															
1999	120	700,000	700,000	700,000	1.000	1.000	0.0%	0.0%	700,000	700,000	0	0	0	0	0
2000	108	735,000	735,000	735,000	1.000	1.000	0.0%	0.0%	735,000	735,000	0	0	0	0	0
2001	96	771,750	771,750	764,033	1.000	1.010	0.0%	1.0%	771,750	771,750	0	0	0	0	0
2002	84	810,338	810,338	802,234	1.000	1.010	0.0%	1.0%	810,338	810,338	0	0	0	0	0
2003	72	850,854	842,346	833,837	1.010	1.020	1.0%	2.0%	850,854	850,854	8,509	8,509	8,509	0	0
2004	60	893,397	1,010,815	980,184	1.010	1.042	1.0%	4.0%	1,019,749	1,015,920	8,934	5,105	10,210	1,276	5,105
2005	48	938,067	1,116,300	1,047,955	1.020	1.087	2.0%	8.0%	1,135,061	1,123,000	18,761	6,700	22,782	4,020	16,081
2006	36	984,970	1,203,071	1,063,768	1.053	1.190	5.0%	16.0%	1,252,319	1,221,363	49,249	18,292	63,320	14,071	45,027
2007	24	1,034,219	1,263,224	996,544	1.111	1.408	10.0%	29.0%	1,366,646	1,296,467	103,422	33,243	140,358	36,936	107,116
2008	12	1,085,930	1,194,523	651,558	1.299	2.381	23.0%	58.0%	1,444,287	1,281,397	249,764	86,874	356,805	107,042	269,931
Total		8,804,525	9,647,366	8,575,112					10,086,004	9,806,090	438,638	158,724	601,984	163,346	443,260

Column Notes:
(2) Age of accident year at December 31, 2008.
(3) See Chapter 8, Exhibit IV, Sheet 1.
(4) and (5) From last diagonal of reported and paid claim triangles in Chapter 7, Exhibit III, Sheets 2 through 5.
(6) and (7) CDF based on 5-year simple average age-to-age factors presented in Chapter 7, Exhibit III, Sheets 2 through 5.
(8) = [1.00 - (1.00 / (6))].
(9) = [1.00 - (1.00 / (7))].
(10) = [((3) x (8)) + (4)].
(11) = [((3) x (9)) + (5)].
(12) = [(10) - (4)].
(13) = [(11) - (4)].
(14) Developed in Chapter 7, Exhibit III, Sheet 1.
(15) = [(14) - (12)].
(16) = [(14) - (13)].

Accident Year	Age of Accident Year at 12/31/08	Expected Claims	Claims at 12/31/08 Reported	Claims at 12/31/08 Paid	CDF to Ultimate Reported	CDF to Ultimate Paid	Expected Percentage Unreported	Expected Percentage Unpaid	Projected Ultimate Claims Using B-F Method with Reported	Projected Ultimate Claims Using B-F Method with Paid	Estimated IBNR Using B-F Method with Reported	Estimated IBNR Using B-F Method with Paid	Actual IBNR	Diff from Actual IBNR Using B-F Method with Reported	Diff from Actual IBNR Using B-F Method with Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Increasing Case Outstanding Strength															
1999	120	700,000	700,000	700,000	1.000	1.000	0.0%	0.0%	700,000	700,000	0	0	0	0	0
2000	108	735,000	735,000	735,000	1.000	1.000	0.0%	0.0%	735,000	735,000	0	0	0	0	0
2001	96	771,750	771,750	764,033	1.000	1.010	0.0%	1.0%	771,750	771,750	0	0	0	0	0
2002	84	810,338	810,338	802,234	1.000	1.010	0.0%	1.0%	810,338	810,338	0	0	0	0	0
2003	72	850,854	842,346	833,837	1.010	1.020	1.0%	2.0%	850,854	850,854	8,509	8,509	8,509	0	0
2004	60	893,397	884,463	857,661	1.010	1.042	1.0%	4.0%	893,397	893,397	8,934	8,934	8,934	0	0
2005	48	938,067	933,377	863,022	1.020	1.087	1.9%	8.0%	951,395	938,067	18,018	4,690	4,690	- 13,328	0
2006	36	984,970	962,808	827,375	1.055	1.190	5.2%	16.0%	1,013,733	984,970	50,925	22,162	22,162	- 28,763	- 0
2007	24	1,034,219	979,922	734,295	1.119	1.408	10.6%	29.0%	1,089,655	1,034,219	109,733	54,296	54,296	- 55,437	0
2008	12	1,085,930	931,185	456,090	1.318	2.381	24.1%	58.0%	1,193,385	1,085,930	262,200	154,745	154,745	- 107,455	- 0
Total		8,804,525	8,551,189	7,573,548					9,009,508	8,804,525	458,319	253,336	253,336	- 204,983	0
Increasing Claim Ratios and Case Outstanding Strength															
1999	120	700,000	700,000	700,000	1.000	1.000	0.0%	0.0%	700,000	700,000	0	0	0	0	0
2000	108	735,000	735,000	735,000	1.000	1.000	0.0%	0.0%	735,000	735,000	0	0	0	0	0
2001	96	771,750	771,750	764,033	1.000	1.010	0.0%	1.0%	771,750	771,750	0	0	0	0	0
2002	84	810,338	810,338	802,234	1.000	1.010	0.0%	1.0%	810,338	810,338	0	0	0	0	0
2003	72	850,854	842,346	833,837	1.010	1.020	1.0%	2.0%	850,854	850,854	8,509	8,509	8,509	0	0
2004	60	893,397	1,010,815	980,184	1.010	1.042	1.0%	4.0%	1,019,749	1,015,920	8,934	5,105	10,210	1,276	5,105
2005	48	938,067	1,133,386	1,047,955	1.019	1.087	1.9%	8.0%	1,151,324	1,123,000	17,938	- 10,386	5,695	- 12,243	16,081
2006	36	984,970	1,237,897	1,063,768	1.055	1.190	5.2%	16.0%	1,289,001	1,221,363	51,105	- 16,533	28,494	- 22,611	45,027
2007	24	1,034,219	1,329,895	996,544	1.120	1.408	10.7%	29.0%	1,440,327	1,296,467	110,432	- 33,427	73,688	- 36,744	107,116
2008	12	1,085,930	1,330,264	651,558	1.320	2.381	24.3%	58.0%	1,593,780	1,281,397	263,516	- 48,867	221,064	- 42,452	269,931
Total		8,804,525	9,901,689	8,575,112					10,362,123	9,806,090	460,434	- 95,600	347,660	- 112,773	443,260

Column Notes:
(2) Age of accident year at December 31, 2008.
(3) See Chapter 8, Exhibit IV, Sheet 2.
(4) and (5) From last diagonal of reported and paid claim triangles in Chapter 7, Exhibit III, Sheets 6 through 9.
(6) and (7) CDF based on 5-year simple average age-to-age factors presented in Chapter 7, Exhibit III, Sheets 6 through 9.
(8) = [1.00 - (1.00 / (6))].
(9) = [1.00 - (1.00 / (7))].
(10) = [((3) x (8)) + (4)].
(11) = [((3) x (9)) + (5)].
(12) = [(10) - (4)].
(13) = [(11) - (4)].
(14) Developed in Chapter 7, Exhibit III, Sheet 1.
(15) = [(14) - (12)].
(16) = [(14) - (13)].

Chapter 9 - Bornhuetter-Ferguson Technique
Impact of Change in Product Mix Example
U.S. Auto - Development of Unpaid Claim Estimate

Accident Year	Age of Accident Year at 12/31/08	Expected Claims	Claims at 12/31/08		CDF to Ultimate		Expected Percentage		Projected Ultimate Claims Using B-F Method with		Estimated IBNR Using B-F Method with		Actual IBNR	Diff from Actual IBNR Using B-F Method with	
			Reported	Paid	Reported	Paid	Unreported	Unpaid	Reported	Paid	Reported	Paid		Reported	Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Steady-State (No Change in Product Mix)															
1999	120	1,500,000	1,500,000	1,500,000	1.000	1.000	0.0%	0.0%	1,500,000	1,500,000	0	0	0	0	0
2000	108	1,575,000	1,575,000	1,566,600	1.000	1.005	0.0%	0.5%	1,575,000	1,575,000	0	0	0	0	0
2001	96	1,653,750	1,653,750	1,628,393	1.000	1.016	0.0%	1.5%	1,653,750	1,653,750	0	0	0	0	0
2002	84	1,736,438	1,736,438	1,700,551	1.000	1.021	0.0%	2.1%	1,736,438	1,736,438	0	0	0	0	0
2003	72	1,823,259	1,814,751	1,757,622	1.005	1.037	0.5%	3.6%	1,823,259	1,823,259	8,509	8,509	8,509	0	0
2004	60	1,914,422	1,885,068	1,786,794	1.016	1.071	1.5%	6.7%	1,914,422	1,914,422	29,354	29,354	29,354	0	0
2005	48	2,010,143	1,948,499	1,742,124	1.032	1.154	3.1%	13.3%	2,010,143	2,010,143	61,644	61,644	61,644	0	0
2006	36	2,110,651	1,937,577	1,581,581	1.089	1.335	8.2%	25.1%	2,110,651	2,110,651	173,073	173,073	173,073	0	0
2007	24	2,216,183	1,852,729	1,277,999	1.196	1.734	16.4%	42.3%	2,216,183	2,216,183	363,454	363,454	363,454	0	0
2008	12	2,326,992	1,568,393	729,124	1.484	3.191	32.6%	68.7%	2,326,992	2,326,992	758,599	758,599	758,599	0	0
Total		18,866,839	17,472,204	15,270,788					18,866,839	18,866,839	1,394,634	1,394,634	1,394,634	0	0
Changing Product Mix															
1999	120	1,500,000	1,500,000	1,500,000	1.000	1.000	0.0%	0.0%	1,500,000	1,500,000	0	0	0	0	0
2000	108	1,575,000	1,575,000	1,566,600	1.000	1.005	0.0%	0.5%	1,575,000	1,575,000	0	0	0	0	0
2001	96	1,653,750	1,653,750	1,628,393	1.000	1.016	0.0%	1.5%	1,653,750	1,653,750	0	0	0	0	0
2002	84	1,736,438	1,736,438	1,700,551	1.000	1.021	0.0%	2.1%	1,736,438	1,736,438	0	0	0	0	0
2003	72	1,823,259	1,814,751	1,757,622	1.005	1.037	0.5%	3.6%	1,823,259	1,823,259	8,509	8,509	8,509	0	0
2004	60	1,914,422	1,885,068	1,786,794	1.016	1.071	1.5%	6.7%	1,914,422	1,914,422	29,354	29,354	29,354	0	0
2005	48	2,249,446	2,193,545	1,951,435	1.032	1.154	3.1%	13.3%	2,262,528	2,251,361	68,983	57,816	71,855	2,872	14,039
2006	36	2,673,012	2,471,446	1,983,482	1.090	1.336	8.3%	25.2%	2,692,025	2,656,353	220,579	184,907	239,057	18,478	54,150
2007	24	3,211,085	2,680,487	1,766,164	1.200	1.750	16.7%	42.9%	3,216,658	3,142,865	536,171	462,378	596,924	60,753	134,547
2008	12	3,897,387	2,556,695	1,097,644	1.503	3.273	33.5%	69.4%	3,860,964	3,804,378	1,304,270	1,247,684	1,445,385	141,115	197,702
Total		22,233,799	20,067,179	16,738,684					22,235,045	22,057,826	2,167,866	1,990,647	2,391,084	223,219	400,438

Column Notes:
(2) Age of accident year at December 31, 2008.
(3) See Chapter 8, Exhibit V.
(4) and (5) From last diagonal of reported and paid claim triangles in Chapter 7, Exhibit IV, Sheets 2 through 5.
(6) and (7) CDF based on 5-year simple average age-to-age factors presented in Chapter 7, Exhibit IV, Sheets 2 through 5.
(8) = [1.00 - (1.00 / (6))].
(9) = [1.00 - (1.00 / (7))].
(10) = [((3) x (8)) + (4)].
(11) = [((3) x (9)) + (5)].
(12) = [(10) - (4)].
(13) = [(11) - (4)].
(14) Developed in Chapter 7, Exhibit IV, Sheet 1.
(15) = [(14) - (12)].
(16) = [(14) - (13)].

Accident	Age of Accident Year	Expected Ultimate Claims Using B-F Method with		Claims at 12/31/08		CDF to Ultimate		Expected Percentage		Projected Ultimate Claims Using G-B Method with		Estimated IBNR Using G-B Method with		Actual	Diff from Actual IBNR Using G-B Method with	
Year	at 12/31/08	Reported	Paid	Reported	Paid	Reported	Paid	Unreported	Unpaid	Reported	Paid	Reported	Paid	IBNR	Reported	Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Steady-State																
1999	120	700,000	700,000	700,000	700,000	1.000	1.000	0.0%	0.0%	700,000	700,000	0	0	0	0	0
2000	108	735,000	735,000	735,000	735,000	1.000	1.000	0.0%	0.0%	735,000	735,000	0	0	0	0	0
2001	96	771,750	771,750	771,750	764,033	1.000	1.010	0.0%	1.0%	771,750	771,750	0	0	0	0	0
2002	84	810,338	810,338	810,338	802,234	1.000	1.010	0.0%	1.0%	810,338	810,338	0	0	0	0	0
2003	72	850,854	850,854	842,346	833,837	1.010	1.020	1.0%	2.0%	850,854	850,854	8,509	8,509	8,509	0	0
2004	60	893,397	893,397	884,463	857,661	1.010	1.042	1.0%	4.0%	893,397	893,397	8,934	8,934	8,934	0	0
2005	48	938,067	938,067	919,306	863,022	1.020	1.087	2.0%	8.0%	938,067	938,067	18,761	18,761	18,761	0	0
2006	36	984,970	984,970	935,722	827,375	1.053	1.190	5.0%	16.0%	984,970	984,970	49,249	49,249	49,249	0	- 0
2007	24	1,034,219	1,034,219	930,797	734,295	1.111	1.408	10.0%	29.0%	1,034,219	1,034,219	103,422	103,422	103,422	0	0
2008	12	1,085,930	1,085,930	836,166	456,090	1.299	2.381	23.0%	58.0%	1,085,930	1,085,930	249,764	249,764	249,764	0	- 0
Total		8,804,525	8,804,525	8,365,887	7,573,548					8,804,525	8,804,525	438,638	438,638	438,638	0	- 0
Increasing Claim Ratios																
1999	120	700,000	700,000	700,000	700,000	1.000	1.000	0.0%	0.0%	700,000	700,000	0	0	0	0	0
2000	108	735,000	735,000	735,000	735,000	1.000	1.000	0.0%	0.0%	735,000	735,000	0	0	0	0	0
2001	96	771,750	771,750	771,750	764,033	1.000	1.010	0.0%	1.0%	771,750	771,750	0	0	0	0	0
2002	84	810,338	810,338	810,338	802,234	1.000	1.010	0.0%	1.0%	810,338	810,338	0	0	0	0	0
2003	72	850,854	850,854	842,346	833,837	1.010	1.020	1.0%	2.0%	850,854	850,854	8,509	8,509	8,509	0	0
2004	60	1,019,749	1,015,920	1,010,815	980,184	1.010	1.042	1.0%	4.0%	1,021,012	1,020,821	10,197	10,006	10,210	13	204
2005	48	1,135,061	1,123,000	1,116,300	1,047,955	1.020	1.087	2.0%	8.0%	1,139,001	1,137,795	22,701	21,495	22,782	80	1,286
2006	36	1,252,319	1,221,363	1,203,071	1,063,768	1.053	1.190	5.0%	16.0%	1,265,687	1,259,186	62,616	56,115	63,320	704	7,204
2007	24	1,366,646	1,296,467	1,263,224	996,544	1.111	1.408	10.0%	29.0%	1,399,889	1,372,519	136,665	109,295	140,358	3,694	31,064
2008	12	1,444,287	1,281,397	1,194,523	651,558	1.299	2.381	23.0%	58.0%	1,526,709	1,394,768	332,186	200,245	356,805	24,620	156,560
Total		10,086,004	9,806,090	9,647,366	8,575,112					10,220,240	10,053,031	572,874	405,665	601,984	29,110	196,319

Column Notes:
(2) Age of accident year at December 31, 2008.
(3) and (4) Developed in Exhibit III, Sheet 1.
(5) and (6) From last diagonal of reported and paid claim triangles in Chapter 7, Exhibit III, Sheets 2 through 5.
(7) and (8) CDF based on 5-year simple average age-to-age factors presented in Chapter 7, Exhibit III, Sheets 2 through 5.
(9) = [1.00 - (1.00 / (7))].
(10) = [1.00 - (1.00 / (8))].
(11) = [((3) x (9)) + (5)].
(12) = [((4) x (10)) + (6)].
(13) = [(11) - (5)].
(14) = [(12) - (5)].
(15) Developed in Chapter 7, Exhibit III, Sheet 1.
(16) = [(15) - (13)].
(17) = [(15) - (14)].

Accident Year	Age of Accident Year at 12/31/08	Expected Ultimate Claims Using B-F Method with Reported	Expected Ultimate Claims Using B-F Method with Paid	Claims at 12/31/08 Reported	Claims at 12/31/08 Paid	CDF to Ultimate Reported	CDF to Ultimate Paid	Expected Percentage Unreported	Expected Percentage Unpaid	Projected Ultimate Claims Using G-B Method with Reported	Projected Ultimate Claims Using G-B Method with Paid	Estimated IBNR Using G-B Method with Reported	Estimated IBNR Using G-B Method with Paid	Actual IBNR	Diff from Actual IBNR Using G-B Method with Reported	Diff from Actual IBNR Using G-B Method with Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Increasing Case Outstanding Strength																
1999	120	700,000	700,000	700,000	700,000	1.000	1.000	0.0%	0.0%	700,000	700,000	0	0	0	0	0
2000	108	735,000	735,000	735,000	735,000	1.000	1.000	0.0%	0.0%	735,000	735,000	0	0	0	0	0
2001	96	771,750	771,750	771,750	764,033	1.000	1.010	0.0%	1.0%	771,750	771,750	0	0	0	0	0
2002	84	810,338	810,338	810,338	802,234	1.000	1.010	0.0%	1.0%	810,338	810,338	0	0	0	0	0
2003	72	850,854	850,854	842,346	833,837	1.010	1.020	1.0%	2.0%	850,854	850,854	8,509	8,509	8,509	0	0
2004	60	893,397	893,397	884,463	857,661	1.010	1.042	1.0%	4.0%	893,397	893,397	8,934	8,934	8,934	0	0
2005	48	951,395	938,067	933,377	863,022	1.020	1.087	1.9%	8.0%	951,651	938,067	18,274	4,690	4,690	- 13,584	0
2006	36	1,013,733	984,970	962,808	827,375	1.055	1.190	5.2%	16.0%	1,015,221	984,970	52,412	22,162	22,162	- 30,250	- 0
2007	24	1,089,655	1,034,219	979,922	734,295	1.119	1.408	10.6%	29.0%	1,095,537	1,034,219	115,615	54,296	54,296	- 61,319	0
2008	12	1,193,385	1,085,930	931,185	456,090	1.318	2.381	24.1%	58.0%	1,219,330	1,085,930	288,146	154,745	154,745	- 133,401	- 0
Total		9,009,508	8,804,525	8,551,189	7,573,548					9,043,078	8,804,525	491,890	253,336	253,336	- 238,553	- 0
Increasing Claim Ratios and Case Outstanding Strength																
1999	120	700,000	700,000	700,000	700,000	1.000	1.000	0.0%	0.0%	700,000	700,000	0	0	0	0	0
2000	108	735,000	735,000	735,000	735,000	1.000	1.000	0.0%	0.0%	735,000	735,000	0	0	0	0	0
2001	96	771,750	771,750	771,750	764,033	1.000	1.010	0.0%	1.0%	771,750	771,750	0	0	0	0	0
2002	84	810,338	810,338	810,338	802,234	1.000	1.010	0.0%	1.0%	810,338	810,338	0	0	0	0	0
2003	72	850,854	850,854	842,346	833,837	1.010	1.020	1.0%	2.0%	850,854	850,854	8,509	8,509	8,509	0	0
2004	60	1,019,749	1,015,920	1,010,815	980,184	1.010	1.042	1.0%	4.0%	1,021,012	1,020,821	10,197	10,006	10,210	13	204
2005	48	1,151,324	1,123,000	1,133,386	1,047,955	1.019	1.087	1.9%	8.0%	1,155,402	1,137,795	22,016	4,409	5,695	- 16,321	1,286
2006	36	1,289,001	1,221,363	1,237,897	1,063,768	1.055	1.190	5.2%	16.0%	1,304,776	1,259,186	66,879	21,289	28,494	- 38,385	7,204
2007	24	1,440,327	1,296,467	1,329,895	996,544	1.120	1.408	10.7%	29.0%	1,483,691	1,372,519	153,796	42,625	73,688	- 80,108	31,064
2008	12	1,593,780	1,281,397	1,330,264	651,558	1.320	2.381	24.3%	58.0%	1,717,017	1,394,768	386,753	64,504	221,064	- 165,689	156,560
Total		10,362,123	9,806,090	9,901,689	8,575,112					10,549,840	10,053,031	648,150	151,342	347,660	- 300,490	196,319

Column Notes:
(2) Age of accident year at December 31, 2008.
(3) and (4) Developed in Exhibit III, Sheet 2.
(5) and (6) From last diagonal of reported and paid claim triangles in Chapter 7, Exhibit III, Sheets 6 through 9.
(7) and (8) CDF based on 5-year simple average age-to-age factors presented in Chapter 7, Exhibit III, Sheets 6 through 9.
(9) = [1.00 - (1.00 / (7))].
(10) = [1.00 - (1.00 / (8))].
(11) = [((3) x (9)) + (5)].
(12) = [((4) x (10)) + (6)].
(13) = [(11) - (5)].
(14) = [(12) - (5)].
(15) Developed in Chapter 7, Exhibit III, Sheet 1.
(16) = [(15) - (13)].
(17) = [(15) - (14)].

Chapter 9 - Bornhuetter-Ferguson Technique
Impact of Change in Product Mix Example
U.S. Auto - Development of Unpaid Claim Estimate Using Gunnar Benktander Method

Accident Year	Age of Accident Year at 12/31/08	Expected Ultimate Claims Using B-F Method with Reported	Expected Ultimate Claims Using B-F Method with Paid	Claims at 12/31/08 Reported	Claims at 12/31/08 Paid	CDF to Ultimate Reported	CDF to Ultimate Paid	Expected Percentage Unreported	Expected Percentage Unpaid	Projected Ultimate Claims Using G-B Method with Reported	Projected Ultimate Claims Using G-B Method with Paid	Estimated IBNR Using G-B Method with Reported	Estimated IBNR Using G-B Method with Paid	Actual IBNR	Diff from Actual IBNR Using G-B Method with Reported	Diff from Actual IBNR Using G-B Method with Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Steady-State (No Change in Product Mix)																
1999	120	1,500,000	1,500,000	1,500,000	1,500,000	1.000	1.000	0.0%	0.0%	1,500,000	1,500,000	0	0	0	0	0
2000	108	1,575,000	1,575,000	1,575,000	1,566,600	1.000	1.005	0.0%	0.5%	1,575,000	1,575,000	0	0	0	0	0
2001	96	1,653,750	1,653,750	1,653,750	1,628,393	1.000	1.016	0.0%	1.5%	1,653,750	1,653,750	0	0	0	0	0
2002	84	1,736,438	1,736,438	1,736,438	1,700,551	1.000	1.021	0.0%	2.1%	1,736,438	1,736,438	0	0	0	0	0
2003	72	1,823,259	1,823,259	1,814,751	1,757,622	1.005	1.037	0.5%	3.6%	1,823,259	1,823,259	8,509	8,509	8,509	0	0
2004	60	1,914,422	1,914,422	1,885,068	1,786,794	1.016	1.071	1.5%	6.7%	1,914,422	1,914,422	29,354	29,354	29,354	0	0
2005	48	2,010,143	2,010,143	1,948,499	1,742,124	1.032	1.154	3.1%	13.3%	2,010,143	2,010,143	61,644	61,644	61,644	0	0
2006	36	2,110,651	2,110,651	1,937,577	1,581,581	1.089	1.335	8.2%	25.1%	2,110,651	2,110,651	173,073	173,073	173,073	0	0
2007	24	2,216,183	2,216,183	1,852,729	1,277,999	1.196	1.734	16.4%	42.3%	2,216,183	2,216,183	363,454	363,454	363,454	0	0
2008	12	2,326,992	2,326,992	1,568,393	729,124	1.484	3.191	32.6%	68.7%	2,326,992	2,326,992	758,599	758,599	758,599	- 0	0
Total		18,866,839	18,866,839	17,472,204	15,270,788					18,866,839	18,866,839	1,394,634	1,394,634	1,394,634	0	0
Changing Product Mix																
1999	120	1,500,000	1,500,000	1,500,000	1,500,000	1.000	1.000	0.0%	0.0%	1,500,000	1,500,000	0	0	0	0	0
2000	108	1,575,000	1,575,000	1,575,000	1,566,600	1.000	1.005	0.0%	0.5%	1,575,000	1,575,000	0	0	0	0	0
2001	96	1,653,750	1,653,750	1,653,750	1,628,393	1.000	1.016	0.0%	1.5%	1,653,750	1,653,750	0	0	0	0	0
2002	84	1,736,438	1,736,438	1,736,438	1,700,551	1.000	1.021	0.0%	2.1%	1,736,438	1,736,438	0	0	0	0	0
2003	72	1,823,259	1,823,259	1,814,751	1,757,622	1.005	1.037	0.5%	3.6%	1,823,259	1,823,259	8,509	8,509	8,509	0	0
2004	60	1,914,422	1,914,422	1,885,068	1,786,794	1.016	1.071	1.5%	6.7%	1,914,422	1,914,422	29,354	29,354	29,354	0	0
2005	48	2,262,528	2,251,361	2,193,545	1,951,435	1.032	1.154	3.1%	13.3%	2,262,929	2,251,616	69,384	58,071	71,855	2,470	13,784
2006	36	2,692,025	2,656,353	2,471,446	1,983,482	1.090	1.336	8.3%	25.2%	2,693,594	2,652,159	222,148	180,713	239,057	16,909	58,344
2007	24	3,216,658	3,142,865	2,680,487	1,766,164	1.200	1.750	16.7%	42.9%	3,217,588	3,113,616	537,101	433,129	596,924	59,823	163,795
2008	12	3,860,964	3,804,378	2,556,695	1,097,644	1.503	3.273	33.5%	69.4%	3,848,776	3,739,784	1,292,081	1,183,089	1,445,385	153,304	262,296
Total		22,235,045	22,057,826	20,067,179	16,738,684					22,225,757	21,960,044	2,158,578	1,892,866	2,391,084	232,507	498,219

Column Notes:
(2) Age of accident year at December 31, 2008.
(3) and (4) Developed in Exhibit IV.
(5) and (6) From last diagonal of reported and paid claim triangles in Chapter 7, Exhibit IV, Sheets 2 through 5.
(7) and (8) CDF based on 5-year simple average age-to-age factors presented in Chapter 7, Exhibit IV, Sheets 2 through 5.
(9) = [1.00 - (1.00 / (7))].
(10) = [1.00 - (1.00 / (8))].
(11) = [((3) x (9)) + (5)].
(12) = [((4) x (10)) + (6)].
(13) = [(11) - (5)].
(14) = [(12) - (5)].
(15) Developed in Chapter 7, Exhibit IV, Sheet 1.
(16) = [(15) - (13)].
(17) = [(15) - (14)].

CHAPTER 10 – CAPE COD TECHNIQUE

The Cape Cod method, also known as the Stanard-Buhlmann method, is similar to the Bornhuetter-Ferguson technique. As in the Bornhuetter-Ferguson technique, the Cape Cod method splits ultimate claims into two components: actual reported (or paid) and expected unreported (or unpaid). As an accident year (or other time interval) matures, the actual reported claims replace the expected unreported claims and the initial expected claims assumption becomes gradually less important. The primary difference between the two methods is the derivation of the expected claim ratio. In the Cape Cod technique, the expected claim ratio is obtained from the reported claims experience instead of an independent and often judgmental selection as in the Bornhuetter-Ferguson technique.

Key Assumptions

The key assumption of the Cape Cod method is that unreported claims will develop based on expected claims, which are derived using reported (or paid) claims and earned premium. Both the Cape Cod and Bornhuetter-Ferguson methods differ from the development method where the primary assumption is that unreported claims will develop based on reported claims to date (not expected claims).

Common Uses of the Cape Cod Technique

Reinsurers are among the most frequent users of the Cape Cod technique. Actuaries generally use the Cape Cod method in a reported claims application, but they can also use it with paid claims. The technique is appropriate for all lines of insurance including short-tail lines and long-tail lines. Similar to the development and Bornhuetter-Ferguson methods, actuaries using the Cape Cod method can organize data in a variety of different time intervals:

- Accident year
- Policy year
- Underwriting year
- Report year
- Fiscal year

Actuaries can also apply this technique with monthly, quarterly, or semiannual data.

Mechanics of the Cape Cod Technique

Similar to the Bornhuetter-Ferguson technique, the Cape Cod method is a blend of two other methods: the claim development method and the expected claims method. We restate below the formula of the reported Bornhuetter-Ferguson method, which is the same as the Cape Cod method:

Ultimate Claims = Actual Reported Claims + Expected Unreported Claims

Again, the major difference between the Cape Cod technique and the Bornhuetter-Ferguson is the source of the expected claims. In "Reinsurance" Patrik states:

> The key innovation of the *SB* (Stanard-Buhlmann) Method is that the ultimate expected loss ratio for all years combined is estimated from the overall reported claims experience, instead of being selected judgmentally, as in the *BF* (Bornhuetter-Ferguson) Method. A problem with the *SB* Method is that the *IBNR* by year is highly dependent upon the rate level adjusted premium by year. The user must adjust each year's premium to reflect the rate level cycle on a relative basis. But this is also a problem with the *BF* Method.[58]

In our step-by step example of the Cape Cod method, we use the cumulative claim development patterns presented in Chapter 7. We begin in Exhibit I, Sheet 1, with the development of the estimated claim ratio. In our U.S. Industry Auto example, we do not have details of historical rate level changes. Thus, in both the Bornhuetter-Ferguson method and the Cape Cod method, we rely on unadjusted earned premium data.

In Column (2) of Exhibit I, Sheet 1, we summarize the unadjusted earned premiums by year. Column (3) contains the age of each accident year as of the latest valuation date, December 31, 2007. The reported claims in Column (4) are the latest diagonal in the reported claim development triangle presented in Chapter 7. We also derive the claim development factor to ultimate, Column (5), in Chapter 7. In Column (6), we show the reporting pattern. The percentage reported is equal to the inverse of the cumulative reported claim development factor.

A new concept of the Cape Cod method is the "used-up premium." The used-up premium is the denominator in our determination of the expected claim ratio. This allocation of premium represents the premium corresponding to the claims that are expected to be reported through the valuation date. The used-up premium in Column (7) is equal to the earned premium in Column (2) multiplied by the percentage of claims reported in Column (6). Reinsurers often use ultimate premiums in Column (2) instead of earned premium. In Column (8), we calculate estimated claim ratios, by accident year, by dividing actual reported claims from Column (4) by the used-up premium in Column (7). (An alternative to the use of premium and claim ratios is exposures and pure premiums. Instead of calculating used-up premium, the actuary could calculate used-up exposures and calculate estimated pure premiums instead of estimated claim ratios for each year in the experience period.)

In our U.S. Industry Auto example, we observe a change in the claim ratios for the latest accident years when compared with the earliest years (i.e., 1998 through 2002). The average estimated claim ratio for accident years 1998 through 2002 is 75.2%. For this period of time, the claim ratios vary from a low of 69.6% to a high of 79.7%. We contrast this with the more recent years' experience, which has an average claim ratio of 64.8%. For each year, 2003 through 2007, the estimated claim ratio is less than 67.5%. In the expected claims technique and the Bornhuetter-Ferguson technique, we rely on different claim ratios for the earlier years and the latest years in the experience period to best reflect our expectation of expected claims for each year. In contrast, the Cape Cod method requires the use of the weighted average claim ratio from all years. Thus, one can distinguish the mechanical approach of developing expected claims in the Cape Cod method from the Bornhuetter-Ferguson method in which actuarial judgment plays an important role in the development of the a priori expected claim estimate.

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[58] *Foundations of Casualty Actuarial Science*, 2001. We refer the reader to "Reinsurance" (Chapter 7) for Patrik's complete development of the formulae underlying the Cape Cod technique.

Unpaid Claim Estimate Based on Cape Cod Technique

We follow a similar procedure for determining the unpaid claim estimate based on the Cape Cod technique as presented in the prior chapters. Estimated IBNR is equal to projected ultimate claims less reported claims and the total unpaid claim estimate is equal to the difference between projected ultimate claims and paid claims.

Exhibit I, Sheet 3 displays the calculations for the estimated unpaid claims of U.S. Industry Auto. Columns (2) and (3) contain reported and paid claims data as of December 31, 2007. We summarize the projected ultimate claims from Exhibit I, Sheet 2 in Column (4). Case outstanding, which are equal to the difference between reported claims and paid claims as of December 31, 2007, are presented in Column (5). Estimated IBNR is equal to projected ultimate claims minus reported claims. We calculate the estimated IBNR based on the Cape Cod technique in Column (6). The total unpaid claim estimate (Column (7)) is equal to the sum of case outstanding and estimated IBNR.

When the Cape Cod Technique Works and When it Does Not

Similar comments apply to the Cape Cod method as to the Bornhuetter-Ferguson technique. The only difference between the two methods is the derivation of the expected claims. Thus, an advantage of the Cape Cod method, when compared to the development technique, is that it may not be distorted by random fluctuations early in the development of an accident year (or other time interval). A determining factor influencing the fluctuations, in either the Bornhuetter-Ferguson or Cape Cod methods, is the extent to which actual claims for the most recent years affect the derivation of expected claims for such years.

The Cape Cod method is not necessarily as appropriate as the Bornhuetter-Ferguson technique if the data is extremely thin or volatile or both. Since the expected claims are based on reported claims to date, there must be a sufficient volume of credible reported claims in order to derive a reliable expected claims estimate.

It is worthwhile to note that in an ideal situation, the actuary would have the history of rate level changes and would be able to adjust historical premiums to an on-level basis for both the Cape Cod and Bornhuetter-Ferguson projections. The actuary would also adjust claims for trend, benefit-level changes, and other similar factors. From a theoretical perspective, these methods require such adjustment. From a practical perspective, however, such information is often unavailable. In these situations, many actuaries continue to use both the Bornhuetter-Ferguson and Cape Cod methods for the purpose of developing the unpaid claim estimate without the adjustment of premiums or claims. Under such circumstances, it would be prudent for the actuary, when evaluating the results of various techniques and selecting final ultimate claims values, to take into consideration where simplifying assumptions (such as not adjusting premium for rate level changes) were required.

XYZ Insurer

In Exhibit II, Sheets 1 through 3, we use the Cape Cod technique for XYZ Insurer. There are weaknesses in this projection technique due to the uncertainty in the selected development patterns for reported claims. Due to the numerous changes the insurer has faced, we are uncertain as to the applicability of historical claim development patterns. Since the Cape Cod method uses claim development patterns to calculate the used-up premium, which is a critical component in the expected claim ratio determination, this method may not be appropriate for this example. (Similar to the Bornhuetter-Ferguson method, we limit the reported cumulative claim development factors to a minimum of 1.00 for the Cape Cod technique.)

We have detailed rate change information for XYZ Insurer as well as information regarding the effect of legal reform on the insurance product. We incorporate this information into the Cape Cod projection method presented in Exhibit II. The first adjustment is to restate earned premium for each accident year as if it were at the 2008 rate level. These calculations are contained within Columns (2) through (4) of Exhibit II, Sheet 1. In Columns (6) through (9), we adjust the current reported claims for the influences of inflation (through claims trend factors) and tort reform. Once we have on-level earned premium and adjusted claims, we proceed to calculate estimated claim ratios as described in the previous example for U.S. Industry Auto. We divide the adjusted claims by used-up, on-level premium to derive the claim ratios shown in Column (13). We use the label "Estimated Adjusted Claim Ratios" to indicate that the reported claims are adjusted for inflation and tort reform. We rely on the claim ratio for all years combined, 70.8%, from Column (13) (also shown in Column (14) for each year) as our starting point for developing estimated unadjusted claim ratios in Column (15). These claim ratios, which are adjusted back to the rate level, inflationary level, and tort environment for each accident year, become our starting point for projecting expected claims in Exhibit II, Sheet 2.

We follow the same format as the example for U.S. Industry Auto in Exhibit II, Sheets 2 and 3. We compare the results of the Cape Cod method with the Bornhuetter-Ferguson method, the expected claims method, and the claim development method in Exhibit II, Sheet 4 (projected ultimate claims) and in Exhibit II, Sheet 5 (estimated IBNR).

Influence of a Changing Environment on the Cape Cod Method[59]

In prior chapters, we discuss the performance of each of the estimation techniques during times of change. We continue these examples using the Cape Cod method.

Scenario 1 – U.S. PP Auto Steady-State

We see in Chapters 7 through 9 that the development technique, expected claims technique, and Bornhuetter-Ferguson techniques all generate an accurate IBNR value in a steady-state environment. It is not surprising to find that the Cape Cod method also generates the actual IBNR in a steady-state environment. The top section of Exhibit III, Sheets 1 and 3, contains detailed calculations for the Cape Cod method.

[59] We present the following examples to demonstrate the effect of not changing assumption on the resulting projections of ultimate claims and the estimate of unpaid claims. We recognize that the examples are not necessarily representative of real-life applications of the Cape Cod method since we assume that there are no adjustments in expected claims in anticipation of the events that caused higher claim ratios or changes in business mix. Most insurers have a feel for whether a market is getting softer or harder, so they would have a sense as to the direction to adjust the expected claims, if not the absolute amount of adjustment.

Scenario 2 – U.S. PP Auto Increasing Claim Ratios

Recall that the weakness of the expected claims method, which is the lack of responsiveness to actual emerging claims, is also a weakness of the Bornhuetter-Ferguson method. The Cape Cod method, which derives the expected claim ratio based on reported claims through the valuation date, does not have this same weakness. In Exhibit III, Sheet 1, we see that the estimated claim ratios in Column (8) respond to the changing environment in claims experience. The total all years combined estimated claim ratio is 80.7% for this scenario; this compares to the 70% expected claim ratio for the steady-state.

In the Bornhuetter-Ferguson reported claim projection, there is no change in the estimated IBNR of $438,638 between Scenario 1 and Scenario 2 since the expected claim ratio does not change. However, using the Cape Cod method, the estimated IBNR is $505,828 for Scenario 2. While this value is still short of the actual IBNR requirements of $601,984, the Cape Cod technique is more responsive than the Bornhuetter-Ferguson method when the claim ratios are increasing.

Scenario 3 – U.S. PP Auto Increasing Case Outstanding Strength

We present the calculations for Scenario 3 in the top section of Exhibit III, Sheets 2 and 4. In this example, we see that the Cape Cod method results in an estimated IBNR that overstates the actual IBNR by an even greater amount than the reported Bornhuetter-Ferguson technique. In the previous chapters, we discuss how the increase in case outstanding strength leads to an increase in the cumulative claim development factors. Whereas the expected claims for Scenario 3 of the Bornhuetter-Ferguson method remain unchanged, the expected claims increase using the Cape Cod method because the method reflects the higher level of reported claims. The projected ultimate claims are increasing for the Cape Cod method under Scenario 3 due to both increasing expected claims and higher claim development factors to ultimate.

Scenario 4 – U.S. PP Auto Increasing Claim Ratios and Case Outstanding Strength

In times of increasing claim ratios and increasing case outstanding strength, the Cape Cod method can overstate the actual IBNR. In this example, the method responds effectively to the change in claim ratios, however it overreacts to the change in case outstanding adequacy. In our example, the Cape Cod method significantly overstates the actual IBNR needed, indicating that the effect of increasing case outstanding strength exceeds the influence of increasing claim ratios. The estimated claim ratios are driven higher than their true values by the combined effects of both increasing claims and greater adequacy in case outstanding. We present the detailed calculations for Scenario 4 in the bottom section of Exhibit III, Sheets 2 and 4.

U.S. Auto Steady-State (No Change in Product Mix)

In the last two examples, we present projections for a combined portfolio of private passenger and commercial automobile. In the top section of Exhibit IV, Sheets 1 and 2, we summarize the calculations for the steady-state environment where there is no change in product mix. Similar to our projections using the development and expected claims techniques, we demonstrate in Exhibit IV, Sheet 2 that the Cape Cod technique generates the correct IBNR requirement when there is no change in the product mix.

U.S. Auto Changing Product Mix

In the final example, we assume that the volume of commercial automobile insurance is increasing at a greater rate than private passenger automobile insurance. In the bottom section of Exhibit IV, Sheet 2, we observe that the Cape Cod method produces estimated IBNR that is lower than the actual IBNR. Even though reported claims are increasing in this scenario when compared to the prior scenario, there are also changes in the reporting pattern. Thus, the Cape Cod method is not responding appropriately to the changing product mix. Detailed calculations are contained within the bottom section of Exhibit IV, Sheets 1 and 2.

Chapter 10 - Cape Cod Technique
U.S. Industry Auto
Development of Expected Claim Ratio

Exhibit I
Sheet 1

Accident Year	Earned Premium	Age of Accident Year at 12/31/07	Reported Claims at 12/31/07	Reported CDF to Ultimate	% of Ultimate Reported	Used Up Premium	Estimated Claim Ratios
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1998	68,574,209	120	47,742,304	1.000	100.0%	68,574,209	69.6%
1999	68,544,981	108	51,185,767	1.000	100.0%	68,544,981	74.7%
2000	68,907,977	96	54,837,929	1.001	99.9%	68,839,138	79.7%
2001	72,544,955	84	56,299,562	1.003	99.7%	72,327,971	77.8%
2002	79,228,887	72	58,592,712	1.006	99.4%	78,756,349	74.4%
2003	86,643,542	60	57,565,344	1.011	98.9%	85,700,833	67.2%
2004	91,763,523	48	56,976,657	1.023	97.8%	89,700,413	63.5%
2005	94,115,312	36	56,786,410	1.051	95.1%	89,548,346	63.4%
2006	95,272,279	24	54,641,339	1.110	90.1%	85,830,882	63.7%
2007	95,176,240	12	48,853,563	1.292	77.4%	73,665,820	66.3%
Total	820,771,905		543,481,587			781,488,943	69.5%

Column and Line Notes:
(2) Based on Best's Aggregates & Averages U.S. private passenger automobile experience.
(3) Age of accident year in (1) at December 31, 2007.
(4) Based on Best's Aggregates & Averages U.S. private passenger automobile experience.
(5) Developed in Chapter 7, Exhibit I, Sheet 1.
(6) = [1.00 / (5)].
(7) = [(2) x (6)].
(8) = [(4) / (7)].

Projection of Ultimate Claims Using Reported Claims ($000)

Accident Year	Earned Premium	Expected Claim Ratio	Estimated Expected Claims	Reported CDF to Ultimate	Percentage Unreported	Expected Unreported Claims	Reported Claims at 12/31/07	Projected Ultimate Claims
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1998	68,574,209	69.5%	47,689,504	1.000	0.0%	0	47,742,304	47,742,304
1999	68,544,981	69.5%	47,669,177	1.000	0.0%	0	51,185,767	51,185,767
2000	68,907,977	69.5%	47,921,621	1.001	0.1%	47,874	54,837,929	54,885,803
2001	72,544,955	69.5%	50,450,934	1.003	0.3%	150,900	56,299,562	56,450,462
2002	79,228,887	69.5%	55,099,233	1.006	0.6%	328,624	58,592,712	58,921,336
2003	86,643,542	69.5%	60,255,708	1.011	1.1%	655,601	57,565,344	58,220,945
2004	91,763,523	69.5%	63,816,367	1.023	2.2%	1,434,777	56,976,657	58,411,434
2005	94,115,312	69.5%	65,451,904	1.051	4.9%	3,176,068	56,786,410	59,962,478
2006	95,272,279	69.5%	66,256,509	1.110	9.9%	6,565,960	54,641,339	61,207,299
2007	95,176,240	69.5%	66,189,720	1.292	22.6%	14,959,286	48,853,563	63,812,849
Total	820,771,905		570,800,677			27,319,090	543,481,587	570,800,677

Column Notes:
(2) Based on Best's Aggregates & Averages U.S. private passenger automobile experience.
(3) Based on total weighted estimated claim ratios developed in Exhibit I, Sheet 1.
(4) = [(2) x (3)].
(5) Developed in Chapter 7, Exhibit I, Sheet 1.
(6) = [1.00 - (1.00 / (5))].
(7) = [(4) x (6)].
(8) Based on Best's Aggregates & Averages U.S. private passenger automobile experience.
(9) = [(7) + (8)].

Chapter 10 - Cape Cod Technique Exhibit I
U.S. Industry Auto Sheet 3
Development of Unpaid Claim Estimate ($000)

Accident Year	Claims at 12/31/07 Reported	Claims at 12/31/07 Paid	Projected Ultimate Claims	Case Outstanding at 12/31/07	Unpaid Claim Estimate Based on Cape Cod Method IBNR	Unpaid Claim Estimate Based on Cape Cod Method Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1998	47,742,304	47,644,187	47,742,304	98,117	0	98,117
1999	51,185,767	51,000,534	51,185,767	185,233	0	185,233
2000	54,837,929	54,533,225	54,885,803	304,704	47,874	352,578
2001	56,299,562	55,878,421	56,450,462	421,141	150,900	572,041
2002	58,592,712	57,807,215	58,921,336	785,497	328,624	1,114,121
2003	57,565,344	55,930,654	58,220,945	1,634,690	655,601	2,290,291
2004	56,976,657	53,774,672	58,411,434	3,201,985	1,434,777	4,636,762
2005	56,786,410	50,644,994	59,962,478	6,141,416	3,176,068	9,317,484
2006	54,641,339	43,606,497	61,207,299	11,034,842	6,565,960	17,600,802
2007	48,853,563	27,229,969	63,812,849	21,623,594	14,959,286	36,582,880
Total	543,481,587	498,050,368	570,800,677	45,431,219	27,319,090	72,750,309

Column Notes:
(2) and (3) Based on Best's Aggregates & Averages U.S. private passenger automobile experience.
(4) Developed in Exhibit I, Sheet 2.
(5) = [(2) - (3)].
(6) = [(4) - (2)].
(7) = [(5) + (6)].

Scenarios 1 and 2 - Development of Expected Claim Ratio

Accident Year	Earned Premium	Age of Accident Year at 12/31/08	Reported Claims at 12/31/08	Reported CDF to Ultimate	% of Ultimate Reported	Used Up Premium	Estimated Claim Ratios
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Steady-State							
1999	1,000,000	120	700,000	1.000	100.0%	1,000,000	70.0%
2000	1,050,000	108	735,000	1.000	100.0%	1,050,000	70.0%
2001	1,102,500	96	771,750	1.000	100.0%	1,102,500	70.0%
2002	1,157,625	84	810,338	1.000	100.0%	1,157,625	70.0%
2003	1,215,506	72	842,346	1.010	99.0%	1,203,351	70.0%
2004	1,276,282	60	884,463	1.010	99.0%	1,263,519	70.0%
2005	1,340,096	48	919,306	1.020	98.0%	1,313,294	70.0%
2006	1,407,100	36	935,722	1.053	95.0%	1,336,745	70.0%
2007	1,477,455	24	930,797	1.111	90.0%	1,329,710	70.0%
2008	1,551,328	12	836,166	1.299	77.0%	1,194,523	70.0%
Total	12,577,893		8,365,887			11,951,267	70.0%
Increasing Claim Ratios							
1999	1,000,000	120	700,000	1.000	100.0%	1,000,000	70.0%
2000	1,050,000	108	735,000	1.000	100.0%	1,050,000	70.0%
2001	1,102,500	96	771,750	1.000	100.0%	1,102,500	70.0%
2002	1,157,625	84	810,338	1.000	100.0%	1,157,625	70.0%
2003	1,215,506	72	842,346	1.010	99.0%	1,203,351	70.0%
2004	1,276,282	60	1,010,815	1.010	99.0%	1,263,519	80.0%
2005	1,340,096	48	1,116,300	1.020	98.0%	1,313,294	85.0%
2006	1,407,100	36	1,203,071	1.053	95.0%	1,336,745	90.0%
2007	1,477,455	24	1,263,224	1.111	90.0%	1,329,710	95.0%
2008	1,551,328	12	1,194,523	1.299	77.0%	1,194,523	100.0%
Total	12,577,893		9,647,366			11,951,267	80.7%

Column Notes:
(2) Assume $1,000,000 for first year in experience period (1999) and 5% annual increase thereafter.
(3) Age of accident year at December 31, 2008.
(4) From last diagonal of reported claim triangles in Chapter 7, Exhibit III, Sheets 2 and 4.
(5) Developed in Chapter 7, Exhibit III, Sheets 2 and 4.
(6) = [1.00 / (5)].
(7) = [(2) x (6)].
(8) = [(4) / (7)].

Chapter 10 - Cape Cod Technique Exhibit III
Impact of Changing Conditions Sheet 2
Scenarios 3 and 4 - Development of Expected Claim Ratio

Accident Year	Earned Premium	Age of Accident Year at 12/31/08	Reported Claims at 12/31/08	Reported CDF to Ultimate	% of Ultimate Reported	Used Up Premium	Estimated Claim Ratios
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Increasing Case Outstanding Strength							
1999	1,000,000	120	700,000	1.000	100.0%	1,000,000	70.0%
2000	1,050,000	108	735,000	1.000	100.0%	1,050,000	70.0%
2001	1,102,500	96	771,750	1.000	100.0%	1,102,500	70.0%
2002	1,157,625	84	810,338	1.000	100.0%	1,157,625	70.0%
2003	1,215,506	72	842,346	1.010	99.0%	1,203,351	70.0%
2004	1,276,282	60	884,463	1.010	99.0%	1,263,519	70.0%
2005	1,340,096	48	933,377	1.020	98.1%	1,314,355	71.0%
2006	1,407,100	36	962,808	1.055	94.8%	1,334,350	72.2%
2007	1,477,455	24	979,922	1.119	89.4%	1,320,694	74.2%
2008	1,551,328	12	931,185	1.318	75.9%	1,176,756	79.1%
Total	12,577,893		8,551,189			11,923,151	71.7%
Increasing Claim Ratios and Case Outstanding Strength							
1999	1,000,000	120	700,000	1.000	100.0%	1,000,000	70.0%
2000	1,050,000	108	735,000	1.000	100.0%	1,050,000	70.0%
2001	1,102,500	96	771,750	1.000	100.0%	1,102,500	70.0%
2002	1,157,625	84	810,338	1.000	100.0%	1,157,625	70.0%
2003	1,215,506	72	842,346	1.010	99.0%	1,203,351	70.0%
2004	1,276,282	60	1,010,815	1.010	99.0%	1,263,519	80.0%
2005	1,340,096	48	1,133,386	1.019	98.1%	1,314,470	86.2%
2006	1,407,100	36	1,237,897	1.055	94.8%	1,334,094	92.8%
2007	1,477,455	24	1,329,895	1.120	89.3%	1,319,695	100.8%
2008	1,551,328	12	1,330,264	1.320	75.7%	1,174,877	113.2%
Total	12,577,893		9,901,689			11,920,130	83.1%

Column Notes:
(2) Assume $1,000,000 for first year in experience period (1999) and 5% annual increase thereafter.
(3) Age of accident year at December 31, 2008.
(4) From last diagonal of reported claim triangles in Chapter 7, Exhibit III, Sheets 6 and 8.
(5) Developed in Chapter 7, Exhibit III, Sheets 6 and 8.
(6) = [1.00 / (5)].
(7) = [(2) x (6)].
(8) = [(4) / (7)].

Chapter 10 - Cape Cod Technique
Impact of Changing Conditions
U.S. PP Auto - Development of Unpaid Claim Estimate

Exhibit III
Sheet 3

Accident Year	Earned Premium	Expected Claim Ratio	Estimated Expected Claims	Reported CDF to Ultimate	Percentage Unreported	Expected Unreported Claims	Reported Claims at 12/31/08	Projected Ultimate Claims	Estimated IBNR	Actual IBNR	Difference from Actual IBNR
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Steady-State											
1999	1,000,000	70.0%	700,000	1.000	0.0%	0	700,000	700,000	0	0	0
2000	1,050,000	70.0%	735,000	1.000	0.0%	0	735,000	735,000	0	0	0
2001	1,102,500	70.0%	771,750	1.000	0.0%	0	771,750	771,750	0	0	0
2002	1,157,625	70.0%	810,338	1.000	0.0%	0	810,338	810,338	0	0	0
2003	1,215,506	70.0%	850,854	1.010	1.0%	8,509	842,346	850,854	8,509	8,509	0
2004	1,276,282	70.0%	893,397	1.010	1.0%	8,934	884,463	893,397	8,934	8,934	0
2005	1,340,096	70.0%	938,067	1.020	2.0%	18,761	919,306	938,067	18,761	18,761	0
2006	1,407,100	70.0%	984,970	1.053	5.0%	49,249	935,722	984,970	49,249	49,249	0
2007	1,477,455	70.0%	1,034,219	1.111	10.0%	103,422	930,797	1,034,219	103,422	103,422	0
2008	1,551,328	70.0%	1,085,930	1.299	23.0%	249,764	836,166	1,085,930	249,764	249,764	0
Total	12,577,893		8,804,525			438,638	8,365,887	8,804,525	438,638	438,638	0
Increasing Claim Ratios											
1999	1,000,000	80.7%	807,225	1.000	0.0%	0	700,000	700,000	0	0	0
2000	1,050,000	80.7%	847,587	1.000	0.0%	0	735,000	735,000	0	0	0
2001	1,102,500	80.7%	889,966	1.000	0.0%	0	771,750	771,750	0	0	0
2002	1,157,625	80.7%	934,464	1.000	0.0%	0	810,338	810,338	0	0	0
2003	1,215,506	80.7%	981,188	1.010	1.0%	9,812	842,346	852,158	9,812	8,509	- 1,303
2004	1,276,282	80.7%	1,030,247	1.010	1.0%	10,302	1,010,815	1,021,117	10,302	10,210	- 92
2005	1,340,096	80.7%	1,081,759	1.020	2.0%	21,635	1,116,300	1,137,935	21,635	22,782	1,146
2006	1,407,100	80.7%	1,135,847	1.053	5.0%	56,792	1,203,071	1,259,863	56,792	63,320	6,527
2007	1,477,455	80.7%	1,192,640	1.111	10.0%	119,264	1,263,224	1,382,488	119,264	140,358	21,094
2008	1,551,328	80.7%	1,252,272	1.299	23.0%	288,022	1,194,523	1,482,545	288,022	356,805	68,783
Total	12,577,893		10,153,194			505,828	9,647,366	10,153,194	505,828	601,984	96,155

Column Notes:
(2) Assume $1,000,000 for first year in experience period (1999) and 5% annual increase thereafter.
(3) Selected based on estimated overall claim ratio developed in Exhibit III, Sheet 1.
(4) = [(2) x (3)].
(5) Developed in Chapter 7, Exhibit III, Sheets 2 and 4.
(6) = [1.00 - (1.00 / (5))].
(7) = [(4) x (6)].
(8) From last diagonal of reported claim triangles in Chapter 7, Exhibit III, Sheets 2 and 4.
(9) = [(7) + (8)].
(10) = [(9) - (8)].
(11) Developed in Chapter 7, Exhibit III, Sheet 1.
(12) = [(11) - (10)].

Accident Year	Earned Premium	Expected Claim Ratio	Estimated Expected Claims	Reported CDF to Ultimate	Percentage Unreported	Expected Unreported Claims	Reported Claims at 12/31/08	Projected Ultimate Claims	Estimated IBNR	Actual IBNR	Difference from Actual IBNR
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Increasing Case Outstanding Strength											
1999	1,000,000	71.7%	717,192	1.000	0.0%	0	700,000	700,000	0	0	0
2000	1,050,000	71.7%	753,052	1.000	0.0%	0	735,000	735,000	0	0	0
2001	1,102,500	71.7%	790,704	1.000	0.0%	0	771,750	771,750	0	0	0
2002	1,157,625	71.7%	830,239	1.000	0.0%	0	810,338	810,338	0	0	0
2003	1,215,506	71.7%	871,751	1.010	1.0%	8,718	842,346	851,063	8,718	8,509	- 209
2004	1,276,282	71.7%	915,339	1.010	1.0%	9,153	884,463	893,617	9,153	8,934	- 219
2005	1,340,096	71.7%	961,106	1.020	1.9%	18,461	933,377	951,838	18,461	4,690	- 13,771
2006	1,407,100	71.7%	1,009,161	1.055	5.2%	52,176	962,808	1,014,984	52,176	22,162	- 30,014
2007	1,477,455	71.7%	1,059,619	1.119	10.6%	112,428	979,922	1,092,350	112,428	54,296	- 58,132
2008	1,551,328	71.7%	1,112,600	1.318	24.1%	268,640	931,185	1,199,825	268,640	154,745	- 113,895
Total	12,577,893		9,020,764			469,576	8,551,189	9,020,764	469,576	253,336	- 216,240
Increasing Claim Ratios and Case Outstanding Strength											
1999	1,000,000	83.1%	830,670	1.000	0.0%	0	700,000	700,000	0	0	0
2000	1,050,000	83.1%	872,203	1.000	0.0%	0	735,000	735,000	0	0	0
2001	1,102,500	83.1%	915,813	1.000	0.0%	0	771,750	771,750	0	0	0
2002	1,157,625	83.1%	961,604	1.000	0.0%	0	810,338	810,338	0	0	0
2003	1,215,506	83.1%	1,009,684	1.010	1.0%	10,097	842,346	852,443	10,097	8,509	- 1,588
2004	1,276,282	83.1%	1,060,168	1.010	1.0%	10,602	1,010,815	1,021,417	10,602	10,210	- 391
2005	1,340,096	83.1%	1,113,177	1.019	1.9%	21,287	1,133,386	1,154,673	21,287	5,695	- 15,591
2006	1,407,100	83.1%	1,168,835	1.055	5.2%	60,644	1,237,897	1,298,541	60,644	28,494	- 32,150
2007	1,477,455	83.1%	1,227,277	1.120	10.7%	131,047	1,329,895	1,460,941	131,047	73,688	- 57,359
2008	1,551,328	83.1%	1,288,641	1.320	24.3%	312,707	1,330,264	1,642,971	312,707	221,064	- 91,642
Total	12,577,893		10,448,073			546,383	9,901,689	10,448,073	546,383	347,660	- 198,721

Column Notes:
(2) Assume $1,000,000 for first year in experience period (1999) and 5% annual increase thereafter.
(3) Selected based on estimated overall claim ratio developed in Exhibit III, Sheet 2.
(4) = [(2) x (3)].
(5) Developed in Chapter 7, Exhibit III, Sheets 6 and 8.
(6) = [1.00 - (1.00 / (5))].
(7) = [(4) x (6)].
(8) From last diagonal of reported claim triangles in Chapter 7, Exhibit III, Sheets 6 and 8.
(9) = [(7) + (8)].
(10) = [(9) - (8)].
(11) Developed in Chapter 7, Exhibit III, Sheet 1.
(12) = [(11) - (10)].

Chapter 10 - Cape Cod Technique Exhibit IV
Impact of Change in Product Mix Example Sheet 1
Scenarios 5 and 6 - Development of Expected Claim Ratio

Accident Year	Earned Premium	Age of Accident Year at 12/31/08	Reported Claims at 12/31/08	Reported CDF to Ultimate	% of Ultimate Reported	Used Up Premium	Estimated Claim Ratios
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Steady-State (No Change in Product Mix)							
1999	2,000,000	120	1,500,000	1.000	100.0%	2,000,000	75.0%
2000	2,100,000	108	1,575,000	1.000	100.0%	2,100,000	75.0%
2001	2,205,000	96	1,653,750	1.000	100.0%	2,205,000	75.0%
2002	2,315,250	84	1,736,438	1.000	100.0%	2,315,250	75.0%
2003	2,431,013	72	1,814,751	1.005	99.5%	2,419,668	75.0%
2004	2,552,563	60	1,885,068	1.016	98.5%	2,513,424	75.0%
2005	2,680,191	48	1,948,499	1.032	96.9%	2,597,999	75.0%
2006	2,814,201	36	1,937,577	1.089	91.8%	2,583,436	75.0%
2007	2,954,911	24	1,852,729	1.196	83.6%	2,470,306	75.0%
2008	3,102,656	12	1,568,393	1.484	67.4%	2,091,190	75.0%
Total	25,155,785		17,472,204			23,296,273	75.0%
Changing Product Mix							
1999	2,000,000	120	1,500,000	1.000	100.0%	2,000,000	75.0%
2000	2,100,000	108	1,575,000	1.000	100.0%	2,100,000	75.0%
2001	2,205,000	96	1,653,750	1.000	100.0%	2,205,000	75.0%
2002	2,315,250	84	1,736,438	1.000	100.0%	2,315,250	75.0%
2003	2,431,013	72	1,814,751	1.005	99.5%	2,419,668	75.0%
2004	2,552,563	60	1,885,068	1.016	98.5%	2,513,424	75.0%
2005	2,999,262	48	2,193,545	1.032	96.9%	2,907,284	75.4%
2006	3,564,016	36	2,471,446	1.090	91.7%	3,269,911	75.6%
2007	4,281,446	24	2,680,487	1.200	83.3%	3,566,552	75.2%
2008	5,196,516	12	2,556,695	1.503	66.5%	3,457,489	73.9%
Total	29,645,066		20,067,179			26,754,578	75.0%

Column and Line Notes:
(2) For no change scenario, assume $2,000,000 for first year in experience period (1999) and 5% annual increase thereafter. For change scenario, assume annual increase of 30% for commercial auto beginning in 2005.
(3) Age of accident year at December 31, 2008.
(4) From last diagonal of reported claim triangles in Chapter 7, Exhibit IV, Sheets 2 and 4.
(5) Developed in Chapter 7, Exhibit IV, Sheets 2 and 4.
(6) = [1.00 / (5)].
(7) = [(2) x (6)].
(8) = [(4) / (7)].

Chapter 10 - Cape Cod Technique
Impact of Change in Product Mix Example
U.S. Auto - Development of Unpaid Claim Estimate

Exhibit IV
Sheet 2

Accident Year	Earned Premium	Expected Claim Ratio	Estimated Expected Claims	Reported CDF to Ultimate	Percentage Unreported	Expected Unreported Claims	Reported Claims at 12/31/08	Projected Ultimate Claims	Estimated IBNR	Actual IBNR	Difference from Actual IBNR
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Steady-State (No Change in Product Mix)											
1999	2,000,000	75.0%	1,500,000	1.000	0.0%	0	1,500,000	1,500,000	0	0	0
2000	2,100,000	75.0%	1,575,000	1.000	0.0%	0	1,575,000	1,575,000	0	0	0
2001	2,205,000	75.0%	1,653,750	1.000	0.0%	0	1,653,750	1,653,750	0	0	0
2002	2,315,250	75.0%	1,736,438	1.000	0.0%	0	1,736,438	1,736,438	0	0	0
2003	2,431,013	75.0%	1,823,259	1.005	0.5%	8,509	1,814,751	1,823,259	8,509	8,509	0
2004	2,552,563	75.0%	1,914,422	1.016	1.5%	29,354	1,885,068	1,914,422	29,354	29,354	0
2005	2,680,191	75.0%	2,010,143	1.032	3.1%	61,644	1,948,499	2,010,143	61,644	61,644	0
2006	2,814,201	75.0%	2,110,651	1.089	8.2%	173,073	1,937,577	2,110,651	173,073	173,073	0
2007	2,954,911	75.0%	2,216,183	1.196	16.4%	363,454	1,852,729	2,216,183	363,454	363,454	0
2008	3,102,656	75.0%	2,326,992	1.484	32.6%	758,599	1,568,393	2,326,992	758,599	758,599	0
Total	25,155,785		18,866,839			1,394,634	17,472,204	18,866,839	1,394,634	1,394,634	0
Changing Product Mix											
1999	2,000,000	75.0%	1,500,093	1.000	0.0%	0	1,500,000	1,500,000	0	0	0
2000	2,100,000	75.0%	1,575,098	1.000	0.0%	0	1,575,000	1,575,000	0	0	0
2001	2,205,000	75.0%	1,653,853	1.000	0.0%	0	1,653,750	1,653,750	0	0	0
2002	2,315,250	75.0%	1,736,545	1.000	0.0%	0	1,736,438	1,736,438	0	0	0
2003	2,431,013	75.0%	1,823,373	1.005	0.5%	8,509	1,814,751	1,823,260	8,509	8,509	- 1
2004	2,552,563	75.0%	1,914,541	1.016	1.5%	29,356	1,885,068	1,914,424	29,356	29,354	- 2
2005	2,999,262	75.0%	2,249,586	1.032	3.1%	68,987	2,193,545	2,262,532	68,987	71,855	2,867
2006	3,564,016	75.0%	2,673,178	1.090	8.3%	220,593	2,471,446	2,692,039	220,593	239,057	18,464
2007	4,281,446	75.0%	3,211,284	1.200	16.7%	536,204	2,680,487	3,216,691	536,204	596,924	60,720
2008	5,196,516	75.0%	3,897,629	1.503	33.5%	1,304,351	2,556,695	3,861,045	1,304,351	1,445,385	141,035
Total	29,645,066		22,235,179			2,168,000	20,067,179	22,235,179	2,168,000	2,391,084	223,083

Column Notes:
(2) For no change scenario, assume $2,000,000 for first year in experience period (1999) and 5% annual increase thereafter.
For change scenario, assume annual increase of 30% for commercial auto beginning in 2005.
(3) Selected based on estimated overall claim ratios developed in Exhibit IV, Sheet 1.
(4) = [(2) x (3)].
(5) Developed in Chapter 7, Exhibit IV, Sheets 2 and 4.
(6) = [1.00 - (1.00 / (5))].
(7) = [(4) x (6)].
(8) From last diagonal of reported claim triangles in Chapter 7, Exhibit IV, Sheets 2 and 4.
(9) = [(7) + (8)].
(10) = [(9) - (8)].
(11) Developed in Chapter 7, Exhibit IV, Sheet 1.
(12) = [(11) - (10)].

CHAPTER 11 – FREQUENCY-SEVERITY TECHNIQUES

Projections based on frequency-severity techniques can be extremely valuable, not only in providing additional estimates of unpaid claims, but also in understanding the drivers in claims activity. In the paper "Evaluating Bodily Injury Liabilities Using a Claims Closure Model," Martin Adler and Charles D. Kline discuss the rhythm in the claims settlement process:

> Claims emerge at an identifiable rate, they are settled at an identifiable rate, the payments grow at an identifiable rate and the accuracy of individual case estimates improves at an identifiable rate.[60]

When actuaries use frequency-severity techniques in their simplest form, they project ultimate claims by multiplying the estimated ultimate number of claims (i.e., frequency) by the estimated ultimate average value (i.e., severity). By analyzing claims experience by its frequency and severity components, actuaries are able to examine trends and patterns in the rates of claims emergence (i.e., reporting) and settlement (i.e., closure) as well as in the average values of claims. This can be particularly valuable when an organization is undergoing change in operations, philosophy, or management. Frequency-severity methods can also be important to validate or reject the findings from other actuarial projection techniques.

Common Uses of Frequency-Severity Techniques

Actuaries can use frequency-severity techniques for projecting unpaid claim estimates in a wide variety of situations. They can use them with accident year, policy year, report year, and calendar year data. Generally reinsurers do not use frequency-severity methods with underwriting year data simply because they do not have access to detailed statistics regarding the number of claims. Frequency-severity techniques are appropriate for all lines of insurance but are more often used for long-tail lines. Furthermore, actuaries can use frequency-severity methods for projecting unpaid claims for both primary layers of coverage and excess layers of insurance.

Technically, *frequency* refers to the number of claims per unit of exposure, and *severity* refers to the average cost per claim. Thus, for a true frequency-severity projection method, the actuary would require historical data for the claims, number of claims, and exposures. In practice, many actuaries use the term "frequency-severity methods" to refer to projections of ultimate claim counts multiplied by ultimate severities without the direct incorporation of an exposure measurement.

Types of Frequency-Severity Techniques

There are many different types of projection methods that fall under the classification of frequency-severity techniques. In this chapter, we examine three different types of frequency-severity projection methods. Since the number of claims is not available from our source of the consolidated industry data in the U.S., which is *Best's Aggregates & Averages*, we are not able to carry forward most of the examples contained in the preceding chapters. We do, however, continue with our example for XYZ Insurer.

[60] *CAS Discussion Paper Program*, 1988.

The first and simplest frequency-severity approach is the development technique applied separately to claim counts and average values. We present this approach in Exhibit I for a Canadian portfolio of private passenger automobile collision coverage (Auto Collision Insurer) and in Exhibit II for XYZ Insurer.

In the second frequency-severity approach, we focus on projecting ultimate claims for the most recent two accident years. The development method can often result in substantial development factors to ultimate for the most recent accident years. Highly leveraged factors typically lead to greater uncertainty in actuarial projections of ultimate claims; this, in turn, results in greater uncertainty for the estimate of unpaid claims. It is important for actuaries to consider alternative projection techniques in such situations. The expected claims and Bornhuetter-Ferguson techniques are two of the most commonly used methods to supplement claim development methods, particularly for the most recent accident years. Frequency-severity methods are also a valuable alternative for the actuary.

In the second frequency-severity approach, we compare, by accident year, the projected ultimate number of claims to an exposure base. The selected frequency rate (i.e., ultimate number of claims per exposure unit) is then used to project the ultimate number of claims for the most recent two accident years. The severities for the most recent accident years are based on the development technique applied to reported severities after adjustment for inflation. We use this approach in Exhibit III for a self-insurer of U.S. workers compensation (WC Self-Insurer) and in Exhibit IV for XYZ Insurer.

Our third frequency-severity approach is based on a disposal rate analysis. This final approach builds upon the basic development triangle used with both claims and claim counts. In this method, we examine the rate of claim count closure at each maturity age and the incremental paid severity by maturity age. In Exhibit V, we present an example of this approach for a portfolio of general liability insurance (GL Insurer) and in Exhibit VI for XYZ Insurer.

In the following sections, we describe each of the three frequency-severity approaches in detail including the key assumptions and the mechanics of each technique.

Frequency-Severity Approach #1 – Development Technique with Claim Counts and Severities

Key Assumptions

Two of the major requirements of frequency-severity techniques are that the individual claim counts being grouped are defined in a consistent manner over the experience period and that the claim counts are reasonably homogenous. For example, it is not appropriate to group together claimant counts and occurrence counts, which record all claimants under the occurrence as a single claim, unless the mix of the two ways of counting a claim is consistent. It is also important that the type of claim be reasonably homogenous. For example, it is not reasonable to combine the average values for slip-and-fall claims with those resulting from class action proceedings in which thousands of injured parties are grouped together; such average values would have little meaning. Likewise, it is not appropriate to analyze first-dollar, low-limit claims with high-layer, multi-million dollar, excess claims.

As indicated previously, many frequency-severity methods rely on the development technique applied separately to claim counts and average values. Thus, a key assumption of the development technique is also applicable to this type of frequency-severity analysis. Recall that the underlying assumption in the development technique is that claims reported (or paid) to date will continue to develop in a similar manner in the future. In a frequency-severity method where reported (or closed) claim counts are used to project the ultimate number of claims, the actuary assumes that the claim counts reported (or closed) to date will continue to develop in a similar manner in the future. Similarly, the actuary using the development technique on severities assumes that the relative change in a given year's severities from one evaluation point to the next is similar to the relative change in prior years' severities at similar evaluation points.

Mechanics of the Technique

In Exhibit I, Sheets 1 through 8, we present our first frequency-severity example for Auto Collision Insurer. This first example has four basic steps:

- Project and select ultimate claim counts
- Project ultimate severity
- Project ultimate claims
- Develop unpaid claim estimate

In this example, we use semi-annual accident periods and valuations in intervals of six months.[61]

Project and Select Ultimate Claim Counts

In Exhibit I, Sheets 1 through 3, we use the development technique to project both closed and reported claim counts to an ultimate basis. (We describe the development technique in detail in Chapter 7 – Development Technique.) For Auto Collision Insurer, the closed claim counts include claim counts closed with payments or claim-related expense payments or both, but do not include claim counts closed with no payment (CNP). Reported claim counts include the number of closed claims in addition to the number of open claims with a case outstanding (for claim only or claim-related expense) greater than $0.

Since the reported claim counts in this example exclude CNP counts, it is not surprising to observe negative (or downward) development (i.e., age-to-age factors of less than 1.00) in Exhibit I, Sheet 2. Recall that private passenger collision is a very fast reporting and settling coverage of automobile insurance. In our example, the reported claim counts at six months include many open claims with case outstanding values. However, as time passes and these claims mature, many will close without any payment. Due to the fast-reporting nature of this coverage, for a particular accident half-year, there are more claim counts closed without payment in subsequent valuations than new claim counts reported. Thus, we see age-to-age factors of less than 1.00 for every accident half-year at 6-to-12 months. Similar behavior is evident through 36 months for the reported claim count triangle of age-to-age factors.

[61] We present this example using data at six-month evaluations for two reasons. First, to demonstrate to the reader that the estimation of unpaid claims is often conducted using data at valuations other than 12-month intervals. Second, this example demonstrates the potential influence of seasonality on claim development factors.

We again stress the importance of understanding the type of data provided by the insurer. If the closed counts exclude CNP counts but reported counts include the CNP counts, the actuary will not be able to use both the closed and reported counts to produce comparable estimates of the ultimate number of claims. If claims include all claim adjustment expense (with or without claim payments or case outstanding) but counts do not include claims with claim adjustment expense only, there will not be an appropriate match of the number of claims and the dollars that are spent on the claims. Another important issue related to the number of claims is claimant count versus occurrence count. A single occurrence, such as an automobile accident may result in multiple injured parties or damaged vehicles or both. Does the insurer record one count or multiple counts for such an occurrence? The actuary must understand how the insurer defines and records claim counts and whether or not there have been changes in the insurer's practices during the experience period. There may also be different practices with respect to recording claim counts on the insurer's systems when the payment is below the deductible. As we note continually through this book, the important point is that the actuary must understand the data that he or she is working with.

In Exhibit I, Sheets 1 and 2, we present the development triangles for closed and reported claim counts, respectively. We judgmentally select age-to-age factors based on the simple average for the latest three half-years for both closed and reported counts. At first glance, we note that there is variability from accident half-year to accident half-year at 6-to-12 months for the closed claim counts, but the averages appear relatively close to one another. We will further investigate this particular age-to-age maturity (6-to-12 months) later in this example.

In Exhibit I, Sheet 3, we project the ultimate number of claims by accident half-year. Note, that accident half-year 2008-1, which represents the period from January 1, 2008 through June 30, 2008, is six months old as of June 30, 2008; and accident half-year 2007-2, which represents the period from July 1, 2007 to December 31, 2007, is 12 months old at June 30, 2008. (We begin counting with the beginning of the accident half-year period.)

Exhibit I, Sheet 3, where we project the claim counts to ultimate, is similar to the development projections contained in preceding chapters. We present the age of the accident half-year in Column (2) of Exhibit I, Sheet 3. Columns (3) and (4) show closed and reported claim counts, respectively, as of June 30, 2008. The next two columns are the development factors to ultimate. The projected ultimate claim counts based on closed counts are shown in Column (7), and the projected ultimate claim counts based on the reported counts are in Column (8). It is obvious after a quick examination of Columns (7) and (8) that the two projection methods produce similar results for all accident half-years except for the latest period (i.e., 2008-1).

We now return to the claim count triangles to determine if there is something taking place that we missed upon our first review. One quick way to look for changes or patterns in the triangular data is to use a development diagnostic. In Exhibit I, Sheet 4, we present the ratio of closed-to-reported claim counts. Looking down the column at age six months, we immediately see evidence of seasonality in the relationship between closed and reported counts. For accident half-years ending with a 2 (i.e., July 1 through December 31), the average ratio of closed-to-reported counts is 0.71, and there is minimal variability from period to period around this average. Similarly, there is minimal variability in the ratio of closed-to-reported claim counts for accident half-years ending with a 1 (i.e., January 1 to June 30); they have an average ratio of 0.81.

There are numerous factors that could result in a lower proportion of claim counts closed at six months for the accident half-years ending December 31 than for those ending June 30. For example, there may be a higher number of claims reported in Canada in November and December due to the beginning of winter weather and the resulting more hazardous driving conditions. There is also less time to settle the November and December winter claims with a December 31 closing date than the winter claims occurring in January and February with a half-year closing date of June 30. There may also be less time available to process and close the November and December claims due to the shorter work period for many companies that close over the Christmas holidays. The actuary should speak to claims department management to understand the reasons for such patterns in the data. We also observe that there are no material differences or patterns evident in any maturities beyond six months.

Since we observe a distinctive pattern in the ratio of closed-to-reported claim counts at six months, the next step is to see if we can discern any patterns in either the closed count triangle or the reported count triangle or both. Upon a second examination of the age-to-age factors for closed claim counts (Part 2 of Exhibit I, Sheet 1), we note differences in the age-to-age factors for accident half-years ending June versus December. We do not see obvious patterns in the reported claim count triangle at the 6-to-12 month interval. In the table below we summarize the 6-to-12 month factors for both closed and reported counts. We also present the simple averages for all years and the latest three years.

	Age-to-Age Factors at 6-12 Months	
Accident Half-Year	**Closed Claim Counts**	**Reported Claim Counts**
2003-2	1.281	0.932
2004-1	1.153	0.934
2004-2	1.275	0.910
2005-1	1.154	0.956
2005-2	1.327	0.942
2006-1	1.181	0.966
2006-2	1.353	0.956
2007-1	1.212	0.983
2007-2	1.312	0.995
Accident Half-Years – 1		
Simple Average All Years	1.175	0.960
Simple Average Latest 3 Years	1.183	0.968
Accident Half-Years – 2		
Simple Average All Years	1.310	0.947
Simple Average Latest 3 Years	1.331	0.964

Now that we are aware of the difference in 6-to-12 month development factors for closed claim counts, we revise our selected age-to-age factor from 1.292, which is the simple average of the latest three accident half-years, to 1.183, which is the simple average latest three accident half-years ending at June 30. We choose the factors based on accident half-years ending June because the latest point in our six-month data ends June 30. Since we do not notice any material differences in the development factors for reported claim counts, we do not change our original selected factor.

The new projected ultimate claim counts for accident half-year 2008-1 based on closed counts are:

[(closed claim counts at June 30, 2008) x (development factor to ultimate)] =

[(2,533) x (1.001 x 1.009 x 1.183)] = [(2,533) x (1.195)] = 3,027

The projected number of ultimate claims based on reported claim counts for accident half-year 2008-1 is 3,061; this is very close to our new projected value of 3,027, which is based on closed claim counts.

Project Ultimate Severity

The development technique is also used to project reported severities to an ultimate basis. In Exhibit I, Sheet 5, we summarize the triangles of reported claims (in thousands of dollars) and reported severities (i.e., average reported claim). We analyze the reported severity triangle and select development factors in Exhibit I, Sheet 6. Since we note some seasonality in the claim count triangle, we also check for seasonality differences between the half-years in the triangle of reported severities. There does appear to be greater development for accident half-years ending December rather than June, particularly for the older periods in the triangle. In such a situation, the actuary should seek further explanation from claims management professionals to fully understand the factors influencing the claim development patterns. In our example, we select a 6-to-12 month factor of 1.039 based on the medial average (i.e., average excluding high and low values) and the assumption that the experience of the most recent few years is more representative of future experience than the earliest periods in the triangle. We also use the medial average to select the age-to-age factors for the remaining maturities.

Project Ultimate Claims

In Exhibit I, Sheet 7, we multiply the projected ultimate severities by the projected ultimate claim counts to determine the projected ultimate claims by accident half-year period.

Develop Unpaid Claim Estimate

The steps involved in the calculation of the unpaid claim estimate are similar to all the previous methods presented. Estimated IBNR is equal to the difference between projected ultimate claims and reported claims. For Auto Collision Insurer, the estimated IBNR is negative for all accident half-years except the latest period, 2008-1. Negative IBNR is often a result of either salvage and subrogation recoveries, which are included with the claim development data, or a conservative philosophy towards setting case outstanding. In this particular example, the negative IBNR is a result of the downward (i.e., favorable) development of claim counts and not salvage or subrogation recoveries. The total unpaid claim estimate is equal to the sum of case outstanding and estimated IBNR and is shown in Column (6) of Exhibit I, Sheet 8.

Analysis for XYZ Insurer

In Exhibit II, we use the same frequency-severity approach for XYZ Insurer. This example has been addressed in each of the preceding chapters of Part 3. We know, based on interviews with management of XYZ Insurer and reviews of the diagnostic development triangles, that there have been significant changes in both their internal and external environments. (It may be valuable to review the diagnostic triangles presented in Chapter 6 for XYZ Insurer.) The only adjustment we make to the severity methodology to reflect these recent changes is in our selection of the development factors. We select the volume-weighted average of the age-to-age factors for the latest two years; we use the latest two years in an attempt to reflect the most recent operating environment at XYZ Insurer.

In Exhibit II, Sheet 3, we project the ultimate number of claims based on closed and reported claim counts. While the two projections of claim counts are somewhat close for accident years 1998 through 2005, we observe significant differences in the projected number of ultimate claims for 2006 through 2008. For every year starting in 2000 through 2008, the ultimate count projections based on closed counts are greater than the ultimate projections based on reported counts.

Similar to the previous collision example, the next step is to project the ultimate severities by accident year. We analyze the triangle of reported severities in Exhibit II, Sheet 5. We observe that within the triangle of age-to-age factors, the latest point in each column is usually the lowest point in the column. This is consistent with management's assertion that there has been a significant increase in case outstanding strength, particularly in calendar year 2007. Again, we use the latest two years for our selected development factors in an attempt to best reflect the current environment at this insurer.

In Exhibit II, Sheet 6, we multiply the projected ultimate severities by the projected number of ultimate claims for each accident year to project ultimate claims. We calculate estimated IBNR and the total unpaid claim estimate in Exhibit II, Sheet 7.

We observe that the estimated IBNR and total unpaid claim estimate from this type of frequency-severity projection are higher than the estimated unpaid claims generated from the reported claim development technique and lower than the estimate generated from the paid claim development technique. At XYZ Insurer, we know that there have been changes in case outstanding adequacy and claims settlement procedures. Without appropriate adjustment to our projection techniques, either in the types of data that are used or the methodological adjustments, we may exacerbate problems in our projected results. For an example, return to the projected number of ultimate claims in Exhibit II, Sheet 3. Projected ultimate claim counts based on closed counts are significantly greater than projected ultimate claim counts based on reported counts. This is consistent with our conclusions regarding an increased rate of claims settlement. Thus, it may be more appropriate to rely on the reported claim count projection which is not affected by changes in claims closure patterns. This change alone reduces the estimated IBNR by more than $30 million.

Frequency-Severity Approach #2 – Incorporation of Exposures and Inflation into the Methodology

Key Assumptions

This second frequency-severity approach also relies on the development technique applied to historical closed and reported claim counts and average reported claims. Thus, critical assumptions include:

- Claim counts and reported claim activity to date will continue to develop in a similar manner in the future

- Claim counts are defined consistently over time

- The mix by claim type is reasonably consistent (to the extent that the potential claims can vary significantly by type of claim)

In this second approach, however, we also incorporate trend rates into the analysis of both frequency and severity parameters. In our examples, we examine three specific trend rates: exposure trend, frequency trend, and severity trend.

When selecting trend rates, there are numerous considerations for the actuary. The selection of frequency and severity trends often reflects not only economic inflationary factors but also societal factors that tend to increase both the number and the size of claims over time. Trend rates typically vary by line of business and even by subcoverage within a line of business. In addition, there can be significant variation in trend rates for exposures, frequency, and severity by geographic region (e.g., country, state/province within a country, and even subdivisions within a state/province). Severity and frequency trend rates can also vary based on the limits (i.e., retention) carried by the insurer or self-insurer. For U.S. workers compensation, it is often appropriate to incorporate adjustments for statutory benefit changes into the analysis as well as inflationary trend factors.

There are various sources actuaries turn to when selecting trend assumptions, including general insurance industry data, government statistical organizations, economic indices, and insurer-specific experience. Later in this chapter, we present examples in which regression analysis of the insurer's own claims experience is used to determine trend rates. The accuracy and appropriateness of the assumed trend rates is critical for many frequency-severity methods that are used to project ultimate claims.[62] The longer the projection period, the greater the uncertainty as trend factors can become very large and thus highly leveraged.

[62] For example, there have been times when the inflation rate for many of the items covered by U.S. auto insurance was positive, but the observed average claim severity trend was negative. Two possible reasons for this disparity of inflation rates include a change in the mix of claim types and the impact of various safety features added to new cars.

Mechanics of the Approach

In our second frequency-severity approach, we use historical claim counts and severities to project ultimate claims for the latest two accident years. We present two examples: a self-insurer of U.S. workers compensation (WC Self-Insurer) and XYZ Insurer. As we discuss previously, the claim development factor to ultimate can be highly leveraged for the most recent accident years, which can lead to a greater degree of uncertainty in the estimate of unpaid claims. Therefore, actuaries can turn to this type of frequency-severity approach as an alternative method for projecting ultimate claims.

This second approach to frequency-severity has five basic steps:

- Project and select ultimate claim counts
- Compare ultimate claim counts to exposures and select frequency
- Project ultimate severity
- Project ultimate claims
- Develop unpaid claim estimate

Project and Select Ultimate Claim Counts

Similar to our examples based on approach #1, we begin with projecting both closed and reported claim counts to an ultimate basis and selecting the ultimate claim counts by accident year (Exhibit III, Sheets 1 through 3). In this example, we select development factors based on the volume-weighted average for the latest five years. For the oldest maturity periods in the closed claim count triangle (84-to-96 months), we judgmentally select a development factor of 1.003, which results in a smoother pattern than the one data point of 1.008. We also judgmentally select a tail factor for closed claim counts of 1.007, which is based on a review of the relationship between closed and reported claim counts at ages of 72, 84, and 96 months. In Exhibit III, Sheet 3, we summarize the projected ultimate claim count projections; the selected ultimate claim counts are based on the average of the two projections, which are very similar for each year.

Compare Ultimate Claim Counts to Exposures and Select Frequency

In this approach, we take the frequency analysis one step further by comparing the ultimate claim counts by accident year to an exposure base. (See Exhibit III, Sheet 4.) For U.S. workers compensation, the most common exposure base is payroll (in hundreds of dollars). Our goal is to determine the appropriate frequency (i.e., number of claims per exposure unit) for the latest two accident years. Since payroll is an inflation-sensitive exposure base, we must adjust the payroll for each accident year to a common time period. For simplification purposes, we assume a 2.5% annual inflation rate for payroll for all years in the experience period and trend all historical payroll to the cost level of accident year 2008. (Columns (5) through (7) of Exhibit III, Sheet 4, contain these calculations.)

Similarly, the claim counts should be adjusted using trend factors to reflect changes in counts. Ideally, the actuary can analyze the self-insurer's own historical experience to determine the frequency trend rate. In our example, however, sufficient historical data is not available. Thus, we rely on our knowledge of U.S. workers compensation in general and the specific industry of this self-insured organization; we assume a -1.0% annual trend in the number of claims.[63] (See calculations in Columns (2) through (4) of Exhibit III, Sheet 4.)

We divide the ultimate trended claim counts in Column (4) of Exhibit III, Sheet 4, by the trended payroll in Column (7). After examining the frequency rates by accident year in Column (8), we recognize a change in frequency between the earliest years in the experience period (2001 through 2004) and the most recent years (2006 through 2008).

It is important for the actuary to speak to management at WC Self-Insurer to understand what caused the dramatic change in frequency. Has there been a new cost containment program introduced? Has there been a change in the definition of a claim? Has there been a change in third-party administrators? Was there a change in the type of work performed by employees? We note a large increase in both claims and payroll between 2005 and 2006. Was this the result of a corporate acquisition? Any of these changes could have an effect on the frequency analysis. In our example, we assume that the change in frequency is due to a major acquisition, which resulted in the hiring of a new risk manager and the introduction of new safety and risk control procedures. Thus, we select a 2008 frequency rate of 0.36%, which is reflective of the new and improved environment with respect to claims at this organization. We derive the 2007 frequency rate of 0.37% by multiplying 0.36% by 1.025, which represents the adjustment for payroll inflation, and dividing by 0.99, which represents the adjustment for claims trend.

Project Ultimate Severity

We now turn our attention to the analysis of severity. We begin with projecting paid severities and reported severities to an ultimate value (Exhibit III, Sheets 5 through 8). The development analysis is presented in Exhibit III, Sheet 6 for paid severities and in Exhibit III, Sheet 7 for reported severities. For both paid and reported severities, we select development factors based on the medial average (i.e., average excluding high and low values) for the latest five years. We select a tail factor at 96 months of 1.025 for the reported severities and 1.15 for the paid severities. These selections are based on our analysis of insurance industry benchmark development patterns for U.S. workers compensation.

In Exhibit III, Sheet 8, we compare these two projections and select ultimate severities for accident years 2001 through 2006. The next step is to adjust the severities for each historical accident year to the cost level of accident year 2008. For simplicity purposes, we assume a 7.5% annual severity trend rate for WC Self-Insurer. This self-insurer operates throughout the U.S., and for illustration purposes, we chose to simplify the model by not incorporating an adjustment of claims by year to the 2008 statutory benefits level. Many actuaries would likely incorporate such an adjustment when selecting the 2008 severity value, particularly if the entity operated in a single state. In Exhibit III, Sheet 9, we select a 2008 severity value of $7,100. We then derive the 2007 severity value of $6,605 by dividing the selected 2008 severity by the trend factor or 1.075.

[63] Potential factors that may cause a negative claim count trend for U.S. workers compensation include improvements in workplace safety or changes in the mix of job types (e.g., a shift from less construction and manufacturing to lower risk “white collar” type of work).

Project Ultimate Claims

We can now calculate (in Exhibit III, Sheet 10) the projected ultimate claims for accident years 2007 and 2008. The self-insured organization provided us with the payroll for both accident years. We multiply the payroll by the selected frequency rates to determine the projected ultimate number of claims (Line (3)). We then multiply the ultimate number of claims by the selected severities to derive the projected ultimate claims (Line (5)).

Develop Unpaid Claim Estimate

Estimated IBNR is equal to projected ultimate claims less reported claims; and the total unpaid claim estimate is equal to estimated IBNR plus case outstanding.

Analysis for XYZ Insurer

We continue the example presented in Exhibit II for XYZ Insurer. (See Exhibit IV, Sheets 1 through 3.) We use the second frequency-severity approach to review the experience of older, more mature accident years for the purpose of determining estimates of both frequency and severity for 2007 and 2008. In this second approach, we incorporate adjustments for rate level changes, inflation, and tort reform.

In Exhibit IV, Sheet 1, we first summarize the selected ultimate claim counts for accident years 2002 through 2006. In this example, we rely on the reported claim count projection instead of the average of the reported and closed count projections. (See Exhibit II, Sheet 3.) Based on our analysis of insurance industry trends, we assume an annual -1.5% claims frequency trend for this portfolio.

Ideally, the actuary would have vehicle or policy count available as an exposure base when conducting an analysis of unpaid claims for automobile liability insurance. However, there are numerous situations in which reliable exposure and policy count data is not available. For XYZ Insurer, earned premium is the only exposure data available. We recall from Chapter 6, that the insurer provided us with a rate level history for the period 2002 through 2008. Thus, in Columns (5) through (7) of Exhibit IV, Sheet 1, we adjust historical earned premiums to the 2008 rate level. We divide the trended claim counts by the on-level earned premium to determine frequency rates at the 2008 level. We select a 2008 frequency of 2.36%. To determine the 2007 frequency, we adjust the selected frequency for 2008 (2.36%) by the annual claim count trend (-1.5%) and the rate level change that took place in 2008 (20%). Thus, the 2007 frequency is 1.92%.

In Exhibit IV, Sheet 2, we adjust the projected ultimate severities from Exhibit II, Sheet 6 by trend factors to reflect the accident year 2008 cost level. For this example, we assume a 5% annual severity trend. We also include an adjustment for the regulatory reforms that took place in recent years. After a review of various averages and the adjusted severity indications by year in Column (5), we select a 2008 severity value of $26,720. We derive the 2007 severity value of $25,448 by adjusting the selected 2008 for one less year of trend.

In Exhibit IV, Sheet 3, we derive projections of ultimate claims for 2007 and 2008 based on the earned premium provided by XYZ Insurer and the selected frequency and severity values derived in Exhibit IV, Sheets 1 and 2, respectively. We also calculate the estimated IBNR and the estimate of total unpaid claims for accident years 2007 and 2008.

It is interesting to compare the projection of ultimate claim counts, severities, and claims using this frequency-severity approach and the first approach. The following table summarizes these values. Ultimate claims from the second approach are roughly half of the projections from the first approach due to lower projections of both ultimate claim counts and average values per claim.

	Approach # 1	**Approach # 2**
2007 Ultimate Claim Counts		
Closed Counts Projection	1,804	
Reported Counts Projection	1,308	
Selected Value	1,556	1,199
2007 Severity	37,606	25,448
2008 Ultimate Claim Counts		
Closed Counts Projection	1,679	
Reported Counts Projection	1,172	
Selected Value	1,426	1,128
2008 Severity	41,544	26,720
Projected Ultimate Claims ($000)		
Accident Year 2007	58,516	30,512
Accident Year 2008	59,242	30,140

In Chapter 15, we compare and contrast the various projection methods for this example.

Frequency-Severity Approach #3 – Disposal Rate Technique

Key Assumptions

Similar to the previous two frequency-severity approaches, we begin this final method by projecting reported and closed claim counts to an ultimate value using the development technique. Thus, we assume that historical patterns of claims emergence and settlement are predictive of future patterns of reported and closed claim counts. An implicit assumption of this method is that there are no significant partial (i.e., interim) payments.

In this method, we also explicitly incorporate an inflation adjustment for severity. The selected trend rate is an important assumption as a slight change in trend can result in a material change in the estimated of unpaid claims, and therefore the trend rate must be selected carefully.

Mechanics of the Approach

We present this final frequency-severity method in seven steps:

- Project ultimate claim counts and select ultimate claim counts by accident year
- Develop disposal rate triangle and select disposal rate by maturity age
- Project claim counts by accident year and maturity (complete the square)
- Analyze severities and select severities by maturity
- Calculate severities by maturity age and accident year (complete the square)
- Multiply claim counts by severities to determine projected claims
- Determine unpaid claim estimate

Project Ultimate Claim Counts and Select Ultimate Claim Counts by Accident Year

For this example, we use a portfolio of occurrence basis, general liability insurance data (GL Insurer). We start by following the same approach as the previous two frequency-severity techniques: project ultimate claim counts based on development projections of closed and reported claim counts. (See Exhibit V, Sheets 1 through 3.) Our data excludes CNP counts, which helps to explain why we observe downward (i.e., negative) development in the age-to-age factors for reported claim counts (Exhibit V, Sheet 2). For GL Insurer, we select development factors based on the volume-weighted averages for the latest three years. We judgmentally select tail factors based on the observed experience for the oldest maturities, including the ratio of closed-to-reported claim counts, and benchmark patterns for a similar portfolio of coverage. In Exhibit V, Sheet 3, we summarize the projection of ultimate closed and reported claim counts; for each accident year, we then select the ultimate number of claims, based on the average of the two projections.

Develop Disposal Rate Triangle and Select Disposal Rate by Maturity Age

The next step is to derive the disposal rate triangle. We define the *disposal rate* as the cumulative closed claim counts for each accident year-maturity age cell divided by the selected ultimate claim count for the particular accident year. We present this triangle in the top part of Exhibit V, Sheet 4. Each ratio represents the percentage of ultimate claim counts that are closed at a given stage of maturity for a given accident year.

In the middle part of Exhibit V, Sheet 4, we calculate various averages of the disposal rates by maturity age; we use the medial five-year average to select a disposal rate at each maturity age. For our example, we observe considerable stability in the disposal rates at each maturity. The following table summarizes the selected disposal rates at maturities 12 months through 96 months. We generally expect disposal rates to monotonically increase over time, as evidenced by the disposal rates in the following table.

Maturity Age (Months)	Selected Disposal Rate
12	0.200
24	0.433
36	0.585
48	0.710
60	0.791
72	0.862
84	0.882
96	0.912

Project Claim Counts by Accident Year and Maturity (Complete the Square)

In Exhibit V, Sheet 5, we use the selected disposal rates by maturity and the selected ultimate claim counts by accident year to complete the square of the incremental closed claim count triangle. Incremental claim counts in the column labeled 12 represent counts that are closed in the first 12 months from the start of the accident year. Incremental claim counts in the column labeled 24 represent the counts that are closed in the period between 12 months and 24 months. The rest of the triangle follows a similar naming pattern. (We use similar labeling in the triangle of incremental paid claims and incremental paid severities that are presented later in this chapter.)

We calculate the top left part of the "completed square" based on the differences between successive columns of the cumulative closed claim count triangle. This part of the completed square is simply the incremental closed claim count triangle based on the actual experience for GL Insurer. To calculate the bottom-right, highlighted part of the incremental closed claim count square, we first adjust the cumulative closed claim counts at the latest valuation to an ultimate basis and then apply the selected disposal rates for each age interval.

For example, for accident year *x* at age *y*, we calculate projected incremental closed claim counts as follows:

> [(ultimate claim counts for accident year *x* – cumulative closed claim counts for accident year *x* along latest diagonal) / (1.00 – selected disposal rate at maturity of latest diagonal)] x [disposal rate at *y* – disposal rate at *y-12*]

For example, the estimated incremental closed claim counts for accident year 2008 at 24 months are equal to:

[(609 – 127) / (1.000 - 0.200)] x [0.433 – 0.200] = 140

The estimated incremental closed claim counts for accident year 2005 at 84 months are:

[(588 – 403) / (1.000 – 0.710)] x [0.882 – 0.862] = 13

To differentiate the actual values from the calculated values, we highlight the bottom part of the completed square in Exhibit V, Sheet 5. In this frequency-severity approach, we derive projected ultimate claims by multiplying incremental closed claim counts by average incremental paid claims. The use of incremental claim counts and incremental severities differentiates this frequency-severity method from the other methods presented in this chapter.

Analyze Severities and Select Severities by Maturity

The next step is an analysis of paid severities. We first derive the incremental paid claim triangle from the cumulative paid claim triangle (Exhibit V, Sheet 6). We then divide the incremental paid claim triangle by the incremental closed claim count triangle to produce incremental paid severities. It is worthwhile to pause and observe the patterns in this incremental triangle of paid severities. There are significant differences in the incremental paid severities at each maturity age. In general, the paid severities increase as the claims mature. This is consistent with the common belief that smaller claims settle at a quicker rate than more complicated and costly claims. Such patterns are particularly common for long-tail lines of insurance such as U.S. general liability.

Since the paid severities for each accident year are at different cost levels, we adjust the severities to a common time period (i.e., common cost level) before we analyze the severities and make selections. For decades, actuaries have used exponential regression analyses to determine annual trend rates. One reason for the use of exponential regression analysis is because it implies a constant percentage increase in inflation. Many actuaries believe such trends tend to be most indicative of the normal inflation process. Actuaries also use weighted exponential least squares fit in order to give greater weight to more recent experience. Linear projections are rarely used due to the implied decreasing percentage trend.

In Exhibit V, Sheet 7, we summarize the results of numerous regression analyses for the incremental paid severities. To determine a severity trend, we fit many exponential curves to the incremental paid severities at each maturity age. We run a variety of combinations of years and test for the goodness-of-fit of the regression. In this exhibit, we summarize the estimated annual rate of change (i.e., trend rate) and the goodness-of-fit test (i.e., *R-squared*).[64] Based on GL Insurer's experience alone, we do not find a particularly good fit to the data. However, based on our knowledge of industry-wide experience for this particular product type, supplemented with this insurer's limited data, we select a 5% annual severity trend rate.[65] There is some evidence, based on our example, that trend rates may differ and may be greater for the older maturities. However, to simplify our example we use a single trend rate for all maturities. We recommend that you test the sensitivity of alternative trend rate assumptions at different maturities.

[64] It is important to recognize that regression with only a few data points may not be very meaningful and certainly is not very robust. The parameter estimate and *R-squared* can change dramatically by using different segments of the data, as in our example with all years versus latest six years or latest four years. An extreme example is when there are only two data points to fit; in such situations there will always be a perfect fit and 100% *R-squared*. In our example, there are only two points at 84 months. We note that the actuary must take care in interpreting the results of any regression analysis when there are limited data points.

[65] We have already addressed the challenges of using benchmark data several times in this book. We further point out that the potential difficulties in using industry-wide severity trends for general liability. The general liability line of business can include a very diverse mixture of coverages including but not limited to: excess health, employers' liability, first-dollar premises and operations, personal umbrella, contractors' liability, and environmental. Thus, it is an extremely heterogeneous line with extreme problems in claim count definition consistency and comparability due to class actions, asbestos (accounting files and account files versus claimant files), casualty deductibles, etc. When reviewing industry benchmarks for trend (or any other purpose), it is important to narrow the review to comparison with data representing similar product types and claim characteristics.

In the middle part of Exhibit V, Sheet 8, we restate all the incremental paid severities at the 2008 cost level. For example, the incremental paid severity for accident year 2007 at 12 months is \$10,086; after adjustment for trend to the 2008 cost level, the severity is \$10,590 (\$10,086 x 1.05^1). The incremental paid severity for accident year 2003 at 72 months is \$46,648; after adjustment for trend to the accident year 2008 cost level, the severity is \$59,536 (\$46,648 x 1.05^5).

We calculate various averages of the trended severities at the bottom of Exhibit V, Sheet 8. As noted, we observe an increasing pattern in the paid severities by age from 12 months through 96 months. At the bottom of Exhibit V, Sheet 8, we select incremental paid severities at the 2008 cost level for maturity ages 12 months through 60 months. Beyond this point, the data become sparse and unreliable for trending purposes. We rely on the simple average of the latest three years for our selections.

Where we begin to see variability in the trended severities, we consider combining the experience of several maturity ages. Such variability may be the result of one or more large claims that were closed at older ages. Variability is also often related to a smaller number of claims in the data set at the oldest maturity ages. By combining the experience of multiple years we seek to limit the influence of random large claims or other factors that can easily distort patterns in the severities.

In Exhibit V, Sheet 9, we review the combined experience of maturity ages 60 and older and 72 and older. We first present the triangle of incremental closed claim counts for maturities 60 through 96 months. We then summarize the incremental paid claims for these same maturities. Since the paid claims represent different cost levels, the next step is an adjustment based on the selected 5% annual severity trend to bring all payments to the 2008 cost level. The estimated trended tail severity is equal to the sum of trended claim payments divided by the sum of the incremental closed claim counts.

The importance of the selection of the tail severity (i.e., the average value for the oldest years) is similar to the selection of a tail factor for the development technique; tail factors and tail severities require substantial judgment. Considerations as to the maturity age at which to combine data for analysis of the tail factor depend on:

- The age(s) at which the results become erratic
- The influence on the total projections of selecting a particular age
- The percentage of claims expected to be closed beyond the selected maturity age

In our example, we observe greater variability in the trended severities beginning at age 60. The selected disposal rate at 60 months is 0.791; in other words, we expect more than 20% of the claim counts to remain open at this age. There are 227 incremental closed claim counts in our data set at 60 months that can be compared with only 124 at age 72 months. It is quite clear that for ages 72 months and older, the experience should be combined for the purpose of selecting an incremental tail severity. However, it is less obvious what the actuary should do at 60 months. In our example, we select an incremental trended severity of \$140,802 at 60 months based on the experience of 60-month data only. This is not very different from the estimated severity of \$144,160 for ages 60 and older developed in Exhibit V, Sheet 9. We select a trended tail severity of \$175,816 based on the combined experience of ages 72 and greater. The effect of selecting a tail severity based on the experience of 60 months and greater, would be a reduction of the unpaid claim estimate of more than 10%. This demonstrates the importance of selecting the appropriate point at which data should be combined for determining a tail severity.

In the following table, we summarize the selected severities, at the 2008 cost level, by maturity.

Maturity Age (Months)	Selected Severity at 2008 Cost Level
12	11,259
24	32,980
36	65,523
48	80,544
60	140,802
72 and older	175,816

While we have selected increasingly greater severities for GL Insurer for all maturities through 72 months, it is important to recognize that at some point in time, the average value will likely not continue to increase.

When selecting severity values, it is important for the actuary to consider the potential influence of large claims on the incremental average paid values. To avoid potential distortions due to spurious large claims, the actuary may want to consider capping claims to a predetermined value or excluding large claims in their entirety. In either case, the actuary will then need to add a provision for large claims to the estimate of unpaid claims.

Calculate Severities by Maturity Age and Accident Year (Complete the Square)

Once we have selected severity values at the 2008 accident year cost level, we are ready to complete the square for incremental paid severities. The top part of the square is equivalent to the incremental paid severity triangle. The bottom part of the square is a function of the selected severities at each particular age at the 2008 cost level and the selected trend rate. To complete the matrix shown on the bottom part of Exhibit V, Sheet 10, we must adjust the selected severities at each age to the cost level expected for each accident year. For example, for accident year 2006 at age 48 months, the severity of \$73,056 is equal to the selected 2008 cost level severity at 48 months of \$80,544 divided by 1.05^2. Similarly, for accident year 2002 at 96 months, the severity of \$131,197[66] is equal to the selected 2008 cost level severity of \$175,816 divided by 1.05^6.

Multiply Claim Counts by Severities to Determine Projected Claims

We now can multiply each accident year-maturity age cell of the two completed squares, the incremental closed claim counts and the incremental paid severities, to produce projected incremental paid claims. We cumulate the projected incremental paid claims to derive projected cumulative paid claims (i.e., projected ultimate claims). (See bottom part of Exhibit V, Sheet 11.)

Determine Unpaid Claim Estimate

In Exhibit V, Sheet 12, we calculate unpaid claim estimates in the same way that we have for all the previous methods. Estimated IBNR is equal to projected ultimate claims by accident year less

[66] Note, slight differences which exist between values in the text and values in the exhibits are due to the fact that the exhibits carry a greater number of decimals than shown.

reported claims by accident year. The total unpaid claims estimate is equal to estimated IBNR plus case outstanding.

We observe an unusually low value of IBNR for accident year 2004 (-$1,950) when compared with the immediate preceding year ($3,611) and immediate following year ($9,340). Thus, we return to the data to see if we can identify anything unusual in either the claims or the severity for this particular year. The closed claim counts in Exhibit V, Sheet 1 seem reasonable when compared with other years. We do note, however, that the paid severity for accident year 2004 at 60 months is low when compared to prior accident years at 60 months and compared to accident year 2005 at 48 months. We also note an unusually high case outstanding for accident year 2004 in comparison with other years. The estimate of total unpaid claims for 2004, however, is reasonable when compared to other years. Accident year 2003 seems to have similar issues. The incremental paid severity for accident year 2003 is unusually low when compared to other accident years, and the IBNR is lower than usual when compared to accident years 2002 and 2005.

This exemplifies the type of questioning and probing that the actuary should undertake when reviewing the results of any technique used for estimating unpaid claims. The actuary should turn to claims department management of the insurer to understand the reasons for the high value of case outstanding and the low values for average payments, and to determine if there are any factors that might preclude the use of this type of projection methodology.

Analysis for XYZ Insurer

Before we begin this frequency-severity analysis for XYZ Insurer, we recall from Chapter 6, that the closed claim counts for XYZ Insurer exclude claims closed with no payment (CNP) and that paid claims include partial payments as well as payments on closed claims. Thus, our average paid claim triangle is a combination of payments on settled claims as well as payments on claims that are still open. We must consider whether or not the volume of partial payments is significant enough such that this mismatch of dollars and claim counts results in severity values that are inappropriate for use in this type of methodology. Based on our discussions with claims department management, it is our understanding that there is not a large volume of partial payments and thus, we proceed with the analysis.[67]

In Exhibit VI, Sheets 1 through 8, we present the disposal rate method for XYZ Insurer. Similar to Approach #2, we rely on the projected ultimate claim counts derived from the reported claim count experience. In Exhibit VI, Sheet 1, we select disposal rates based on the simple average of the latest two years. We see evidence of change in the disposal rates for the latest valuations, particularly at 12, 24 and 36 months. In Exhibit VI, Sheet 2, we complete the square of projected incremental claim counts. The next step is to determine the incremental paid severities; we show this process in Exhibit VI, Sheet 3.

In Exhibit VI, Sheet 4, we select severity values at the 2008 cost level (after adjustment for trend and tort reform) by maturity age. We assume 5% severity trend for XYZ Insurer. Similar to the prior example for GL Insurer, we observe increasing severity values for each successive maturity age. As we look at the triangle of incremental paid severities, we observe that the severities along

[67] The actuary may also use paid claims on closed claims instead of total paid claims, if such data is available. Another option is to use the paid claims in the interval divided by the number of claims open at the start of the interval.

the latest diagonal are the highest value in each column for six of the eight accident years in our experience period. If we return to the questions raised in Chapter 6, we wonder whether or not the speed-up in settlement has resulted in a shift in the type of claim now being closed at each maturity age. The actuary must consider the effect of this phenomenon on the projection methodology and the true unpaid claims requirement for XYZ Insurer.

We perform a review of the tail severity in Exhibit VI, Sheet 5. We select a tail severity of $70,432 for ages 84 and 96. In Exhibit VI, Sheets 6 and 7, we present the development of projected ultimate claims by accident year-maturity age cell. Exhibit VI, Sheet 8 displays the calculation of estimated IBNR and the total unpaid claim estimate.

We compare the results of the three frequency-severity projections for XYZ Insurer with the results of the Cape Cod method, the Bornhuetter-Ferguson method, the expected claims method, and the development method in Exhibit VI, Sheet 9 (projected ultimate claims) and in Exhibit VI, Sheet 10 (estimated IBNR).

When the Frequency-Severity Techniques Work and When they Do Not

Frequency-severity techniques can be valuable in many situations. Both paid and reported claim development methods can prove unstable and inaccurate for the more recent accident years. We can address the weaknesses of these methods by separating the estimates of ultimate claims into the components of frequency and severity. For many lines of insurance, the number of claims reported is stable, and thus the projection of ultimate claim counts based on a development approach generally produces reliable estimates. Similarly, we can often estimate the severity, particularly for the more mature accident years, with greater certainty. By adjusting severities from older years by trend factors, the actuary may be able to readily develop estimates of severities for the most recent accident years. Frequency-severity projections can provide a valuable alternative for the actuary, particularly for the most recent accident years.

One of the most important advantages of a frequency-severity approach is the potential to gain greater insight into the claims process, both with respect to the rate of claims reporting and settlement and the average dollar value of claims. Another important strength of many frequency-severity methods is that they can be used with paid claims data only so that they are independent of case outstanding. Thus, changes in case outstanding philosophy or procedures will not affect the results of such techniques.

An often-cited advantage of frequency-severity based techniques is the ability to explicitly reflect inflation in the projection methodology instead of assuming that past development patterns will properly account for inflationary forces. However, the advantage of directly incorporating inflation can also be a disadvantage as the method is highly sensitive to the inflation assumption. If the inflation assumption proves incorrect, then the estimate of unpaid claims will likely also prove incorrect. We suggest that you test the sensitivity of the inflation assumption in several of the examples presented in this chapter.

One of the most common reasons that actuaries do not use frequency-severity methods is simply the unavailability of data. Another reason that many actuaries do not use these methods is because changes in the definition of claim counts, claims processing, or both can invalidate the underlying assumption that future claim count development will be similar to historical claim count development. Joseph O. Thorne discusses the influence of changes in the definition of a claim in his review of the Berquist and Sherman paper "Loss Reserve Adequacy Testing: A

Comprehensive, Systematic Approach." Mr. Thorne states: "A change in the meaning of a 'claim' can cause substantial errors in the resulting reserve estimates when relying on the projection of ultimate severity for recent accident years. These changes need not even be internal to the company. For example, changes in the waiting periods, statutes of limitation, and no-fault coverage can have a significant effect on the meaning of a 'claim' and thus on ultimate severity."[68]

These methods also rely on the mix of claims to be relatively consistent. For example, if an unusually stormy season results in numerous but minor slip-and-fall accidents, then a general liability insurer may see a significant increase in claim counts but at significantly lower average values than typically seen at that accident year maturity. This will distort a frequency-severity analysis unless an adjustment is made for the change in the mix of claim types or claim causes.

Enhancements for Frequency-Severity Techniques

We already address the importance of seasonality in one of the examples presented earlier in this chapter. The actuary should consider the influence of seasonality on both the frequency and the severity of claims. We also discuss the influence of inflation on both the number of claims and the average value of claims. Our discussions of trend with respect to the frequency-severity projection methods are intended to be an introduction to the topic only. There is a considerable body of literature within the actuarial community that addresses the topic of trend. We recommend that the actuary further his or her knowledge on this important topic and incorporate more sophisticated trending analyses into the frequency-severity techniques presented in this chapter.

As we note previously in this chapter (and other chapters), it is important to understand the data underlying the analysis of unpaid claims. This is particularly vital with respect to the type of paid claims and claim count statistics that are used in frequency-severity methods. Does the paid claims data include significant partial payments? Do you have claim count statistics for the number of paid claims or only closed claim counts? If only closed counts are available, is it reasonable to calculate an average paid value using paid claims that contain substantial partial payments? How are reopened claims treated in the claims database? In some systems, they may appear as a negative reported claim count or as a new claim. The actuary must determine, based on his or her knowledge of the claims data available and the consistency of such data over time, what types of data are most appropriate for each of the different methods.

The examples presented in this chapter ignore the effect of reopened claims. Depending on how reopened claims are handled within the insurer's systems (e.g., is the claim assigned the original claim identification number or a new claim identification number?) there could be distortions in the claim count statistics due to reopened claims. This could affect both frequency and severity indications. Reopened claims are more prevalent in some lines of insurance, such as U.S. workers compensation and Canadian automobile accident benefits, than other lines. Depending on the method in which the insurer's claims and information reporting systems handles reopened claims and the volume of reopenings, the actuary may choose to segregate reopened claims from other claims and analyze reopened claims separately.

[68] *PCAS*, 1978.

Frequency-Severity Projection as Input to Bornhuetter-Ferguson Technique

The projected ultimate claims from a frequency-severity technique are often valuable to the actuary as an alternative expected claims estimate for the Bornhuetter-Ferguson technique. An actuary working closely with management and in particular with representatives from the claims department may feel more comfortable selecting frequency and severity values than an expected claim ratio (or pure premium) value. We suggest that you calculate the unpaid claim estimate for XYZ Insurer using one of the frequency-severity projections as the expected claims with the Bornhuetter-Ferguson technique.

Chapter 11 - Frequency-Severity Technique Exhibit I
Frequency-Severity Approach 1 - Auto Collision Insurer Sheet 1
Closed Claim Counts

PART 1 - Data Triangle

Accident Half - Year	Closed Claim Counts as of (months)									
	6	12	18	24	30	36	42	48	54	60
2003-2	2,547	3,262	3,287	3,291	3,292	3,292	3,292	3,292	3,292	3,292
2004-1	2,791	3,217	3,240	3,242	3,243	3,243	3,243	3,243	3,242	
2004-2	2,099	2,677	2,695	2,697	2,697	2,698	2,698	2,698		
2005-1	2,370	2,735	2,751	2,754	2,755	2,755	2,756			
2005-2	1,966	2,609	2,630	2,634	2,634	2,634				
2006-1	2,261	2,671	2,694	2,696	2,697					
2006-2	1,949	2,637	2,659	2,662						
2007-1	2,059	2,496	2,520							
2007-2	2,083	2,732								
2008-1	2,533									

PART 2 - Age-to-Age Factors

Accident Half - Year	Age-to-Age Factors									
	6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	42 - 48	48 - 54	54 - 60	To Ult
2003-2	1.281	1.008	1.001	1.000	1.000	1.000	1.000	1.000	1.000	
2004-1	1.153	1.007	1.001	1.000	1.000	1.000	1.000	1.000		
2004-2	1.275	1.007	1.001	1.000	1.000	1.000	1.000			
2005-1	1.154	1.006	1.001	1.000	1.000	1.000				
2005-2	1.327	1.008	1.002	1.000	1.000					
2006-1	1.181	1.009	1.001	1.000						
2006-2	1.353	1.008	1.001							
2007-1	1.212	1.010								
2007-2	1.312									
2008-1										

PART 3 - Average Age-to-Age Factors

	Averages									
	6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	42 - 48	48 - 54	54 - 60	To Ult
Simple Average										
Latest 5	1.277	1.008	1.001	1.000	1.000	1.000	1.000	1.000	1.000	
Latest 3	1.292	1.009	1.001	1.000	1.000	1.000	1.000	1.000	1.000	
Medial Average										
Latest 5x1	1.284	1.008	1.001	1.000	1.000	1.000	1.000	1.000	1.000	
Volume-weighted Average										
Latest 5	1.274	1.008	1.001	1.000	1.000	1.000	1.000	1.000	1.000	
Latest 3	1.291	1.009	1.001	1.000	1.000	1.000	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection									
	6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	42 - 48	48 - 54	54 - 60	To Ult
Selected	1.292	1.009	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000
CDF to Ultimate	1.305	1.010	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Percent Closed	76.6%	99.0%	99.9%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chapter 11 - Frequency-Severity Technique Exhibit I
Frequency-Severity Approach 1 - Auto Collision Insurer Sheet 2
Reported Claim Counts

PART 1 - Data Triangle

Accident Half - Year	Reported Claim Counts as of (months) 6	12	18	24	30	36	42	48	54	60
2003-2	3,556	3,314	3,301	3,299	3,295	3,294	3,293	3,293	3,293	3,292
2004-1	3,492	3,262	3,250	3,247	3,247	3,245	3,245	3,244	3,243	
2004-2	2,980	2,712	2,704	2,702	2,700	2,700	2,699	2,699		
2005-1	2,896	2,768	2,761	2,758	2,758	2,758	2,757			
2005-2	2,814	2,650	2,640	2,639	2,638	2,636				
2006-1	2,808	2,712	2,704	2,701	2,700					
2006-2	2,799	2,675	2,670	2,668						
2007-1	2,578	2,533	2,529							
2007-2	2,791	2,778								
2008-1	3,139									

PART 2 - Age-to-Age Factors

Accident Half - Year	Age-to-Age Factors 6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	42 - 48	48 - 54	54 - 60	To Ult
2003-2	0.932	0.996	0.999	0.999	1.000	1.000	1.000	1.000	1.000	
2004-1	0.934	0.996	0.999	1.000	0.999	1.000	1.000	1.000		
2004-2	0.910	0.997	0.999	0.999	1.000	1.000	1.000			
2005-1	0.956	0.997	0.999	1.000	1.000	1.000				
2005-2	0.942	0.996	1.000	1.000	0.999					
2006-1	0.966	0.997	0.999	1.000						
2006-2	0.956	0.998	0.999							
2007-1	0.983	0.998								
2007-2	0.995									
2008-1										

PART 3 - Average Age-to-Age Factors

	Averages 6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	42 - 48	48 - 54	54 - 60	To Ult
Simple Average										
Latest 5	0.968	0.997	0.999	1.000	1.000	1.000	1.000	1.000	1.000	
Latest 3	0.978	0.998	0.999	1.000	1.000	1.000	1.000	1.000	1.000	
Medial Average										
Latest 5x1	0.968	0.998	0.999	1.000	1.000	1.000	1.000	1.000	1.000	
Volume-weighted Average										
Latest 5	0.968	0.997	0.999	1.000	1.000	1.000	1.000	1.000	1.000	
Latest 3	0.978	0.998	0.999	1.000	1.000	1.000	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	42 - 48	48 - 54	54 - 60	To Ult
Selected	0.978	0.998	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000
CDF to Ultimate	0.975	0.997	0.999	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Percent Reported	102.6%	100.3%	100.1%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chapter 11 - Frequency-Severity Technique
Frequency-Severity Approach 1 - Auto Collision Insurer
Projection of Ultimate Claim Counts

	Age of Acc.	Claim Counts				Proj. Ult. Claim Counts		Selected
Accident	Half-Year at	at 6/30/08		CDF to Ultimate		Using Dev Method with		Ult. Claim
Half-Year	6/30/08	Closed	Reported	Closed	Reported	Closed	Reported	Counts
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2003-2	60	3,292	3,292	1.000	1.000	3,292	3,292	3,292
2004-1	54	3,242	3,243	1.000	1.000	3,242	3,243	3,243
2004-2	48	2,698	2,699	1.000	1.000	2,698	2,699	2,699
2005-1	42	2,756	2,757	1.000	1.000	2,756	2,757	2,757
2005-2	36	2,634	2,636	1.000	1.000	2,634	2,636	2,635
2006-1	30	2,697	2,700	1.000	1.000	2,697	2,700	2,699
2006-2	24	2,662	2,668	1.000	1.000	2,662	2,668	2,665
2007-1	18	2,520	2,529	1.001	0.999	2,523	2,526	2,524
2007-2	12	2,732	2,778	1.010	0.997	2,759	2,770	2,764
2008-1	6	2,533	3,139	1.305	0.975	3,306	3,061	3,061
Total		27,766	28,441			28,568	28,352	28,339

Column Notes:
(2) Age of accident half-year in (1) at June 30, 2008.
(3) and (4) Based on portfolio of private passenger automobile collision experience.
(5) and (6) Based on CDF from Exhibit I, Sheets 1 and 2.
(7) = [(3) x (5)].
(8) = [(4) x (6)].
(9) = Average of (7) and (8) for all accident half-years other than 2008-1. For 2008-1, (9) = (8).

Diagnostics

Accident Half - Year	Ratio of Closed to Reported Claim Counts as of (months)									
	6	12	18	24	30	36	42	48	54	60
2003-2	0.716	0.984	0.996	0.998	0.999	0.999	1.000	1.000	1.000	1.000
2004-1	0.799	0.986	0.997	0.998	0.999	0.999	0.999	1.000	1.000	
2004-2	0.704	0.987	0.997	0.998	0.999	0.999	1.000	1.000		
2005-1	0.818	0.988	0.996	0.999	0.999	0.999	1.000			
2005-2	0.699	0.985	0.996	0.998	0.998	0.999				
2006-1	0.805	0.985	0.996	0.998	0.999					
2006-2	0.696	0.986	0.996	0.998						
2007-1	0.799	0.985	0.996							
2007-2	0.746	0.983								
2008-1	0.807									

Accident Half - Year	Reported Claims ($000) as of (months)									
	6	12	18	24	30	36	42	48	54	60
2003-2	14,235	14,960	14,921	14,911	14,926	14,864	14,860	14,854	14,850	14,847
2004-1	14,548	14,674	14,643	14,626	14,621	14,610	14,610	14,611	14,617	
2004-2	12,129	12,576	12,541	12,531	12,523	12,523	12,510	12,502		
2005-1	11,980	11,921	11,882	11,862	11,854	11,844	11,841			
2005-2	11,283	11,843	11,805	11,789	11,772	11,770				
2006-1	11,947	11,856	11,820	11,772	11,760					
2006-2	12,503	12,762	12,706	12,697						
2007-1	11,662	11,523	11,492							
2007-2	12,647	12,854								
2008-1	14,071									

Accident Half - Year	Reported Severity = (Reported Claims x 1000) / Reported Claim Counts									
	6	12	18	24	30	36	42	48	54	60
2003-2	4,003	4,514	4,520	4,520	4,530	4,512	4,513	4,511	4,510	4,510
2004-1	4,166	4,498	4,506	4,505	4,503	4,502	4,502	4,504	4,507	
2004-2	4,070	4,637	4,638	4,638	4,638	4,638	4,635	4,632		
2005-1	4,137	4,307	4,304	4,301	4,298	4,294	4,295			
2005-2	4,010	4,469	4,472	4,467	4,462	4,465				
2006-1	4,254	4,372	4,371	4,359	4,356					
2006-2	4,467	4,771	4,759	4,759						
2007-1	4,524	4,549	4,544							
2007-2	4,531	4,627								
2008-1	4,483									

Chapter 11 - Frequency-Severity Technique
Frequency-Severity Approach 1 - Auto Collision Insurer
Reported Severities

PART 1 - Data Triangle

Accident Half - Year	Reported Severities as of (months) 6	12	18	24	30	36	42	48	54	60
2003-2	4,003	4,514	4,520	4,520	4,530	4,512	4,513	4,511	4,510	4,510
2004-1	4,166	4,498	4,506	4,505	4,503	4,502	4,502	4,504	4,507	
2004-2	4,070	4,637	4,638	4,638	4,638	4,638	4,635	4,632		
2005-1	4,137	4,307	4,304	4,301	4,298	4,294	4,295			
2005-2	4,010	4,469	4,472	4,467	4,462	4,465				
2006-1	4,254	4,372	4,371	4,359	4,356					
2006-2	4,467	4,771	4,759	4,759						
2007-1	4,524	4,549	4,544							
2007-2	4,531	4,627								
2008-1	4,483									

PART 2 - Age-to-Age Factors

Accident Half - Year	Age-to-Age Factors 6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	42 - 48	48 - 54	54 - 60	To Ult
2003-2	1.128	1.001	1.000	1.002	0.996	1.000	1.000	1.000	1.000	
2004-1	1.080	1.002	1.000	1.000	1.000	1.000	1.000	1.001		
2004-2	1.139	1.000	1.000	1.000	1.000	0.999	0.999			
2005-1	1.041	0.999	0.999	0.999	0.999	1.000				
2005-2	1.115	1.001	0.999	0.999	1.001					
2006-1	1.028	1.000	0.997	0.999						
2006-2	1.068	0.997	1.000							
2007-1	1.006	0.999								
2007-2	1.021									
2008-1										

PART 3 - Average Age-to-Age Factors

	Averages 6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	42 - 48	48 - 54	54 - 60	To Ult
Simple Average										
Latest 5	1.047	0.999	0.999	0.999	0.999	1.000	1.000	1.000	1.000	
Latest 3	1.032	0.999	0.999	0.999	1.000	1.000	1.000	1.000	1.000	
Medial Average										
Latest 5x1	1.039	0.999	0.999	0.999	1.000	1.000	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 6 - 12	12 - 18	18 - 24	24 - 30	30 - 36	36 - 42	42 - 48	48 - 54	54 - 60	To Ult
Selected	1.039	0.999	0.999	0.999	1.000	1.000	1.000	1.000	1.000	1.000
CDF to Ultimate	1.036	0.997	0.998	0.999	1.000	1.000	1.000	1.000	1.000	1.000

				Projected Ultimate Using Frequency-Severity Method		
Accident Half-Year	Age of Acc. Half-Year at 6/30/08	Reported Severities at 6/30/08	CDF to Ultimate	Severities	Claim Counts	Ult. Claims ($000)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2003-2	60	4,510	1.000	4,510	3,292	14,847
2004-1	54	4,507	1.000	4,507	3,243	14,617
2004-2	48	4,632	1.000	4,632	2,699	12,502
2005-1	42	4,295	1.000	4,295	2,757	11,841
2005-2	36	4,465	1.000	4,465	2,635	11,766
2006-1	30	4,356	1.000	4,356	2,699	11,756
2006-2	24	4,759	0.999	4,754	2,665	12,670
2007-1	18	4,544	0.998	4,535	2,524	11,446
2007-2	12	4,627	0.997	4,613	2,764	12,751
2008-1	6	4,483	1.036	4,644	3,061	14,216
Total					28,339	128,413

Column Notes:
(2) Age of accident half-year in (1) at June 30, 2008.
(3) Based on portfolio of private passenger automobile collision experience.
(4) Based on CDF from Exhibit I, Sheet 6.
(5) = [(3) x (4)].
(6) Developed in Exhibit I, Sheet 3.
(7) = [(5) x (6) / 1000].

Development of Unpaid Claim Estimate ($000)

Accident Half-Year	Claims at 6/30/08 Reported	Claims at 6/30/08 Paid	Projected Ultimate Claims	Case Outstanding at 6/30/08	Unpaid Claim Estimate at 6/30/08 IBNR	Unpaid Claim Estimate at 6/30/08 Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2003-2	14,847	14,846	14,847	1	0	1
2004-1	14,617	14,614	14,617	3	0	3
2004-2	12,502	12,502	12,502	0	0	0
2005-1	11,841	11,840	11,841	1	0	1
2005-2	11,770	11,765	11,766	5	- 4	0
2006-1	11,760	11,755	11,756	6	- 4	1
2006-2	12,697	12,679	12,670	18	- 27	- 9
2007-1	11,492	11,406	11,446	86	- 46	40
2007-2	12,854	12,648	12,751	206	- 103	103
2008-1	14,071	11,833	14,216	2,239	144	2,383
Total	128,453		128,413	2,565	- 40	2,524

Column Notes:
(2) and (3) Based on portfolio of private passenger automobile collision experience.
(4) Developed in Exhibit I, Sheet 7.
(5) = [(2) - (3)].
(6) = [(4) - (2)].
(7) = [(5) + (6)].

PART 1 - Data Triangle

Accident Year	Closed Claim Counts as of (months) 12	24	36	48	60	72	84	96
2001	789	1,196	1,255	1,310	1,324	1,327	1,332	1,343
2002	978	1,506	1,609	1,629	1,669	1,676	1,683	
2003	1,070	1,557	1,665	1,721	1,738	1,748		
2004	1,029	1,525	1,618	1,688	1,717			
2005	974	1,459	1,532	1,597				
2006	1,746	2,632	2,761					
2007	1,683	2,572						
2008	1,560							

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
2001	1.515	1.050	1.044	1.011	1.002	1.004	1.008	
2002	1.539	1.069	1.012	1.025	1.004	1.004		
2003	1.456	1.069	1.034	1.009	1.006			
2004	1.483	1.061	1.043	1.017				
2005	1.498	1.050	1.042					
2006	1.507	1.049						
2007	1.528							
2008								

PART 3 - Average Age-to-Age Factors

Averages	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Simple Average								
Latest 5	1.494	1.060	1.035	1.016	1.004	1.004	1.008	
Latest 3	1.511	1.053	1.040	1.017	1.004	1.004	1.008	
Medial Average								
Latest 5x1	1.496	1.060	1.040	1.014	1.004	1.004	1.008	
Volume-weighted Average								
Latest 5	1.499	1.058	1.035	1.016	1.004	1.004	1.008	
Latest 3	1.513	1.053	1.040	1.017	1.004	1.004	1.008	

PART 4 - Selected Age-to-Age Factors

Development Factor Selection	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Selected	1.499	1.058	1.035	1.016	1.004	1.004	1.003	1.007
CDF to Ultimate	1.698	1.133	1.071	1.034	1.018	1.014	1.010	1.007
Percent Closed	58.9%	88.3%	93.4%	96.7%	98.2%	98.6%	99.0%	99.3%

Reported Claim Counts

PART 1 - Data Triangle

Accident	Reported Claim Counts as of (months)							
Year	12	24	36	48	60	72	84	96
2001	1,235	1,321	1,342	1,349	1,350	1,350	1,350	1,350
2002	1,555	1,660	1,685	1,695	1,700	1,700	1,700	
2003	1,628	1,740	1,762	1,771	1,775	1,775		
2004	1,600	1,714	1,740	1,747	1,750			
2005	1,510	1,612	1,639	1,647				
2006	2,750	2,941	2,985					
2007	2,650	2,842						
2008	2,438							

PART 2 - Age-to-Age Factors

Accident	Age-to-Age Factors							
Year	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
2001	1.070	1.016	1.005	1.001	1.000	1.000	1.000	
2002	1.068	1.015	1.006	1.003	1.000	1.000		
2003	1.069	1.013	1.005	1.002	1.000			
2004	1.071	1.015	1.004	1.002				
2005	1.068	1.017	1.005					
2006	1.069	1.015						
2007	1.072							
2008								

PART 3 - Average Age-to-Age Factors

	Averages							
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Simple Average								
Latest 5	1.070	1.015	1.005	1.002	1.000	1.000	1.000	
Latest 3	1.070	1.016	1.005	1.002	1.000	1.000	1.000	
Medial Average								
Latest 5x1	1.070	1.015	1.005	1.002	1.000	1.000	1.000	
Volume-weighted Average								
Latest 5	1.070	1.015	1.005	1.002	1.000	1.000	1.000	
Latest 3	1.070	1.015	1.005	1.002	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection							
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Selected	1.070	1.015	1.005	1.002	1.000	1.000	1.000	1.000
CDF to Ultimate	1.094	1.022	1.007	1.002	1.000	1.000	1.000	1.000
Percent Reported	91.4%	97.8%	99.3%	99.8%	100.0%	100.0%	100.0%	100.0%

Chapter 11 - Frequency-Severity Technique
Frequency-Severity Approach 2 - WC Self-Insurer
Projection of Ultimate Claim Counts

Exhibit III
Sheet 3

Accident Year	Age of Accident Year at 12/31/08	Claim Counts at 12/31/08 Closed	Claim Counts at 12/31/08 Reported	CDF to Ultimate Closed	CDF to Ultimate Reported	Proj. Ult. Claim Counts Using Dev Method with Closed	Proj. Ult. Claim Counts Using Dev Method with Reported	Selected Ult. Claim Counts
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2001	96	1,343	1,350	1.007	1.000	1,353	1,350	1,351
2002	84	1,683	1,700	1.010	1.000	1,700	1,700	1,700
2003	72	1,748	1,775	1.014	1.000	1,773	1,775	1,774
2004	60	1,717	1,750	1.018	1.000	1,748	1,750	1,749
2005	48	1,597	1,647	1.034	1.002	1,652	1,650	1,651
2006	36	2,761	2,985	1.071	1.007	2,957	3,006	2,982
2007	24	2,572	2,842	1.133	1.022	2,914	2,905	2,909
2008	12	1,560	2,438	1.698	1.094	2,649	2,667	2,658
Total		14,982	16,487			16,745	16,803	16,774

Column Notes:
(2) Age of accident year in (1) at December 31, 2008.
(3) and (4) Based on U.S. workers compensation self-insurance experience.
(5) and (6) Based on CDF from Exhibit III, Sheets 1 and 2.
(7) = [(3) x (5)].
(8) = [(4) x (6)].
(9) = [Average of (7) and (8)].

Frequency-Severity Approach 2 - WC Self-Insurer

Projection of Ultimate Frequency

	Claim Counts						
Accident Year	Selected Ultimate	Trend to 2008 at -1.00%	Trended Ultimate	Payroll ($00)	Trend to 2008 at 2.50%	Trended Payroll ($00)	Trended Ultimate Frequency
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2001	1,351	0.932	1,260	195,000	1.189	231,794	0.54%
2002	1,700	0.941	1,600	260,000	1.160	301,520	0.53%
2003	1,774	0.951	1,687	280,000	1.131	316,794	0.53%
2004	1,749	0.961	1,680	280,000	1.104	309,068	0.54%
2005	1,651	0.970	1,602	350,000	1.077	376,912	0.43%
2006	2,982	0.980	2,922	790,000	1.051	829,994	0.35%
2007	2,909	0.990	2,880	780,000	1.025	799,500	0.36%
2008	2,658	1.000	2,658	740,000	1.000	740,000	0.36%
Total	16,774		16,289	3,675,000		3,905,581	0.42%

(9) Selected frequency at 2008 level 0.36%

(10) Selected frequency at 2007 level 0.37%

<u>Column and Line Notes:</u>

(2) Developed in (9) in Exhibit III, Sheet 3.
(3) Assume -1.00% annual claim count trend.
(4) = [(2) x (3)].
(5) Based on U.S. workers compensation self-insurance experience.
(6) Assume 2.50% annual payroll trend.
(7) = [(5) x (6)].
(8) = [(4) / (7)].
(9) Judgmentally selected.
(10) = {(9) x [1 + (annual payroll trend of 2.50%)] / [1 + (annual claim count trend of -1.00%)]}.

Accident Year	Paid Claims as of (months)							
	12	24	36	48	60	72	84	96
2001	1,318,000	2,842,000	3,750,000	4,300,000	4,650,000	4,850,000	5,050,000	5,200,000
2002	1,780,000	3,817,000	5,016,000	5,750,000	6,100,000	6,300,000	6,555,000	
2003	1,890,000	4,184,000	5,500,000	6,300,000	6,800,000	7,100,000		
2004	1,900,000	4,100,000	5,560,000	6,430,000	6,950,000			
2005	1,960,000	4,290,000	5,688,000	6,570,000				
2006	4,030,000	8,650,000	11,400,000					
2007	4,200,000	9,043,000						
2008	4,170,000							

Accident Year	Paid Severities = Paid Claims / Closed Claim Counts							
	12	24	36	48	60	72	84	96
2001	1,670	2,377	2,989	3,283	3,511	3,655	3,790	3,871
2002	1,820	2,535	3,117	3,530	3,654	3,759	3,895	
2003	1,767	2,687	3,303	3,660	3,913	4,061		
2004	1,847	2,688	3,436	3,810	4,048			
2005	2,012	2,941	3,712	4,113				
2006	2,308	3,286	4,129					
2007	2,496	3,516						
2008	2,673							

Accident Year	Reported Claims as of (months)							
	12	24	36	48	60	72	84	96
2001	3,200,000	4,300,000	4,900,000	5,200,000	5,300,000	5,400,000	5,550,000	5,650,000
2002	4,300,000	5,900,000	6,600,000	6,950,000	7,200,000	7,400,000	7,500,000	
2003	4,800,000	6,600,000	7,400,000	7,800,000	8,100,000	8,300,000		
2004	4,900,000	6,700,000	7,700,000	8,150,000	8,600,000			
2005	5,200,000	7,100,000	7,900,000	8,350,000				
2006	10,100,000	13,800,000	15,500,000					
2007	10,500,000	14,400,000						
2008	10,300,000							

Accident Year	Reported Severities = Reported Claims / Reported Claim Counts							
	12	24	36	48	60	72	84	96
2001	2,591	3,255	3,651	3,855	3,926	4,000	4,111	4,185
2002	2,765	3,554	3,917	4,100	4,235	4,353	4,412	
2003	2,948	3,793	4,200	4,404	4,563	4,676		
2004	3,063	3,909	4,425	4,665	4,914			
2005	3,444	4,404	4,821	5,071				
2006	3,673	4,692	5,193					
2007	3,962	5,067						
2008	4,225							

PART 1 - Data Triangle

Accident Year	Paid Severities as of (months) 12	24	36	48	60	72	84	96
2001	1,670	2,377	2,989	3,283	3,511	3,655	3,790	3,871
2002	1,820	2,535	3,117	3,530	3,654	3,759	3,895	
2003	1,767	2,687	3,303	3,660	3,913	4,061		
2004	1,847	2,688	3,436	3,810	4,048			
2005	2,012	2,941	3,712	4,113				
2006	2,308	3,286	4,129					
2007	2,496	3,516						
2008	2,673							

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
2001	1.423	1.257	1.098	1.070	1.041	1.037	1.021	
2002	1.393	1.230	1.132	1.035	1.029	1.036		
2003	1.520	1.229	1.108	1.069	1.038			
2004	1.455	1.278	1.109	1.063				
2005	1.461	1.262	1.108					
2006	1.424	1.256						
2007	1.409							
2008								

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Simple Average								
Latest 5	1.454	1.251	1.111	1.059	1.036	1.037	1.021	
Latest 3	1.431	1.266	1.108	1.056	1.036	1.037	1.021	
Medial Average								
Latest 5x1	1.447	1.249	1.108	1.066	1.038	1.037	1.021	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Selected	1.447	1.249	1.108	1.066	1.038	1.037	1.021	1.150
CDF to Ultimate	2.698	1.864	1.493	1.347	1.264	1.218	1.174	1.150

PART 1 - Data Triangle

Accident Year	Reported Severities as of (months) 12	24	36	48	60	72	84	96
2001	2,591	3,255	3,651	3,855	3,926	4,000	4,111	4,185
2002	2,765	3,554	3,917	4,100	4,235	4,353	4,412	
2003	2,948	3,793	4,200	4,404	4,563	4,676		
2004	3,063	3,909	4,425	4,665	4,914			
2005	3,444	4,404	4,821	5,071				
2006	3,673	4,692	5,193					
2007	3,962	5,067						
2008	4,225							

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
2001	1.256	1.122	1.056	1.018	1.019	1.028	1.018	
2002	1.285	1.102	1.047	1.033	1.028	1.014		
2003	1.286	1.107	1.049	1.036	1.025			
2004	1.276	1.132	1.054	1.053				
2005	1.279	1.094	1.052					
2006	1.278	1.107						
2007	1.279							
2008								

PART 3 - Average Age-to-Age Factors

Averages	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Simple Average								
Latest 5	1.280	1.108	1.051	1.035	1.024	1.021	1.018	
Latest 3	1.278	1.111	1.052	1.041	1.024	1.021	1.018	
Medial Average								
Latest 5x1	1.278	1.105	1.052	1.035	1.025	1.021	1.018	

PART 4 - Selected Age-to-Age Factors

Development Factor Selection	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Selected	1.278	1.105	1.052	1.035	1.025	1.021	1.018	1.025
CDF to Ultimate	1.679	1.314	1.189	1.130	1.092	1.065	1.043	1.025

Accident Year	Age of Accident Year at 12/31/08	Severities at 12/31/08		CDF to Ultimate		Projected Ultimate Severities Using Dev. Method with		Selected Severity
		Paid	Reported	Paid	Reported	Paid	Reported	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2001	96	3,871	4,185	1.150	1.025	4,452	4,290	4,371
2002	84	3,895	4,412	1.174	1.043	4,573	4,601	4,587
2003	72	4,061	4,676	1.218	1.065	4,946	4,980	4,963
2004	60	4,048	4,914	1.264	1.092	5,117	5,366	5,242
2005	48	4,113	5,071	1.347	1.130	5,540	5,730	5,635
2006	36	4,129	5,193	1.493	1.189	6,164	6,174	6,169

Column Notes:
(2) Age of accident year in (1) at December 31, 2008.
(3) and (4) Based on U.S. workers compensation self-insurance experience.
(5) and (6) Based on CDF from Exhibit III, Sheets 6 and 7.
(7) = [(3) x (5)].
(8) = [(4) x (6)].
(9) = [Average of (7) and (8)].

Selection of 2008 and 2007 Severities

Accident Year	Selected Ultimate Severity	Trend to 2008 at 7.50%	Trended Ultimate Severity
(1)	(2)	(3)	(4)
2001	4,371	1.659	7,251
2002	4,587	1.543	7,079
2003	4,963	1.436	7,125
2004	5,242	1.335	7,000
2005	5,635	1.242	7,001
2006	6,169	1.156	7,129

(5) Average Trended Severity at 2008 Cost Level	
(a) All Years	7,098
(b) All Years Excl. High and Low	7,084
(c) Latest 3 Years	7,043
(6) Selected 2008 Severity	7,100
(7) Estimated 2007 Severity	6,605

Column Notes:
(2) Developed in (9) in Exhibit III, Sheet 8.
(3) Trend factors with annual severity trend of 7.50%.
(4) = [(2) x (3)].
(5) Based on (4).
(6) Judgmentally selected.
(7) = {(6) / [1 + (annual severity trend of 7.50%)]}.

Chapter 11 - Frequency-Severity Technique
Frequency-Severity Approach 2 - WC Self-Insurer
Projection of Ultimate Claims and Development of Unpaid Claim Estimate

		Accident Year	
		2007	2008
(1)	Payroll ($00)	780,000	740,000
(2)	Selected Frequency	0.37%	0.36%
(3)	Projected Ultimate Claim Counts	2,907	2,664
(4)	Selected Severity	6,605	7,100
(5)	Projected Ultimate Claims	19,200,735	18,914,400
(6)	Reported Claims at 12/31/08	14,400,000	10,300,000
(7)	Case Outstanding at 12/31/08	5,357,000	6,130,000
(8)	Estimated IBNR at 12/31/08	4,800,735	8,614,400
(9)	Unpaid Claim Estimate at 12/31/08	10,157,735	14,744,400

Line Notes:
(1) Based on U.S. workers compensation self-insurance experience.
(2) Developed in Exhibit III, Sheet 4.
(3) = [(1) x (2)].
(4) Developed in Exhibit III, Sheet 9.
(5) = [(3) x (4)].
(6) and (7) Based on U.S. workers compensation self-insurance experience.
(8) = [(5) - (6)].
(9) = [(7) + (8)].

PART 1 - Data Triangle

Accident Year	Closed Claim Counts as of (months) 12	24	36	48	60	72	84	96
2001	195	375	510	625	702	752	780	796
2002	199	349	445	508	563	594	626	
2003	106	294	383	453	499	542		
2004	126	281	377	445	494			
2005	114	249	315	403				
2006	114	229	300					
2007	79	188						
2008	127							

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
2001	1.923	1.360	1.225	1.123	1.071	1.037	1.021	
2002	1.754	1.275	1.142	1.108	1.055	1.054		
2003	2.774	1.303	1.183	1.102	1.086			
2004	2.230	1.342	1.180	1.110				
2005	2.184	1.265	1.279					
2006	2.009	1.310						
2007	2.380							
2008								

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Simple Average								
Latest 5	2.315	1.299	1.202	1.111	1.071	1.046	1.021	
Latest 3	2.191	1.306	1.214	1.107	1.071	1.046	1.021	
Medial Average								
Latest 5x1	2.265	1.296	1.196	1.109	1.071	1.046	1.021	
Volume-weighted Average								
Latest 5	2.302	1.298	1.199	1.112	1.070	1.045	1.021	
Latest 3	2.169	1.307	1.210	1.107	1.070	1.045	1.021	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Selected	2.169	1.307	1.210	1.107	1.070	1.045	1.021	1.100
CDF to Ultimate	4.769	2.199	1.682	1.390	1.256	1.174	1.123	1.100
Percent Closed	21.0%	45.5%	59.5%	71.9%	79.6%	85.2%	89.0%	90.9%

Reported Claim Counts

PART 1 - Data Triangle

Accident Year	Reported Claim Counts as of (months) 12	24	36	48	60	72	84	96
2001	1,299	1,077	1,057	965	930	917	864	870
2002	847	945	864	787	784	743	731	
2003	800	831	762	704	669	636		
2004	823	862	797	728	684			
2005	828	850	765	687				
2006	824	809	734					
2007	604	620						
2008	812							

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
2001	0.829	0.981	0.913	0.964	0.986	0.942	1.007	
2002	1.116	0.914	0.911	0.996	0.948	0.984		
2003	1.039	0.917	0.924	0.950	0.951			
2004	1.047	0.925	0.913	0.940				
2005	1.027	0.900	0.898					
2006	0.982	0.907						
2007	1.026							
2008								

PART 3 - Average Age-to-Age Factors

Averages	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Simple Average								
Latest 5	1.024	0.913	0.912	0.962	0.961	0.963	1.007	
Latest 3	1.012	0.911	0.912	0.962	0.961	0.963	1.007	
Medial Average								
Latest 5x1	1.031	0.913	0.912	0.957	0.951	0.963	1.007	
Volume-weighted Average								
Latest 5	1.024	0.913	0.912	0.963	0.963	0.961	1.007	
Latest 3	1.010	0.911	0.912	0.963	0.963	0.961	1.007	

PART 4 - Selected Age-to-Age Factors

Development Factor Selection	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Selected	1.010	0.911	0.912	0.963	0.963	0.961	1.007	1.000
CDF to Ultimate	0.753	0.746	0.818	0.897	0.932	0.968	1.007	1.000
Percent Reported	132.8%	134.0%	122.2%	111.5%	107.3%	103.3%	99.3%	100.0%

Projection of Ultimate Claim Counts

Accident Year	Age of Accident Year at 12/31/08	Claim Counts at 12/31/08		CDF to Ultimate		Proj. Ult. Claim Counts Using Dev. Method with		Selected Ult. Claim Counts
		Closed	Reported	Closed	Reported	Closed	Reported	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2001	96	796	870	1.100	1.000	876	870	873
2002	84	626	731	1.123	1.007	703	736	720
2003	72	542	636	1.174	0.968	636	616	626
2004	60	494	684	1.256	0.932	620	637	629
2005	48	403	687	1.390	0.897	560	616	588
2006	36	300	734	1.682	0.818	505	600	553
2007	24	188	620	2.199	0.746	413	463	438
2008	12	127	812	4.769	0.753	606	611	609
Total		3,476	5,774			4,919	5,150	5,035

Column Notes:
(2) Age of accident year in (1) at December 31, 2008.
(3) and (4) Based on data from GL Insurer.
(5) and (6) Based on CDF from Exhibit V, Sheets 1 and 2.
(7) = [(3) x (5)].
(8) = [(4) x (6)].
(9) = [Average of (7) and (8)].

Chapter 11 - Frequency-Severity Technique
Frequency-Severity Approach 3 - GL Insurer
Development of Disposal Rate

Exhibit V
Sheet 4

PART 1 - Disposal Rate Triangle

Accident Year	Disposal Rate as of (months) 12	24	36	48	60	72	84	96
2001	0.223	0.430	0.584	0.716	0.804	0.862	0.894	0.912
2002	0.277	0.485	0.618	0.706	0.782	0.826	0.870	
2003	0.169	0.470	0.612	0.724	0.797	0.866		
2004	0.200	0.447	0.599	0.707	0.785			
2005	0.194	0.423	0.536	0.685				
2006	0.206	0.414	0.543					
2007	0.180	0.429						
2008	0.209							

PART 2 - Average Disposal Rate Factors

	Average Disposal Rate by Maturity Age 12	24	36	48	60	72	84	96	To Ult
Simple Average									
Latest 5	0.198	0.437	0.582	0.708	0.792	0.851	0.882	0.912	
Latest 3	0.198	0.422	0.559	0.705	0.788	0.851	0.882	0.912	
Medial Average									
Latest 5x1	0.200	0.433	0.585	0.710	0.791	0.862	0.882	0.912	

PART 3 - Selected Disposal Rate Factors

	Selected Disposal Rate by Maturity Age 12	24	36	48	60	72	84	96	To Ult
Selected	0.200	0.433	0.585	0.710	0.791	0.862	0.882	0.912	1.000

Accident Year	Closed Claim Counts as of (months)							
	12	24	36	48	60	72	84	96
2001	195	375	510	625	702	752	780	796
2002	199	349	445	508	563	594	626	
2003	106	294	383	453	499	542		
2004	126	281	377	445	494			
2005	114	249	315	403				
2006	114	229	300					
2007	79	188						
2008	127							

Accident Year	Projected Incremental Closed Claim Counts (months)								
	12	24	36	48	60	72	84	96	To Ult
2001	195	180	135	115	77	50	28	16	77
2002	199	150	96	63	55	31	32	24	70
2003	106	188	89	70	46	43	12	18	54
2004	126	155	96	68	49	46	13	19	57
2005	114	135	66	88	52	45	13	19	56
2006	114	115	71	76	49	43	12	18	54
2007	79	109	67	55	36	31	9	13	39
2008	127	140	91	75	49	43	12	18	53

Accident Year	Paid Claims as of (months)							
	12	24	36	48	60	72	84	96
2001	1,119,962	4,373,268	8,398,345	13,490,793	17,372,233	22,052,662	27,359,691	29,901,361
2002	1,411,957	6,287,005	11,443,820	15,520,552	21,295,572	28,410,418	32,468,911	
2003	984,748	6,128,957	10,470,758	14,604,684	21,936,647	23,942,499		
2004	1,158,659	5,811,172	10,497,504	15,087,416	18,242,570			
2005	1,198,767	5,103,837	9,042,134	15,443,929				
2006	1,220,778	4,594,746	8,983,864					
2007	796,774	4,233,641						
2008	1,445,365							

Accident Year	Incremental Paid Claims as of (months)							
	12	24	36	48	60	72	84	96
2001	1,119,962	3,253,306	4,025,077	5,092,448	3,881,440	4,680,429	5,307,029	2,541,670
2002	1,411,957	4,875,048	5,156,815	4,076,732	5,775,020	7,114,846	4,058,493	
2003	984,748	5,144,209	4,341,801	4,133,926	7,331,963	2,005,852		
2004	1,158,659	4,652,513	4,686,332	4,589,912	3,155,154			
2005	1,198,767	3,905,070	3,938,297	6,401,795				
2006	1,220,778	3,373,968	4,389,118					
2007	796,774	3,436,867						
2008	1,445,365							

Accident Year	Incremental Closed Claim Counts as of (months)							
	12	24	36	48	60	72	84	96
2001	195	180	135	115	77	50	28	16
2002	199	150	96	63	55	31	32	
2003	106	188	89	70	46	43		
2004	126	155	96	68	49			
2005	114	135	66	88				
2006	114	115	71					
2007	79	109						
2008	127							

Accident Year	Incremental Paid Severities as of (months)							
	12	24	36	48	60	72	84	96
2001	5,743	18,074	29,815	44,282	50,408	93,609	189,537	158,854
2002	7,095	32,500	53,717	64,710	105,000	229,511	126,828	
2003	9,290	27,363	48,784	59,056	159,391	46,648		
2004	9,196	30,016	48,816	67,499	64,391			
2005	10,516	28,926	59,671	72,748				
2006	10,709	29,339	61,819					
2007	10,086	31,531						
2008	11,381							

Regression Analysis of Severities

Accident Year	Incremental Paid Severities as of (months)							
	12	24	36	48	60	72	84	96
2001	5,743	18,074	29,815	44,282	50,408	93,609	189,537	158,854
2002	7,095	32,500	53,717	64,710	105,000	229,511	126,828	
2003	9,290	27,363	48,784	59,056	159,391	46,648		
2004	9,196	30,016	48,816	67,499	64,391			
2005	10,516	28,926	59,671	72,748				
2006	10,709	29,339	61,819					
2007	10,086	31,531						
2008	11,381							

Annual Change based on Exponential Regression Analysis of Severities and Accident Year							
All Years	8.8%	5.6%	12.0%	10.9%	12.2%	-29.4%	-33.1%
Latest 6	3.8%	0.1%	12.0%	10.9%	12.2%	-29.4%	-33.1%
Latest 4	1.8%	1.6%	9.5%	5.0%	12.2%	-29.4%	-33.1%
All Years x/ 2001	6.4%	0.1%	4.9%	5.0%	-21.7%	-79.7%	0.0%
Goodness of Fit Test of Exponential Regression Analysis (R-Squared)							
All Years	78.7%	34.9%	64.4%	72.2%	8.4%	19.0%	100.0%
Latest 6	70.4%	0.0%	64.4%	72.2%	8.4%	19.0%	100.0%
Latest 4	20.8%	30.6%	85.6%	51.8%	8.4%	19.0%	100.0%
All Years x/ 2001	73.7%	0.0%	47.8%	51.8%	29.0%	100.0%	100.0%

Exhibit V
Sheet 8

Development of Trended Severities

Accident Year	Incremental Paid Severities as of (months)							
	12	24	36	48	60	72	84	96
2001	5,743	18,074	29,815	44,282	50,408	93,609	189,537	158,854
2002	7,095	32,500	53,717	64,710	105,000	229,511	126,828	
2003	9,290	27,363	48,784	59,056	159,391	46,648		
2004	9,196	30,016	48,816	67,499	64,391			
2005	10,516	28,926	59,671	72,748				
2006	10,709	29,339	61,819					
2007	10,086	31,531						
2008	11,381							

Accident Year	Trended Average Incremental Paid Claims Assuming 5% Annual Severity Trend Rate							
	12	24	36	48	60	72	84	96
2001	8,082	25,432	41,953	62,309	70,930	131,717	266,697	223,524
2002	9,508	43,554	71,986	86,718	140,711	307,567	169,962	
2003	11,857	34,923	62,262	75,372	203,427	59,536		
2004	11,177	36,485	59,336	82,045	78,268			
2005	12,173	33,486	69,077	84,215				
2006	11,806	32,346	68,155					
2007	10,590	33,107						
2008	11,381							

	Averages of the Trended Incremental Paid Severities as of (months)							
	12	24	36	48	60	72	84	96
Simple Average								
Latest 5	11,426	34,069	66,163	78,132	123,334	166,273	218,329	223,524
Latest 3	11,259	32,980	65,523	80,544	140,802	166,273	218,329	223,524
Medial Average								
Latest 5x1	11,455	33,839	66,498	80,544	109,489	131,717	218,329	223,524

	Selected Incremental Paid Severities as of (months)							
	12	24	36	48	60	72	84	96
Selected	11,259	32,980	65,523	80,544	140,802	(To be determined in Exhibit V, Sheet 9)		

Accident Year	Incremental Closed Claim Counts as of (months)			
	60	72	84	96
2001	77	50	28	16
2002	55	31	32	
2003	46	43		
2004	49			
Total	227	124	60	16

Accident Year	Incremental Paid Claims as of (months)			
	60	72	84	96
2001	3,881,440	4,680,429	5,307,029	2,541,670
2002	5,775,020	7,114,846	4,058,493	
2003	7,331,963	2,005,852		
2004	3,155,154			

Accident Year	Trended Incremental Paid Claims as of (months)			
	60	72	84	96
2001	5,461,576	6,585,834	7,467,523	3,576,385
2002	7,739,079	9,534,574	5,438,769	
2003	9,357,649	2,560,032		
2004	3,835,109			
Total	26,393,414	18,680,440	12,906,292	3,576,385

	Age 60 & Older	Age 72 & Older
(1) Total Closed Claim Counts	427	200
(2) Total Trended Paid Claims	61,556,530	35,163,116
(3) Estimated Trended Tail Severity	144,160	175,816
(4) Estimated Incremental Trended Paid Severity	140,802	166,273
(5) Selected Incremental Paid Severity	140,802	175,816

Accident Year	Incremental Paid Severities as of (months) 12	24	36	48	60	72	84	96
2001	5,743	18,074	29,815	44,282	50,408	93,609	189,537	158,854
2002	7,095	32,500	53,717	64,710	105,000	229,511	126,828	
2003	9,290	27,363	48,784	59,056	159,391	46,648		
2004	9,196	30,016	48,816	67,499	64,391			
2005	10,516	28,926	59,671	72,748				
2006	10,709	29,339	61,819					
2007	10,086	31,531						
2008	11,381							

	Selected Incremental Paid Severity at 2008 Cost Level 12	24	36	48	60	72	84	96	108+
Selected	11,259	32,980	65,523	80,544	140,802	175,816	175,816	175,816	175,816

Accident Year	Incremental Paid Severities Adjusted to Cost Level of Accident Year Assuming 5% Annual Trend Rate 12	24	36	48	60	72	84	96	108+
2001	5,743	18,074	29,815	44,282	50,408	93,609	189,537	158,854	124,949
2002	7,095	32,500	53,717	64,710	105,000	229,511	126,828	131,196	131,196
2003	9,290	27,363	48,784	59,056	159,391	46,648	137,756	137,756	137,756
2004	9,196	30,016	48,816	67,499	64,391	144,644	144,644	144,644	144,644
2005	10,516	28,926	59,671	72,748	121,630	151,876	151,876	151,876	151,876
2006	10,709	29,339	61,819	73,056	127,711	159,470	159,470	159,470	159,470
2007	10,086	31,531	62,403	76,709	134,097	167,443	167,443	167,443	167,443
2008	11,381	32,980	65,523	80,544	140,802	175,816	175,816	175,816	175,816

Accident Year	Projected Incremental Closed Claim Counts								
	12	24	36	48	60	72	84	96	108+
2001	195	180	135	115	77	50	28	16	77
2002	199	150	96	63	55	31	32	24	70
2003	106	188	89	70	46	43	12	18	54
2004	126	155	96	68	49	46	13	19	57
2005	114	135	66	88	52	45	13	19	56
2006	114	115	71	76	49	43	12	18	54
2007	79	109	67	55	36	31	9	13	39
2008	127	140	91	75	49	43	12	18	53

Accident Year	Incremental Paid Severities Adjusted to Cost Level of Accident Year Assuming 5% Annual Trend Rate								
	12	24	36	48	60	72	84	96	108+
2001	5,743	18,074	29,815	44,282	50,408	93,609	189,537	158,854	124,949
2002	7,095	32,500	53,717	64,710	105,000	229,511	126,828	131,196	131,196
2003	9,290	27,363	48,784	59,056	159,391	46,648	137,756	137,756	137,756
2004	9,196	30,016	48,816	67,499	64,391	144,644	144,644	144,644	144,644
2005	10,516	28,926	59,671	72,748	121,630	151,876	151,876	151,876	151,876
2006	10,709	29,339	61,819	73,056	127,711	159,470	159,470	159,470	159,470
2007	10,086	31,531	62,403	76,709	134,097	167,443	167,443	167,443	167,443
2008	11,381	32,980	65,523	80,544	140,802	175,816	175,816	175,816	175,816

Accident Year	Projected Incremental Paid Claims = Projected Closed Claim Counts x Projected Incremental Paid Severities								
	12	24	36	48	60	72	84	96	108+
2001	1,119,962	3,253,306	4,025,077	5,092,448	3,881,440	4,680,429	5,307,029	2,541,670	9,596,072
2002	1,411,957	4,875,048	5,156,815	4,076,732	5,775,020	7,114,846	4,058,493	3,120,609	9,153,788
2003	984,748	5,144,209	4,341,801	4,133,926	7,331,963	2,005,852	1,676,592	2,514,887	7,377,003
2004	1,158,659	4,652,513	4,686,332	4,589,912	3,155,154	6,632,371	1,868,273	2,802,410	8,220,403
2005	1,198,767	3,905,070	3,938,297	6,401,795	6,291,855	6,886,544	1,939,872	2,909,807	8,535,435
2006	1,220,778	3,373,968	4,389,118	5,556,332	6,294,164	6,889,072	1,940,584	2,910,875	8,538,568
2007	796,774	3,436,867	4,181,633	4,227,190	4,788,524	5,241,122	1,476,372	2,214,559	6,496,039
2008	1,445,365	4,625,488	5,994,988	6,060,300	6,865,055	7,513,922	2,116,598	3,174,896	9,313,030

Accident Year	Projected Cumulative Paid Claims								
	12	24	36	48	60	72	84	96	108+
2001	1,119,962	4,373,268	8,398,345	13,490,793	17,372,233	22,052,662	27,359,691	29,901,361	39,497,433
2002	1,411,957	6,287,005	11,443,820	15,520,552	21,295,572	28,410,418	32,468,911	35,589,520	44,743,308
2003	984,748	6,128,957	10,470,758	14,604,684	21,936,647	23,942,499	25,619,091	28,133,978	35,510,981
2004	1,158,659	5,811,172	10,497,504	15,087,416	18,242,570	24,874,941	26,743,214	29,545,624	37,766,027
2005	1,198,767	5,103,837	9,042,134	15,443,929	21,735,784	28,622,328	30,562,200	33,472,007	42,007,442
2006	1,220,778	4,594,746	8,983,864	14,540,196	20,834,360	27,723,432	29,664,016	32,574,891	41,113,459
2007	796,774	4,233,641	8,415,274	12,642,464	17,430,988	22,672,110	24,148,483	26,363,041	32,859,080
2008	1,445,365	6,070,853	12,065,841	18,126,141	24,991,196	32,505,117	34,621,715	37,796,611	47,109,641

Chapter 11 - Frequency-Severity Technique
Frequency-Severity Approach 3 - GL Insurer
Development of Unpaid Claim Estimate ($000)

Accident Year	Claims at 12/31/08 Reported	Claims at 12/31/08 Paid	Projected Ultimate Claims	Case Outstanding at 12/31/08	Unpaid Claim Estimate at 12/31/08 IBNR	Unpaid Claim Estimate at 12/31/08 Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2001	35,592	29,901	39,497	5,691	3,905	9,596
2002	36,330	32,469	44,743	3,861	8,414	12,274
2003	31,900	23,942	35,511	7,958	3,611	11,568
2004	39,716	18,243	37,766	21,473	- 1,950	19,523
2005	32,667	15,444	42,007	17,223	9,340	26,564
2006	27,774	8,984	41,113	18,790	13,339	32,130
2007	16,246	4,234	32,859	12,013	16,613	28,625
2008	8,216	1,445	47,110	6,771	38,894	45,664
Total	228,441	134,662	320,607	93,779	92,166	185,945

Column Notes:
(2) and (3) Based on data from GL Insurer.
(4) Developed in in Exhibit V, Sheet 11.
(5) Based on data from GL Insurer.
(6) = [(4) - (2)].
(7) = [(5) + (6)].

CHAPTER 12 – CASE OUTSTANDING DEVELOPMENT TECHNIQUE

In "Loss Reserving,"[69] Ronald Wiser describes a development approach that incorporates the historical relationships between paid claims and case outstanding. Mr. Wiser states: "The reserve development method attempts to analyze the adequacy of case reserves based on the history of payments against those case reserves." In this chapter, we present two accident year examples of Mr. Wiser's case outstanding development technique.[70] In this chapter, we refer to this technique as Approach #1. We also present an example for a self-insurer of the standard development technique applied to case outstanding in which the case outstanding development factors to ultimate are derived from industry-based benchmark reported and paid claim development factors; we refer to this example as Approach #2.

Case Outstanding Development Technique – Approach #1

Key Assumptions

Assumptions for the case outstanding development technique are similar to those for other development techniques described in this book. An additional important assumption is that claims activity related to IBNR is related consistently to claims already reported.

Common Uses

The case outstanding development technique is not used extensively by actuaries. The assumption that IBNR claim activity is related to claims already reported (i.e., development on known claims versus pure IBNR) limits its use. In other words, this method is appropriate when applied to lines of insurance for which most of the claims are reported in the first accident period. It is this requirement that makes the case outstanding development method so strong for claims-made coverages and report year analysis because the claims for a given accident year are known at the end of the accident year.

Mechanics of the Method

We use both U.S. Industry Auto and XYZ Insurer as examples of the case outstanding development technique. We begin with an explanation of the projection for U.S. Industry Auto.

In Exhibit I, Sheet 1, we summarize the development triangles for case outstanding and incremental paid claims. These are derived from the reported and paid claim triangles presented in Chapter 7. The next step is to calculate the ratio of the incremental paid claims at age *x* to the

[69] *Foundations of Casualty Actuarial Science*, 2001.

[70] The case outstanding development method can also be used with report year data; such analysis can be valuable for testing the accuracy of case outstanding on known claims over time. We refer the reader to both Wiser's "Loss Reserving" and "Loss Reserve Testing: A Report Year Approach," by W.H. Fisher and J.T. Lange (*PCAS*, 1973).

case outstanding at age *x-12*. (See Exhibit I, Sheet 2.) This ratio tells us the proportion of claims that were paid during the development interval (i.e., age *x-12* to age *x*) on the claims outstanding at the beginning of the age (i.e., age *x-12*). For example, the incremental paid claims for accident year 1998 were $14,691,785 between the 12- and 24-month age interval (labeled 24 months in our development triangle). At the end of 12 months, the case outstanding for accident year 1998 was $18,478,233. Thus, the incremental payment in the 12-to-24 month interval represents 79.5% of the case outstanding at 12 months (i.e., $14,691,785/$18,478,233). Similarly, the incremental paid claims for accident year 2004 between 24 and 36 months were $7,746,815. At the end of 24 months, the case outstanding for accident year 2004 was $11,150,459. Thus, the payment in the this interval represents 69.5% of the case outstanding at 24 months (i.e. $7,746,815/$11,150,459) In Exhibit I, Sheet 2, we present the triangle of ratios of incremental paid claims to previous case outstanding and calculate various averages of these ratios at each maturity. In our example, we select ratios based on the simple average of the latest three years. For the ratio to ultimate, we judgmentally select a ratio of 1.10. In other words, we assume that 10% more than the case outstanding at 120 months will ultimately be paid out.

In Exhibit I, Sheet 3, we calculate the ratios of the case outstanding to the previous case outstanding; these ratios are equal to the case outstanding at age *x* divided by the case outstanding at age *x-12*. For example, the case outstanding for accident year 1998 is $9,937,970 at 24 months and $18,478,233 at 12 months. Thus, the ratio of the case outstanding to the previous case outstanding at 24 months is equal to $9,937,970/$18,478,233, or 0.538. For accident year 2004, the case outstanding at 36 months is $6,316,995, and the case outstanding at 24 months is $11,150,459. Thus, the ratio of case outstanding to previous case outstanding for accident year 2004 at 36 months is 0.567 ($6,316,995/$11,150,459). At the bottom of Exhibit I, Sheet 3, we calculate various averages and select ratios based on the simple average for the latest three years. For the ratio to ultimate, we judgmentally select 0.00. In other words, we make a simplifying assumption in this example for U.S. Industry Auto that there will be no case outstanding remaining for 132 months and later.[71]

A challenge of this technique is the selection of the "to ultimate" ratios for both the ratio of incremental paid claims to previous case outstanding and the ratio of case outstanding to previous case outstanding. These concepts are not frequently used nor are there readily available benchmarks for comparison purposes.

The goal of the case outstanding development method is to project ultimate claims based on completing the square of incremental paid claims. In this method, the incremental paid claims in each interval are related to the case outstanding at the beginning of the interval. Thus, the next step is to complete the square of the case outstanding triangle. We will then be able to project the incremental paid claims using the completed square of case outstanding.

We use the selected ratios of case outstanding to previous case outstanding in Exhibit I, Sheet 3, to project the case outstanding for each accident year and age combination in Exhibit I, Sheet 4. Examples will assist in understanding the mechanics of this projection. For accident year 1999, the projected case outstanding at 120 months of $107,435 is equal to the 0.580 selected ratio at 120 months multiplied by the case outstanding at 108 months of $185,233. Similarly, for accident year 2007, the projected case outstanding at 24 months of $11,374,010 is equal to the 0.526 selected ratio at 24 months multiplied by the case outstanding at 12 months of $21,623,594. (See top section of Exhibit I, Sheet 4.)

[71] If the actuary were to choose a ratio of case outstanding to previous case outstanding greater than 0.0 beyond 120 months, the size of the projection matrices in Exhibit I, Sheet 4 would require expansion.

Now that we have the completed square of case outstanding, we can use the selected ratios of incremental paid claims to case outstanding to project incremental paid claims for all accident years and maturities. (See middle section of Exhibit I, Sheet 4.) Again, we use examples to demonstrate the calculations. To project the 2000 accident year incremental payments for 120 months (i.e., the interval 108 to 120 months is labeled 120 months in the exhibit), we multiply the 0.524 selected ratio at 120 months by the case outstanding at 108 months ($205,370 x 0.524 = $107,614). Similarly, accident year 2006 incremental paid claims at 48 months of $4,459,444 are equal to the selected ratio at 48 months of 0.714 multiplied by the case outstanding at 36 months of $6,245,721.

The highlighted cells represent the projected values; the others values are from the original data triangles for U.S. Industry Auto.

At the bottom of Exhibit I, Sheet 4, we calculate cumulative paid claims. The projected ultimate claims are equal to the last column of the cumulative paid claims. (Ultimate claims are also summarized in Column (4) of Exhibit I, Sheet 5.) We calculate estimated IBNR and the total unpaid claim estimate in Exhibit I, Sheet 5 in the same manner as that presented in the preceding chapters. Estimated IBNR is equal to projected ultimate claims minus reported claims, and the total unpaid claim estimate is equal to projected ultimate claims less paid claims. We suggest that you compare the results of the case outstanding development method with the reported and paid claim development projections from Chapter 7.

XYZ Insurer

We present the example for XYZ Insurer in Exhibit II, Sheets 1 through 5; these exhibits follow the exact same format as Exhibit I. We first present the case outstanding and incremental paid claim triangles. The next step is to calculate the ratios of incremental paid claims to previous case outstanding (Exhibit II, Sheet 2) and the ratios of case outstanding to previous case outstanding (Exhibit II, Sheet 3). As a result of the various operational and environmental changes noted in our discussions with management and our previous diagnostic review, we select ratios based on the latest two years of experience in an attempt to reflect the most current operating environment for XYZ Insurer.

In Exhibit II, Sheet 4, we complete the square for both case outstanding and incremental paid claims. Projected ultimate claims using the case outstanding development technique are based on the cumulative paid claims through all maturities. We summarize projected ultimate claims in Column (4) of Exhibit II, Sheet 5 and calculate estimated IBNR and the total unpaid claim estimate in Columns (6) and (7), respectively. We compare the results of the case outstanding development technique method with the frequency-severity method, the Cape Cod method, the Bornhuetter-Ferguson method, the expected claims method, and the development method in Exhibit II, Sheet 6 (projected ultimate claims) and in Exhibit II, Sheet 7 (estimated IBNR).

When the Case Outstanding Development Technique Works and When it Does Not

There are several limitations with the use of the case outstanding development technique. First, as noted earlier in this chapter, an important assumption underlying this method is that future IBNR is related to claims already reported. This assumption does not hold true for many P&C lines of insurance. Other limitations, also referred to earlier, are the infrequent use and the absence of benchmark data (for accident year applications of this method). Related to the infrequent use and absence of benchmarks is a lack of intuitive sense and experiential knowledge as to what ratios are appropriate at each maturity for both the incremental paid claims to previous case outstanding and the case outstanding to previous case outstanding across P&C lines of insurance.

Case Outstanding Development Technique – Approach #2

In our final example of this chapter, we assume that the only data available for our self-insurer is case outstanding. While this situation is not particularly common, it can occur, particularly for older years. The absence of historical cumulative paid claims can arise following times of transition such as mergers and acquisitions of corporations with self-insurance programs or consolidation or amalgamation of self-insured public entities. Some organizations create self-insurance programs to address insurance coverage needs that are not readily met in the commercial market. Such organizations may have complete data for the years following the start of the formal self-insurance program; however, the only information that may be available for years prior to the commencement of the self-insurance program may be current case outstanding for claims in the process of investigation and settlement.

Key Assumptions

In this example (called Self-Insurer Case Only), we use the standard development technique with case outstanding to project an estimate of total unpaid claims for a self-insured entity of general liability coverage. In Chapter 7, we described the development technique and demonstrated its use with reported and paid claims. The key assumptions presented in Chapter 7 are equally applicable in our Self-Insurer Case Only example. We use industry-based reporting and payment development patterns to derive case outstanding development patterns. Thus, we implicitly assume that claims recorded to date for the self-insurer will develop in a similar manner in the future as our industry benchmark (i.e., the historical industry experience is indicative of the future experience for the self-insurer).

Common Uses

Similar to the case outstanding development technique Approach #1, Approach #2 is also not used extensively by actuaries. When used, it is most often due to the absence of other reliable claims data for the purpose of developing an unpaid claim estimate.

Mechanics of the Method

In our Self-Insurer Case Only example, there is no available data for historical paid claims. Therefore, we are not able to create paid or reported claim development triangles based on the self-insurer’s own experience. Instead we rely on insurance industry benchmark development patterns to project the general liability case outstanding values that are available. One important difference between the development technique applied to case outstanding and the development technique applied to reported claims and paid claims is that the projected values are estimates of unpaid claims and not ultimate claims.

The projection of the unpaid claim estimates for GL Self-Insurer Case Only is presented in Exhibit III. We use the benchmark reported and paid claim development factors to ultimate to derive the development factor for case outstanding. The following presents the formula for the case outstanding development factor:

$$\frac{(\text{Reported CDF to Ultimate} - 1.00) \times (\text{Paid CDF to Ultimate})}{(\text{Paid CDF to Ultimate} - \text{Reported CDF to Ultimate})} + 1.00$$

The resulting case development factor includes provisions for case outstanding and IBNR (the broad definition of IBNR, which includes development on known claims). The estimated unpaid claims for GL self-insurer are shown in Column (6) of Exhibit III and are equal to the current estimate of case outstanding multiplied by the derived case outstanding CDF to ultimate.

Potential Limitations

There are a few potential drawbacks of this case outstanding development approach. First, by its nature, this technique is used when historical claims experience specific to the insurer (or self-insurer) is not available, and thus industry benchmarks development patterns are required. Such benchmarks may prove to be inaccurate in projecting future claims experience for the particular insurer. Furthermore, this technique is generally inappropriate for the more recent, less mature years due to the increased variability of results related to the highly leveraged nature of the derived development factors. Finally, individual large claims present in the case outstanding data can distort the results of projections based on this approach.

Chapter 12 - Case Outstanding Development Technique
U.S. Industry Auto
Case Outstanding and Incremental Paid Claims ($000)

Exhibit I
Sheet 1

Accident Year	Case Outstanding as of (months)									
	12	24	36	48	60	72	84	96	108	120
1998	18,478,233	9,937,970	5,506,911	2,892,519	1,440,783	767,842	413,097	242,778	169,222	98,117
1999	18,544,291	9,955,034	5,623,522	3,060,431	1,520,760	764,736	443,528	284,732	185,233	
2000	19,034,933	10,395,464	5,969,194	3,217,937	1,567,806	842,849	457,854	304,704		
2001	19,401,810	10,487,914	5,936,461	3,056,202	1,532,147	777,926	421,141			
2002	20,662,461	11,176,330	6,198,509	3,350,967	1,609,188	785,497				
2003	21,078,651	11,098,119	6,398,219	3,431,210	1,634,690					
2004	21,047,539	11,150,459	6,316,995	3,201,985						
2005	21,260,172	11,087,832	6,141,416							
2006	20,973,908	11,034,842								
2007	21,623,594									

Accident Year	Incremental Paid Claims as of (months)									
	12	24	36	48	60	72	84	96	108	120
1998	18,539,254	14,691,785	6,830,969	3,830,031	2,004,496	868,887	455,900	225,555	108,579	88,731
1999	20,410,193	15,680,491	7,168,718	3,899,839	2,049,291	953,511	463,714	253,051	121,726	
2000	22,120,843	16,855,171	7,413,268	4,173,103	2,172,895	1,004,821	544,233	248,891		
2001	22,992,259	17,103,939	7,671,637	4,326,081	2,269,520	1,015,365	499,620			
2002	24,092,782	17,702,531	8,108,490	4,449,081	2,401,492	1,052,839				
2003	24,084,451	17,315,161	7,670,720	4,513,869	2,346,453					
2004	24,369,770	17,120,093	7,746,815	4,537,994						
2005	25,100,697	17,601,532	7,942,765							
2006	25,608,776	17,997,721								
2007	27,229,969									

Chapter 12 - Case Outstanding Development Technique
U.S. Industry Auto
Ratio of Incremental Paid Claims to Previous Case Outstanding

Exhibit I
Sheet 2

Accident Year	Ratio of Incremental Paid Claims to Previous Case Outstanding as of (months)										
	12	24	36	48	60	72	84	96	108	120	To Ult
1998		0.795	0.687	0.695	0.693	0.603	0.594	0.546	0.447	0.524	
1999		0.846	0.720	0.693	0.670	0.627	0.606	0.571	0.428		
2000		0.885	0.713	0.699	0.675	0.641	0.646	0.544			
2001		0.882	0.731	0.729	0.743	0.663	0.642				
2002		0.857	0.726	0.718	0.717	0.654					
2003		0.821	0.691	0.705	0.684						
2004		0.813	0.695	0.718							
2005		0.828	0.716								
2006		0.858									
2007											

Averages of the Ratio of Incremental Paid Claims to Previous Case Outstanding

	12	24	36	48	60	72	84	96	108	120	To Ult
Simple Average											
Latest 5		0.836	0.712	0.714	0.698	0.638	0.622	0.553	0.437	0.524	
Latest 3		0.833	0.701	0.714	0.714	0.653	0.631	0.553	0.437	0.524	
Medial Average											
Latest 5x1		0.835	0.712	0.714	0.692	0.641	0.624	0.546	0.437	0.524	

Selected Ratio of Incremental Paid Claims to Previous Case Outstanding

	12	24	36	48	60	72	84	96	108	120	To Ult
Selected		0.833	0.701	0.714	0.714	0.653	0.631	0.553	0.437	0.524	1.100

Chapter 12 - Case Outstanding Development Technique
U.S. Industry Auto
Ratio of Case Outstanding to Previous Case Outstanding

Exhibit I
Sheet 3

Accident Year	Ratio of Case Outstanding to Previous Case Outstanding as of (months) 12	24	36	48	60	72	84	96	108	120	To Ult
1998		0.538	0.554	0.525	0.498	0.533	0.538	0.588	0.697	0.580	
1999		0.537	0.565	0.544	0.497	0.503	0.580	0.642	0.651		
2000		0.546	0.574	0.539	0.487	0.538	0.543	0.666			
2001		0.541	0.566	0.515	0.501	0.508	0.541				
2002		0.541	0.555	0.541	0.480	0.488					
2003		0.527	0.577	0.536	0.476						
2004		0.530	0.567	0.507							
2005		0.522	0.554								
2006		0.526									
2007											

Averages of the Ratio of Case Outstanding to Previous Case Outstanding

	12	24	36	48	60	72	84	96	108	120	To Ult
Simple Average											
Latest 5		0.529	0.564	0.528	0.488	0.514	0.551	0.632	0.674	0.580	
Latest 3		0.526	0.566	0.528	0.486	0.511	0.555	0.632	0.674	0.580	
Medial Average											
Latest 5x1		0.527	0.562	0.530	0.488	0.515	0.542	0.642	0.674	0.580	

Selected Ratio of Case Outstanding to Previous Case Outstanding

	12	24	36	48	60	72	84	96	108	120	To Ult
Selected		0.526	0.566	0.528	0.486	0.511	0.555	0.632	0.674	0.580	0.000

Chapter 12 - Case Outstanding Development Technique
U.S. Industry Auto
Projection of Paid Claims ($000)

Exhibit I
Sheet 4

Accident Year	Case Outstanding as of (months)										
	12	24	36	48	60	72	84	96	108	120	To Ult
1998	18,478,233	9,937,970	5,506,911	2,892,519	1,440,783	767,842	413,097	242,778	169,222	98,117	0
1999	18,544,291	9,955,034	5,623,522	3,060,431	1,520,760	764,736	443,528	284,732	185,233	107,435	0
2000	19,034,933	10,395,464	5,969,194	3,217,937	1,567,806	842,849	457,854	304,704	205,370	119,115	0
2001	19,401,810	10,487,914	5,936,461	3,056,202	1,532,147	777,926	421,141	266,161	179,393	104,048	0
2002	20,662,461	11,176,330	6,198,509	3,350,967	1,609,188	785,497	435,951	275,521	185,701	107,707	0
2003	21,078,651	11,098,119	6,398,219	3,431,210	1,634,690	835,327	463,606	292,999	197,481	114,539	0
2004	21,047,539	11,150,459	6,316,995	3,201,985	1,556,165	795,200	441,336	278,924	187,995	109,037	0
2005	21,260,172	11,087,832	6,141,416	3,242,668	1,575,936	805,304	446,943	282,468	190,384	110,422	0
2006	20,973,908	11,034,842	6,245,721	3,297,740	1,602,702	818,981	454,534	287,266	193,617	112,298	0
2007	21,623,594	11,374,010	6,437,690	3,399,100	1,651,963	844,153	468,505	296,095	199,568	115,749	0

Accident Year	Incremental Paid Claims as of (months)										
	12	24	36	48	60	72	84	96	108	120	To Ult
1998	18,539,254	14,691,785	6,830,969	3,830,031	2,004,496	868,887	455,900	225,555	108,579	88,731	107,929
1999	20,410,193	15,680,491	7,168,718	3,899,839	2,049,291	953,511	463,714	253,051	121,726	97,062	118,179
2000	22,120,843	16,855,171	7,413,268	4,173,103	2,172,895	1,004,821	544,233	248,891	133,156	107,614	131,026
2001	22,992,259	17,103,939	7,671,637	4,326,081	2,269,520	1,015,365	499,620	232,891	116,312	94,002	114,452
2002	24,092,782	17,702,531	8,108,490	4,449,081	2,401,492	1,052,839	495,649	241,081	120,403	97,307	118,477
2003	24,084,451	17,315,161	7,670,720	4,513,869	2,346,453	1,067,453	527,091	256,374	128,041	103,480	125,993
2004	24,369,770	17,120,093	7,746,815	4,537,994	2,286,217	1,016,176	501,771	244,059	121,890	98,509	119,941
2005	25,100,697	17,601,532	7,942,765	4,384,971	2,315,265	1,029,087	508,147	247,160	123,439	99,761	121,465
2006	25,608,776	17,997,721	7,735,424	4,459,444	2,354,587	1,046,564	516,777	251,357	125,535	101,455	123,528
2007	27,229,969	18,012,454	7,973,181	4,596,511	2,426,958	1,078,732	532,661	259,083	129,394	104,574	127,324

Accident Year	Cumulative Paid Claims as of (months)										
	12	24	36	48	60	72	84	96	108	120	To Ult
1998	18,539,254	33,231,039	40,062,008	43,892,039	45,896,535	46,765,422	47,221,322	47,446,877	47,555,456	47,644,187	47,752,116
1999	20,410,193	36,090,684	43,259,402	47,159,241	49,208,532	50,162,043	50,625,757	50,878,808	51,000,534	51,097,596	51,215,775
2000	22,120,843	38,976,014	46,389,282	50,562,385	52,735,280	53,740,101	54,284,334	54,533,225	54,666,381	54,773,995	54,905,021
2001	22,992,259	40,096,198	47,767,835	52,093,916	54,363,436	55,378,801	55,878,421	56,111,312	56,227,624	56,321,626	56,436,079
2002	24,092,782	41,795,313	49,903,803	54,352,884	56,754,376	57,807,215	58,302,864	58,543,944	58,664,347	58,761,654	58,880,132
2003	24,084,451	41,399,612	49,070,332	53,584,201	55,930,654	56,998,107	57,525,198	57,781,572	57,909,613	58,013,093	58,139,086
2004	24,369,770	41,489,863	49,236,678	53,774,672	56,060,889	57,077,065	57,578,836	57,822,895	57,944,785	58,043,294	58,163,235
2005	25,100,697	42,702,229	50,644,994	55,029,965	57,345,230	58,374,316	58,882,463	59,129,623	59,253,061	59,352,822	59,474,287
2006	25,608,776	43,606,497	51,341,921	55,801,366	58,155,952	59,202,517	59,719,294	59,970,651	60,096,186	60,197,641	60,321,169
2007	27,229,969	45,242,423	53,215,604	57,812,115	60,239,072	61,317,804	61,850,464	62,109,548	62,238,941	62,343,515	62,470,839

Chapter 12 - Case Outstanding Development Technique Exhibit I
U.S. Industry Auto Sheet 5
Development of Unpaid Claim Estimate ($000)

Accident Year	Claims at 12/31/07 Reported	Claims at 12/31/07 Paid	Projected Ultimate Claims	Case Outstanding at 12/31/07	Unpaid Claim Estimate Based on Case Outstanding Development Method IBNR	Unpaid Claim Estimate Based on Case Outstanding Development Method Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1998	47,742,304	47,644,187	47,752,116	98,117	9,812	107,929
1999	51,185,767	51,000,534	51,215,775	185,233	30,008	215,241
2000	54,837,929	54,533,225	54,905,021	304,704	67,092	371,796
2001	56,299,562	55,878,421	56,436,079	421,141	136,517	557,658
2002	58,592,712	57,807,215	58,880,132	785,497	287,420	1,072,917
2003	57,565,344	55,930,654	58,139,086	1,634,690	573,742	2,208,432
2004	56,976,657	53,774,672	58,163,235	3,201,985	1,186,578	4,388,563
2005	56,786,410	50,644,994	59,474,287	6,141,416	2,687,877	8,829,293
2006	54,641,339	43,606,497	60,321,169	11,034,842	5,679,830	16,714,672
2007	48,853,563	27,229,969	62,470,839	21,623,594	13,617,276	35,240,870
Total	543,481,587	498,050,368	567,757,738	45,431,219	24,276,151	69,707,370

Column Notes:
(2) and (3) Based on Best's Aggregates & Averages U.S. private passenger automobile experience.
(4) Developed in Exhibit I, Sheet 4.
(5) = [(2) - (3)].
(6) = [(4) - (2)].
(7) = [(4) - (3)].

Chapter 12 - Case Outstanding Development Technique
Self-Insurer Case Outstanding Only - General Liability
Development of Unpaid Claim Estimate

Exhibit III

Accident Year	Case Outstanding at 12/31/08	CDF to Ultimate Reported	CDF to Ultimate Paid	CDF to Ultimate Case Outstanding	Unpaid Claim Estimate
(1)	(2)	(3)	(4)	(5)	(6)
1998	500,000	1.015	1.046	1.506	753,000
1999	650,000	1.020	1.067	1.454	945,100
2000	800,000	1.030	1.109	1.421	1,136,800
2001	850,000	1.051	1.187	1.445	1,228,250
2002	975,000	1.077	1.306	1.439	1,403,025
2003	1,000,000	1.131	1.489	1.545	1,545,000
Total	4,775,000				7,011,175

Column Notes:
(2) Based on data from Self-Insurer Case Outstanding Only.
(3) and (4) From Exhibit I, Sheet 2 in Chapter 8.
(5) = {[((3) - 1) x (4)] / ((4) - (3))} + 1.
(6) = [(2) x (5)].

CHAPTER 13 – BERQUIST-SHERMAN TECHNIQUES

We have already referred frequently to the pivotal paper by Berquist and Sherman "Loss Reserve Adequacy Testing: A Comprehensive, Systematic Approach."[72] This paper, which continues to be invaluable to actuaries more than 30 years after its publication, addresses many important issues for actuaries conducting analyses of unpaid claims.

One of the many valuable contributions that arose from this paper was a methodical actuarial approach for analyzing unpaid claims for insurers who had undergone changes in operations and procedures. Berquist and Sherman present two alternatives for the actuary in addressing such situations:

- Treat problem areas through data selection and rearrangement
- Treat problem areas through data adjustment

Reacting to a Changing Environment through Data Selection and Rearrangement

Berquist and Sherman recommend that, wherever possible, the actuary should use data that is relatively unaffected by changes in the insurer's claims and underwriting procedures and operations. For example, if the insurer has experienced a change in its approach to the establishment of opening case outstanding, then the actuary may place greater reliance on methods using paid claims that will be unaffected by the changes in case outstanding. Berquist and Sherman cite the following examples for selecting alternative data to respond to potential problems related to a changing environment:

- Using earned exposures instead of the number of claims when claim count data is of questionable accuracy or if there has been a major change in the definition of a claim count.

- Substituting policy year data for accident year data when there has been a significant change in policy limits or deductibles between successive policy years.

- Substituting report year data for accident year data when there has been a dramatic shift in the social or legal climate that causes claim severity to more closely correlate with the report year than with the accident date.

- Substituting accident quarter for accident year when the rate of growth of earned exposures changes markedly, causing distortions in development factors due to significant shifts in the average accident date within each exposure period.

Another way to adjust the data for changes in operations is to divide the data into more homogeneous groups. This approach may be particularly valuable when there have been changes in the composition of business by jurisdiction, coverage, class, territory, or size of risk. We recall from Chapter 6, the discussion of homogeneity and credibility of data. While dividing the data into more homogeneous groups, the actuary must seek to retain sufficient volume of experience within each grouping to ensure the credibility of the data.

[72] *PCAS*, 1977.

Berquist and Sherman also discuss the value of grouping claims data according to the size of the claim. A shift in emphasis by the claims department affecting its propensity to settle large claims versus small claims is an example of an operational change that could affect many types of data that actuaries typically use for estimating unpaid claims. For example, greater attention to large claims could result in an overall slowdown in the rate of total claim settlements. If claims adjusters focus on the larger claims, which are typically fewer in number, more complex, and require a longer period of time to settle than small claims, the small claims may not be settled at the same rate as in the past. Furthermore, with greater attention directed at the handling of large claims, there may be a speed-up in the settlement of these particular claims that could affect both the paid claims and case outstanding triangles; if the large claims are settled earlier then the case outstanding will no longer be present in the triangle at the later maturities and the payments will appear in the triangles at earlier maturities than in the past. Also, without appropriate attention, the smaller claims may become larger claims more quickly than past experience would suggest.

Treat Problem Areas through Data Adjustment

In some circumstances, the actuary is not able to sufficiently address the effect of changes in operations through data selection and rearrangement. In these situations, Berquist and Sherman introduce two techniques for quantitative adjustments to the data prior to application of traditional development techniques. The first technique adjusts the case outstanding triangle when there have been changes in the adequacy of case outstanding. The second technique adjusts the paid claim triangle where there have been changes in the rate of claims settlement.

In the discussion below we use the same examples that were presented in the 1977 paper by Berquist and Sherman. The first example is for a portfolio of U.S. medical malpractice insurance for an experience period of 1969 to 1976 (Berq-Sher Med Mal Insurer); and the second example is a portfolio of automobile bodily injury liability also for an experience period of 1969 to 1976 (Berq-Sher Auto BI Insurer). Notwithstanding the dated nature of these examples, the concepts are equally applicable to insurers operating today. Later in this chapter, we use the Berquist-Sherman adjustments to project ultimate claims for XYZ Insurer.

Detecting Changes in the Adequacy Level of Case Outstanding and Reducing the Effect of Such Changes on Reported Claims Projections

We present the analysis for Berq-Sher Med Mal Insurer in Exhibit I, Sheets 1 through 10. In Exhibit I, Sheet 1, we present the unadjusted reported claim development triangle. Berquist and Sherman use the simple average for all years to project ultimate claims. In Exhibit I, Sheet 2, we show the unadjusted paid claim triangle; for paid claims, Berquist and Sherman use the volume-weighted average for all years to project ultimate claims. In Exhibit I, Sheet 3, we project the unadjusted reported and unadjusted paid claims to an ultimate basis. There are significant differences in these projections by accident year and in total. It is worth noting that while Berquist and Sherman show the paid claim development method in this example for demonstration purposes, it is not a reliable projection method due to the highly leveraged nature of the cumulative development factors for almost every accident year in the experience period. (The format of Exhibit I, Sheet 3 is similar to that presented in the preceding chapters.)

Testing the Assumptions of the Reported Claim Development Technique

We recall that the underlying assumption of the reported claim development technique is that claims reported to date will continue to develop in a similar manner in the future. Thus, we assume that the adequacy of the case outstanding is not changing over time or at least is relatively stable other than inflationary pressures. If there has been a change in the adequacy of case outstanding over the experience period, then the fundamental assumption of the development method does not hold and the method will most likely not produce reliable results of ultimate claims or unpaid claims.

It is very important that the actuary test the appropriateness of underlying assumptions prior to relying on the results of any particular method. There are several approaches that an actuary can use to determine if an insurer has sustained changes in case outstanding adequacy. As we discuss in Chapter 6, one of the most important sources of information for the actuary is the claims department management of the insurer. A meeting with claims department management to discuss the claims process should be a prerequisite to any analysis of unpaid claims. The actuary can also calculate various claim development diagnostic tests, including: the ratio of paid-to-reported claims, average case outstanding, average reported claim, and average paid claims. In their medical malpractice example, Berquist and Sherman compare the annual change in the average case outstanding to the annual change in the average paid claims to confirm a shift in case outstanding adequacy.

We begin our testing of the underlying assumptions in Exhibit I, Sheet 4 with a review of the average case outstanding triangle. (Note that the average case outstanding triangle is the unadjusted case outstanding divided by the open claim counts in Exhibit I, Sheet 4.) When we look down each column, we observe that the two latest points are significantly higher than the preceding values at each maturity age (i.e., the latest two diagonals are higher than prior diagonals). For example, at 24 months, the average case outstanding values for the last two accident years are $22,477 and $32,160 compared to $13,785 and $11,433 for the preceding two accident years.

We use an exponential regression analysis to determine the annual trend rate in the average case outstanding at each maturity age. We fit the average case outstanding at each maturity age with the accident year. At the bottom of Exhibit I, Sheet 4, we present the fitted trend rate and the *R-squared* test for each maturity age. The *R-squared* test provides an indication of the goodness of the exponential fit for each maturity age. We observe annual trend rates of roughly 30% for maturity ages 24 months through 72 months with *R-squared* values of 85% or greater for all of these ages.[73]

In Exhibit I, Sheet 5, we continue our testing by calculating the ratios of paid-to-reported claims and reviewing the trend rates inherent in the average paid claim triangle. If there had been an increase in the case outstanding adequacy level, which seems apparent based on a review of the average case outstanding triangle, we would expect the ratios of paid-to-reported claims to be decreasing along the latest two diagonals of the triangle. While we see some decreases in this ratio triangle, there is substantial variability and it is hard to draw definitive conclusions based on this diagnostic alone.

[73] We again remind the reader that the results of regression analyses with limited data points must be used with caution.

The test that Berquist and Sherman used to determine that there had been an increase in case outstanding adequacy is a comparison of the annual trend rates, based on regression analysis, of the average case outstanding and the average paid claims on closed counts. Since medical malpractice tends to be a line of business where partial payments are not common, the paid claim triangle can be used with the closed claim counts triangle to approximate the average paid claims on closed counts. At the bottom of Exhibit I, Sheet 5, we reproduce the average paid claims on closed count triangle from the Berquist-Sherman paper.

When we compare the annual rates of change between average case outstanding and average paid claims, we observe very different trend indications. The annual trend rate appears to be approximately 30% based on a review of the average case outstanding triangle; however, using the average paid claim triangle, the annual trend rate indications range from approximately 7% to 14%. Berquist and Sherman note that the observed trends for average paid claims are similar to industry benchmarks (at the time), and thus they conclude that the higher trends for average case outstanding are indicative of changes in case outstanding adequacy.

Mechanics of the Berquist-Sherman Case Outstanding Adjustment

The mechanics of the Berquist-Sherman adjustment for changes in case outstanding adequacy are fairly straightforward. There are, however, two decisions requiring judgment by the actuary. First, the actuary must choose a diagonal from which he or she will calculate all other values of the adjusted average case outstanding triangle. For this purpose, the most prevalent choice tends to be the latest diagonal of the average case outstanding triangle. An advantage of selecting these average case outstanding values is that the latest diagonal of the adjusted reported claim triangle will not change from the unadjusted data triangle. Second, the actuary must select an annual severity trend to adjust the average case outstanding values from the selected diagonal to all other accident year-maturity age cells in the triangle.

In the medical malpractice example, Berquist and Sherman selected the latest diagonal as the starting point and a 15% annual severity trend. (The annual trend rate was based on a review of the historical experience for the specific insurer as well as overall insurance industry experience at the time.) In Exhibit I, Sheet 6, we present the adjusted average case outstanding triangle. The last diagonal does not change from the unadjusted average case outstanding triangle which we present in Exhibit I, Sheet 4. However, we now derive all other values by formula; these shaded values differ from the original triangle. The calculations proceed within each column starting with the latest point and the selected severity trend rate. For example, the 1975 adjusted average case outstanding at 12 months of $11,329 is equal to the 1976 average case outstanding at 12 months of $13,028 divided by 1.15^1, which represents one year of trend. Similarly, we calculate the 1970 adjusted average case outstanding at 48 months of $21,873 based on the 1973 average case outstanding of $33,266 divided by 1.15^3, which represents three years of trend.

The intent of these calculations is to restate the average case outstanding triangle so that each diagonal in the triangle is at the same case outstanding adequacy level as the latest diagonal (i.e., latest valuation). To determine the adjusted reported claims, we multiply the adjusted average case outstanding by the number of open claims and then add the unadjusted paid claims. In Exhibit I, Sheet 7, we analyze the adjusted reported claim triangle and select development factors for each age-to-age maturity. At the bottom of this exhibit, we compare the selected development factors from the unadjusted reported claim triangle to those selected for the adjusted reported claim triangle. We note that the selected development factor is lower based on adjusted data than on unadjusted data for all age-to-age maturities except 12-to-24 months. This is consistent with our belief that the case outstanding adequacy had increased in recent years and an unadjusted reported claim development projection would overstate future claim development.

In Exhibit I, Sheet 8, we repeat the claim development projections based on unadjusted reported and paid claims data. We also add the projection based on the adjusted reported claims. As expected, the projected ultimate claims based on the adjusted reported claim triangle are significantly less than the ultimate claims produced by the unadjusted data. To demonstrate the significant effect on the estimate of unpaid claims of this type of data adjustment, we calculate estimated IBNR and the total unpaid claim estimate in Exhibit I, Sheet 9 using all three projection methods (i.e., unadjusted reported claims, unadjusted paid claims, and adjusted reported claims). We summarize the totals in the following table.

Claims Data Type	**Estimated IBNR Total All Years ($ millions)**	**Total Unpaid Claim Estimate Total All Years ($ millions)**
Unadjusted Reported	470	747
Unadjusted Paid	284	560
Adjusted Reported	154	431

Because these three methods produce such dramatically different results, the actuary would likely seek alternative methods and additional information to determine which is, in fact, the most appropriate estimate of unpaid claims or whether another estimation method may be more appropriate. In many situations, actuaries summarize the results of numerous methodologies and select a final estimate of unpaid claims that they believe is most appropriate based on the insurer's particular circumstances. (See Chapter 15 – Evaluation of Techniques for further discussion.)

Potential Difficulty with the Adjustment

In his review of the Berquist and Sherman paper, Joseph Thorne comments on the importance of the estimation of the underlying trend in severity. He states: "The estimation of the underlying trend in severity requires much care due to the sensitivity of the reserve estimates to the selected rate, and due to the substantial judgment often necessary."[74] In his review, he presents a graph depicting the sensitivity of the unpaid claim estimate to the assumed rate of growth in the average outstanding claim cost. We reproduce this graph in Exhibit I, Sheet 10. He notes that estimating severity trends for medical malpractice is complicated by the following factors:

- The slow payment of claims substantially reduces the data available by accident year (less than 3% of ultimate claims are paid during the first 24 months and less than 30% during the first 60 months)

- Severity trends can be distorted by irregular settlements and variation in the rate of claims closed without payment

He concludes: "The degree of judgment necessary in the estimation of the severity trend makes this substantial effect on the loss reserve estimate particularly critical." While the CAS published Thorne's review in 1978, his comments are equally applicable today.

[74] *PCAS*, 1978

Detecting Changes in the Rate of Settlement of Claims and Adjusting Paid Claims for Such Changes

Berquist and Sherman also present a technique to adjust the paid claim development method for changes in settlement rates. We reproduce the Berq-Sher Auto BI Insurer example in Exhibit II, Sheets 1 through 12. In Exhibit II, Sheet 1, we present the unadjusted paid claim development triangle analysis; we include this analysis for comparison purposes with the Berquist-Sherman adjusted paid claim triangle. Berquist and Sherman use the volume-weighted average for all years to project ultimate claims.

Similar to the previous example, we test the data to determine if the rate of claims settlement is consistent for the reviewed line over the experience period (i.e., the underlying assumption of the paid claim development technique). In Exhibit II, Sheet 2, we summarize closed and reported claim counts and the ratio of closed-to-reported claim counts. When we look down each column of the ratio triangle, we readily see evidence of a steady decrease in the rate of claim settlement over the experience period. Thus, the primary assumption of the paid claim development method does not appear to hold true for Berq-Sher Auto BI Insurer, and the method would likely understate the true value required for unpaid claims.

Mechanics of the Berquist-Sherman Paid Claim Development Adjustment

The first step of the Berquist-Sherman paid claims adjustment is to determine the disposal rates by accident year and maturity. Berquist and Sherman use the same definition of disposal rates as that presented in the final frequency-severity approach of Chapter 11. (It is worthwhile to note that the definition of disposal rate differs among different authors in published actuarial papers.) To determine the disposal rates, we first project the number of ultimate claims based on reported claim counts (Exhibit II, Sheets 3 and 4). The disposal rate is equal to the cumulative closed claim counts for each accident year-maturity age cell divided by the ultimate claim counts for the particular accident year. Upon review of the disposal rates (top part of Exhibit II, Sheet 5), we see evidence of a decrease in the rate of claims settlement for Berq-Sher Auto BI Insurer.

Berquist and Sherman select the claims disposal rate along the latest diagonal as the basis for adjusting the closed claim count triangle. An advantage of selecting the latest diagonal as the starting point is that the latest diagonal of the adjusted paid claim triangle will not change from the unadjusted paid claim triangle.

We multiply the selected disposal rate for each maturity by the ultimate number of claims to determine the adjusted triangle of closed claim counts. For example, the adjusted closed claim counts for accident year 1974 at 12 months of 3,379[75] is equal to the selected disposal rate at 12 months of 0.433 multiplied by the projected ultimate claim counts for accident year 1974 of 7,803. Similarly, the adjusted closed claim counts for accident year 1971 at 60 months of 9,716[76] is equal to the selected disposal rate at 60 months of 0.977 multiplied by the projected ultimate claim counts for accident year 1971 of 9,945. The last diagonal in the adjusted closed claim count triangle in Exhibit II, Sheet 5 is the same as the unadjusted closed claim count triangle presented

[75] Note, slight differences which exist between values in the text and values in the exhibits are due to the fact that the exhibits carry a greater number of decimals than shown.

[76] Note, slight differences which exist between values in the text and values in the exhibits are due to the fact that the exhibits carry a greater number of decimals than shown.

in Exhibit II, Sheet 2. We highlight all other values in the triangle to indicate that they are adjusted, not actual values.

Berquist and Sherman then use regression analysis to identify a mathematical formula that approximates the relationship between the cumulative number of closed claims (X) and cumulative paid claims (Y). Using the automobile BI data, Berquist and Sherman find that a curve of the form $Y = ae^{(bX)}$ fits exceptionally well. We conduct the regression analysis for the oldest three accident years. In Exhibit II, Sheet 6, we present the results of this analysis for accident years 1969, 1970, and 1971, including the *R-squared* value and the estimated *a* and *b* values.

Since exponential curves closely approximate the relationship between cumulative closed claim counts and cumulative paid claims, Berquist and Sherman suggest that fitting exponential curves for every pair of two successive points is appropriate as the basis for adjusting paid claims. For ease of illustration, we reproduce triangles for unadjusted closed claim counts, unadjusted paid claims, and adjusted closed claim counts on the left side of Exhibit II, Sheet 7. We show the estimated parameters *a* and *b* for all two-point exponential regressions on the right side. For example, the exponential regression for accident year 1969 between ages 12 and 24, such that X = (4,079; 6,616) and Y = (1,904; 5,398), would result in a = 356 and b = 0.000411, which we place in the age 24 cell.

After estimating all parameter values, we can then proceed with adjusting the paid claims. We adjust paid claims based on the modifications that we have made to the closed claim count triangle earlier. In general, there are three kinds of treatments: no adjustment, interpolation, and extrapolation. Since adjusted closed claim counts are the same as unadjusted closed claim counts along the latest diagonal, the latest diagonal of the paid claim triangle does not require any adjustment. If the number of adjusted closed claims is within the range of any regression in its specific accident year, we use interpolation. For example, accident year 1970 at age 48 has 8,231 adjusted closed claims, which is within the range of unadjusted closed claims between ages 36 and 48 (7,899; 8,291), then the paid claims for accident year 1970 at age 48 would be adjusted based on such regression with a = 215 and b = 0.000468. Therefore, the adjusted paid claims for accident year 1970 at age 48 are equal to {215 x [$e^{(0.000468 \text{ x } 8{,}231)}$]} = 10,156. On the other hand, if the number of adjusted closed claims is not within the range of all regression in its specific accident year, then extrapolation would be used to the regression that has the closest range. For example, accident year 1969 at age 12 has 3,383 adjusted closed claim counts, in which the regression between ages 12 and 24 has the closest unadjusted closed claim count range (4,079; 6,616) among all regressions in year 1969. Therefore, the adjusted paid claims for year 1969 at age 12 is calculated as {356 x [$e^{(0.000411 \text{ x } 3{,}383)}$]} = 1,431.

In Exhibit II, Sheet 8, we analyze the adjusted paid claim development triangle and select development factors for each age-to-age maturity. At the bottom of this exhibit, we compare the selected development factors from the unadjusted paid claim triangle to those selected for the adjusted paid claim triangle. For both the adjusted and unadjusted paid claim development triangles, we select factors based on the volume-weighted average for all years. We note that at all age-to-age maturities except 72-to-84 and 84-to-96 months, the selected development factors are higher based on the adjusted data than on the unadjusted data. This is consistent with our belief that the rate of claims settlement has decreased in recent years and an unadjusted paid claim development projection would understate future claim development and the estimate of unpaid claims.

In their 1977 paper, Berquist and Sherman present numerous alternatives for the derivation of claim development factors. We continue the example for Berq-Sher Auto BI Insurer with two additional approaches for determining claim development factors for the adjusted paid claim triangle. The first approach, presented in Exhibit II, Sheet 9, is based on a linear regression of the claim development factors at each maturity age with the accident year. We show the *Y* intercepts, slope, and *R-squared* values for each maturity age. The second approach, shown in Exhibit II, Sheet 10, is similar to the first except that the development factors are derived using an exponential regression analysis rather than a linear regression analysis. As we see in the middle section of both Sheets, the *R-squared* values are never greater than 75% for any maturity age. We use the extrapolated claim development factors to complete the age-to-age triangles in order to derive the ultimate claim development factor for each accident year.[77]

In Exhibit II, Sheet 11, we project ultimate claims based on the unadjusted and adjusted paid claim development triangles. The projections based on the unadjusted paid claim triangle rely on the all-year volume-weighted average age-to-age factors. For the adjusted paid claims, we project claims using the all-year volume-weighted average as well as the development factors derived from the linear and exponential regression analyses. In Exhibit II, Sheet 12, we calculate the unpaid claim estimates based on the results of the four claims projections. The estimated IBNR based on the adjusted paid claims projections are relatively close to one another; these estimates are all roughly $10 million greater than the estimates from the unadjusted development technique.

Potential Difficulty with the Adjustment

A key assumption in the Berquist-Sherman paid claims adjustment is that a higher percentage of closed claim counts relative to ultimate claim counts is associated with a higher percentage of ultimate claims paid. Joseph O. Thorne, in his review of the Berquist-Sherman paper, notes: "Lack of recognition of the settlement patterns *by size of loss* can be an important source of error … it may be necessary to modify the technique to apply to size of loss categories adjusted for 'inflation'." Thorne presents a detailed example in which the number of small claims (limited to $3,000) is steadily decreasing and the number of larger claims (limited to $20,000) is steadily increasing. He shows that the percentage of closed claim counts decreases and yet the percentage of paid claims increases due to the shift to settling larger claims. Thus, he notes that the Berquist-Sherman technique actually adjusts paid claims to be less comparable among accident years and increases the error in the estimate of unpaid claims. He concludes: "Although the example is hypothetical, it was selected recognizing the recent trend toward an increasing proportion of severe, late closing claims in many lines of business and demonstrates the hazards of not recognizing settlement patterns by size of loss."[78]

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[77] We note that actuaries must take care when extrapolating development patterns particularly for high maturity ages where data is thin. For volatile age-to-age factors, extrapolation can lead to unreasonable estimates of age-to-age factors.

[78] *PCAS*, 1978.

XYZ Insurer

In previous chapters, we discuss the numerous operational and environmental changes that XYZ Insurer has been subject to in recent years. Therefore, we conclude that both Berquist-Sherman adjustments are appropriate for XYZ Insurer. For this example, we prepare three separate projections:

— Adjustment due to changes in case outstanding adequacy only
— Adjustment for changes in settlement rate only
— Adjustments for both the change in case outstanding adequacy and settlement rates

The first step of the adjustment for changes in case outstanding adequacy is the determination of the severity trend rate. In Exhibit III, Sheet 1, we analyze the average paid claims (using unadjusted data). We perform exponential regression analyses at each maturity age. Based on this analysis and our knowledge of the insurance industry's experience for this line of business, we select a 5% severity trend rate for XYZ Insurer. We do not observe any significant differences in the trend rate by maturity age for ages 24 through 72 months; thus, we use the 5% severity trend rate for all maturities.

In the top part of Exhibit III, Sheet 2, we present the adjusted average case outstanding triangle. We use the latest diagonal as the starting point and the selected 5% severity trend rate to develop this triangle. In the bottom part of Exhibit III, Sheet 2, we summarize the adjusted reported claim development triangle. Adjusted reported claims are equal to the adjusted average case outstanding triangle multiplied by the number of open claims and then added to the paid claims for each accident year-maturity age cell. We follow this approach for ages 12 months through 84 months.

For the most mature ages (i.e., ages 96 months through 132 months), we judgmentally assume that the unadjusted reported claim triangle is appropriate without any adjustment, although the method can be applied to all claim maturities. For claims at these older maturities, we expect that the claims department has complete information and thus the case outstanding amounts for these claims are adequate. This is an example of how actuarial judgment influences the application of a mechanical projection methodology for a specific insurer.

We analyze the adjusted reported claim development triangle (case adjustment only) in Exhibit III, Sheet 3. At the 12-to-24 month interval, we observe a persistent downward trend in the age-to-age factors. A similar pattern, though not quite as pronounced, also exists at 24 months. This leads us to question whether or not the trend rate is appropriate, particularly for these two maturity ages. We also return to an issue raised earlier about a potential shift in the type of claim that is now closed at 12 and 24 months. This could have a distorting effect on this projection methodology.

We select claim development factors based on the volume-weighted three-year average to recognize the decreasing age-to-age factors in the most recent diagonals. We compare the estimated average age-to-age factors with our selected factors based on the unadjusted reported claim triangle (from Chapter 7). As expected, the estimated average age-to-age factors for most maturities are less than those based on the unadjusted claims. This is consistent with our expectation since we believe that case outstanding strengthening has occurred at XYZ Insurer; thus, an unadjusted reported claim development method would likely result in an overstated estimate of unpaid claims. When selecting claim development factors, we rely on the latest three-year volume-weighted average for ages 12-to-24, 24-to-36, and 36-to-48. We judgmentally select a factor of 1.000 for all remaining intervals to smooth out the variability seen in the average age-to-age factors. In practice, actuarial judgment plays a vital role in the selection of claim development factors.

In Exhibit III, Sheet 4, we begin the adjustment process for changes in claims settlement rates. We select disposal rates based on the last diagonal of closed claim counts divided by the projected ultimate reported claim counts. (We developed the projected ultimate reported claim counts in Chapter 11.) We follow the same approach that is described for Berq-Sher Auto BI Insurer. Exhibits III, Sheets 5 and 6, which provide for the derivation of adjusted paid claims, follow the same format as the previous example.

We analyze the adjusted paid claim development triangle in Exhibit III, Sheet 7. We select claim development factors based on the five-year volume-weighted average and compare these selected factors to those selected in Chapter 7 based on the unadjusted paid claim triangle. For most maturity ages, the selected development factors based on the adjusted paid claims are less than those based on the unadjusted claims. This is consistent with our expectations since we believe that the rate of settlement has increased, and thus, an unadjusted paid claim development method would likely result in an overstated unpaid claim estimate.

Our last projection for XYZ Insurer adjusts the data for changes in both case outstanding adequacy and the rate of claims settlement. Since we know that there have been changes in the rate of claims settlement for XYZ Insurer, we question the first projection, which is a case outstanding only adjustment. In our final projection, we use both an adjusted average paid claim triangle and the adjusted average case outstanding triangle. There is one new adjusted triangle we need to create for this projection: the adjusted number of open claims. We derive the adjusted open claim count triangle by subtracting the adjusted closed claim count triangle from reported claim counts. The adjusted reported claim triangle is then equal to:

{[(adjusted average case outstanding) x (adjusted open claim counts)] + (adjusted paid claims)}

We analyze this adjusted reported claim triangle in Exhibit III, Sheet 9. We present the unadjusted selected claim development factors as well as the selected claim development factors from the case outstanding only adjustment. We note that the average age-to-age factors tend to be between these two sets of selected claim development factors. In Exhibit III, Sheet 9, we select claim development factors based on the three-year volume-weighted average through 72 months; to smooth the indications for the older maturities, we select a claim development factor of 1.00 for all remaining age intervals.

In Exhibit III, Sheets 10 and 11, we project ultimate claims and derive estimates of unpaid claims, respectively, based on the three Berquist-Sherman adjustments to reported and paid claims. We quickly see that all three projections are relatively close to one another for all accident years. In Exhibit III, Sheets 12 and 13, we compare the results of the Berquist-Sherman projections with all the other techniques presented for XYZ Insurer. In Exhibit III, Sheet 12, we compare projected ultimate claims and in Exhibit III, Sheet 13, we compare estimated IBNR.

We observe significant differences when we compare the estimates of total unpaid claims based on the unadjusted development technique to the unpaid claim estimates based on the development technique applied to adjusted claims data. In the following table, we summarize these estimates of unpaid claims.

($ Millions)	**Estimated IBNR**	**Total Unpaid Claim Estimate**
Unadjusted Reported Claims	65	184
Unadjusted Paid Claims	155	274
Adjusted (Case Only) Reported Claims	27	146
Adjusted (Case and Settlement) Reported Claims	40	159
Adjusted Paid Claims	36	155

In Chapter 15, we address the evaluation and selection of ultimate claims for many of our examples, including XYZ Insurer.

The actuary may also want to consider whether or not the results of the Berquist-Sherman analyses should be reflected in a revised Bornhuetter-Ferguson projection for XYZ Insurer. Specifically, the adjusted reporting and payment patterns could be used in place of the unadjusted reporting and payment patterns, and any changes in the expected claim ratios due to Berquist-Sherman indications could also be considered in the initial expected claims.

Unadjusted Reported Claims

PART 1 - Data Triangle

Accident Year	Unadjusted Reported Claims as of (months) 12	24	36	48	60	72	84	96
1969	2,897,000	5,160,000	10,714,000	15,228,000	16,611,000	20,899,000	22,892,000	23,506,000
1970	4,828,000	10,707,000	16,907,000	22,840,000	26,211,000	31,970,000	32,216,000	
1971	5,455,000	11,941,000	20,733,000	30,928,000	42,395,000	48,377,000		
1972	8,732,000	18,633,000	32,143,000	57,196,000	61,163,000			
1973	11,228,000	19,967,000	50,143,000	73,733,000				
1974	8,706,000	33,459,000	63,477,000					
1975	12,928,000	48,904,000						
1976	15,791,000							

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
1969	1.781	2.076	1.421	1.091	1.258	1.095	1.027	
1970	2.218	1.579	1.351	1.148	1.220	1.008		
1971	2.189	1.736	1.492	1.371	1.141			
1972	2.134	1.725	1.779	1.069				
1973	1.778	2.511	1.470					
1974	3.843	1.897						
1975	3.783							

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Simple Average								
All Years	2.532	1.921	1.503	1.170	1.206	1.052	1.027	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108
Selected	2.532	1.921	1.503	1.170	1.206	1.052	1.027	1.000
CDF to Ultimate	11.145	4.402	2.291	1.524	1.303	1.080	1.027	1.000
Percent Reported	9.0%	22.7%	43.6%	65.6%	76.7%	92.6%	97.4%	100.0%

Unadjusted Paid Claims

PART 1 - Data Triangle

Accident Year	Unadjusted Paid Claims as of (months) 12	24	36	48	60	72	84	96
1969	125,000	406,000	1,443,000	2,986,000	4,467,000	8,179,000	12,638,000	15,815,000
1970	43,000	529,000	2,016,000	3,641,000	7,523,000	14,295,000	18,983,000	
1971	295,000	1,147,000	2,479,000	5,071,000	11,399,000	17,707,000		
1972	50,000	786,000	3,810,000	9,771,000	18,518,000			
1973	213,000	833,000	3,599,000	11,292,000				
1974	172,000	1,587,000	6,267,000					
1975	210,000	1,565,000						
1976	209,000							

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
1969	3.248	3.554	2.069	1.496	1.831	1.545	1.251	
1970	12.302	3.811	1.806	2.066	1.900	1.328		
1971	3.888	2.161	2.046	2.248	1.553			
1972	15.720	4.847	2.565	1.895				
1973	3.911	4.321	3.138					
1974	9.227	3.949						
1975	7.452							

PART 3 - Average Age-to-Age Factors

Averages	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Volume-weighted Average								
All Years	6.185	3.709	2.455	1.952	1.718	1.407	1.251	

PART 4 - Selected Age-to-Age Factors

Development Factor Selection	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108
Selected	6.185	3.709	2.455	1.952	1.718	1.407	1.251	1.486
CDF to Ultimate	494.097	79.886	21.538	8.773	4.495	2.616	1.859	1.486
Percent Paid	0.2%	1.3%	4.6%	11.4%	22.2%	38.2%	53.8%	67.3%

Projection of Ultimate Claims Using Development Technique and Unadjusted Data

Accident Year	Age of Accident Year at 12/31/76	Claims at 12/31/76		CDF to Ultimate		Projected Ultimate Claims Using Dev. Method with	
		Reported	Paid	Reported	Paid	Reported	Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1969	96	23,506,000	15,815,000	1.000	1.486	23,506,000	23,501,090
1970	84	32,216,000	18,983,000	1.027	1.859	33,085,832	35,289,397
1971	72	48,377,000	17,707,000	1.080	2.616	52,247,160	46,321,512
1972	60	61,163,000	18,518,000	1.303	4.495	79,695,389	83,238,410
1973	48	73,733,000	11,292,000	1.524	8.773	112,369,092	99,064,716
1974	36	63,477,000	6,267,000	2.291	21.538	145,425,807	134,978,646
1975	24	48,904,000	1,565,000	4.402	79.886	215,275,408	125,021,590
1976	12	15,791,000	209,000	11.145	494.097	175,990,695	103,266,273
Total		367,167,000	90,356,000			837,595,383	650,681,634

Column Notes:
(2) Age of accident year in (1) at December 31, 1976.
(3) and (4) Based on data from Berq-Sher Med Mal Insurer.
(5) and (6) Based on CDF from Exhibit I, Sheets 1 and 2.
(7) = [(3) x (5)].
(8) = [(4) x (6)].

Accident Year	Unadjusted Case Outstanding as of (months) 12	24	36	48	60	72	84	96
1969	2,772,000	4,754,000	9,271,000	12,242,000	12,144,000	12,720,000	10,254,000	7,691,000
1970	4,785,000	10,178,000	14,891,000	19,199,000	18,688,000	17,675,000	13,233,000	
1971	5,160,000	10,794,000	18,254,000	25,857,000	30,996,000	30,670,000		
1972	8,682,000	17,847,000	28,333,000	47,425,000	42,645,000			
1973	11,015,000	19,134,000	46,544,000	62,441,000				
1974	8,534,000	31,872,000	57,210,000					
1975	12,718,000	47,339,000						
1976	15,582,000							

Accident Year	Open Claim Counts as of (months) 12	24	36	48	60	72	84	96
1969	749	840	1,001	1,206	1,034	765	533	359
1970	660	957	1,149	1,350	1,095	755	539	
1971	878	1,329	1,720	1,799	1,428	1,056		
1972	1,043	1,561	1,828	1,894	1,522			
1973	1,088	1,388	1,540	1,877				
1974	1,033	1,418	1,663					
1975	1,138	1,472						
1976	1,196							

Accident Year	Unadjusted Average Case Outstanding as of (months) 12	24	36	48	60	72	84	96
1969	3,701	5,660	9,262	10,151	11,745	16,627	19,238	21,423
1970	7,250	10,635	12,960	14,221	17,067	23,411	24,551	
1971	5,877	8,122	10,613	14,373	21,706	29,044		
1972	8,324	11,433	15,499	25,040	28,019			
1973	10,124	13,785	30,223	33,266				
1974	8,261	22,477	34,402					
1975	11,176	32,160						
1976	13,028							
Annual Change based on Exponential Regression Analysis of Severities and Accident Year	15.6%	29.5%	31.1%	34.2%	33.0%	32.2%	27.6%	
Goodness of Fit Test of Exponential Regression Analysis (R-Squared)	80.0%	89.5%	85.8%	94.1%	98.9%	98.3%	100.0%	

Chapter 13 - Berquist-Sherman Techniques
Berq-Sher Med Mal Insurer
Development Triangles - Unadjusted Data

Exhibit I
Sheet 5

Accident Year	Unadjusted Paid Claims as of (months)							
	12	24	36	48	60	72	84	96
1969	125,000	406,000	1,443,000	2,986,000	4,467,000	8,179,000	12,638,000	15,815,000
1970	43,000	529,000	2,016,000	3,641,000	7,523,000	14,295,000	18,983,000	
1971	295,000	1,147,000	2,479,000	5,071,000	11,399,000	17,707,000		
1972	50,000	786,000	3,810,000	9,771,000	18,518,000			
1973	213,000	833,000	3,599,000	11,292,000				
1974	172,000	1,587,000	6,267,000					
1975	210,000	1,565,000						
1976	209,000							

Accident Year	Ratio of Unadjusted Paid Claims to Reported Claims as of (months)							
	12	24	36	48	60	72	84	96
1969	0.043	0.079	0.135	0.196	0.269	0.391	0.552	0.673
1970	0.009	0.049	0.119	0.159	0.287	0.447	0.589	
1971	0.054	0.096	0.120	0.164	0.269	0.366		
1972	0.006	0.042	0.119	0.171	0.303			
1973	0.019	0.042	0.072	0.153				
1974	0.020	0.047	0.099					
1975	0.016	0.032						
1976	0.013							

Accident Year	Unadjusted Average Paid Claims as of (months)							
	12	24	36	48	60	72	84	96
1969	402	539	2,971	8,620	9,199	12,669	17,084	16,634
1970	110	919	5,487	9,129	12,403	18,452	19,533	
1971	706	1,115	5,644	4,928	12,994	14,948		
1972	161	862	5,782	9,477	14,085			
1973	724	541	4,003	11,709				
1974	518	1,394	7,635					
1975	517	1,494						
1976	525							
Annual Change based on Exponential Regression Analysis of Severities and Accident Year								
	12.9%	12.0%	11.5%	6.7%	14.2%	8.6%	14.3%	
Goodness of Fit Test of Exponential Regression Analysis (R-Squared)								
	18.3%	35.3%	37.9%	10.1%	84.6%	19.3%	100.0%	

Chapter 13 - Berquist-Sherman Techniques Exhibit I
Berq-Sher Med Mal Insurer Sheet 6
Derivation of Adjusted Reported Claim Development Triangle

Accident Year	Adjusted Average Case Outstanding as of (months)							
	12	24	36	48	60	72	84	96
1969	4,898	13,904	17,104	19,020	18,423	21,961	21,349	21,423
1970	5,633	15,989	19,669	21,873	21,186	25,255	24,551	
1971	6,477	18,387	22,620	25,154	24,364	29,044		
1972	7,449	21,145	26,013	28,927	28,019			
1973	8,566	24,317	29,915	33,266				
1974	9,851	27,965	34,402					
1975	11,329	32,160						
1976	13,028							

Selected Annual Severity Trend Rate 15%

Accident Year	Adjusted Reported Claims as of (months)							
	12	24	36	48	60	72	84	96
1969	3,793,504	12,084,942	18,563,821	25,924,316	23,516,364	24,979,245	24,016,864	23,506,000
1970	3,760,482	15,830,500	24,615,996	33,169,802	30,722,141	33,362,729	32,216,000	
1971	5,982,185	25,583,831	41,384,825	50,323,342	46,191,356	48,377,000		
1972	7,819,355	33,794,110	51,361,061	64,559,286	61,163,000			
1973	9,533,246	34,585,431	49,667,342	73,733,000				
1974	10,348,458	41,241,243	63,477,000					
1975	13,102,479	48,904,000						
1976	15,791,000							

PART 1 - Data Triangle

Accident Year	Adjusted Reported Claims as of (months) 12	24	36	48	60	72	84	96
1969	3,793,504	12,084,942	18,563,821	25,924,316	23,516,364	24,979,245	24,016,864	23,506,000
1970	3,760,482	15,830,500	24,615,996	33,169,802	30,722,141	33,362,729	32,216,000	
1971	5,982,185	25,583,831	41,384,825	50,323,342	46,191,356	48,377,000		
1972	7,819,355	33,794,110	51,361,061	64,559,286	61,163,000			
1973	9,533,246	34,585,431	49,667,342	73,733,000				
1974	10,348,458	41,241,243	63,477,000					
1975	13,102,479	48,904,000						
1976	15,791,000							

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
1969	3.186	1.536	1.396	0.907	1.062	0.961	0.979	
1970	4.210	1.555	1.347	0.926	1.086	0.966		
1971	4.277	1.618	1.216	0.918	1.047			
1972	4.322	1.520	1.257	0.947				
1973	3.628	1.436	1.485					
1974	3.985	1.539						
1975	3.732							

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Simple Average								
All Years	3.906	1.534	1.340	0.925	1.065	0.964	0.979	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108
Unadj Selected	2.532	1.921	1.503	1.170	1.206	1.052	1.027	1.000
Adj Selected	3.906	1.534	1.340	0.925	1.065	0.964	0.979	1.000
CDF to Ultimate	7.465	1.911	1.246	0.930	1.005	0.944	0.979	1.000
Percent Reported	13.4%	52.3%	80.3%	107.5%	99.5%	105.9%	102.1%	100.0%

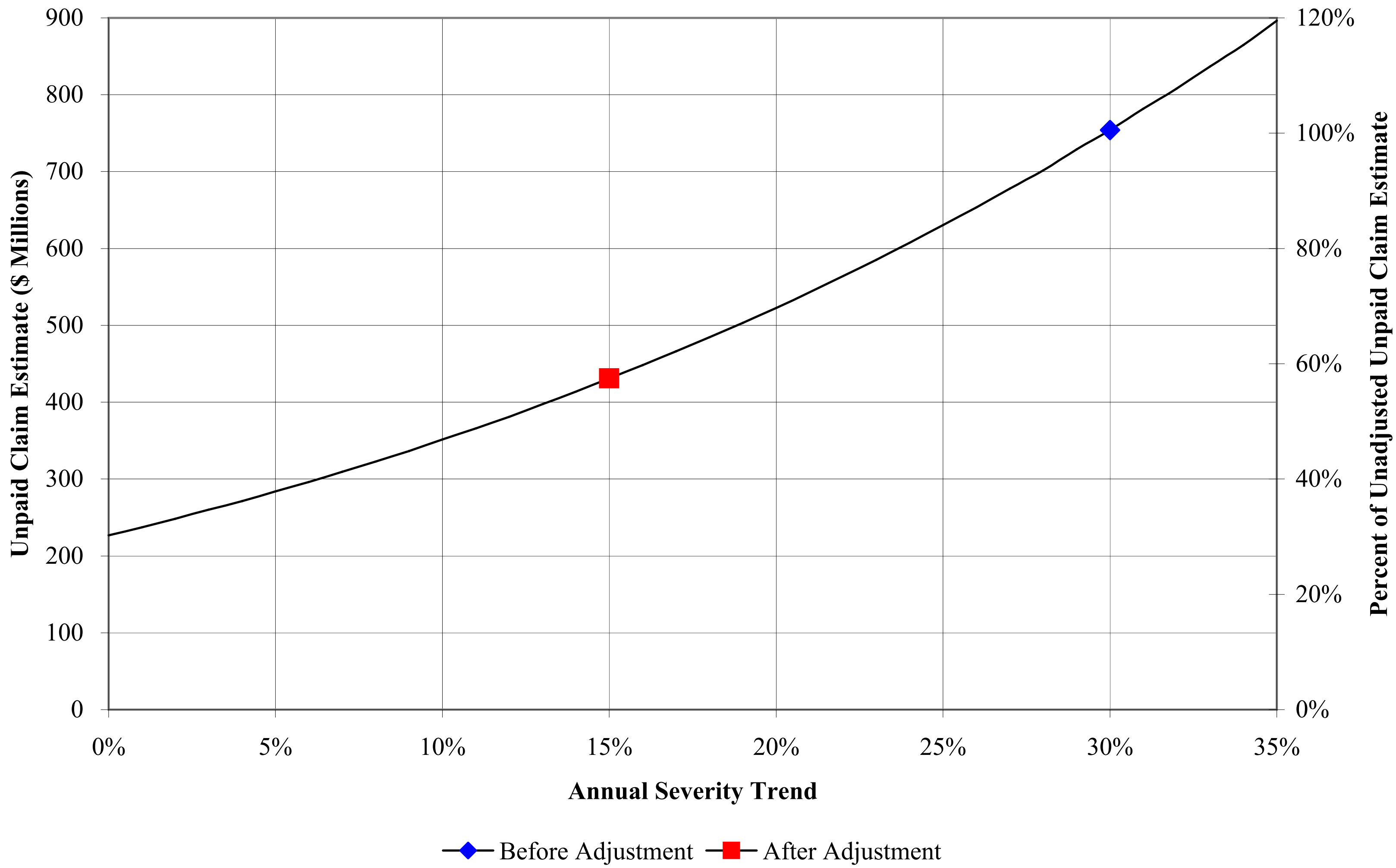
	Age of	Claims at 12/31/76			CDF to Ultimate			Projected Ultimate Claims Using Dev. Method with		
Accident Year	Accident Year at 12/31/76	Reported	Paid	Adjusted Reported	Reported	Paid	Adjusted Reported	Reported	Paid	Adjusted Reported
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1969	96	23,506,000	15,815,000	23,506,000	1.000	1.486	1.000	23,506,000	23,501,090	23,506,000
1970	84	32,216,000	18,983,000	32,216,000	1.027	1.859	0.979	33,085,832	35,289,397	31,539,464
1971	72	48,377,000	17,707,000	48,377,000	1.080	2.616	0.944	52,247,160	46,321,512	45,667,888
1972	60	61,163,000	18,518,000	61,163,000	1.303	4.495	1.005	79,695,389	83,238,410	61,468,815
1973	48	73,733,000	11,292,000	73,733,000	1.524	8.773	0.930	112,369,092	99,064,716	68,571,690
1974	36	63,477,000	6,267,000	63,477,000	2.291	21.538	1.246	145,425,807	134,978,646	79,092,342
1975	24	48,904,000	1,565,000	48,904,000	4.402	79.886	1.911	215,275,408	125,021,590	93,455,544
1976	12	15,791,000	209,000	15,791,000	11.145	494.097	7.465	175,990,695	103,266,273	117,879,815
Total		367,167,000	90,356,000	367,167,000				837,595,383	650,681,634	521,181,558

Column Notes:
(2) Age of accident year in (1) at December 31, 1976.
(3) and (4) Based on data from Berq-Sher Med Mal Insurer.
(5) Developed in Exhibit I, Sheet 6.
(6) and (7) Based on CDF from Exhibit I, Sheets 1 and 2.
(8) Based on CDF from Exhibit I, Sheet 7.
(9) = [(3) x (6)].
(10) = [(4) x (7)].
(11) = [(5) x (8)].

Accident Year	Claims at 12/31/76 Reported	Claims at 12/31/76 Paid	Projected Ultimate Claims Using Dev. Method with Reported	Projected Ultimate Claims Using Dev. Method with Paid	Projected Ultimate Claims Using Dev. Method with Adjusted Reported	Case Outstanding at 12/31/76	Unpaid Claim Estimate at 12/31/76: IBNR - Based on Dev. Method with Reported	IBNR - Based on Dev. Method with Paid	IBNR - Based on Dev. Method with Adjusted Reported	Total - Based on Dev. Method with Reported	Total - Based on Dev. Method with Paid	Total - Based on Dev. Method with Adjusted Reported
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1969	23,506,000	15,815,000	23,506,000	23,501,090	23,506,000	7,691,000	0	- 4,910	0	7,691,000	7,686,090	7,691,000
1970	32,216,000	18,983,000	33,085,832	35,289,397	31,539,464	13,233,000	869,832	3,073,397	- 676,536	14,102,832	16,306,397	12,556,464
1971	48,377,000	17,707,000	52,247,160	46,321,512	45,667,888	30,670,000	3,870,160	- 2,055,488	- 2,709,112	34,540,160	28,614,512	27,960,888
1972	61,163,000	18,518,000	79,695,389	83,238,410	61,468,815	42,645,000	18,532,389	22,075,410	305,815	61,177,389	64,720,410	42,950,815
1973	73,733,000	11,292,000	112,369,092	99,064,716	68,571,690	62,441,000	38,636,092	25,331,716	- 5,161,310	101,077,092	87,772,716	57,279,690
1974	63,477,000	6,267,000	145,425,807	134,978,646	79,092,342	57,210,000	81,948,807	71,501,646	15,615,342	139,158,807	128,711,646	72,825,342
1975	48,904,000	1,565,000	215,275,408	125,021,590	93,455,544	47,339,000	166,371,408	76,117,590	44,551,544	213,710,408	123,456,590	91,890,544
1976	15,791,000	209,000	175,990,695	103,266,273	117,879,815	15,582,000	160,199,695	87,475,273	102,088,815	175,781,695	103,057,273	117,670,815
Total	367,167,000	90,356,000	837,595,383	650,681,634	521,181,558	276,811,000	470,428,383	283,514,634	154,014,558	747,239,383	560,325,634	430,825,558

Column Notes:
(2) and (3) Based on data from Berq-Sher Med Mal Insurer.
(4) through (6) Developed in Exhibit I, Sheet 8.
(7) = [(2) - (3)].
(8) = [(4) - (2)].
(9) = [(5) - (2)].
(10) = [(6) - (2)].
(11) = [(7) + (8)].
(12) = [(7) + (9)].
(13) = [(7) + (10)].

Sensitivity of Unpaid Claim Estimate to Assumed Annual Severity Trend



Unadjusted Paid Claims ($000)

PART 1 - Data Triangle

Accident Year	Paid Claims as of (months) 12	24	36	48	60	72	84	96
1969	1,904	5,398	7,496	8,882	9,712	10,071	10,199	10,256
1970	2,235	6,261	8,691	10,443	11,346	11,754	12,031	
1971	2,441	7,348	10,662	12,655	13,748	14,235		
1972	2,503	8,173	11,810	14,176	15,383			
1973	2,838	8,712	12,728	15,278				
1974	2,405	7,858	11,771					
1975	2,759	9,182						
1976	2,801							

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
1969	2.835	1.389	1.185	1.093	1.037	1.013	1.006	
1970	2.801	1.388	1.202	1.086	1.036	1.024		
1971	3.010	1.451	1.187	1.086	1.035			
1972	3.265	1.445	1.200	1.085				
1973	3.070	1.461	1.200					
1974	3.267	1.498						
1975	3.328							

PART 3 - Average Age-to-Age Factors

Averages	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Simple Average								
All Years	3.082	1.439	1.195	1.088	1.036	1.018	1.006	
Latest 4	3.233	1.464	1.197	1.088	1.036	1.018	1.006	
Volume-weighted Average								
All Years	3.098	1.444	1.196	1.087	1.036	1.019	1.006	
Latest 4	3.229	1.464	1.197	1.087	1.036	1.019	1.006	

PART 4 - Selected Age-to-Age Factors

Development Factor Selection	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108
Selected	3.098	1.444	1.196	1.087	1.036	1.019	1.006	1.000
CDF to Ultimate	6.170	1.991	1.379	1.154	1.061	1.024	1.006	1.000
Percent Reported	16.2%	50.2%	72.5%	86.7%	94.3%	97.7%	99.4%	100.0%

Development Triangles - Unadjusted Data

Accident Year	Closed Claim Counts as of (months) 12	24	36	48	60	72	84	96
1969	4,079	6,616	7,192	7,494	7,670	7,749	7,792	7,806
1970	4,429	7,230	7,899	8,291	8,494	8,606	8,647	
1971	4,914	8,174	9,068	9,518	9,761	9,855		
1972	4,497	7,842	8,747	9,254	9,469			
1973	4,419	7,665	8,659	9,093				
1974	3,486	6,214	6,916					
1975	3,516	6,226						
1976	3,230							

Accident Year	Reported Claim Counts as of (months) 12	24	36	48	60	72	84	96
1969	6,553	7,696	7,770	7,799	7,814	7,819	7,820	7,821
1970	7,277	8,537	8,615	8,661	8,675	8,679	8,682	
1971	8,259	9,765	9,884	9,926	9,940	9,945		
1972	7,858	9,474	9,615	9,664	9,680			
1973	7,808	9,376	9,513	9,562				
1974	6,278	7,614	7,741					
1975	6,446	7,884						
1976	6,115							

Accident Year	Ratio of Closed to Reported Claim Counts as of (months) 12	24	36	48	60	72	84	96
1969	0.622	0.860	0.926	0.961	0.982	0.991	0.996	0.998
1970	0.609	0.847	0.917	0.957	0.979	0.992	0.996	
1971	0.595	0.837	0.917	0.959	0.982	0.991		
1972	0.572	0.828	0.910	0.958	0.978			
1973	0.566	0.818	0.910	0.951				
1974	0.555	0.816	0.893					
1975	0.545	0.790						
1976	0.528							

Chapter 13 - Berquist-Sherman Techniques Exhibit II
Berq-Sher Auto BI Insurer Sheet 3
Reported Claim Counts

PART 1 - Data Triangle

Accident Year	Reported Claim Counts as of (months) 12	24	36	48	60	72	84	96
1969	6,553	7,696	7,770	7,799	7,814	7,819	7,820	7,821
1970	7,277	8,537	8,615	8,661	8,675	8,679	8,682	
1971	8,259	9,765	9,884	9,926	9,940	9,945		
1972	7,858	9,474	9,615	9,664	9,680			
1973	7,808	9,376	9,513	9,562				
1974	6,278	7,614	7,741					
1975	6,446	7,884						
1976	6,115							

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
1969	1.174	1.010	1.004	1.002	1.001	1.000	1.000	
1970	1.173	1.009	1.005	1.002	1.000	1.000		
1971	1.182	1.012	1.004	1.001	1.001			
1972	1.206	1.015	1.005	1.002				
1973	1.201	1.015	1.005					
1974	1.213	1.017						
1975	1.223							

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Simple Average								
All Years	1.196	1.013	1.005	1.002	1.001	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108
Selected	1.196	1.013	1.005	1.002	1.001	1.000	1.000	1.000
CDF to Ultimate	1.221	1.021	1.008	1.003	1.001	1.000	1.000	1.000
Percent Reported	81.9%	97.9%	99.2%	99.7%	99.9%	100.0%	100.0%	100.0%

Projection of Ultimate Claim Counts

Accident Year	Age of Accident Year at 12/31/76	Reported Claim Counts at 12/31/76	CDF to Ultimate	Projected Ultimate Claim Counts
(1)	(2)	(3)	(4)	(5)
1969	96	7,821	1.000	7,821
1970	84	8,682	1.000	8,682
1971	72	9,945	1.000	9,945
1972	60	9,680	1.001	9,690
1973	48	9,562	1.003	9,591
1974	36	7,741	1.008	7,803
1975	24	7,884	1.021	8,050
1976	12	6,115	1.221	7,466
Total		67,430		69,047

Column Notes:
(2) Age of accident year in (1) at December 31, 1976.
(3) Based on data from Berq-Sher Auto BI Insurer.
(4) Based on CDF from Exhibit II, Sheet 3.
(5) = [(3) x (4)].

Disposal Rate and Development of Adjusted Closed Claim Counts

Accident Year	Disposal Rate as of (months) 12	24	36	48	60	72	84	96	Projected Ultimate Claim Counts
1969	0.522	0.846	0.920	0.958	0.981	0.991	0.996	0.998	7,821
1970	0.510	0.833	0.910	0.955	0.978	0.991	0.996		8,682
1971	0.494	0.822	0.912	0.957	0.981	0.991			9,945
1972	0.464	0.809	0.903	0.955	0.977				9,690
1973	0.461	0.799	0.903	0.948					9,591
1974	0.447	0.796	0.886						7,803
1975	0.437	0.773							8,050
1976	0.433								7,466

Selected Disposal Rate by Maturity Age

	12	24	36	48	60	72	84	96
	0.433	0.773	0.886	0.948	0.977	0.991	0.996	0.998

Accident Year	Adjusted Closed Claim Counts as of (months) 12	24	36	48	60	72	84	96
1969	3,383	6,049	6,932	7,415	7,643	7,750	7,789	7,806
1970	3,756	6,715	7,695	8,231	8,484	8,603	8,647	
1971	4,302	7,692	8,815	9,429	9,719	9,855		
1972	4,192	7,495	8,588	9,187	9,469			
1973	4,149	7,418	8,501	9,093				
1974	3,376	6,035	6,916					
1975	3,482	6,226						
1976	3,230							

	Accident Year 1969			Accident Year 1970			Accident Year 1971		
	Cumulative			Cumulative			Cumulative		
Months of Development	Closed Claim Counts X	Paid Claims Y	Predicted Y Value Y=ae^(bX)	Closed Claim Counts X	Paid Claims Y	Predicted Y Value Y=ae^(bX)	Closed Claim Counts X	Paid Claims Y	Predicted Y Value Y=ae^(bX)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(5)	(6)	(7)
12	4,079	1,904	1,850	4,429	2,235	2,184	4,914	2,441	2,404
24	6,616	5,398	5,885	7,230	6,261	6,715	8,174	7,348	7,722
36	7,192	7,496	7,653	7,899	8,691	8,781	9,068	10,662	10,634
48	7,494	8,882	8,783	8,291	10,443	10,275	9,518	12,655	12,493
60	7,670	9,712	9,518	8,494	11,346	11,147	9,761	13,748	13,628
72	7,749	10,071	9,867	8,606	11,754	11,659	9,855	14,235	14,095
84	7,792	10,199	10,062	8,647	12,031	11,852			
96	7,806	10,256	10,127						
R Squared			0.99573			0.99709			0.99866
a			287.742			369.685			413.901
b			0.000456			0.000401			0.000358

Accident Year	Closed Claim Counts as of (months)							
	12	24	36	48	60	72	84	96
1969	4,079	6,616	7,192	7,494	7,670	7,749	7,792	7,806
1970	4,429	7,230	7,899	8,291	8,494	8,606	8,647	
1971	4,914	8,174	9,068	9,518	9,761	9,855		
1972	4,497	7,842	8,747	9,254	9,469			
1973	4,419	7,665	8,659	9,093				
1974	3,486	6,214	6,916					
1975	3,516	6,226						
1976	3,230							

Accident Year	Parameter a for Two-Point Exponential Fit							
	12	24	36	48	60	72	84	96
1969		356	124	132	198	286	1,034	459
1970		438	181	215	353	778	88	
1971		464	244	337	493	370		
1972		510	337	506	421			
1973		616	468	333				
1974		530	220					
1975		580						
1976								

Accident Year	Paid Claims ($000) as of (months)							
	12	24	36	48	60	72	84	96
1969	1,904	5,398	7,496	8,882	9,712	10,071	10,199	10,256
1970	2,235	6,261	8,691	10,443	11,346	11,754	12,031	
1971	2,441	7,348	10,662	12,655	13,748	14,235		
1972	2,503	8,173	11,810	14,176	15,383			
1973	2,838	8,712	12,728	15,278				
1974	2,405	7,858	11,771					
1975	2,759	9,182						
1976	2,801							

Accident Year	Parameter b for Two-Point Exponential Fit							
	12	24	36	48	60	72	84	96
1969		0.000411	0.000570	0.000562	0.000508	0.000459	0.000294	0.000398
1970		0.000368	0.000490	0.000468	0.000409	0.000315	0.000568	
1971		0.000338	0.000416	0.000381	0.000341	0.000370		
1972		0.000354	0.000407	0.000360	0.000380			
1973		0.000346	0.000381	0.000421				
1974		0.000434	0.000576					
1975		0.000444						
1976								

Accident Year	Adjusted Closed Claim Counts as of (months)							
	12	24	36	48	60	72	84	96
1969	3,383	6,049	6,932	7,415	7,643	7,750	7,789	7,806
1970	3,756	6,715	7,695	8,231	8,484	8,603	8,647	
1971	4,302	7,692	8,815	9,429	9,719	9,855		
1972	4,192	7,495	8,588	9,187	9,469			
1973	4,149	7,418	8,501	9,093				
1974	3,376	6,035	6,916					
1975	3,482	6,226						
1976	3,230							

Accident Year	Adjusted Paid Claims ($000) as of (months)							
	12	24	36	48	60	72	84	96
1969	1,431	4,277	6,463	8,497	9,579	10,075	10,191	10,256
1970	1,745	5,181	7,865	10,156	11,301	11,744	12,031	
1971	1,985	6,243	9,594	12,233	13,550	14,235		
1972	2,247	7,228	11,072	13,837	15,383			
1973	2,585	7,999	11,982	15,278				
1974	2,292	7,271	11,771					
1975	2,718	9,182						
1976	2,801							

Berq-Sher Auto BI Insurer
Adjusted Paid Claims ($000)

PART 1 - Data Triangle

Accident Year	Adjusted Paid Claims as of (months) 12	24	36	48	60	72	84	96
1969	1,431	4,277	6,463	8,497	9,579	10,075	10,191	10,256
1970	1,745	5,181	7,865	10,156	11,301	11,744	12,031	
1971	1,985	6,243	9,594	12,233	13,550	14,235		
1972	2,247	7,228	11,072	13,837	15,383			
1973	2,585	7,999	11,982	15,278				
1974	2,292	7,271	11,771					
1975	2,718	9,182						
1976	2,801							

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
1969	2.989	1.511	1.315	1.127	1.052	1.012	1.006	
1970	2.969	1.518	1.291	1.113	1.039	1.024		
1971	3.145	1.537	1.275	1.108	1.051			
1972	3.217	1.532	1.250	1.112				
1973	3.094	1.498	1.275					
1974	3.172	1.619						
1975	3.378							

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
Simple Average								
All Years	3.138	1.536	1.281	1.115	1.047	1.018	1.006	
Latest 4	3.215	1.546	1.273	1.115	1.047	1.018	1.006	
Volume-weighted Average								
All Years	3.158	1.538	1.277	1.114	1.047	1.018	1.006	
Latest 4	3.219	1.545	1.271	1.114	1.047	1.018	1.006	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108
Unadj Selected	3.098	1.444	1.196	1.087	1.036	1.019	1.006	1.000
Adj Selected	3.158	1.538	1.277	1.114	1.047	1.018	1.006	1.000
CDF to Ultimate	7.416	2.348	1.527	1.195	1.073	1.025	1.006	1.000
Percent Reported	13.5%	42.6%	65.5%	83.7%	93.2%	97.6%	99.4%	100.0%

Accident Year	Age-to-Age Factors							
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
1969	2.989	1.511	1.315	1.127	1.052	1.012	1.006	
1970	2.969	1.518	1.291	1.113	1.039	1.024		
1971	3.145	1.537	1.275	1.108	1.051			
1972	3.217	1.532	1.250	1.112				
1973	3.094	1.498	1.275					
1974	3.172	1.619						
1975	3.378							

	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72
Estimated Intercept from Linear Regression Analysis of Age-to-Age Factors and Accident Year	-104.01	-25.08	25.05	11.36	2.21
Estimated Slope from Linear Regression Analysis of Age-to-Age Factors and Accident Year	0.0543	0.0135	-0.0121	-0.0052	-0.0006
Goodness of Fit Test of Linear Regression Analysis (R-Squared)	70.3%	34.4%	63.7%	61.0%	0.7%

Accident Year	Age-to-Age Factors								CDF
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult	to Ultimate
1969	2.989	1.511	1.315	1.127	1.052	1.012	1.006	1.000	1.000
1970	2.969	1.518	1.291	1.113	1.039	1.024	1.006	1.000	1.006
1971	3.145	1.537	1.275	1.108	1.051	1.018	1.006	1.000	1.024
1972	3.217	1.532	1.250	1.112	1.047	1.018	1.006	1.000	1.073
1973	3.094	1.498	1.275	1.102	1.047	1.018	1.006	1.000	1.182
1974	3.172	1.619	1.245	1.097	1.047	1.018	1.006	1.000	1.465
1975	3.378	1.583	1.233	1.091	1.047	1.018	1.006	1.000	2.285
1976	3.355	1.596	1.221	1.086	1.047	1.018	1.006	1.000	7.621

Exponential Regression of Development Factors Using Adjusted Paid Claims

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult
1969	2.989	1.511	1.315	1.127	1.052	1.012	1.006	
1970	2.969	1.518	1.291	1.113	1.039	1.024		
1971	3.145	1.537	1.275	1.108	1.051			
1972	3.217	1.532	1.250	1.112				
1973	3.094	1.498	1.275					
1974	3.172	1.619						
1975	3.378							

	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72
Estimated Constant from Exponential Regression Analysis of Age-to-Age Factors and Accident Year					
	0	0	135,483,653	10,606	3
Estimated Growth from Exponential Regression Analysis of Age-to-Age Factors and Accident Year					
	1.0174	1.0086	0.9907	0.9954	0.9994
Goodness of Fit Test of Exponential Regression Analysis (R-Squared)					
	70.6%	34.0%	63.3%	61.0%	0.7%

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	To Ult	CDF to Ultimate
1969	2.989	1.511	1.315	1.127	1.052	1.012	1.006	1.000	1.000
1970	2.969	1.518	1.291	1.113	1.039	1.024	1.006	1.000	1.006
1971	3.145	1.537	1.275	1.108	1.051	1.018	1.006	1.000	1.024
1972	3.217	1.532	1.250	1.112	1.047	1.018	1.006	1.000	1.073
1973	3.094	1.498	1.275	1.102	1.047	1.018	1.006	1.000	1.182
1974	3.172	1.619	1.245	1.097	1.047	1.018	1.006	1.000	1.466
1975	3.378	1.582	1.234	1.092	1.047	1.018	1.006	1.000	2.286
1976	3.359	1.596	1.222	1.087	1.047	1.018	1.006	1.000	7.638

Chapter 13 - Berquist-Sherman Techniques Exhibit II
Berq-Sher Auto BI Insurer Sheet 11
Projection of Ultimate Claims Using Development Technique and Adjusted Data ($000)

			CDF to Ultimate				Projected Ultimate Claims Using Dev Method with			
	Age of			Adjusted Paid				Adjusted Paid		
Accident	Accident Year	Paid Claims	Unadjusted	Volume	Regression		Unadjusted	Volume	Regression	
Year	at 12/31/76	at 12/31/76	Paid	Weighted	Linear	Exponential	Paid	Weighted	Linear	Exponential
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1969	96	10,256	1.000	1.000	1.000	1.000	10,256	10,256	10,256	10,256
1970	84	12,031	1.006	1.006	1.006	1.006	12,103	12,103	12,107	12,107
1971	72	14,235	1.024	1.025	1.024	1.024	14,577	14,591	14,583	14,583
1972	60	15,383	1.061	1.073	1.073	1.073	16,321	16,506	16,502	16,502
1973	48	15,278	1.154	1.195	1.182	1.182	17,631	18,257	18,059	18,061
1974	36	11,771	1.379	1.527	1.465	1.466	16,232	17,974	17,241	17,251
1975	24	9,182	1.991	2.348	2.285	2.286	18,281	21,559	20,984	20,993
1976	12	2,801	6.170	7.416	7.621	7.638	17,282	20,772	21,346	21,394
Total		90,937					122,684	132,019	131,079	131,147

Column Notes:
(2) Age of accident year in (1) at December 31, 1976.
(3) Developed in Exhibit II, Sheet 7.
(4) Based on CDF from Exhibit II, Sheet 1.
(5) through (7) Based on CDF from Exhibit II, Sheets 8 through 10, respectively.
(8) = [(3) x (4)].
(9) = [(3) x (5)].
(10) = [(3) x (6)].
(11) = [(3) x (7)].

Development of Unpaid Claim Estimate ($000)

		Projected Ultimate Claims Using Dev Method with				Unpaid Claim Estimate at 12/31/76			
			Adjusted Paid				Adjusted Paid		
Accident	Paid Claims	Unadjusted	Volume	Regression		Unadjusted	Volume	Regression	
Year	at 12/31/76	Paid	Weighted	Linear	Exponential	Paid	Weighted	Linear	Exponential
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1969	10,256	10,256	10,256	10,256	10,256	0	0	0	0
1970	12,031	12,103	12,103	12,107	12,107	72	72	76	76
1971	14,235	14,577	14,591	14,583	14,583	342	356	348	348
1972	15,383	16,321	16,506	16,502	16,502	938	1,123	1,119	1,119
1973	15,278	17,631	18,257	18,059	18,061	2,353	2,979	2,781	2,783
1974	11,771	16,232	17,974	17,241	17,251	4,461	6,203	5,470	5,480
1975	9,182	18,281	21,559	20,984	20,993	9,099	12,377	11,802	11,811
1976	2,801	17,282	20,772	21,346	21,394	14,481	17,971	18,545	18,593
Total	90,937	122,684	132,019	131,079	131,147	31,747	41,082	40,142	40,210

Column Notes:
(2) Based on data from Berq-Sher Auto BI Insurer.
(3) through (6) Developed in Exhibit II, Sheet 11.
(7) = [(3) - (2)].
(8) = [(4) - (2)].
(9) = [(5) - (2)].
(10) = [(6) - (2)].

CHAPTER 14 – RECOVERIES: SALVAGE AND SUBROGATION AND REINSURANCE

Salvage and subrogation (S&S) are two of the most common types of recoveries for insurers. When an insurer pays an insured for a claim considered to be a total loss, the insurer acquires the rights to the damaged property. Salvage represents any amount that the insurer is able to collect from the sale of such damaged property. Subrogation refers to an insurer's right to recover the amount of claim payment to a covered insured from a third-party responsible for the injury or damage.

In Chapter 3 – Information Gathering, we discuss the importance of the actuary understanding the insurer's practices with respect to S&S. The actuary needs to know whether paid claims are recorded net or gross of these recoveries.

Salvage, Subrogation, and Collateral Sources

Some insurers maintain detailed information regarding case outstanding estimates and payments for the different types of recoveries (e.g., salvage, subrogation, deductibles, and collateral sources). Other insurers may combine claims data for all types of recoveries; many insurers record only payments and do not estimate case outstanding for recoveries. Finally, some insurers treat recoveries as a negative claim payment and do not maintain separate data for recoveries. In order for the actuary to determine how to quantify the potential effect of S&S, he or she must understand how the insurer processes such recoveries and what data is available for analysis.

When S&S data is available, actuaries frequently use the development technique to quantify the effect of S&S recoveries on estimates of total unpaid claims. The salvage portion of such recoveries is most commonly associated with property coverages and tends to be fast reporting and fast settling. Recoveries due to subrogation, typically associated with liability types of coverage, can take years to realize, well after the underlying claims are paid, resulting in age-to-age factors less than one for older maturities for some lines of business.

Estimating S&S Recoveries – Auto Physical Damage Insurer

We use an example of an insurer writing automobile physical damage insurance (Auto Physical Damage Insurer) to demonstrate two methods commonly used to quantify S&S recoveries. This particular insurer maintains, separately, payment activity and case outstanding estimates for S&S. In Exhibit I, Sheets 1 and 2, we use the development technique on reported and received S&S. (Some insurers use the term paid S&S instead of received S&S. It is important to recognize that paid S&S represents a payment made by a third-party to the insurer.) Since automobile physical damage is typically a quick reporting line of business, it is not surprising that the S&S associated with this coverage is also exhibiting a quick reporting pattern.

The reported salvage and subrogation development factors in Exhibit I, Sheet 1, are very stable and indicate an age-to-age factor of approximately 1.068 at 12-to-24 months and slightly less than 1.00 at 24-to-36 months. The development factors are also fairly stable for received S&S (Exhibit I, Sheet 2). We select factors based on the latest five-year volume-weighted average factors. In Exhibit I, Sheet 3, we project ultimate S&S based on the development technique described in previous chapters of this book. The format of Exhibit I, Sheet 3 is identical to the development projection exhibits of many other chapters.

Many actuaries also use a ratio approach when analyzing S&S. The first step in such an approach is to estimate the ultimate claims gross of S&S. In Exhibit I, Sheets 4 through 6, we project ultimate claims for Auto Physical Damage Insurer based on reported and paid claims. We rely on the five-year volume-weighted averages and select ultimate claims based on the average of the reported and paid claims projections (Exhibit I, Sheet 6). It is not surprising that the projections are very similar for this fast reporting and settling line of insurance. In Exhibit I, Sheet 7, we use the development technique to analyze the ratio of received S&S to paid claims.[79]

One advantage of the ratio approach is that the development factors tend not to be as highly leveraged as the development factors based on received S&S dollars. Another advantage is related to the selection of the ultimate S&S ratio(s) for the most recent year(s) in the experience period. In Exhibit I, Sheet 8, we use the development technique to project an initial estimate of the S&S ratio to claim amount of 0.315 for accident year 2008. However, based on comparison to the immediate preceding years, 0.315 seems low. This may be due to a change in procedures for recording S&S or an unusually large claim. The average of the ultimate S&S ratios for the last five years excluding 2008 is 0.347 and for the last three years excluding 2008 is 0.344. Thus, we select an ultimate S&S ratio for 2008 of 0.345. We determine ultimate S&S based on the multiplication of selected ultimate claims (from Exhibit I, Sheet 6) and the selected ultimate S&S ratio (from Column (6)).

The results of all three projections are summarized in Exhibit I, Sheet 9. In this exhibit, we also present the estimated S&S recoverable, which are equal to projected ultimate S&S less received S&S. The estimated S&S recoverable represent a reduction to total estimate of unpaid claims for the insurer.

Reinsurance and Aggregate Limits

All of the different types of techniques for estimating unpaid claims presented in Chapters 7 through 13 can be applied to gross, ceded, or net of reinsurance claims experience. When required to estimate unpaid claims on a net of reinsurance basis, actuaries vary in their approach. Some actuaries analyze gross (i.e., direct and assumed) and ceded experience separately; others analyze gross and net experience separately. The choice of a gross versus net versus ceded analysis may depend on data availability, characteristics of the gross versus ceded program, and also personal preferences of the actuary. Some insurers code ceded claims in the same information system as the gross data; thus, the net data is readily available. For such insurers, the actuary is more likely to conduct both gross and net analyses. On the other hand, some insurers code the ceded claims data to a different system; thus matching the gross and ceded data to derive net claim triangles may be more difficult. For these insurers, the actuary will likely prepare separate gross and ceded analyses. Furthermore, the choice of gross versus net versus ceded analysis may be a function of data volume and quality.

[79] To present a complete example for the reader of this text, we use the development method with paid and reported claims to project ultimate claims for Auto Physical Damage. However, we could use many other projection methods to derive ultimate claims. The ratio method for determining ultimate S&S is independent of any specific methodology for estimating ultimate claims.

It is particularly important for a net (of reinsurance) or ceded analysis that the actuary be aware of the implied relationships between gross, ceded, and net claims. This is critical at all stages of the analysis:

- At the beginning of the analysis when the actuary is reviewing and reconciling the data
- During the analysis especially when the actuary uses judgment in the process of developing an unpaid claim estimate
- At the end of the analysis when the actuary evaluates the various projection methods and selects ultimate claims and unpaid claim estimates

One of the first checks that an actuary can conduct with the data provided for the analysis of unpaid claims is that net claim and net premium data are equal to or less than the gross data. Reinsurance arrangements are typically categorized as quota share or excess of loss. If the reinsurance program consists of quota share arrangements, the actuary can create a development triangle with the ratio of net-to-gross claims and thus test the quota share percentage(s) by year. The actuary will want to confirm that the ratios in such a triangle are consistent with information available for the insurer and consistent with relationships between net and gross premium. In Exhibit II, Sheet 1, we present three triangles for an insurer who has maintained a quota share reinsurance program for the past four years. For 2005, the insurer had a 70% quota share arrangement; the insurer increased the percentage to 85% in 2007 and to 90% in 2008. We present the gross reported claims, the net reported claims, and the ratio of net to gross reported claims.

If the reinsurance program consists of excess of loss arrangements, the actuary may want to examine large claims to confirm that retentions and limits for ceded claims by year are consistent with the corresponding excess of loss reinsurance contracts or with information provided. Such verification of the treatment of large claims is an important part of ensuring that the ceded and/or net claim triangles are correct. In Exhibit II, Sheet 2, we present three triangles for an insurer who maintains $1 million excess of loss reinsurance. In accident year 2005, the insurer sustained two large claims in excess of $1 million, and in accident year 2007, one large claim in excess of $1 million. We present the gross, net, and ceded reported claim triangles in Exhibit II, Sheet 2.

During the analysis, the actuary should ensure that key assumptions, particularly those involving actuarial judgment, are consistent between the gross and net or gross and ceded analyses. For example, it is generally not reasonable for the tail factor to be larger for net claims than for gross claims. Since net claims are often capped due to excess or aggregate coverage, we frequently observe net claim development patterns that are less than or equal to gross claim development patterns.[80]

Actuaries differ in their practice with respect to the order in which they choose gross or net claim development factors. Some actuaries first select gross claim development factors since these triangles contain a greater volume of claims experience, and thus may be considered to have greater credibility. The gross claim development factors may then be used as input for the selection of ceded or net claim development factors. On the other hand, it may be that gross

[80] This relationship does not hold in some circumstances, such as for an insurance company fronting for a captive insurer (where the captive assumes the working layer and the fronting company retains the excess layer). There are also situations in which the effect of limiting large claims due to excess coverage may result in net factors that are greater than gross factors.

claims are subject to more random variation due to large claims, and thus the actuary first selects claim development factors for the net claims. In such situations, the actuary may then use the selected net claim development factors as input for the selection of gross claim development factors. The important point to remember is that there should generally be a reasonable relationship between the selected development factors for net and gross claims. It should be recognized, however, that this is not always the case.

Similarly, the actuary must consider the reasonableness of trend assumptions between the net and gross or ceded and gross analyses as well as expected claim ratios, frequency, and severity assumptions. At the final stages of the analysis, when the actuary is selecting ultimate claims, the actuary must review the implied relationship between the net and gross claims and resulting estimates of unpaid claims to ensure that the ceded claims are reasonable, or alternatively the relationship between gross and ceded ultimate claims to ensure that net ultimate claims and unpaid claim estimates are appropriate. A critical point is that net IBNR in each accident year is generally not greater than gross IBNR.[81]

Many insurers also use aggregate or stop-loss coverage to protect their financial results across multiple lines of coverage. This coverage can apply on an accident year, policy year, or calendar year basis. In addition to fully understanding how the coverage operates, it is important that the actuary understands how the insurer treats prior recoveries from aggregate coverage in the source data used in the actuarial analysis of unpaid claims. The actuary will need to determine whether or not he or she should take stop-loss or aggregate programs into account within the claim development triangles or at a later stage of the analysis. The specific circumstances of the stop-loss program could influence the actuary's decision. Typically, the actuary would want data prior to the application of stop-loss or aggregate coverage since the actuary will often adjust for such coverage as a final step in the development of the unpaid claim estimate.

In Exhibit II, Sheet 3, we present a simple example with one approach for adjusting for the effect of excess of loss and stop-loss reinsurance. In this example, we assume that Self-Insurance Pool is an association of self-insured municipalities that has maintained a $500,000 per occurrence excess of loss coverage since the inception of the pool. The stop-loss coverage, however, has varied over time depending on the availability and price of such coverage. For the first three years of Self-Insurance Pool, there was a $4 million combined stop-loss (i.e., the stop-loss limit of $4 million applied to the sum of ultimate claims for policy years 2002-03 through 2004-05). The stop-loss limit was $1.5 million for policy years 2005-06 and 2006-07. There was no stop-loss coverage purchased for 2007-08. For Self-Insurance Pool, the actuary first estimates ultimate claims using reported and paid claims limited to the per occurrence retention (i.e., $500,000 per occurrence). In Exhibit II, Sheet 3, we summarize the selected ultimate claims at $500,000 per occurrence in Column (2) and the stop-loss limits in Column (3). In Column (4), we apply the stop-loss limits to derive the estimates of ultimate claims for Self-Insurance Pool that take into account both the excess of loss and stop-loss coverages. In the final columns of this exhibit, we calculate the unpaid claim estimate net of both excess of loss and stop-loss coverage.

[81] There are times when the net IBNR will be greater than the gross IBNR. This occurs when an estimate of uncollectible reinsurance is included in the net IBNR but not in the gross IBNR and there are significant billed reinsurance amounts for which significant collectibility issues exist. Another example in which net IBNR may be greater than gross IBNR is for a runoff book with reinsurance disputes for items such as asbestos.

Reported Salvage and Subrogation ($000)

PART 1 - Data Triangle

Accident Year	Reported Salvage and Subrogation as of (months) 12	24	36	48	60	72	84	96	108	120	132
1998	713	781	771	770	770	785	793	793	793	793	793
1999	1,328	1,369	1,361	1,360	1,360	1,360	1,360	1,360	1,360	1,360	
2000	2,180	2,432	2,423	2,424	2,421	2,421	2,421	2,421	2,421		
2001	3,314	3,674	3,656	3,637	3,635	3,637	3,637	3,637			
2002	3,807	4,092	4,085	4,088	4,084	4,085	4,091				
2003	4,171	4,323	4,317	4,341	4,360	4,366					
2004	4,805	5,166	5,162	5,163	5,160						
2005	5,387	5,735	5,731	5,731							
2006	5,337	5,752	5,715								
2007	5,590	6,031									
2008	5,414										

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	109 - 120	To Ult
1998	1.095	0.987	0.998	1.000	1.019	1.011	1.000	1.000	1.000	1.000	
1999	1.031	0.995	0.999	1.000	1.000	1.000	1.000	1.000	1.000		
2000	1.115	0.996	1.000	0.999	1.000	1.000	1.000	1.000			
2001	1.109	0.995	0.995	0.999	1.001	1.000	1.000				
2002	1.075	0.998	1.001	0.999	1.000	1.001					
2003	1.036	0.999	1.006	1.004	1.001						
2004	1.075	0.999	1.000	0.999							
2005	1.065	0.999	1.000								
2006	1.078	0.994									
2007	1.079										
2008											

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Simple Average											
Latest 5	1.067	0.998	1.000	1.000	1.000	1.002	1.000	1.000	1.000	1.000	
Latest 3	1.074	0.997	1.002	1.001	1.001	1.000	1.000	1.000	1.000	1.000	
Medial Average											
Latest 5x1	1.072	0.999	1.000	0.999	1.000	1.000	1.000	1.000	1.000	1.000	
Volume-weighted Average											
Latest 5	1.068	0.998	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.000	
Latest 3	1.074	0.997	1.002	1.001	1.001	1.001	1.000	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Selected	1.068	0.998	1.000	1.000	1.000	1.001	1.000	1.000	1.000	1.000	1.000
CDF to Ultimate	1.067	0.999	1.001	1.001	1.001	1.001	1.000	1.000	1.000	1.000	1.000
Percent Reported	93.7%	100.1%	99.9%	99.9%	99.9%	99.9%	100.0%	100.0%	100.0%	100.0%	100.0%

PART 1 - Data Triangle

Accident Year	Received Salvage and Subrogation as of (months)										
	12	24	36	48	60	72	84	96	108	120	132
1998	312	735	766	770	770	770	793	793	793	793	793
1999	704	1,324	1,360	1,360	1,360	1,360	1,360	1,360	1,360	1,360	
2000	951	2,356	2,407	2,421	2,421	2,421	2,421	2,421	2,421		
2001	2,101	3,591	3,619	3,635	3,635	3,637	3,637	3,637			
2002	2,251	4,023	4,082	4,084	4,084	4,084	4,090				
2003	2,122	4,264	4,317	4,321	4,360	4,365					
2004	2,602	5,100	5,156	5,157	5,160						
2005	3,279	5,666	5,731	5,731							
2006	3,104	5,493	5,655								
2007	2,863	5,957									
2008	2,710										

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	109 - 120	To Ult
1998	2.357	1.043	1.004	1.000	1.001	1.030	1.000	1.000	1.000	1.000	
1999	1.880	1.027	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
2000	2.478	1.022	1.006	1.000	1.000	1.000	1.000	1.000			
2001	1.709	1.008	1.004	1.000	1.001	1.000	1.000				
2002	1.787	1.015	1.000	1.000	1.000	1.001					
2003	2.010	1.012	1.001	1.009	1.001						
2004	1.960	1.011	1.000	1.001							
2005	1.728	1.011	1.000								
2006	1.769	1.029									
2007	2.081										
2008											

PART 3 - Average Age-to-Age Factors

	Averages										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Simple Average											
Latest 5	1.910	1.016	1.001	1.002	1.000	1.006	1.000	1.000	1.000	1.000	
Latest 3	1.860	1.017	1.000	1.003	1.001	1.000	1.000	1.000	1.000	1.000	
Medial Average											
Latest 5x1	1.913	1.013	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Volume-weighted Average											
Latest 5	1.896	1.016	1.001	1.002	1.001	1.002	1.000	1.000	1.000	1.000	
Latest 3	1.851	1.017	1.000	1.003	1.001	1.001	1.000	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Selected	1.896	1.016	1.001	1.002	1.001	1.002	1.000	1.000	1.000	1.000	1.000
CDF to Ultimate	1.938	1.022	1.006	1.005	1.003	1.002	1.000	1.000	1.000	1.000	1.000
Percent Received	51.6%	97.8%	99.4%	99.5%	99.7%	99.8%	100.0%	100.0%	100.0%	100.0%	100.0%

Projection of Ultimate Salvage and Subrogation ($000)

	Age of					Projected Ultimate S&S	
Accident	Accident Year	S&S at 12/31/08		CDF to Ultimate		Using Dev. Method with	
Year	at 12/31/08	Reported	Received	Reported	Received	Reported	Received
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1998	132	793	793	1.000	1.000	793	793
1999	120	1,360	1,360	1.000	1.000	1,360	1,360
2000	108	2,421	2,421	1.000	1.000	2,421	2,421
2001	96	3,637	3,637	1.000	1.000	3,637	3,637
2002	84	4,091	4,090	1.000	1.000	4,091	4,090
2003	72	4,366	4,365	1.001	1.002	4,370	4,374
2004	60	5,160	5,160	1.001	1.003	5,165	5,175
2005	48	5,731	5,731	1.001	1.005	5,737	5,760
2006	36	5,715	5,655	1.001	1.006	5,720	5,688
2007	24	6,031	5,957	0.999	1.022	6,025	6,088
2008	12	5,414	2,710	1.067	1.938	5,776	5,252
Total		44,718	41,879			45,096	44,639

Column Notes:
(2) Age of accident year in (1) at December 31, 2008.
(3) and (4) Based on data from Auto Physical Damage Insurer.
(5) and (6) Based on CDF from Exhibit I, Sheets 1 and 2.
(7) = [(3) x (5)].
(8) = [(4) x (6)].

Chapter 14 - Recoveries: Salvage and Subrogation and Reinsurance Exhibit I
Auto Physical Damage Insurer Sheet 4
Reported Claims Gross of S&S ($000)

PART 1 - Data Triangle

Accident	Reported Claims as of (months)										
Year	12	24	36	48	60	72	84	96	108	120	132
1998	2,412	2,862	2,864	2,864	2,864	2,864	2,864	2,864	2,864	2,864	2,864
1999	4,225	4,677	4,695	4,696	4,697	4,697	4,697	4,697	4,697	4,697	
2000	6,968	7,879	7,896	7,900	7,901	7,902	7,902	7,902	7,902		
2001	9,063	10,277	10,314	10,318	10,318	10,318	10,319	10,319			
2002	9,982	11,115	11,136	11,138	11,139	11,139	11,137				
2003	11,396	12,493	12,508	12,527	12,526	12,527					
2004	12,878	14,505	14,540	14,544	14,552						
2005	15,181	16,815	16,834	16,837							
2006	15,117	16,953	16,945								
2007	15,092	16,862									
2008	14,727										

PART 2 - Age-to-Age Factors

Accident	Age-to-Age Factors										
Year	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	109 - 120	To Ult
1998	1.187	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1999	1.107	1.004	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
2000	1.131	1.002	1.001	1.000	1.000	1.000	1.000	1.000			
2001	1.134	1.004	1.000	1.000	1.000	1.000	1.000				
2002	1.113	1.002	1.000	1.000	1.000	1.000					
2003	1.096	1.001	1.002	1.000	1.000						
2004	1.126	1.002	1.000	1.001							
2005	1.108	1.001	1.000								
2006	1.121	1.000									
2007	1.117										
2008											

PART 3 - Average Age-to-Age Factors

	Averages										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Simple Average											
Latest 5	1.114	1.001	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Latest 3	1.115	1.001	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Medial Average											
Latest 5x1	1.115	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Volume-weighted Average											
Latest 5	1.114	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Latest 3	1.115	1.001	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Selected	1.114	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
CDF to Ultimate	1.115	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Percent Reported	89.7%	99.9%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Chapter 14 - Recoveries: Salvage and Subrogation and Reinsurance
Auto Physical Damage Insurer
Paid Claims Gross of S&S ($000)

Exhibit I
Sheet 5

PART 1 - Data Triangle

Accident Year	Paid Claims as of (months) 12	24	36	48	60	72	84	96	108	120	132
1998	1,991	2,858	2,861	2,864	2,864	2,864	2,864	2,864	2,864	2,864	2,864
1999	3,558	4,666	4,694	4,696	4,697	4,697	4,697	4,697	4,697	4,697	
2000	5,718	7,869	7,893	7,900	7,901	7,902	7,902	7,902	7,902		
2001	7,967	10,253	10,307	10,317	10,317	10,318	10,319	10,319			
2002	8,745	11,076	11,126	11,134	11,136	11,136	11,137				
2003	9,658	12,459	12,500	12,526	12,526	12,526					
2004	11,088	14,466	14,503	14,505	14,521						
2005	13,518	16,775	16,827	16,837							
2006	13,322	16,872	16,942								
2007	13,191	16,822									
2008	12,889										

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	109 - 120	To Ult
1998	1.436	1.001	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
1999	1.311	1.006	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
2000	1.376	1.003	1.001	1.000	1.000	1.000	1.000	1.000			
2001	1.287	1.005	1.001	1.000	1.000	1.000	1.000				
2002	1.267	1.005	1.001	1.000	1.000	1.000					
2003	1.290	1.003	1.002	1.000	1.000						
2004	1.305	1.003	1.000	1.001							
2005	1.241	1.003	1.001								
2006	1.266	1.004									
2007	1.275										
2008											

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Simple Average											
Latest 5	1.275	1.004	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Latest 3	1.261	1.003	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Medial Average											
Latest 5x1	1.277	1.004	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Volume-weighted Average											
Latest 5	1.273	1.004	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
Latest 3	1.261	1.003	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Selected	1.273	1.004	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
CDF to Ultimate	1.279	1.005	1.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Percent Paid	78.2%	99.5%	99.9%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Projection of Ultimate Claims Gross of S&S Using Reported and Paid Claims ($000)

Accident Year	Age of Accident Year at 12/31/08	Claims at 12/31/08 Reported	Claims at 12/31/08 Paid	CDF to Ultimate Reported	CDF to Ultimate Paid	Projected Ultimate Claims Using Dev. Method with Reported	Projected Ultimate Claims Using Dev. Method with Paid	Selected Ult. Claims Gross of S&S
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1998	132	2,864	2,864	1.000	1.000	2,864	2,864	2,864
1999	120	4,697	4,697	1.000	1.000	4,697	4,697	4,697
2000	108	7,902	7,902	1.000	1.000	7,902	7,902	7,902
2001	96	10,319	10,319	1.000	1.000	10,319	10,319	10,319
2002	84	11,137	11,137	1.000	1.000	11,137	11,137	11,137
2003	72	12,527	12,526	1.000	1.000	12,527	12,526	12,527
2004	60	14,552	14,521	1.000	1.000	14,552	14,521	14,536
2005	48	16,837	16,837	1.000	1.000	16,837	16,837	16,837
2006	36	16,945	16,942	1.000	1.001	16,945	16,959	16,952
2007	24	16,862	16,822	1.001	1.005	16,879	16,906	16,893
2008	12	14,727	12,889	1.115	1.279	16,421	16,485	16,453
Total		129,370	127,456			131,081	131,153	131,117

Column Notes:
(2) Age of accident year in (1) at December 31, 2008.
(3) and (4) Based on data from Auto Physical Damage Insurer.
(5) and (6) Based on CDF from Exhibit I, Sheets 4 and 5.
(7) = [(3) x (5)].
(8) = [(4) x (6)].
(9) = [Average of (7) and (8)].

Chapter 14 - Recoveries: Salvage and Subrogation and Reinsurance
Auto Physical Damage Insurer
Ratio of Received Salvage and Subrogation to Paid Claims

PART 1 - Ratio Triangle

Accident Year	Ratio of Received Salvage and Subrogation to Paid Claims as of (months)										
	12	24	36	48	60	72	84	96	108	120	132
1998	0.157	0.257	0.268	0.269	0.269	0.269	0.277	0.277	0.277	0.277	0.277
1999	0.198	0.284	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	
2000	0.166	0.299	0.305	0.306	0.306	0.306	0.306	0.306	0.306		
2001	0.264	0.350	0.351	0.352	0.352	0.353	0.352	0.352			
2002	0.257	0.363	0.367	0.367	0.367	0.367	0.367				
2003	0.220	0.342	0.345	0.345	0.348	0.348					
2004	0.235	0.353	0.355	0.355	0.355						
2005	0.243	0.338	0.341	0.340							
2006	0.233	0.326	0.334								
2007	0.217	0.354									
2008	0.210										

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	109 - 120	To Ult
1998	1.642	1.041	1.003	1.000	1.001	1.030	1.000	1.000	1.000	1.000	
1999	1.434	1.021	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
2000	1.801	1.019	1.005	1.000	1.000	1.000	1.000	1.000			
2001	1.328	1.003	1.003	1.000	1.001	1.000	1.000				
2002	1.411	1.010	1.000	1.000	1.000	1.001					
2003	1.558	1.009	0.999	1.009	1.001						
2004	1.502	1.008	1.000	1.000							
2005	1.393	1.008	0.999								
2006	1.397	1.025									
2007	1.632										
2008											

PART 3 - Average Age-to-Age Factors

	Averages										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Simple Average											
Latest 5	1.496	1.012	1.000	1.002	1.000	1.006	1.000	1.000	1.000	1.000	
Latest 3	1.474	1.014	0.999	1.003	1.001	1.000	1.000	1.000	1.000	1.000	
Medial Average											
Latest 5x1	1.486	1.009	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Selected	1.486	1.009	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
CDF to Ultimate	1.499	1.009	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Projection of Ultimate Salvage and Subrogation ($000)

Accident Year	Age of Accident Year at 12/31/08	Ratio of Received S&S to Paid Claims at 12/31/08	CDF to Ultimate	Projected Ultimate Ratio	Selected Ultimate S&S Ratio	Selected Ultimate Claims Gross of S&S	Projected Ultimate S&S
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1998	132	0.277	1.000	0.277	0.277	2,864	793
1999	120	0.290	1.000	0.290	0.290	4,697	1,360
2000	108	0.306	1.000	0.306	0.306	7,902	2,421
2001	96	0.352	1.000	0.352	0.352	10,319	3,637
2002	84	0.367	1.000	0.367	0.367	11,137	4,090
2003	72	0.348	1.000	0.348	0.348	12,527	4,365
2004	60	0.355	1.000	0.355	0.355	14,536	5,165
2005	48	0.340	1.000	0.340	0.340	16,837	5,731
2006	36	0.334	1.000	0.334	0.334	16,952	5,658
2007	24	0.354	1.009	0.357	0.357	16,893	6,036
2008	12	0.210	1.499	0.315	0.345	16,453	5,676
Total						131,117	44,934

Column Notes:
(2) Age of accident year in (1) at December 31, 2008.
(3) From latest diagonal of triangle in Exhibit I, Sheet 7.
(4) Based on CDF from Exhibit I, Sheet 7.
(5) = [(3) x (4)].
(6) = (5) for all years except accident year 2008. Judgmentally selected 0.345 for 2008 based on review of prior years.
(7) Developed in Exhibit I, Sheet 6.
(8) = [(6) x (7)].

Development of Unpaid Claim Estimate ($000)

			Projected Ultimate S&S			Estimated S&S Recoverables		
	Age of	Received	Using Dev Method with			Using Dev Method with		
Accident Year	Accident Year at 12/31/08	S&S at 12/31/08	Reported	Received	Ratio	Reported	Received	Ratio
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1998	132	793	793	793	793	0	0	0
1999	120	1,360	1,360	1,360	1,360	0	0	0
2000	108	2,421	2,421	2,421	2,421	0	0	0
2001	96	3,637	3,637	3,637	3,637	0	0	0
2002	84	4,090	4,091	4,090	4,090	0	0	0
2003	72	4,365	4,370	4,374	4,365	5	9	0
2004	60	5,160	5,165	5,175	5,165	5	15	6
2005	48	5,731	5,737	5,760	5,731	6	29	0
2006	36	5,655	5,720	5,688	5,658	66	34	3
2007	24	5,957	6,025	6,088	6,036	68	131	79
2008	12	2,710	5,776	5,252	5,676	3,066	2,542	2,966
Total		41,879	45,096	44,639	44,934	3,216	2,760	3,054

Column Notes:
(2) Age of accident year in (1) at December 31, 2008.
(3) Based on data from Auto Physical Damage Insurer.
(4) and (5) Developed in Exhibit I, Sheet 3.
(6) Developed in Exhibit I, Sheet 8.
(7) = [(4) - (3)].
(8) = [(5) - (3)].
(9) = [(6) - (3)].

Accident Year	Gross Reported Claims ($000) as of (months)			
	12	24	36	48
2005	35,839	42,290	47,365	49,733
2006	37,452	44,568	49,024	
2007	39,324	46,009		
2008	41,212			

Accident Year	Net Reported Claims ($000) as of (months)			
	12	24	36	48
2005	25,087	29,603	33,155	34,813
2006	26,216	31,197	34,317	
2007	33,426	39,108		
2008	37,091			

Accident Year	Ratio of Net to Gross Reported Claims as of (months)			
	12	24	36	48
2005	0.700	0.700	0.700	0.700
2006	0.700	0.700	0.700	
2007	0.850	0.850		
2008	0.900			

Accident Year	Gross Reported Claims ($000) as of (months) 12	24	36	48
2005	12,199	15,615	18,425	20,268
2006	12,992	16,890	20,267	
2007	13,901	17,655		
2008	14,735			

Accident Year	Net Reported Claims ($000) as of (months) 12	24	36	48
2005	11,752	14,076	16,502	18,056
2006	12,992	16,890	20,267	
2007	13,644	17,303		
2008	14,735			

Accident Year	Ceded Reported Claims ($000) as of (months) 12	24	36	48
2005	447	1,539	1,924	2,212
2006	-	-	-	
2007	257	352		
2008	-			

Self-Insurance Pool with Excess of Loss and Stop Loss Reinsurance

Policy Year	Ultimate Claims Net of Excess of Loss Gross of Stop Loss	Stop Loss Limit	Net of Excess of Loss, Net of Stop Loss: Ultimate Claims	Claims at 12/31/08: Reported	Claims at 12/31/08: Paid	Estimated IBNR	Unpaid Claim Estimate
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2002 - 03	1,184,999						
2003 - 04	1,770,725	4,000,000	4,000,000	3,753,248	3,253,624	246,752	746,376
2004 - 05	1,306,107						
2005 - 06	2,168,077	1,500,000	1,500,000	1,500,000	1,016,783	-	483,217
2006 - 07	1,137,216	1,500,000	1,137,216	914,262	629,296	222,954	507,920
2007 - 08	1,364,048	N/A	1,364,048	432,679	257,877	931,369	1,106,171
Total	8,931,172		8,001,264	6,600,189	5,157,579	1,401,075	2,843,685

Column Notes:
(2) Selected based on review of various projection techniques.
(3) Based on Self-Insurance Pool stop-loss reinsurance program.
(4) = [minimum of (2) and (3)].
(5) and (6) Based on Self-Insurance Pool experience.
(7) = [(4) - (5)].
(8) = [(4) - (6)].

CHAPTER 15 – EVALUATION OF TECHNIQUES

In this final chapter in Part 3, we bring together the various methods for estimating unpaid claims used for the examples presented in Chapters 7 through 14. We use numerous methodologies for the same examples, not simply for the purpose of demonstration, but because actuaries should use more than one method when analyzing unpaid claims. No single method can produce the best estimate in all situations. In their 1977 paper, Berquist and Sherman recommend that where possible, the actuary conducting an analysis of unpaid claims should use methods that incorporate the following:

- Projections of reported claims
- Projections of paid claims
- Projections of ultimate reported claim counts and severities
- Estimates of the number and average amount of outstanding claims
- Claim ratio estimates[82]

Berquist and Sherman further recommend that wherever possible the actuary should incorporate the concepts of credibility, regression analysis, and data smoothing into the actuarial methods used. They state: "The methods applied should range from those which are highly stable (i.e., representative of the average of experience over several years) to those which are highly responsive to trends and to more recent experience." It is then the responsibility of the actuary to select the most appropriate estimate of unpaid claims. In some situations, actuaries may incorporate the concept of credibility into the selection process; at other times actuarial judgment will prevail. When incorporating regression analysis into a method, Berquist and Sherman recommend using some measure of the goodness-of-fit to evaluate the appropriateness of that method's projections.

In "Reinsurance," Patrik comments on the selection process of techniques for the analysis of unpaid claims:

> You can see there are many possibilities, and no single right method. Any good actuary will want to use as many legitimate methods for which reasonably good information and time is available, and compare and contrast the estimates from these methods. As with pricing, it is often informative to see the spread of estimates derived from different approaches. This helps us understand better the range and distribution of possibilities, and may give us some idea of the sensitivity of our answers to varying assumptions and varying estimation methodologies.[83]

If there is sufficient claim history available, testing the method retroactively is one method for evaluating the appropriateness of a particular technique for estimating unpaid claims. The actuary can then determine the historical accuracy of the method and whether or not the particular method is free from bias in projecting future results.

[82] *PCAS*, 1977.

[83] *Foundations of Casualty Actuarial Science*, 2001.

The actuary should explain significant differences between the projections of various methods. Often such differences are due to changes in company operations and procedures or to changes in the external environment. Ronald Wiser notes in "Loss Reserving"[84] that the attempt to reconcile a number of different estimates is extremely difficult, but often yields important new insights for the actuary.

An important final check of the selected ultimate claims, particularly for the most recent years, should include calculation of claim ratios, severities, pure premiums, and claim frequencies. Such a review is consistent with Mr. Wiser's recommendations that proposed ultimate amounts be evaluated in contexts outside their original frame of analysis. If exposures are not available, the actuary can compare ultimate claim counts with premiums as a proxy for frequency. Another valuable test for the actuary is the implied average case outstanding and unreported claim on open and unreported claims. The actuary should review these statistics for reasonableness from the perspective of year-to-year changes, knowledge gained from meetings with management, and knowledge of the industry in general. Such review should either result in the actuary having greater confidence in the unpaid claim estimate or lead the actuary to seek additional information before reaching a conclusion.

In Chapters 7 through 14, we present numerous examples for insurers and self-insurers providing coverage for many different lines of insurance. In the following sections of this chapter, we review the results for many of these examples. We conclude this chapter with a brief discussion of monitoring and interim testing of unpaid claim estimates.

U.S. Industry Auto

For U.S. Industry Auto, the results of the various projection techniques are all quite consistent. This is not surprising given the volume of business. This example is based on the consolidated results for all U.S. private passenger automobile insurance. The following table summarizes the estimated IBNR and the total unpaid claim estimate (in billions of dollars) for each of the projection techniques.

	Estimated Unpaid Claims as of 12/31/07	
$ Billions	**IBNR**	**Total**
Development – Reported	26	71
Development – Paid	29	74
Expected Claims	26	71
Bornhuetter-Ferguson – Reported	26	71
Bornhuetter-Ferguson – Paid	27	73
Cape Cod	27	73
Case Outstanding Development	24	70

In total and by accident year, the methods produce unpaid claims that are similar to one another.

[84] *Foundations of Casualty Actuarial Science*, 2001.

XYZ Insurer

While we do not expect to see material differences in the various estimates of unpaid claims for U.S. Industry Auto, we do expect significant differences in results for XYZ Insurer. We know that the underlying assumptions of some of the methods do not hold true for XYZ Insurer as a result of recent changes in both its internal operations as well as the external environment. To demonstrate the influence of the Berquist-Sherman adjustments on the projected ultimate claims, we summarize in Exhibit I, Sheet 1, the projected ultimate claims from the following methods:

- Reported and paid claim development techniques based on unadjusted reported and paid claims

- Bornhuetter-Ferguson technique based on unadjusted reported and paid claim development patterns

- Cape Cod method based on unadjusted reported claim development pattern

- Reported and paid claim development techniques incorporating Berquist-Sherman adjustments to case outstanding only, paid claims only, as well as to both case outstanding and paid claims

- Bornhuetter-Ferguson based on adjusted reported and paid claim development patterns as well as revised expected claim ratios

The calculations for the revised Bornhuetter-Ferguson incorporating the Berquist-Sherman adjustments on development patterns and the expected claim ratio are not included in this book. We suggest that the user of this book reproduce these calculations to ensure a greater understanding of the mechanics of each method.

Since we know that using unadjusted data does not satisfy the underlying assumptions for the first three projection techniques above, we do not consider these projections when selecting ultimate claims for XYZ Insurer. We also do not consider the Berquist-Sherman adjustment for case outstanding only since this projection does not reflect the changes observed in settlement rates.

In Exhibit I, Sheets 2 through 6, we present exhibits that will assist us in selecting ultimate claims by accident year. We present the following:

- Exhibit I, Sheet 2 – Summary of Ultimate Claims
- Exhibit I, Sheet 3 – Comparison of Estimated Ultimate Claim Ratios
- Exhibit I, Sheet 4 – Comparison of Estimated Ultimate Severities
- Exhibit I, Sheet 5 – Comparison of Estimated Average Case Outstanding and Unreported Claims
- Exhibit I, Sheet 6 – Comparison of Estimated IBNR

Each of these exhibits contains details by accident year. For some techniques, such as the frequency-severity approaches (#2 and #3), we only estimate ultimate claims for the recent accident years. For other techniques, we project ultimate claims for all accident years in the experience period (i.e., 1998 through 2008). In Exhibit I, Sheets 2 through 6, we summarize the results for the following methods:

— Reported and paid claim development techniques incorporating Berquist-Sherman adjustments to paid claims only as well as to both case outstanding and paid claims

— Bornhuetter-Ferguson based on adjusted reported and paid claim development patterns as well as revised expected claim ratios

— All three frequency-severity projections (from Chapter 11)

We recall from Chapter 11, that there are concerns about the first frequency-severity approach for XYZ Insurer. We believe that the incorporation of closed claim counts into the selection of ultimate claim counts may overstate the true value of projected ultimate claims. We observe that this projection method results in significantly higher ultimate claims than all other methods summarized in Exhibit I, Sheet 2. The estimate of total ultimate claims for all accident years combined from frequency-severity approach method 1 is $551,155; the total ultimate claims for all other methods are less than $490,000. Thus, we exclude the frequency-severity method 1 from further consideration.

For the oldest seven years, 1998 through 2004, we observe fairly consistent results from the various projection methods. However, beginning in 2005, the differences become more substantial. A review of the estimated ultimate claim ratios and ultimate severities as well as the estimated IBNR can assist the actuary in the selection of ultimate claims. Another valuable statistic is the estimated average case outstanding and unreported claim on open and IBNR claims.

There are many acceptable ways to select ultimate claims in such an example. Some actuaries may select one method and use it for all years. The Berquist-Sherman adjusted reported claim (both case and paid adjustments) method may be a reasonable selection for all years for XYZ Insurer. Alternatively, an actuary may select different methods for different accident years. For example, select the Berquist-Sherman adjusted reported claim method for accident years 1998 through 2006 and the Bornhuetter-Ferguson method for 2007 and 2008. Another alternative is for the actuary to use a weighted average based on assigned weights to the various methods; these weights may be consistent for all years or may vary by accident year. The important point is that there is no single "right" way for the actuary to select ultimate claims (and thus the unpaid claim estimate). The actuary must take into consideration the results of the various techniques, diagnostic tests including implied claim ratios and severities, and all the information gained during the process of estimating unpaid claims. As stated earlier in this chapter, to the extent sufficient data is available, retroactive tests may also prove valuable to the actuary when selecting which methods to rely on for selecting ultimate claims.

For our example, we select ultimate claims based on: the Berquist-Sherman adjusted reported claim for accident years 1998 through 2004; the average of the adjusted reported and paid Bornhuetter-Ferguson techniques for accident years 2005 and 2006; the adjusted reported Bornhuetter-Ferguson technique for accident year 2007; and the average of the adjusted reported Bornhuetter-Ferguson technique and frequency-severity approach #2 for accident year 2008. The key drivers in our selections by accident year are the estimated IBNR, the estimated ultimate severities, and the estimated claim ratios. Later in this chapter, we will return to these selected ultimate claims when we present an example for monitoring the unpaid claim estimate on a quarterly basis.

Changing Conditions – Changes in Claim Ratios and Case Outstanding Adequacy and Changes in Product Mix

In Chapters 7 through 10, we present various scenarios related to changes in claim ratios and case outstanding adequacy based on a U.S. private passenger automobile example. For the first scenario, U.S. PP Auto Steady-State, all of the techniques produced an accurate estimate of unpaid claims. In this scenario, we assume that there are no changes in the underlying claim ratio or the strength of case outstanding. In the next three scenarios (U.S. PP Auto Increasing Claim Ratios, U.S. PP Auto Increasing Case Outstanding Strength, and U.S. PP Auto Increasing Claim Ratios and Case Outstanding Strength) the estimation techniques vary in their ability to accurately respond to the changing conditions.

We also create an example based on a combined portfolio of private passenger and commercial automobile insurance. Similar to the U.S. PP Auto Steady-State, all of the techniques used for the example with a steady-state product mix (U.S. Auto Steady-State) produce the actual IBNR value. When the product mix changes, however, the methods respond differently to the changing conditions.

The following table summarizes the estimated IBNR for each of the projection techniques for all of the scenarios other than steady-state examples. The first line of the table shows the actual IBNR needed for each scenario.

Estimated IBNR ($000)

Estimation Technique	Increasing Claim Ratios	Increasing Case Outstanding Strength	Increasing Claim Ratios and Case Outstanding Strength	Changing Product Mix
True IBNR	602	253	348	2,391
Development – Reported	602	501	694	2,153
Development – Paid	602	253	348	1,723
Expected Claims	-843	253	-1,097	2,167
Bornhuetter-Ferguson – Reported	439	458	460	2,168
Bornhuetter-Ferguson – Paid	159	253	-96	1,991
Benktander – Reported	573	492	648	2,159
Benktander – Paid	406	253	151	1,893
Cape Cod	506	470	546	2,168

For each of these scenarios, there is considerable variability between the methods in total and by accident year. In such a situation, it is very important that the actuary seek to understand what the drivers are for the differences between methods. The actuary might require more information from management as well as further quantitative analysis to determine which method is most appropriate for the particular circumstances. In these types of situations, the availability of claim counts and the ability to test the estimated ultimate severities could prove very valuable to the actuary.

Berq-Sher Insurers

The Berq-Sher Med Mal Insurer and Berq-Sher Auto BI Insurer are copies of examples presented in the Berquist and Sherman paper "Loss Reserve Adequacy Testing: A Comprehensive, Systematic Approach."[85] In Exhibit II, we summarize the results of the various projection methods for Berq-Sher Med Mal Insurer; and in Exhibit III, we summarize the results for Berq-Sher Auto BI Insurer.

For Berq-Sher Med Mal Insurer, we develop ultimate claims using the development technique applied to unadjusted reported and paid claims. We also use the development technique with adjusted reported claims, whereby claims are adjusted to reflect changes in case outstanding adequacy. In Exhibit II, we compare ultimate claims and estimated IBNR. We are limited in the diagnostics we can perform for both the Berquist-Sherman examples since we do not have complete claim count data.

In our analysis, it is clear from the diagnostics that an increase in case outstanding strength occurred during the experience period. Thus, the development method based on unadjusted reported claims is not appropriate since an underlying assumption of this technique is not valid (i.e., case outstanding adequacy did not remain constant over the experience period). Since the two remaining methods (i.e., unadjusted paid claim development and adjusted reported claim development) produce such significant differences, the actuary should seek additional information, including the potential use of other methodologies, before making a final determination as to ultimate claims and thus the unpaid claim estimate.

For Berq-Sher Auto BI Insurer, we develop four estimates of ultimate claims using the development technique. First, we project ultimate claims based on unadjusted paid claims data. We then adjust the paid claims data for changes in the rate of claims settlement and develop three alternative sets of claim development factors. In Exhibit III, we summarize ultimate claims and estimated ultimate severities for each of the four projections. All three of the projections based on the adjusted paid claim triangle are similar to one another, in total and by accident year. The results of the Berquist-Sherman adjustment are consistent with our expectations due to our conclusion of a decrease in the rate of claims settlement.

While the three projections based on adjusted paid claims are similar to one another, we do not consider these methods to necessarily be independent since they are based on the same source data. Ideally, the actuary would incorporate other techniques to verify the results of the Berquist-Sherman adjusted paid claims methodology.

Monitoring and Interim Techniques for Unpaid Claim Estimates

We begin Part 2 of this book by presenting Ronald Wiser's four-phase approach to estimating unpaid claims. His final phase is monitoring projections of the development of unpaid claims over subsequent calendar periods. He notes that deviations of actual development from projected development of claims or claim counts are one of the most useful diagnostic tools for evaluating the accuracy of the unpaid claim estimate.

Monitoring performance between detailed analyses of unpaid claims is important both for commercial insurers and self-insurers. Many actuaries build models to capture the difference

[85] *PCAS*, 1977.

between actual and expected claims reported (or paid) in the month or quarter. While some actuaries at very large companies may perform detailed analyses of unpaid claims on a quarterly basis, many use "roll-forward" types of analyses to capture and compare actual claims with expected claims between complete, detailed analyses. In addition to measuring changes in claims for historical periods, the actuary must incorporate the effect of changes in the exposure for the current period to any changes in the unpaid claim estimate used for financial reporting purposes.

Comparisons of actual-to-expected claims are valuable so that the actuary can understand the appropriateness of prior selections and make revisions as necessary if actual claims do not emerge as expected. Monitoring unpaid claims can be important for insurers from a financial reporting perspective, for budgeting and planning purposes, for pricing and other strategic decision-making, and for planning for the next complete analysis of unpaid claims.

It is typically a simple exercise to develop a model that allows comparisons of actual and expected claims by accident year between successive annual valuations. We present an example of such a model in Exhibit IV. For DC Insurer, we derive ultimate claims at December 31, 2007 based on the reported claim development technique. In Exhibit IV, Sheet 3, we use the selected ultimate claims and the selected reporting pattern to compare actual reported claims one year later (i.e., December 31, 2008) with our expected claims for the year.

For each accident year, expected reported claims in the calendar year are equal to:

[(ultimate claims selected at December 31, 2007 – actual reported claims at December 31, 2007) / (% unreported at December 31, 2007)] x (% reported at December 31, 2008 - % reported at December 31, 2007)

We derive the percentage unreported from the selected claim development pattern as [1.00 – (1.00 / cumulative claim development factor)]. For example, the expected reported claims for accident year 2007 during calendar year 2008 are equal to:

$$AY_{07} \text{ Expected Claim}_{CY08} = \{[(\$2{,}798 - \$2{,}463) / (1 - 0.880)] \times (0.999 - 0.880)\} = \$332$$

The expected reported claims for accident year 2006 during calendar year 2008 are equal to:

$$AY_{06} \text{ Expected Claim}_{CY08} = \{[(\$2{,}952 - \$2{,}949) / (1 - 0.999)] \times (1.000 - 0.999)\} = \$3$$

In the example for DC Insurer, we derive the reporting pattern based on the development factors to ultimate. This is a reasonable approach when selected ultimate claims for all accident years are based on the reported claim development technique. However, actuaries often rely on techniques other than the development technique to select ultimate claims. In such situations, it is often valuable to look at an alternative method for deriving reporting and payment patterns (other than the inverse of the cumulative development factor). A method often used to derive payment patterns is to compare the historical paid claim development triangle to the final value of selected ultimate claims. We present such a comparison for XYZ Insurer in Exhibit V, Sheet 1. Various averages of the percentage paid at each maturity are calculated and a payment pattern is selected. We present similar calculations for the reporting pattern in Exhibit V, Sheet 2.

In the table below, we compare the implied payment and reporting patterns based on the unadjusted development patterns, the development patterns after Berquist-Sherman adjustments, and the final selections from Exhibit V, Sheets 1 and 2.

Comparison of Reporting and Payment Patterns						
	Reporting Patterns			Payment Patterns		
Maturity Age	**Unadjusted CDF**	**Adjusted CDF**	**Selected**	**Unadjusted CDF**	**Adjusted CDF**	**Selected**
12	39.2%	44.9%	51.1%	4.5%	7.4%	8.5%
24	66.1%	74.3%	75.8%	15.2%	30.8%	22.4%
36	83.6%	91.4%	88.7%	31.6%	44.1%	38.1%
48	92.2%	99.0%	95.8%	49.8%	58.3%	55.5%
60	94.0%	99.3%	97.1%	65.6%	74.0%	72.9%
72	98.7%	100.0%	98.9%	78.9%	89.2%	84.4%

It can be a challenging task to develop a system for quarterly or monthly monitoring given an estimation process that focuses only on annual claim development patterns. Some insurers maintain claim development data on a quarterly basis. For these organizations, development factors are readily available for quarterly analyses, and linear interpolation between quarters is likely sufficient for monthly monitoring purposes. However, for insurers who only have annual claim development data, linear interpolation of annual development patterns is usually not appropriate, particularly for the most immature accident years.

In the paper "The Actuary and IBNR," Bornhuetter and Ferguson suggest:

> In the absence of data, it might be reasonable to assume that the cumulative distribution of development by quarter for the most recent accident year is skewed say 40% at three months, 70% at six months, 85% at nine months, 100% at 12 months, and that the distribution for prior accident years is uniform: 25%, 50%, 75%, 100%. Upon further study the authors were somewhat surprised to find that their data revealed prior year's development were also skewed; approximate distribution: 33%, 60%, 80%, 100%. The data reviewed were excess of loss and it is recognized that distributions observed may not be typical of ordinary business.[86]

For our example, we assume that DC Insurer has the systems capability to capture claim development data on a quarterly basis. Thus, we are able to build a model for monthly claims monitoring based on linear interpolation of the quarterly claim development factors. In Exhibit IV, Sheet 4, we present the template for January and February 2008.

In his 1973 review of the Bornhuetter and Ferguson's paper "The Actuary and IBNR," Hugh White offered a problem that is still relevant for actuaries monitoring unpaid claims today. Mr. White stated:

> You are trying to establish the reserve for commercial automobile bodily injury and the reported proportion of expected losses as of statement date for the current accident year period is 8% higher than it should be. Do you:

[86] *PCAS*, 1972.

> 1. Reduce the bulk (i.e., IBNR) reserve a corresponding amount (because you sense an acceleration in the rate of report);
>
> 2. Leave the bulk reserve at the same percentage level of expected losses (because you sense a random fluctuation such as a large loss); or
>
> 3. Increase the bulk reserve in proportion to the increase of actual reported over expected reported (because you don't have 100% confidence in your "expected losses")?
>
> Obviously, none of the three suggested "answers" is satisfactory without further extensive investigation, and yet, all are reasonable.[87]

While his comments are directed at limitations in the expected claims component of the Bornhuetter-Ferguson technique, in our opinion they are more applicable to an actuary monitoring unpaid claims and trying to determine the consequences that differences in expected and actual claims will have on the unpaid claim estimate. As Mr. White notes, there is no single "satisfactory" answer as to how an increase in reported claims should be addressed in establishing the unpaid claim estimate. In an effort to best understand the drivers underlying the greater-than-expected claims, the actuary must seek a comprehensive understanding of the specific situation. Such understanding can be achieved through meetings with management and other parties who understand the situation at-hand and through detailed analyses of the claims and claims experience.

[87] *PCAS*, 1973.

	Unadjusted Projections for Ultimate Claims					Adjusted Projections for Ultimate Claims				
Accident	Development Method		B-F Method		Cape Cod	Development Method			B-F Method	
Year	Reported	Paid	Reported	Paid	Method	Case Rptd	Both Rptd	Paid	Reported	Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1998	15,822	15,980	15,822	15,977	15,822	15,822	15,822	15,980	15,822	15,975
1999	25,082	25,164	25,107	25,158	25,107	25,107	25,107	25,140	25,107	25,128
2000	36,948	37,922	37,246	37,841	37,246	37,246	37,246	37,334	37,246	37,294
2001	38,487	40,600	38,798	40,525	38,798	38,798	38,798	39,290	38,798	39,274
2002	48,313	49,592	48,312	49,417	48,313	48,169	48,169	47,326	48,169	47,313
2003	44,950	49,858	45,068	50,768	45,062	44,373	44,373	44,078	44,373	45,070
2004	74,787	80,537	75,492	82,593	74,754	70,288	70,780	71,401	70,792	71,688
2005	76,661	80,333	79,129	94,301	77,931	70,655	71,362	68,685	71,554	77,898
2006	58,370	72,108	60,404	71,205	58,759	50,756	53,392	51,776	53,906	56,031
2007	47,979	77,941	45,221	45,636	43,307	38,237	42,680	38,549	40,300	34,988
2008	47,530	74,995	42,607	41,049	39,201	37,227	41,531	45,987	36,842	33,988
Total	514,929	605,030	513,207	554,471	504,300	476,678	489,258	485,546	482,910	484,648

Column Notes:
(2) and (3) Developed in Chapter 7, Exhibit II, Sheet 3.
(4) and (5) Developed in Chapter 9, Exhibit II, Sheet 1.
(6) Developed in Chapter 10, Exhibit II, Sheet 2.
(7) through (9) Developed in Chapter 13, Exhibit III, Sheet 10.
(10) and (11) Developed using projected ultimate claims in (8) as the new intial expected claims estimates.

			Adjusted Projections for Ultimate Claims				Projections for Ultimate Claims			Selected
Accident	Claims as of 12/31/08		Development Method		B-F Method		Frequency-Severity			Ultimate
Year	Reported	Paid	Both Rptd	Paid	Reported	Paid	Method 1	Method 2	Method 3	Claims
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1998	15,822	15,822	15,822	15,980	15,822	15,975	15,822			15,822
1999	25,107	24,817	25,107	25,140	25,107	25,128	25,082			25,107
2000	37,246	36,782	37,246	37,334	37,246	37,294	37,083			37,246
2001	38,798	38,519	38,798	39,290	38,798	39,274	38,778		39,192	38,798
2002	48,169	44,437	48,169	47,326	48,169	47,313	48,655		46,869	48,169
2003	44,373	39,320	44,373	44,078	44,373	45,070	46,107		44,479	44,373
2004	70,288	52,811	70,780	71,401	70,792	71,688	76,620		71,906	70,780
2005	70,655	40,026	71,362	68,685	71,554	77,898	80,745		71,684	74,726
2006	48,804	22,819	53,392	51,776	53,906	56,031	64,505		49,913	54,968
2007	31,732	11,865	42,680	38,549	40,300	34,988	58,516	30,512	31,805	40,300
2008	18,632	3,409	41,531	45,987	36,842	33,988	59,242	30,140	29,828	33,491
Total	449,626	330,629	489,258	485,546	482,910	484,648	551,155			483,781

Column Notes:
(2) and (3) Based on data from XYZ Insurer.
(4) and (5) Developed in Chapter 13, Exhibit III, Sheet 10.
(6) and (7) Developed using projected ultimate claims in (4) as the new intial expected claims estimates.
(8) Developed in Chapter 11, Exhibit II, Sheet 6.
(9) Developed in Chapter 11, Exhibit IV, Sheet 3.
(10) Developed in Chapter 11, Exhibit VI, Sheet 8.
(11) = (4) for AYs 2004 and prior; (11) = [Average of (6) and (7) for 2005 and 2006]; (11) = (6) for 2007; (11) = [Average of (6) and (9)] for 2008.

Chapter 15 - Evaluation of Techniques
XYZ Insurer - Auto BI
Comparison of Estimated Ultimate Claim Ratios

Exhibit I
Sheet 3

		Estimated Ultimate Claim Ratios Based on							Selected
Accident	Earned	Development Method		B-F Method		Frequency-Severity			Ult. Claims
Year	Premium	Both Rptd	Paid	Reported	Paid	Method 1	Method 2	Method 3	Ratios
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1998	20,000	79.1%	79.9%	79.1%	79.9%	79.1%			79.1%
1999	31,500	79.7%	79.8%	79.7%	79.8%	79.6%			79.7%
2000	45,000	82.8%	83.0%	82.8%	82.9%	82.4%			82.8%
2001	50,000	77.6%	78.6%	77.6%	78.5%	77.6%		78.4%	77.6%
2002	61,183	78.7%	77.4%	78.7%	77.3%	79.5%		76.6%	78.7%
2003	69,175	64.1%	63.7%	64.1%	65.2%	66.7%		64.3%	64.1%
2004	99,322	71.3%	71.9%	71.3%	72.2%	77.1%		72.4%	71.3%
2005	138,151	51.7%	49.7%	51.8%	56.4%	58.4%		51.9%	54.1%
2006	107,578	49.6%	48.1%	50.1%	52.1%	60.0%		46.4%	51.1%
2007	62,438	68.4%	61.7%	64.5%	56.0%	93.7%	48.9%	50.9%	64.5%
2008	47,797	86.9%	96.2%	77.1%	71.1%	123.9%	63.1%	62.4%	70.1%
Total	732,144	66.8%	66.3%	66.0%	66.2%	75.3%			66.1%

Column Notes:
(2) Based on data from XYZ Insurer.
(3) through (10) = [(projected ultimate claims in Exhibit I, Sheet 2) / (2)].

Chapter 15 - Evaluation of Techniques
XYZ Insurer - Auto BI
Comparison of Estimated Ultimate Severities

Exhibit I
Sheet 4

Accident Year	Ultimate Claim Counts	Estimated Ultimate Severities Based on: Development Method: Both Rptd	Development Method: Paid	B-F Method: Reported	B-F Method: Paid	Frequency-Severity: Method 1	Frequency-Severity: Method 2	Frequency-Severity: Method 3	Selected Ultimate Severities
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1998	637	24,839	25,087	24,839	25,078	24,839			24,839
1999	1,047	23,980	24,011	23,980	24,000	23,956			23,980
2000	1,416	26,304	26,365	26,304	26,338	26,189			26,304
2001	1,466	26,465	26,801	26,465	26,790	26,452		26,734	26,465
2002	1,565	30,779	30,240	30,779	30,232	31,090		29,948	30,779
2003	1,666	26,634	26,457	26,634	27,053	27,675		26,698	26,634
2004	2,309	30,654	30,923	30,659	31,047	33,183		31,142	30,654
2005	2,483	28,740	27,662	28,817	31,373	32,519		28,870	30,095
2006	1,807	29,547	28,653	29,832	31,008	35,697		27,622	30,420
2007	1,556	27,429	24,775	25,900	22,486	37,606	19,609	20,440	25,900
2008	1,426	29,124	32,249	25,836	23,835	41,544	21,136	20,918	23,486
Total	17,378	28,154	27,940	27,789	27,889	31,716			27,839

Column Notes:
(2) Developed in Chapter 11, Exhibit II, Sheet 3.
(3) through (10) = [(projected ultimate claims in Exhibit I, Sheet 2) x 1000 / (2)].

Chapter 15 - Evaluation of Techniques Exhibit I
XYZ Insurer - Auto BI Sheet 5
Comparison of Estimated Average Case Outstanding and Unreported Claims

Accident Year	Open and IBNR Counts at 12/31/08	Estimated Average Case Outstanding and Unreported Claims Based on: Development Method		B-F Method		Frequency-Severity			Selected Ultimate Average
		Both Rptd	Paid	Reported	Paid	Method 1	Method 2	Method 3	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1998	0	-	-	-	-	-			-
1999	3	96,618	107,540	96,618	103,768	88,249			96,618
2000	14	33,181	39,409	33,181	36,581	21,541			33,181
2001	20	13,908	38,519	13,908	37,750	12,938		33,619	13,908
2002	42	88,842	68,772	88,842	68,468	100,425		57,899	88,842
2003	98	51,555	48,549	51,555	58,674	69,248		52,638	51,555
2004	280	64,176	66,391	64,219	67,418	85,031		68,196	64,176
2005	537	58,352	53,369	58,710	70,525	75,826		58,953	64,617
2006	606	50,450	47,784	51,299	54,805	68,789		44,710	53,052
2007	765	40,280	34,882	37,170	30,226	60,981	24,375	26,065	37,170
2008	1,150	33,149	37,025	29,073	26,591	48,551	23,245	22,973	26,159
Total	3,515	530,511	542,240	524,574	554,805	631,578			529,277

Column Notes:
(2) Based on data from XYZ Insurer.
(3) through (10) = {[(estimated IBNR in Exhibit I, Sheet 6) + ((2) in Exhibit I, Sheet 6)] x 1000 / (2)}.

Chapter 15 - Evaluation of Techniques
XYZ Insurer - Auto BI
Comparison of Estimated IBNR ($000)

	Case	Estimated IBNR Based on							
Accident	Outstanding	Development Method		B-F Method		Frequency-Severity			Selected
Year	at 12/31/08	Both Rptd	Paid	Reported	Paid	Method 1	Method 2	Method 3	IBNR
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1998	0	0	158	0	152	0			0
1999	290	0	33	0	21	- 25			0
2000	465	0	87	0	48	- 163			0
2001	278	0	492	0	477	- 19		394	0
2002	3,731	0	- 843	0	- 856	486		- 1,300	0
2003	5,052	0	- 295	0	698	1,734		106	0
2004	17,477	492	1,112	504	1,400	6,331		1,618	492
2005	30,629	707	- 1,970	899	7,243	10,090		1,029	4,071
2006	25,985	4,588	2,972	5,102	7,227	15,701		1,109	6,164
2007	19,867	10,948	6,817	8,568	3,256	26,784	- 1,220	73	8,568
2008	15,223	22,899	27,355	18,210	15,356	40,610	11,508	11,196	14,859
Total	118,997	39,632	35,920	33,284	35,022	101,529			34,155

Column Notes:
(2) Based on data from XYZ Insurer.
(3) through (10) = [(projected ultimate claims in Exhibit I, Sheet 2) - ((2) in Exhibit I, Sheet 2)].

Chapter 15 - Evaluation of Techniques
Berq-Sher Med Mal Insurer
Summary of Ultimate Claims and Estimated IBNR

Exhibit II

Accident	Claims as of 12/31/76		Projected Ultimate Claims			Estimated IBNR Based on		
			Development Method		Berq-Sher	Development Method		Berq-Sher
Year	Reported	Paid	Reported	Paid	Adj Rptd	Reported	Paid	Adj Rptd
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1969	23,506,000	15,815,000	23,506,000	23,501,090	23,506,000	0	- 4,910	0
1970	32,216,000	18,983,000	33,085,832	35,289,397	31,539,464	869,832	3,073,397	- 676,536
1971	48,377,000	17,707,000	52,247,160	46,321,512	45,667,888	3,870,160	- 2,055,488	- 2,709,112
1972	61,163,000	18,518,000	79,695,389	83,238,410	61,468,815	18,532,389	22,075,410	305,815
1973	73,733,000	11,292,000	112,369,092	99,064,716	68,571,690	38,636,092	25,331,716	- 5,161,310
1974	63,477,000	6,267,000	145,425,807	134,978,646	79,092,342	81,948,807	71,501,646	15,615,342
1975	48,904,000	1,565,000	215,275,408	125,021,590	93,455,544	166,371,408	76,117,590	44,551,544
1976	15,791,000	209,000	175,990,695	103,266,273	117,879,815	160,199,695	87,475,273	102,088,815
Total	367,167,000	90,356,000	837,595,383	650,681,634	521,181,558	470,428,383	283,514,634	154,014,558

Column Notes:
(2) and (3) Based on medical malpractice insurance experience.
(4) through (6) Developed in Chapter 13, Exhibit I, Sheet 8.
(7) = [(4) - (2)].
(8) = [(5) - (2)].
(9) = [(6) - (2)].

Chapter 15 - Evaluation of Techniques Exhibit III
Berq-Sher Auto BI Insurer
Summary of Ultimate Claims and Estimated Ultimate Severities

	Paid	Projected Ultimate Claims					Estimated Ultimate Severities Based on			
			Berquist-Sherman Adjusted Paid					Berquist-Sherman Adjusted Paid		
Accident Year	Claims at 12/31/76	Paid Claims Dev Method	Dev Method	Lin Reg	Exp Reg	Ultimate Claim Counts	Paid Claims Dev Method	Dev Method	Lin Reg	Exp Reg
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1969	10,256	10,256	10,256	10,256	10,256	7,821	1,311	1,311	1,311	1,311
1970	12,031	12,103	12,103	12,107	12,107	8,682	1,394	1,394	1,395	1,395
1971	14,235	14,577	14,591	14,583	14,583	9,945	1,466	1,467	1,466	1,466
1972	15,383	16,321	16,506	16,502	16,502	9,690	1,684	1,703	1,703	1,703
1973	15,278	17,631	18,257	18,059	18,061	9,591	1,838	1,904	1,883	1,883
1974	11,771	16,232	17,974	17,241	17,251	7,803	2,080	2,304	2,210	2,211
1975	9,182	18,281	21,559	20,984	20,993	8,050	2,271	2,678	2,607	2,608
1976	2,801	17,282	20,772	21,346	21,394	7,466	2,315	2,782	2,859	2,865
Total	90,937	122,684	132,019	131,079	131,147	69,047	1,777	1,912	1,898	1,899

Column Notes:
(2) Based on automobile bodily injurty experience.
(3) through (6) Developed in Chapter 13, Exhibit II, Sheet 11.
(7) Developed in Chapter 13, Exhibit II, Sheet 4.
(8) = [(3) x 1000 / (7)].
(9) = [(4) x 1000 / (7)].
(10) = [(5) x 1000 / (7)].
(11) = [(6) x 1000 / (7)].

PART 1 - Data Triangle

Accident Year	Reported Claims as of (months) 3	6	9	12	15	18	21	24	27	30	33	36
1997	861	1,668	2,459	3,255	3,366	3,385	3,385	3,374	3,372	3,374	3,376	3,376
1998	878	1,493	2,248	2,756	2,826	2,812	2,805	2,804	2,785	2,787	2,787	2,788
1999	463	786	1,166	1,605	1,673	1,642	1,646	1,645	1,649	1,649	1,649	1,649
2000	511	806	1,112	1,530	1,684	1,689	1,686	1,688	1,686	1,687	1,687	1,687
2001	414	750	1,264	1,836	2,088	2,078	2,081	2,086	2,086	2,087	2,087	2,088
2002	502	961	1,424	2,016	2,307	2,330	2,342	2,348	2,352	2,354	2,355	2,355
2003	614	1,231	1,940	2,576	2,878	2,936	2,977	2,988	2,992	2,992	2,994	2,994
2004	833	1,576	2,181	3,048	3,407	3,406	3,397	3,403	3,407	3,410	3,412	3,412
2005	675	1,248	1,833	2,601	2,792	2,791	2,803	2,810	2,813	2,814	2,814	2,814
2006	764	1,374	2,157	2,531	2,897	2,930	2,945	2,949				
2007	754	1,468	1,987	2,463								

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 3 - 6	6 - 9	9 - 12	12 - 15	15 - 18	18 - 21	21 - 24	24 - 27	27 - 30	30 - 33	33 - 36	To Ult
1997	1.936	1.475	1.324	1.034	1.006	1.000	0.997	1.000	1.001	1.000	1.000	
1998	1.700	1.506	1.226	1.025	0.995	0.997	1.000	0.993	1.001	1.000	1.000	
1999	1.697	1.483	1.377	1.043	0.981	1.002	1.000	1.002	1.000	1.000	1.000	
2000	1.575	1.380	1.376	1.101	1.003	0.998	1.001	0.999	1.000	1.000	1.000	
2001	1.813	1.685	1.452	1.137	0.995	1.001	1.002	1.000	1.000	1.000	1.000	
2002	1.913	1.482	1.416	1.144	1.010	1.005	1.002	1.002	1.001	1.000	1.000	
2003	2.005	1.576	1.328	1.117	1.020	1.014	1.004	1.001	1.000	1.000	1.000	
2004	1.892	1.384	1.397	1.118	0.999	0.998	1.002	1.001	1.001	1.001	1.000	
2005	1.848	1.468	1.420	1.073	1.000	1.004	1.003	1.001	1.000	1.000	1.000	
2006	1.798	1.569	1.174	1.145	1.011	1.005	1.001					
2007	1.947	1.354	1.240									

PART 3 - Average Age-to-Age Factors

	Averages 3 - 6	6 - 9	9 - 12	12 - 15	15 - 18	18 - 21	21 - 24	24 - 27	27 - 30	30 - 33	33 - 36	To Ult
Simple Average												
All Years	1.830	1.487	1.339	1.094	1.002	1.003	1.001	1.000	1.000	1.000	1.000	
Latest 7	1.888	1.503	1.347	1.119	1.006	1.004	1.002	1.001	1.000	1.000	1.000	
Latest 5	1.898	1.470	1.312	1.119	1.008	1.005	1.002	1.001	1.000	1.000	1.000	
Medial Average												
Latest 5x1	1.883	1.496	1.360	1.124	1.005	1.003	1.002	1.001	1.000	1.000	1.000	
Volume-weighted Average												
All Years	1.838	1.480	1.326	1.091	1.003	1.003	1.001	1.000	1.001	1.000	1.000	
Latest 7	1.889	1.485	1.335	1.119	1.006	1.004	1.002	1.001	1.000	1.000	1.000	
Latest 5	1.895	1.464	1.309	1.118	1.008	1.005	1.002	1.001	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 3 - 6	6 - 9	9 - 12	12 - 15	15 - 18	18 - 21	21 - 24	24 - 27	27 - 30	30 - 33	33 - 36	To Ult
Selected	1.895	1.464	1.309	1.118	1.008	1.005	1.002	1.001	1.000	1.000	1.000	1.000
CDF to Ultimate	4.125	2.177	1.487	1.136	1.016	1.008	1.003	1.001	1.000	1.000	1.000	1.000
Percent Reported	24.2%	45.9%	67.2%	88.0%	98.4%	99.2%	99.7%	99.9%	100.0%	100.0%	100.0%	100.0%

Projection of Ultimate Claims Using Reported Claims ($000)

Accident Year	Age of Accident Year at 12/31/07	Reported Claims at 12/31/07	CDF to Ultimate	Projected Ultimate Claims
(1)	(2)	(3)	(4)	(5)
1997	132	3,376	1.000	3,376
1998	120	2,788	1.000	2,788
1999	108	1,649	1.000	1,649
2000	96	1,687	1.000	1,687
2001	84	2,088	1.000	2,088
2002	72	2,355	1.000	2,355
2003	60	2,994	1.000	2,994
2004	48	3,412	1.000	3,412
2005	36	2,814	1.000	2,814
2006	24	2,949	1.001	2,952
2007	12	2,463	1.136	2,798
Total		28,577		28,915

Column Notes:
(2) Age of accident year in (1) at December 31, 2007.
(3) Based on data from DC Insurer.
(4) Based on selected CDF in Exhibit IV, Sheet 1.
(5) = [(3) x (4)].

Accident Year	Selected Ultimate Claims	Expected % Reported at 12/31/07	Expected % Reported at 12/31/08	Reported Claims at 12/31/07	Reported Claims at 12/31/08	Claims Reported Between 12/31/07 and 12/31/08 Actual	Claims Reported Between 12/31/07 and 12/31/08 Expected	Claims Reported Between 12/31/07 and 12/31/08 Difference
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1997	3,376	100.0%	100.0%	3,376	3,376	0	0	0
1998	2,788	100.0%	100.0%	2,788	2,788	0	0	0
1999	1,649	100.0%	100.0%	1,649	1,649	0	0	0
2000	1,687	100.0%	100.0%	1,687	1,687	0	0	0
2001	2,088	100.0%	100.0%	2,088	2,096	8	0	8
2002	2,355	100.0%	100.0%	2,355	2,340	- 15	0	- 15
2003	2,994	100.0%	100.0%	2,994	3,007	13	0	13
2004	3,412	100.0%	100.0%	3,412	3,392	- 20	0	- 20
2005	2,814	100.0%	100.0%	2,814	2,885	71	0	71
2006	2,952	99.9%	100.0%	2,949	3,030	81	3	78
2007	2,798	88.0%	99.9%	2,463	2,733	270	332	- 62
Total	28,915			28,577	28,984	407	335	72

Column Notes:
(2) Developed in Exhibit IV, Sheet 2.
(3) and (4) Based on selected CDF in Exhibit IV, Sheet 1.
(5) and (6) Based on data from DC Insurer.
(7) = [(6) - (5)].
(8) = {[(2) - (5)] / [1.0 - (3)] x [(4) - (3)]}.
(9) = [(7) - (8)].

Accident Year	Selected Ultimate Claims	Expected % Reported at			Actual Reported Claims at			Claims Reported Between 12/31/07 and 01/31/08			Claims Reported Between 01/31/08 and 02/29/08		
		12/31/07	01/31/08	02/29/08	12/31/07	01/31/08	02/29/08	Actual	Expected	Difference	Actual	Expected	Difference
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1997	3,376	100.0%	100.0%	100.0%	3,376	3,376	3,376	0	0	0	0	0	0
1998	2,788	100.0%	100.0%	100.0%	2,788	2,788	2,788	0	0	0	0	0	0
1999	1,649	100.0%	100.0%	100.0%	1,649	1,649	1,649	0	0	0	0	0	0
2000	1,687	100.0%	100.0%	100.0%	1,687	1,687	1,687	0	0	0	0	0	0
2001	2,088	100.0%	100.0%	100.0%	2,088	2,096	2,096	8	0	8	0	0	0
2002	2,355	100.0%	100.0%	100.0%	2,355	2,355	2,355	0	0	0	0	0	0
2003	2,994	100.0%	100.0%	100.0%	2,994	2,994	2,998	0	0	0	4	0	4
2004	3,412	100.0%	100.0%	100.0%	3,412	3,422	3,422	10	0	10	0	0	0
2005	2,814	100.0%	100.0%	100.0%	2,814	2,825	2,832	10	0	10	7	0	7
2006	2,952	99.9%	99.9%	100.0%	2,949	2,951	2,986	2	1	1	35	1	34
2007	2,798	88.0%	91.5%	95.0%	2,463	2,473	2,538	10	97	- 87	64	97	- 32
Total	28,915				28,577	28,618	28,728	41	98	- 57	110	98	12

Column Notes:
(2) Developed in Exhibit IV, Sheet 2.
(3) Based on selected CDF in Exhibit IV, Sheet 1.
(4) and (5) Based on linear interpolation of selected CDF in Exhibit IV, Sheet 1.
(6) through (8) Based on data from DC Insurer.
(9) = [(7) - (6)].
(10) = {[(2) - (6)] / [1.0 - (3)] x [(4) - (3)]}.
(11) = [(9) - (10)].
(12) = [(8) - (7)].
(13) = {[(2) - (6)] / [1.0 - (3)] x [(5) - (4)]}.
(14) = [(12) - (13)].

Chapter 15 - Evaluation of Techniques
XYZ Insurer - Auto BI
Ratio of Paid Claims to Selected Ultimate Claims ($000)

Exhibit V
Sheet 1

PART 1 - Data Triangle

Accident Year	Paid Claims as of (months) 12	24	36	48	60	72	84	96	108	120	132	Selected Ultimate
1998			6,309	8,521	10,082	11,620	13,242	14,419	15,311	15,764	15,822	15,822
1999		4,666	9,861	13,971	18,127	22,032	23,511	24,146	24,592	24,817		25,107
2000	1,302	6,513	12,139	17,828	24,030	28,853	33,222	35,902	36,782			37,246
2001	1,539	5,952	12,319	18,609	24,387	31,090	37,070	38,519				38,798
2002	2,318	7,932	13,822	22,095	31,945	40,629	44,437					48,169
2003	1,743	6,240	12,683	22,892	34,505	39,320						44,373
2004	2,221	9,898	25,950	43,439	52,811							70,780
2005	3,043	12,219	27,073	40,026								74,726
2006	3,531	11,778	22,819									54,968
2007	3,529	11,865										40,300
2008	3,409											33,491

PART 2 - Ratios

Accident Year	Ratio of Paid Claims to Selected Ultimate Claims as of (months) 12	24	36	48	60	72	84	96	108	120	132
1998			0.399	0.539	0.637	0.734	0.837	0.911	0.968	0.996	1.000
1999		0.186	0.393	0.556	0.722	0.878	0.936	0.962	0.979	0.988	
2000	0.035	0.175	0.326	0.479	0.645	0.775	0.892	0.964	0.988		
2001	0.040	0.153	0.318	0.480	0.629	0.801	0.955	0.993			
2002	0.048	0.165	0.287	0.459	0.663	0.843	0.923				
2003	0.039	0.141	0.286	0.516	0.778	0.886					
2004	0.031	0.140	0.367	0.614	0.746						
2005	0.041	0.164	0.362	0.536							
2006	0.064	0.214	0.415								
2007	0.088	0.294									
2008	0.102										

PART 3 - Average Ratios

	Averages 12	24	36	48	60	72	84	96	108	120	132
Simple Average											
Latest 5	0.065	0.191	0.343	0.521	0.692	0.837	0.909	0.957	0.978	0.992	1.000
Latest 3	0.085	0.224	0.381	0.555	0.729	0.844	0.923	0.973	0.978	0.992	1.000
Latest 2	0.095	0.254	0.389	0.575	0.762	0.865	0.939	0.978	0.984	0.992	1.000
Medial Average											
Latest 5x1	0.064	0.173	0.339	0.510	0.685	0.824	0.917	0.963	0.979	0.992	1.000

PART 4 - Selected Ratios

	Ratios Selection 12	24	36	48	60	72	84	96	108	120	132
Selected	0.085	0.224	0.381	0.555	0.729	0.844	0.923	0.973	0.978	0.992	1.000

XYZ Insurer - Auto BI

Ratio of Reported Claims to Selected Ultimate Claims ($000)

PART 1 - Data Triangle

Accident Year	Reported Claims as of (months) 12	24	36	48	60	72	84	96	108	120	132	Selected Ultimate
1998			11,171	12,380	13,216	14,067	14,688	16,366	16,163	15,835	15,822	15,822
1999		13,255	16,405	19,639	22,473	23,764	25,094	24,795	25,071	25,107		25,107
2000	15,676	18,749	21,900	27,144	29,488	34,458	36,949	37,505	37,246			37,246
2001	11,827	16,004	21,022	26,578	34,205	37,136	38,541	38,798				38,798
2002	12,811	20,370	26,656	37,667	44,414	48,701	48,169					48,169
2003	9,651	16,995	30,354	40,594	44,231	44,373						44,373
2004	16,995	40,180	58,866	71,707	70,288							70,780
2005	28,674	47,432	70,340	70,655								74,726
2006	27,066	46,783	48,804									54,968
2007	19,477	31,732										40,300
2008	18,632											33,491

PART 2 - Ratios

Accident Year	Ratio of Reported Claims to Selected Ultimate Claims as of (months) 12	24	36	48	60	72	84	96	108	120	132
1998			0.706	0.782	0.835	0.889	0.928	1.034	1.022	1.001	1.000
1999		0.528	0.653	0.782	0.895	0.947	0.999	0.988	0.999	1.000	
2000	0.421	0.503	0.588	0.729	0.792	0.925	0.992	1.007	1.000		
2001	0.305	0.412	0.542	0.685	0.882	0.957	0.993	1.000			
2002	0.266	0.423	0.553	0.782	0.922	1.011	1.000				
2003	0.217	0.383	0.684	0.915	0.997	1.000					
2004	0.240	0.568	0.832	1.013	0.993						
2005	0.384	0.635	0.941	0.946							
2006	0.492	0.851	0.888								
2007	0.483	0.787									
2008	0.556										

PART 3 - Average Ratios

Averages	12	24	36	48	60	72	84	96	108	120	132
Simple Average											
Latest 5	0.431	0.645	0.780	0.868	0.917	0.968	0.983	1.007	1.007	1.000	1.000
Latest 3	0.511	0.758	0.887	0.958	0.971	0.989	0.995	0.998	1.007	1.000	1.000
Latest 2	0.520	0.819	0.915	0.979	0.995	1.006	0.997	1.003	0.999	1.000	1.000
Medial Average											
Latest 5x1	0.453	0.663	0.801	0.881	0.932	0.957	0.995	1.003	1.000	1.000	1.000

PART 4 - Selected Ratios

Ratios Selection	12	24	36	48	60	72	84	96	108	120	132
Selected	0.511	0.758	0.887	0.958	0.971	0.989	0.995	0.998	1.000	1.000	1.000

PART 4 – ESTIMATING UNPAID CLAIM ADJUSTMENT EXPENSES

INTRODUCTION TO PART 4 – ESTIMATING UNPAID CLAIM ADJUSTMENT EXPENSES

In prior chapters of this book, we discuss the categorization of claim adjustment expenses into allocated loss adjustment expenses (ALAE) and unallocated loss adjustment expenses (ULAE). ALAE correspond to those costs the insurer can assign to a particular claim, such as legal and expert witness expenses – thus, the name allocated loss adjustment expense. ULAE, on the other hand, cannot be allocated to a specific claim. Examples of ULAE include salaries, rent, and computer expenses for the claims department of an insurer.

Actuaries in Canada still separate LAE into ALAE and ULAE (also known as internal loss adjusting expense, or ILAE, in Canada). However, the NAIC promulgated two new categorizations of claim adjustment expenses (effective January 1, 1998) for U.S. insurers reporting on Schedule P of the P&C statutory Annual Statement: defense and cost containment (DCC) and adjusting and other (A&O). Generally, DCC expenses include all defense litigation and medical cost containment expenses regardless of whether internal or external to the insurer; A&O expenses include all claims adjusting expenses, whether internal or external to the insurer.

Some insurers in the U.S. now separately analyze DCC and A&O. Other U.S. insurers continue to use the ALAE and ULAE categorization for the purpose of determining unpaid claims adjustment expenses; these insurers use other allocation methods to distinguish between DCC and A&O for statutory financial statement reporting purposes. In Chapter 16, we address common techniques for estimating unpaid ALAE. While we choose to use the term ALAE in this chapter, we point out that the development methods presented in Chapter 16 can also be used for DCC. Key determining factors include:

- Whether or not sufficient detail is available regarding the expenses such that the data can be organized by accident year (policy, underwriting, or report year)

- Whether the expenses tend to track accident year (policy, underwriting, or report year) or are more dependent on calendar year

Unlike ALAE, which often demonstrate a close relationship with claims experience, ULAE or A&O are often related to the size of the insurer's claims department and are less closely related to claims. In Chapter 17, we present techniques for estimating unpaid ULAE (and A&O).

CHAPTER 16 – ESTIMATING UNPAID ALLOCATED CLAIM ADJUSTMENT EXPENSES

After describing the 1998 changes to the categorization of expenses from ALAE and ULAE to DCC and A&O, Mr. Wiser states:

> The key in grouping expenses for reserving purposes is still whether or not the expenses are assigned to an individual claim. Significantly more analysis can be completed for those expenses that are assigned to an individual claim (allocated expenses) because more data exists. For instance, the accident date of the claim that generated the expense is known for an allocated expense, but unknown for an unallocated expense.[88]

All of the development techniques described in Part 3 can be used with ALAE. The greatest challenge for the actuary is often obtaining data for ALAE separate from claim only data. In order for the actuary to determine how to estimate unpaid ALAE, he or she must understand how the insurer processes such expenses and what data is available for analysis.

Many insurers record only ALAE payments and do not separately estimate case outstanding for ALAE. Other insurers may combine data for all types of ALAE. Some insurers maintain detailed information regarding case outstanding estimates and payments for the different types of ALAE (e.g., defense costs, expert witness fees, claims adjusting, and investigation). Mr. Wiser comments on the value of splitting the analysis of ALAE by subcategory:

> The most important subcategory is attorneys' fees and court costs. It will often be conducive to obtaining better estimates of loss adjustment expense to develop legal expense separate from all other allocated expense items.

Due to data limitations, actuaries often combine ALAE with claims data for the purpose of determining estimates of unpaid ALAE. However, it is important that the actuary recognizes that for some lines of business the development patterns for ALAE differ significantly from the patterns inherent in the claim only experience. For example, for some third-party liability lines of insurance, defense and expert witness costs may occur on an ongoing basis during the period of investigation and well before any claim payment to the claimant. Furthermore, some defense and settlement costs may lag the payment to the injured party. Thus, combining claim amount with ALAE for such lines of business can present challenges similar to combining two lines of business with non-homogeneous experience.

In Chapter 3 – Understanding the Types of Data Used in the Estimation of Unpaid Claims, we state: "We cannot emphasize strongly enough how critical it is for the actuary to fully understand the types of data generated by the insurer's information systems." This comment is equally applicable for the actuary gathering data for an analysis of unpaid ALAE. The actuary must understand the definition of ALAE used by the insurer and ensure that such definition has not changed over the experience period. The actuary must also understand how changes in the insurer's operations and/or policies may have affected the historical ALAE experience.

[88] *Foundations of Casualty Actuarial Science*, 2001.

Example – Auto Property Damage Insurer

The development technique is frequently used by actuaries with paid ALAE. When separate case outstanding for ALAE exists, actuaries will also use a reported ALAE development technique. Another frequently used approach is the development of the ratio of paid ALAE-to-paid claims only. We use a sample insurer writing automobile property damage insurance (Auto Property Damage Insurer) to demonstrate four projection techniques for ALAE. We understand based on our discussions with the claims department management that Auto Property Damage Insurer maintains separate case outstanding for ALAE.

In Exhibit I, Sheets 1 through 3, we present the ALAE development method for reported and paid ALAE; in Exhibit I, Sheets 4 through 8, we use the development method applied to the ratio of paid ALAE-to-paid claims. We present our final projection of ultimate ALAE in Exhibit I, Sheets 9 and 10. In this approach, we also review the ratio of paid ALAE-to-paid claims. However, we use additive development factors instead of multiplicative factors to project ultimate ALAE. In "Loss Reserving," Mr. Wiser notes: "If the ratios are very small at early maturities, the additive approach seems to be more stable."[89] It is important to remember that all of the assumptions underlying the development technique described in Chapter 7 are equally applicable to the following example for ALAE.

We begin our example with the projection of reported and paid ALAE in Exhibit I, Sheets 1 and 2, respectively. We immediately notice an increasing volume of reported and paid ALAE for accident years 2006 through 2008. After a quick review of the age-to-age factors (looking down the columns) for the reported ALAE, we also observe a changing pattern of development particularly at 12-to-24 months and 24-to-36 months. The age-to-age factors are smaller for the more recent accident year when compared to the earliest accident years in the experience period. Both of these observations should lead us to seek further information. Is ALAE increasing because the size of the portfolio is increasing (i.e., are there more insureds for recent years than prior years)? Were there operational or policy changes over the experience period that have led to earlier recognition of ALAE case outstanding? The same magnitude of change is not evident when looking down the columns of the age-to-age factors for paid ALAE.

To reflect the most recent experience, we select age-to-age factors based on the volume-weighted average for the latest three years for both reported ALAE and paid ALAE. We select a tail factor of 1.00 for reported ALAE since there is no further development beyond 96 months evident in the triangle. For paid ALAE, we select a tail factor of 1.005 based on a review of the ratios of reported ALAE-to-paid ALAE from 96 months to 132 months and consideration of the observed paid development during this period. In Exhibit I, Sheet 3, we project ultimate ALAE using the development technique described previously in this book. The format of Exhibit I, Sheet 3 is identical to the development projection exhibits of many other chapters. The reported and paid ALAE projections are very similar; we do see a significant increase in the ultimate ALAE for accident years 2006 through 2008.

Our second approach for the projection of ultimate ALAE is in Exhibit I, Sheets 4 through 8. This approach uses the development technique applied to the ratio of paid ALAE-to-paid claims only. When using a ratio approach for ALAE, the first step is to determine an estimate of the ultimate claims. In Exhibit I, Sheets 4 and 5, we project ultimate claims for Auto Property Damage Insurer based on reported claims only and paid claims only, respectively. While there is some evidence of an increasing volume of claims, it does not appear as significant as the increase in ALAE

[89] *Foundations of Casualty Actuarial Science*, 2001.

mentioned earlier. We notice age-to-age factors of less than 1.00 (also known as downward or negative development) for reported claims only. This is not surprising to us since we know, based on meetings with claims department management, that Auto Property Damage Insurer does not consider salvage and subrogation (S&S) when setting case outstanding even though substantial recoveries due to S&S are quite common for this line of business.

It is interesting at this time to compare the development patterns for ALAE and claims only. In the following two tables we summarize the selected development patterns and the implied reporting and payment patterns for Auto Property Damage Insurer.

	Reported ALAE		Reported Claims Only	
Age (Months)	**CDF**	**Implied % Reported**	**CDF**	**Implied % Reported**
12	1.367	73.2%	1.101	90.8%
24	1.169	85.5%	0.990	101.0%
36	1.106	90.4%	0.989	101.1%
48	1.066	93.8%	0.991	100.9%
60	1.045	95.7%	0.993	100.7%
72	1.008	99.2%	0.998	100.2%
84	1.002	99.8%	0.999	100.1%
96	1.000	100.0%	0.999	100.1%
108			1.000	100.0%

	Paid ALAE		Paid Claims Only	
Age (Months)	**CDF**	**Implied % Paid**	**CDF**	**Implied % Paid**
12	2.138	46.8%	1.584	63.1%
24	1.241	80.6%	1.029	97.2%
36	1.155	86.6%	1.007	99.3%
48	1.096	91.2%	1.004	99.6%
60	1.058	94.5%	1.002	99.8%
72	1.028	97.3%	1.001	99.9%
84	1.013	98.7%	1.001	99.9%
96	1.009	99.1%	1.001	99.9%
108	1.007	99.3%	1.000	100.0%
120	1.005	99.5%		
132	1.005	99.5%		

We see that the ALAE reported and paid patterns lag the claims only patterns. One potential explanation for this could be related to the S&S and the expenses incurred in achieving these recoveries.

We continue to rely on the three-year volume-weighted averages to reflect the most recent experience for Auto Property Damage Insurer. In Exhibit I, Sheet 6, we select ultimate claims only based on the average of the reported and paid claims only projections. It is not surprising that the reported and paid claims only projections are very similar for this relatively stable, short-tail line of insurance.

In Exhibit I, Sheet 7, we use the development technique to analyze the ratio of paid ALAE-to-paid claims only. An important assumption underlying the ratio analysis is that the relationship between ALAE and claims only is relatively stable over the experience period. The actuary should confirm this assumption during his or her data gathering process and specifically during discussions with management. A change in defense strategy or a new policy with respect to the use of external versus internal defense counsel are two examples of changes that could result in difficulties in using historical relationships to project future ALAE experience.

While an advantage of the ratio method is that it recognizes the relationship between ALAE and claims only, a disadvantage is that any error in the estimate of ultimate claims only could affect the estimate of ultimate ALAE. Another potential challenge with a ratio method exists for some lines of business where large amounts of ALAE may be spent on claims that ultimately settle with no claim payment. In previous chapters, we discuss the importance of reviewing large claims and possibly projecting estimates of unpaid large claims separately. Similar comments apply to the analysis of unpaid ALAE with respect to large expenses as for large claims.

An advantage of the ratio approach (noted previously in our discussion of salvage and subrogation) is that the ratio development factors tend not to be as highly leveraged as the development factors based on paid ALAE dollars. We select age-to-age factors based on the simple average of the latest three years. Initially, we select a tail factor of 1.00 for the ratio of paid ALAE-to-paid claims based on the absence of development seen at 108-to-120 months. We will see that this method produces projected ultimate ALAE that are less than the reported and paid ALAE projections; a key reason for this difference is the absence of a tail factor. If we review the previous tables, we will note that paid ALAE lagged paid claims only. If these implied patterns are, in fact, correct, then there should be a tail factor for the ratio of paid ALAE-to-paid claims only.

Another advantage of using a ratio approach is the ability to easily interject actuarial judgment in the projection analysis, particularly for the selection of the ultimate ALAE ratio for the most recent year(s) in the experience period. In Exhibit I, Sheet 8, we use the development technique to project an initial estimate of the ALAE ratio to claim amount of 0.0102 for accident years 2007 and 2008. However, based on comparison to the immediate preceding years, 0.0102 seems high. The higher ratio may be due to a change in procedures for recording ALAE or unusually large expenses. The average of the ultimate ALAE ratios for all the years up to 2006 in the experience period is .0077, and the average for the latest three years excluding 2007 and 2008 is 0.0071. We select an ultimate ALAE ratio for 2007 and 2008 of 0.0077, based on the average for all years. We determine ultimate ALAE based on the multiplication of the selected ultimate claims (from Exhibit I, Sheet 6) and the ultimate ALAE ratio (from Column (6)).

In Exhibit I, Sheets 9 and 10, we present an alternative to the standard multiplicative development method. In our third approach, we use additive rather than multiplicative development factors to ultimate. The mechanics of this approach are quite similar to the standard method. We first display the ratio of paid ALAE-to-paid claims only. (See Part 1 in the top section of Exhibit I, Sheet 9.) In the middle section of this exhibit (Part 2), we develop age-to-age factors based on the difference between the ratios at successive ages. For example, the 12-to-24 month factor for accident year 1998 is equal to the paid ratio of 0.0081 at 24 months minus the paid ratio of 0.0066 at 12 months, or .0015. Similarly, the 36-to-48 month factor for accident year 2002 is equal to the paid ratio at 48 months of 0.0068 less the paid ratio at 36 months of 0.0063, or 0.0005. In Part 3 of this exhibit, we calculate average age-to-age factors in the same manner as for the standard development technique. To be consistent with the other projections used for Auto Property Damage Insurer, we select additive age-to-age factors based on the simple average for the latest three years. The age-to-ultimate factor is then based on cumulative addition (not multiplication) beginning with the selected factor for the oldest age.

We present the projection of ultimate ALAE using the additive approach in Exhibit I, Sheet 10. The only difference between this projection and the projection in Exhibit I, Sheet 8, which is based on the standard (i.e., multiplicative) approach, is that we add the paid ALAE ratio from the latest diagonal of the triangle to the cumulative development factor instead of multiplying by the cumulative development factor. In Exhibit I, Sheet 9, we do not modify the ALAE ratio for the latest years, instead we allow the initial projected ratio values for 2007 and 2008 to be used to project ultimate ALAE.

The results of the four projections are summarized in Exhibit I, Sheet 11. In this exhibit, we also present the estimated unpaid ALAE, which is equal to projected ultimate ALAE less paid ALAE. The estimated unpaid ALAE in this exhibit represent total unpaid ALAE, including both case outstanding for ALAE and ALAE IBNR. We observe that without a tail factor, the projected ALAE based on the standard development technique applied to the ratio of paid ALAE-to-paid claims only appears low. Even if we change the tail factor to 1.005, this method still does not appear sufficient. The challenge is in selecting the ultimate ALAE ratio for the most recent two accident years. With a selected ratio of 0.0077, the estimate of unpaid ALAE is negative for accident year 2007. This intuitively does not seem correct based on our knowledge of the property damage line of insurance and the operations of XYZ Insurer. In selecting which method is appropriate for each accident year, the actuary will need to conduct similar evaluation analyses as described in Chapter 15 for claims.

Choosing a Technique for Estimating Unpaid ALAE

Similar comments apply for ALAE as for claims with respect to when the various estimation techniques work and when they do not. For many actuaries, the choice of a technique to estimate unpaid ALAE depends primarily on the types of data available, the credibility of the data, and an understanding as to how the insurer's environment affects the various projection techniques.

Reported ALAE ($000)

PART 1 - Data Triangle

Accident Year	Reported ALAE as of (months) 12	24	36	48	60	72	84	96	108	120	132
1998	684	953	1,031	1,062	1,080	1,084	1,089	1,092	1,092	1,092	1,092
1999	625	929	1,006	1,033	1,041	1,046	1,049	1,051	1,051	1,051	
2000	571	771	821	844	858	861	862	862	862		
2001	629	894	943	982	997	1,002	1,003	1,007			
2002	618	872	952	1,005	1,033	1,093	1,110				
2003	757	948	1,035	1,092	1,095	1,143					
2004	743	915	976	1,001	1,032						
2005	789	948	1,001	1,032							
2006	988	1,140	1,198								
2007	1,373	1,596									
2008	1,556										

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	109 - 120	To Ult
1998	1.393	1.082	1.030	1.017	1.004	1.005	1.003	1.000	1.000	1.000	
1999	1.486	1.083	1.027	1.008	1.005	1.003	1.002	1.000	1.000		
2000	1.350	1.065	1.028	1.017	1.003	1.001	1.000	1.000			
2001	1.421	1.055	1.041	1.015	1.005	1.001	1.004				
2002	1.411	1.092	1.056	1.028	1.058	1.016					
2003	1.252	1.092	1.055	1.003	1.044						
2004	1.231	1.067	1.026	1.031							
2005	1.202	1.056	1.031								
2006	1.154	1.051									
2007	1.162										
2008											

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Simple Average											
Latest 5	1.200	1.071	1.042	1.019	1.023	1.005	1.002	1.000	1.000	1.000	
Latest 3	1.173	1.058	1.037	1.021	1.036	1.006	1.002	1.000	1.000	1.000	
Medial Average											
Latest 5x1	1.198	1.071	1.042	1.020	1.018	1.003	1.002	1.000	1.000	1.000	
Volume-weighted Average											
Latest 5	1.193	1.070	1.042	1.018	1.024	1.005	1.002	1.000	1.000	1.000	
Latest 3	1.170	1.057	1.038	1.020	1.036	1.006	1.002	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Selected	1.170	1.057	1.038	1.020	1.036	1.006	1.002	1.000	1.000	1.000	1.000
CDF to Ultimate	1.367	1.169	1.106	1.066	1.045	1.008	1.002	1.000	1.000	1.000	1.000
Percent Reported	73.2%	85.5%	90.4%	93.8%	95.7%	99.2%	99.8%	100.0%	100.0%	100.0%	100.0%

Paid ALAE ($000)

PART 1 - Data Triangle

Accident	Paid ALAE as of (months)										
Year	12	24	36	48	60	72	84	96	108	120	132
1998	512	856	949	1,003	1,049	1,065	1,075	1,080	1,082	1,084	1,084
1999	529	874	952	988	1,016	1,024	1,034	1,040	1,042	1,045	
2000	471	720	787	821	846	855	857	860	861		
2001	480	802	882	936	975	987	995	998			
2002	451	793	887	956	1,004	1,067	1,098				
2003	572	874	974	1,041	1,069	1,085					
2004	557	840	921	960	989						
2005	563	882	941	987							
2006	636	1,064	1,132								
2007	774	1,454									
2008	952										

PART 2 - Age-to-Age Factors

Accident	Age-to-Age Factors										
Year	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	109 - 120	To Ult
1998	1.672	1.109	1.057	1.046	1.015	1.009	1.005	1.002	1.002	1.000	
1999	1.652	1.089	1.038	1.028	1.008	1.010	1.006	1.002	1.003		
2000	1.529	1.093	1.043	1.030	1.011	1.002	1.004	1.001			
2001	1.671	1.100	1.061	1.042	1.012	1.008	1.003				
2002	1.758	1.119	1.078	1.050	1.063	1.029					
2003	1.528	1.114	1.069	1.027	1.015						
2004	1.508	1.096	1.042	1.030							
2005	1.567	1.067	1.049								
2006	1.673	1.064									
2007	1.879										
2008											

PART 3 - Average Age-to-Age Factors

	Averages										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Simple Average											
Latest 5	1.631	1.092	1.060	1.036	1.022	1.012	1.004	1.002	1.002	1.000	
Latest 3	1.706	1.076	1.053	1.036	1.030	1.013	1.004	1.002	1.002	1.000	
Medial Average											
Latest 5x1	1.589	1.093	1.060	1.034	1.013	1.009	1.004	1.002	1.002	1.000	
Volume-weighted Average											
Latest 5	1.649	1.090	1.060	1.036	1.022	1.012	1.004	1.002	1.002	1.000	
Latest 3	1.723	1.075	1.054	1.036	1.030	1.014	1.004	1.002	1.002	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Selected	1.723	1.075	1.054	1.036	1.030	1.014	1.004	1.002	1.002	1.000	1.005
CDF to Ultimate	2.138	1.241	1.155	1.096	1.058	1.028	1.013	1.009	1.007	1.005	1.005
Percent Received	46.8%	80.6%	86.6%	91.2%	94.5%	97.3%	98.7%	99.1%	99.3%	99.5%	99.5%

Chapter 16 - Estimating Unpaid Allocated Claim Adjustment Expenses Exhibit I
Auto Property Damage Insurer Sheet 3
Projection of Ultimate ALAE ($000)

Accident Year	Age of Accident Year at 12/31/08	ALAE at 12/31/08 Reported	ALAE at 12/31/08 Paid	CDF to Ultimate Reported	CDF to Ultimate Paid	Projected Ultimate ALAE Using Dev. Method with Reported	Projected Ultimate ALAE Using Dev. Method with Paid
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1998	132	1,092	1,084	1.000	1.005	1,092	1,089
1999	120	1,051	1,045	1.000	1.005	1,051	1,050
2000	108	862	861	1.000	1.007	862	867
2001	96	1,007	998	1.000	1.009	1,007	1,007
2002	84	1,110	1,098	1.002	1.013	1,112	1,112
2003	72	1,143	1,085	1.008	1.028	1,152	1,115
2004	60	1,032	989	1.045	1.058	1,078	1,046
2005	48	1,032	987	1.066	1.096	1,100	1,082
2006	36	1,198	1,132	1.106	1.155	1,325	1,307
2007	24	1,596	1,454	1.169	1.241	1,866	1,804
2008	12	1,556	952	1.367	2.138	2,127	2,035
Total		12,679	11,685			13,773	13,517

Column Notes:
(2) Age of accident year in (1) at December 31, 2008.
(3) and (4) Based on data from Auto Property Damage Insurer.
(5) and (6) Based on CDF from Exhibit I, Sheets 1 and 2.
(7) = [(3) x (5)].
(8) = [(4) x (6)].

Reported Claims Only ($000)

PART 1 - Data Triangle

Accident Year	Reported Claims Only as of (months) 12	24	36	48	60	72	84	96	108	120	132
1998	109,286	111,832	110,648	109,174	108,849	108,779	108,786	108,646	108,736	108,735	108,732
1999	120,639	119,607	116,924	116,482	116,332	116,230	116,236	116,161	116,160	116,125	
2000	115,422	119,143	118,641	117,008	116,782	116,919	116,860	116,825	116,472		
2001	129,430	139,925	138,161	137,395	137,269	137,033	136,998	137,056			
2002	134,190	143,852	143,093	142,360	142,004	141,715	141,627				
2003	152,678	166,131	166,015	165,579	165,229	163,508					
2004	144,595	154,830	154,295	154,228	153,750						
2005	137,791	154,230	154,307	153,981							
2006	159,818	178,399	179,384								
2007	162,205	178,425									
2008	176,030										

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	109 - 120	To Ult
1998	1.023	0.989	0.987	0.997	0.999	1.000	0.999	1.001	1.000	1.000	
1999	0.991	0.978	0.996	0.999	0.999	1.000	0.999	1.000	1.000		
2000	1.032	0.996	0.986	0.998	1.001	0.999	1.000	0.997			
2001	1.081	0.987	0.994	0.999	0.998	1.000	1.000				
2002	1.072	0.995	0.995	0.997	0.998	0.999					
2003	1.088	0.999	0.997	0.998	0.990						
2004	1.071	0.997	1.000	0.997							
2005	1.119	1.001	0.998								
2006	1.116	1.006									
2007	1.100										
2008											

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Simple Average											
Latest 5	1.099	0.999	0.997	0.998	0.997	1.000	1.000	0.999	1.000	1.000	
Latest 3	1.112	1.001	0.998	0.997	0.995	1.000	1.000	0.999	1.000	1.000	
Medial Average											
Latest 5x1	1.101	0.999	0.997	0.998	0.998	1.000	1.000	1.000	1.000	1.000	
Volume-weighted Average											
Latest 5	1.099	1.000	0.997	0.998	0.997	1.000	1.000	0.999	1.000	1.000	
Latest 3	1.111	1.001	0.998	0.997	0.995	1.000	1.000	0.999	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Selected	1.111	1.001	0.998	0.997	0.995	1.000	1.000	0.999	1.000	1.000	1.000
CDF to Ultimate	1.101	0.990	0.989	0.991	0.993	0.998	0.999	0.999	1.000	1.000	1.000
Percent Reported	90.8%	101.0%	101.1%	100.9%	100.7%	100.2%	100.1%	100.1%	100.0%	100.0%	100.0%

Chapter 16 - Estimating Unpaid Allocated Claim Adjustment Expenses Exhibit I
Auto Property Damage Insurer Sheet 5
Paid Claims Only ($000)

PART 1 - Data Triangle

Accident Year	Paid Claims Only as of (months) 12	24	36	48	60	72	84	96	108	120	132
1998	78,144	105,902	107,306	108,135	108,307	108,494	108,523	108,628	108,731	108,730	108,730
1999	81,290	114,037	115,347	115,696	115,843	115,930	115,962	115,969	115,969	116,033	
2000	83,563	114,175	116,044	116,458	116,620	116,857	116,810	116,807	116,807		
2001	91,475	133,761	136,143	136,552	136,818	136,838	136,960	136,995			
2002	92,349	138,461	140,904	141,323	141,380	141,452	141,461				
2003	111,655	158,092	161,823	162,556	162,802	163,257					
2004	106,032	149,157	151,729	152,229	152,613						
2005	98,270	149,504	152,895	153,154							
2006	107,137	171,332	175,602								
2007	114,337	171,505									
2008	124,470										

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	109 - 120	To Ult
1998	1.355	1.013	1.008	1.002	1.002	1.000	1.001	1.001	1.000	1.000	
1999	1.403	1.011	1.003	1.001	1.001	1.000	1.000	1.000	1.001		
2000	1.366	1.016	1.004	1.001	1.002	1.000	1.000	1.000			
2001	1.462	1.018	1.003	1.002	1.000	1.001	1.000				
2002	1.499	1.018	1.003	1.000	1.001	1.000					
2003	1.416	1.024	1.005	1.002	1.003						
2004	1.407	1.017	1.003	1.003							
2005	1.521	1.023	1.002								
2006	1.599	1.025									
2007	1.500										
2008											

PART 3 - Average Age-to-Age Factors

	Averages 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Simple Average											
Latest 5	1.489	1.021	1.003	1.002	1.001	1.000	1.000	1.000	1.000	1.000	
Latest 3	1.540	1.022	1.003	1.001	1.001	1.000	1.000	1.000	1.000	1.000	
Medial Average											
Latest 5x1	1.479	1.021	1.003	1.002	1.001	1.000	1.000	1.000	1.000	1.000	
Volume-weighted Average											
Latest 5	1.488	1.021	1.003	1.002	1.001	1.000	1.000	1.000	1.000	1.000	
Latest 3	1.540	1.022	1.003	1.002	1.001	1.000	1.000	1.000	1.000	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection 12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Selected	1.540	1.022	1.003	1.002	1.001	1.000	1.000	1.000	1.000	1.000	1.000
CDF to Ultimate	1.584	1.029	1.007	1.004	1.002	1.001	1.001	1.001	1.000	1.000	1.000
Percent Paid	63.1%	97.2%	99.3%	99.6%	99.8%	99.9%	99.9%	99.9%	100.0%	100.0%	100.0%

Projection of Ultimate Claims Using Reported and Paid Claims Only ($000)

Accident Year	Age of Accident Year at 12/31/08	Claims Only at 12/31/08 Reported	Claims Only at 12/31/08 Paid	CDF to Ultimate Reported	CDF to Ultimate Paid	Proj. Ultimate Claims Only Using Dev. Method with Reported	Proj. Ultimate Claims Only Using Dev. Method with Paid	Selected Ultimate Claims Only
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1998	132	108,732	108,730	1.000	1.000	108,732	108,730	108,731
1999	120	116,125	116,033	1.000	1.000	116,125	116,033	116,079
2000	108	116,472	116,807	1.000	1.000	116,472	116,807	116,639
2001	96	137,056	136,995	0.999	1.001	136,919	137,132	137,026
2002	84	141,627	141,461	0.999	1.001	141,485	141,602	141,544
2003	72	163,508	163,257	0.998	1.001	163,181	163,420	163,301
2004	60	153,750	152,613	0.993	1.002	152,674	152,918	152,796
2005	48	153,981	153,154	0.991	1.004	152,596	153,766	153,181
2006	36	179,384	175,602	0.989	1.007	177,410	176,831	177,121
2007	24	178,425	171,505	0.990	1.029	176,641	176,479	176,560
2008	12	176,030	124,470	1.101	1.584	193,809	197,161	195,485
Total		1,625,091	1,560,626			1,636,045	1,640,879	1,638,462

Column Notes:
(2) Age of accident year in (1) at December 31, 2008.
(3) and (4) Based on data from Auto Property Damage Insurer
(5) and (6) Based on CDF from Exhibit I, Sheets 4 and 5.
(7) = [(3) x (5)].
(8) = [(4) x (6)].
(9) = [Average of (7) and (8)].

Chapter 16 - Estimating Unpaid Allocated Claim Adjustment Expenses Exhibit I
Auto Property Damage Insurer Sheet 7
Ratio of Paid ALAE to Paid Claims Only

PART 1 - Ratio Triangle

Accident Year	Ratio of Paid ALAE to Paid Claims Only as of (months)										
	12	24	36	48	60	72	84	96	108	120	132
1998	0.0066	0.0081	0.0088	0.0093	0.0097	0.0098	0.0099	0.0099	0.0100	0.0100	0.0100
1999	0.0065	0.0077	0.0083	0.0085	0.0088	0.0088	0.0089	0.0090	0.0090	0.0090	
2000	0.0056	0.0063	0.0068	0.0070	0.0073	0.0073	0.0073	0.0074	0.0074		
2001	0.0052	0.0060	0.0065	0.0069	0.0071	0.0072	0.0073	0.0073			
2002	0.0049	0.0057	0.0063	0.0068	0.0071	0.0075	0.0078				
2003	0.0051	0.0055	0.0060	0.0064	0.0066	0.0066					
2004	0.0053	0.0056	0.0061	0.0063	0.0065						
2005	0.0057	0.0059	0.0062	0.0064							
2006	0.0059	0.0062	0.0064								
2007	0.0068	0.0085									
2008	0.0076										

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	109 - 120	To Ult
1998	1.234	1.094	1.049	1.044	1.014	1.009	1.004	1.001	1.002	1.000	
1999	1.178	1.077	1.035	1.027	1.007	1.009	1.006	1.002	1.002		
2000	1.119	1.075	1.039	1.029	1.009	1.003	1.004	1.001			
2001	1.143	1.081	1.058	1.040	1.012	1.007	1.003				
2002	1.173	1.099	1.075	1.050	1.062	1.029					
2003	1.079	1.089	1.064	1.025	1.012						
2004	1.072	1.078	1.039	1.028							
2005	1.030	1.043	1.047								
2006	1.046	1.038									
2007	1.252										
2008											

PART 3 - Average Age-to-Age Factors

	Averages										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Simple Average											
Latest 5	1.096	1.069	1.057	1.034	1.020	1.012	1.004	1.001	1.002	1.000	
Latest 3	1.109	1.053	1.050	1.034	1.029	1.013	1.004	1.001	1.002	1.000	
Medial Average											
Latest 5x1	1.066	1.070	1.056	1.032	1.011	1.009	1.004	1.001	1.002	1.000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Selected	1.109	1.053	1.050	1.034	1.029	1.013	1.004	1.001	1.002	1.000	1.000
CDF to Ultimate	1.332	1.201	1.140	1.086	1.050	1.021	1.007	1.003	1.002	1.000	1.000

Projection of Ultimate ALAE ($000)

Accident Year	Age of Accident Year at 12/31/08	Ratio of Paid ALAE to Paid Claims Only at 12/31/08	CDF to Ultimate	Projected Ultimate Ratio	Selected Ultimate Paid-to-Paid Ratio	Selected Ultimate Claims Only	Projected Ultimate Paid ALAE
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1998	132	0.0100	1.000	0.0100	0.0100	108,731	1,084
1999	120	0.0090	1.000	0.0090	0.0090	116,079	1,045
2000	108	0.0074	1.002	0.0074	0.0074	116,639	861
2001	96	0.0073	1.003	0.0073	0.0073	137,026	1,001
2002	84	0.0078	1.007	0.0078	0.0078	141,544	1,106
2003	72	0.0066	1.021	0.0068	0.0068	163,301	1,108
2004	60	0.0065	1.050	0.0068	0.0068	152,796	1,040
2005	48	0.0064	1.086	0.0070	0.0070	153,181	1,072
2006	36	0.0064	1.140	0.0073	0.0073	177,121	1,302
2007	24	0.0085	1.201	0.0102	0.0077	176,560	1,360
2008	12	0.0076	1.332	0.0102	0.0077	195,485	1,505
Total						1,638,462	12,485

Column Notes:
(2) Age of accident year in (1) at December 31, 2008.
(3) From latest diagonal of triangle in Exhibit I, Sheet 7.
(4) Based on CDF from Exhibit I, Sheet 7.
(5) = [(3) x (4)].
(6) = (5), except for 2007 and 2008 which are judgementally selected based on review of prior years.
(7) Developed in Exhibit I, Sheet 6.
(8) = [(6) x (7)].

Chapter 16 - Estimating Unpaid Allocated Claim Adjustment Expenses
Auto Property Damage Insurer
Ratio of Paid ALAE to Paid Claims Only - Additive Method

Exhibit I
Sheet 9

PART 1 - Ratio Triangle

Accident Year	Ratio of Paid ALAE to Paid Claims Only as of (months)										
	12	24	36	48	60	72	84	96	108	120	132
1998	0.0066	0.0081	0.0088	0.0093	0.0097	0.0098	0.0099	0.0099	0.0100	0.0100	0.0100
1999	0.0065	0.0077	0.0083	0.0085	0.0088	0.0088	0.0089	0.0090	0.0090	0.0090	
2000	0.0056	0.0063	0.0068	0.0070	0.0073	0.0073	0.0073	0.0074	0.0074		
2001	0.0052	0.0060	0.0065	0.0069	0.0071	0.0072	0.0073	0.0073			
2002	0.0049	0.0057	0.0063	0.0068	0.0071	0.0075	0.0078				
2003	0.0051	0.0055	0.0060	0.0064	0.0066	0.0066					
2004	0.0053	0.0056	0.0061	0.0063	0.0065						
2005	0.0057	0.0059	0.0062	0.0064							
2006	0.0059	0.0062	0.0064								
2007	0.0068	0.0085									
2008	0.0076										

PART 2 - Age-to-Age Factors

Accident Year	Age-to-Age Factors - Additive										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	109 - 120	To Ult
1998	0.0015	0.0008	0.0004	0.0004	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	
1999	0.0012	0.0006	0.0003	0.0002	0.0001	0.0001	0.0001	0.0000	0.0000		
2000	0.0007	0.0005	0.0003	0.0002	0.0001	0.0000	0.0000	0.0000			
2001	0.0007	0.0005	0.0004	0.0003	0.0001	0.0001	0.0000				
2002	0.0008	0.0006	0.0005	0.0003	0.0004	0.0002					
2003	0.0004	0.0005	0.0004	0.0002	0.0001						
2004	0.0004	0.0004	0.0002	0.0002							
2005	0.0002	0.0003	0.0003								
2006	0.0003	0.0002									
2007	0.0017										
2008											

PART 3 - Average Age-to-Age Factors

	Averages - Additive										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Simple Average											
Latest 5	0.0006	0.0004	0.0004	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	
Latest 3	0.0007	0.0003	0.0003	0.0002	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	
Medial Average											
Latest 5x1	0.0004	0.0004	0.0004	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	

PART 4 - Selected Age-to-Age Factors

	Development Factor Selection - Additive										
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - 132	To Ult
Selected	0.0007	0.0003	0.0003	0.0002	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
CDF to Ultimate	0.0019	0.0012	0.0009	0.0006	0.0004	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000

Chapter 16 - Estimating Unpaid Allocated Claim Adjustment Expenses
Auto Property Damage Insurer
Projection of Ultimate ALAE ($000) - Additive Method

Accident Year	Age of Accident Year at 12/31/08	Ratio of Paid ALAE to Paid Claims Only at 12/31/08	Additive CDF to Ultimate	Projected Ultimate Ratio	Selected Ultimate Paid-to-Paid Ratio	Selected Ultimate Claims Only	Projected Ultimate Paid ALAE
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1998	132	0.0100	0.0000	0.0100	0.0100	108,731	1,084
1999	120	0.0090	0.0000	0.0090	0.0090	116,079	1,045
2000	108	0.0074	0.0000	0.0074	0.0074	116,639	862
2001	96	0.0073	0.0000	0.0073	0.0073	137,026	1,003
2002	84	0.0078	0.0001	0.0078	0.0078	141,544	1,108
2003	72	0.0066	0.0002	0.0068	0.0068	163,301	1,112
2004	60	0.0065	0.0004	0.0068	0.0068	152,796	1,046
2005	48	0.0064	0.0006	0.0070	0.0070	153,181	1,077
2006	36	0.0064	0.0009	0.0073	0.0073	177,121	1,300
2007	24	0.0085	0.0012	0.0097	0.0097	176,560	1,709
2008	12	0.0076	0.0019	0.0096	0.0096	195,485	1,870
Total						1,638,462	13,215

Column Notes:
(2) Age of accident year in (1) at December 31, 2008.
(3) From latest diagonal of triangle in Exhibit I, Sheet 9.
(4) Based on additive CDF from Exhibit I, Sheet 9.
(5) = [(3) + (4)].
(6) = (5).
(7) Developed in Exhibit I, Sheet 6.
(8) = [(6) x (7)].

Development of Estimated Unpaid ALAE ($000)

	Age of	Paid	Projected Ultimate ALAE				Estimated Unpaid ALAE			
Accident	Accident Year	ALAE	Using Dev Method with		Using Ratio Method with		Using Dev Method with		Using Ratio Method with	
Year	at 12/31/08	at 12/31/08	Reported	Paid	Mult.	Additive	Reported	Paid	Mult.	Additive
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1998	132	1,084	1,092	1,089	1,084	1,084	8	5	0	0
1999	120	1,045	1,051	1,050	1,045	1,045	6	5	0	0
2000	108	861	862	867	861	862	1	6	0	1
2001	96	998	1,007	1,007	1,001	1,003	9	9	3	5
2002	84	1,098	1,112	1,112	1,106	1,108	14	14	8	10
2003	72	1,085	1,152	1,115	1,108	1,112	67	30	23	27
2004	60	989	1,078	1,046	1,040	1,046	89	57	51	57
2005	48	987	1,100	1,082	1,072	1,077	113	95	85	90
2006	36	1,132	1,325	1,307	1,302	1,300	193	175	170	168
2007	24	1,454	1,866	1,804	1,360	1,709	412	350	- 94	255
2008	12	952	2,127	2,035	1,505	1,870	1,175	1,083	553	918
Total		11,685	13,773	13,517	12,485	13,215	2,088	1,832	800	1,530

Column Notes:
(2) Age of accident year in (1) at December 31, 2008.
(3) Based on data from Auto Property Damage Insurer.
(4) and (5) Developed in Exhibit I, Sheet 3.
(6) Developed in Exhibit I, Sheet 8.
(7) Developed in Exhibit I, Sheet 10.
(8) = [(4) - (3)].
(9) = [(5) - (3)].
(10) = [(6) - (3)].
(11) = [(7) - (3)].

CHAPTER 17 – ESTIMATING UNPAID UNALLOCATED CLAIM ADJUSTMENT EXPENSES

In this chapter, we present several techniques for estimating unpaid unallocated claim adjustment expenses (ULAE). We rely extensively on the 2003 paper by Robert F. Conger, FCAS, FCIA, MAAA and Alejandra Nolibos, FCAS, MAAA "Estimating ULAE Liabilities: Rediscovering and Expanding Kittel's Approach." [90]

ULAE (known as ILAE in Canada) refer to general overhead expenses associated with the claims-handling process, and particularly the costs of investigating, handling, paying, and resolving claims. We can differentiate between ALAE and ULAE. As described in Chapter 16, ALAE are those costs that can be assigned to a specific claim. Examples of ALAE include legal fees, the cost of expert witnesses, police reports, engineering reports, and independent adjusters if assigned to a particular claim. In contrast, ULAE are the costs that cannot be assigned to a unique claim; ULAE are those costs associated with operating the claims department, including rent, technology, salaries, as well as management and administrative expenses.

There are two broad classifications of techniques for estimating unpaid ULAE: dollar-based and count based. These techniques, which rely on fundamentally different assumptions, vary significantly in the amount of data and calculations required. In practice, the seemingly divergent assumptions of the various methods may not affect the resulting unpaid ULAE estimates quite as severely as it might seem at first glance. Since the methods are used for an entire population of claims, they need to be correct only for the "average" claim being reported, handled, paid, or closed during a time period – not for each individual claim. In other cases, the gulf can be bridged by stratifying the claims data and types of transactions and making assumptions about the relative ULAE resources required in the various strata.

This chapter is organized as follows:

- Dollar-based techniques
- Count-based techniques
- Triangle-based techniques
- Comparison example

Ideally, an actuary estimating unpaid ULAE would have access to sufficient data to employ both dollar-based and count-based methods. Given the specific characteristics of the company, the actuary would then select the methodology that is likely to produce the best estimate of future ULAE.

ULAE liabilities also have a "market value" in the fees that a third-party claims administrator (TPA) would require to take over the management of the book of claims. Many self-insurers use such market values to determine the unpaid ULAE for financial reporting purposes.

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[90] Mr. Conger and Ms. Nolibos granted permission for the use of direct quotes from their paper without the standard punctuation for quotation to facilitate the ease of reading of this text.

Dollar-Based Techniques

A fundamental assumption of dollar-based techniques is that ULAE expenditures track with claim[91] dollars with regards to both timing and relative amount. Most importantly, this assumption means that the general timing of ULAE expenditures (or of specified portions of ULAE expenditures) follows the timing of the reporting or payment of claim dollars. In addition, this assumption implies that a $1,000 claim requires ten times as much ULAE as a $100 claim. In the following sections, we describe four commonly used dollar-based techniques:

- Classical (also known as traditional)
- Kittel refinement
- Conger and Nolibos method – generalized Kittel approach
- Mango-Allen refinement

Classical (or Traditional) Technique

In the classical technique, the unpaid ULAE is estimated using a paid ULAE-to-paid claims ratio determined by comparing the calendar year paid ULAE to the calendar year paid claims.

Key Assumptions of Classical Technique

Key assumptions of the classical technique include:

- The insurer's ULAE-to-claim relationship has achieved a steady-state so that the ratio of paid ULAE-to-paid claims provides a reasonable approximation of the relationship of ultimate ULAE-to-ultimate claims.

- The relative volume and cost of future claims management activity on not-yet-reported claims and reported-but-not-yet-closed claims will be proportional to the dollars of IBNR and case outstanding, respectively.

The classical technique assumes that one-half of ULAE are sustained when opening a claim and one-half is sustained when closing the claim. Thus, we apply 50% of the ULAE ratio to case outstanding, since, for known claims, one-half of the unallocated work was already completed at the time of opening; and we apply 100% of the ULAE ratio to IBNR, since all unallocated work remains to be completed (that is, the work associated with opening and closing the claims).

Mechanics of Classical Technique

There are four steps in the classical technique for estimating unpaid ULAE:

- Calculate ratios of historical calendar year paid ULAE-to-calendar year paid claims

- Review historical paid ULAE-to-paid claims ratios for trends or patterns

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[91] The terms *claim dollars* or *claims* include ALAE but exclude ULAE.

- Select a ratio of ULAE-to-claims applicable to future claims payments

- Apply 50% of the selected ULAE ratio to case outstanding and 100% of the selected ULAE ratio to IBNR

In Exhibit I, we calculate the ratios of paid ULAE-to-paid claims (including ALAE) for XYZ Insurer. In the examples presented for XYZ Insurer in previous chapters, we refer to the experience of one particular line of insurance. In estimating unpaid ULAE, we use the experience for the insurer as a whole (i.e., all lines of coverage combined). For this example, we are fortunate to have five years of complete and accurate data. We are somewhat surprised to observe relatively stable ULAE ratios given all the changes we know transpired at XYZ Insurer during the experience period. We select a ULAE ratio of 0.045 based on a review of the historical experience as well as discussions with company management regarding their expectations for the future. These discussions included expectations regarding claims department caseload, the relationship between claim and salary inflation, as well as management's expectations of the future use of independent adjusters and TPAs.

For XYZ Insurer, case outstanding at December 31, 2008 is $603 million and selected IBNR is $316 million. Using the classical technique, we estimate unpaid ULAE at December 31, 2008 to be $27.8 million. As calculated in Exhibit I, Line (9):

$27.8 million = [(0.045 x 50% x $603 million) + (0.045 x 100% x $316 million)]

Challenges of the Classical Technique

Recall that the key assumption underlying the application of 50% of the ULAE ratio to case outstanding and 100% of the ULAE ratio to IBNR is that 50% of the expenses are sustained when opening the claim and the remaining 50% when closing the claim. One challenge with the classical technique is that "closing" a claim and "paying" a claim do not necessarily mean the same thing. For some lines of business, a single payment may be the norm, and thus, such payment may in fact represent settlement (i.e., closure) of the claim, and therefore the end of the claims handling activity. An example is glass coverage to replace a shattered windshield under automobile physical damage insurance. (Note, not all automobile physical damage insurance can necessarily be categorized as single payment where payment equates to closure of the claim.) An example of insurance where a claim payment and closing of the claim often differ is U.S. workers compensation; for this coverage, regular payments can replace lost wages for an extended period of time.

Some actuaries address this challenge by adjusting the percentages applied to the case outstanding and the IBNR to reflect their expectations for the particular company. For example, an actuary of an insurer with a portfolio of long-tail professional liability coverage, which is characterized by very long-tailed liabilities and substantial claims-handling work during the life of the claim, estimates unpaid ULAE assuming ratios of 25% applied to case outstanding and 75% to IBNR, which includes development on case outstanding. Thus, they assume a greater proportion of the expenses are related to closing the claims rather than opening claims.

The definition of IBNR poses another challenge for actuaries using the classical technique. Actuaries typically use the broad definition of IBNR, and thus IBNR reserves represent the liability for both claims that are not yet reported as well as future case development on known claims. As described in Chapter 1, claims that are incurred but not yet reported (IBNYR) are also referred to as pure IBNR or the narrow definition of IBNR; future case development on known claims is referred to as incurred but not enough reported (IBNER). Theoretically, in using the classical technique, the actuary would apply 100% of the ULAE ratio to IBNYR (pure IBNR) and 50% of the ULAE ratio to the sum of case reserves and IBNER.

Some actuaries refine the classical technique by estimating pure IBNR as a percentage of total IBNR or a percentage of the selected ultimate claims for the latest accident year(s).[92] For example, assume that pure IBNR for XYZ Insurer is equal to 5% of the latest accident year's (2008) ultimate claims. Given ultimate claims for accident year 2008 of \$380 million, we can calculate the unpaid ULAE for XYZ Insurer as follows:

Unpd ULAE = [(ULAE ratio x 50% x unpd known claims) + (ULAE ratio x 100% x Pure IBNR)]
= [(0.045 x 50% x (case outstanding + IBNER)) + (0.045 x 100% x IBNYR)]

We calculate IBNYR claims of \$19 million based on 5% of accident year 2008 ultimate claims (0.05 x \$380 million) and derive the IBNER claims as total IBNR less IBNYR or \$297 million (\$316 million - \$19 million). Following the formula for the classical technique, we calculate that the estimated unpaid ULAE for XYZ Insurer is \$21.1 million.

Unpd ULAE = [(0.045 x 50% x (\$603 million + \$297 million)) + (0.045 x 100% x \$19 million)]

This estimate of unpaid ULAE is significantly less than the initial estimate of \$27.8 million for XYZ insurer. (See Exhibit I, Lines (9) and (10).)

The selected pure IBNR percentage relative to the ultimate losses of the latest accident year is clearly an important assumption in the above calculation. The indicated unpaid ULAE differ by more than \$6 million, or 24%, when the pure IBNR refinement is included in the classical technique. While actuaries frequently assume 5% of the most recent accident year ultimate claims as an approximation to estimate pure IBNR, the actuary should be able to support such an approximation based on the experience of the organization. To the extent possible, the actuary would test this assumption by calculating the pure IBNR claims and determine the ratio to total unpaid claims. One method for testing this assumption is to first estimate the number of IBNR claim counts (projected ultimate claim counts minus reported claim counts). The actuary can then multiply the number of IBNR counts for each accident year by an ultimate severity value for each accident year to determine an estimate of ultimate claims associated with pure IBNR. Such an analysis can be performed for each line of business, and the total ultimate claims associated with pure IBNR can be compared to total ultimate claims for both IBNR and reported claim counts for the latest accident year.

[92] We do not address particular methods for allocating total IBNR between IBNYR and IBNER. However, actuaries may rely on report year analysis, frequency-severity techniques, or other approaches to estimate the proportion of total IBNR that is pure IBNR. Actuaries often rely on judgment for this allocation when estimating unpaid ULAE.

When the Classical Technique Works and When it Does Not

In the 1989 paper "Determination of Outstanding Liabilities for Unallocated Loss Adjustment Expenses,"[93] Wendy Johnson states that upon analysis it is apparent that the classical technique "will only give good results for very short-tailed, stable lines of business."
She continues:

> This method came into use at a time when most lines developed in well under five years, cost inflation was low and level if it existed at all, most calculations were made using only pencil and paper, and claim reporting and payment patterns were stable. We no longer live in this kind of environment. Our estimation methods should be adapted to fit the current environment and grounded firmly in our understanding of the claims process, even for estimation of peripheral liabilities like ULAE.

Similar observations are expressed by Kay Kellogg Rahardjo in the 1996 paper "A Methodology for Pricing and Reserving for Claim Expenses in Workers Compensation."[94] She states:

> It is no longer acceptable for companies to estimate unallocated loss adjustment expenses (ULAE) and, in particular, claim expense reserves by using paid to paid ratios. The paid to paid methodology assumes that claims incur expenses only when initially opened and when closed. While this may not be an unreasonable assumption for claims from short-tailed lines, this is definitely not true for liability claims. Moreover, the paid to paid ratio itself is subject to distortion when a company is growing or shrinking or when a line of business is in "transition", as was the case for workers compensation throughout the early 1990s as many large customers moved to deductible policies or towards self-insurance.

As noted previously, there are challenges associated with the use of the classical technique due to the differences between paying and closing claims as well as the use of total IBNR as opposed to pure IBNR in the formula. Furthermore, the assumption that 50% of ULAE payments are sustained when a claim is opened and the remaining 50% when a claim is closed may not accurately describe an insurer's application of resources to the various stages in the life cycle of its claims.

It is also important to recognize that the classical technique can lead to inaccurate results whenever the volume of claims is growing. Donald Mango and Craig Allen expand on this point in their paper "Two Alternative Methods for Calculating the Unallocated Loss Adjustment Expense Reserve."[95] They note that the numerator in the ratio (i.e., calendar year paid ULAE) tends to react relatively quickly to an increase in exposure or an increase in the number of claims being reported. However, the denominator (i.e., paid claims) reflects claim payments made on claims that were reported at the former, lower, exposure base and will not be as responsive to the growth in volume. Thus, the resulting paid ULAE-to-paid claims ratio may misrepresent the true situation. A similar mismatch between paid ULAE and paid claims can occur if the volume is decreasing.

[93] *CAS Discussion Paper Program*, May 1988.
[94] *CAS Forum*, Summer 1996.
[95] *CAS Forum*, Fall 1999.

Finally, we point out that inflation can also create distortions in the classical technique. In his 1973 paper "Unallocated Loss Adjustment Expense Reserves in an Inflationary Economic Environment,"[96] John Kittel notes that the classical technique does include an inflation adjustment to the degree that total unpaid claims take inflation into account. If the costs underlying ULAE inflate at the same rate as claim costs, then inflation is accounted for. However, if different rates of inflation underlie the claims experience and ULAE, the estimated unpaid ULAE may not be predictive of future experience.

Mango and Allen expand on this point:

> … the paid-to-paid ratio is distorted in an upward direction under inflationary conditions. This distortion arises because the impact of inflation on the denominator of the ratio lags its impact on the numerator. This lag is due to the fact that most of the losses paid in a calendar year were incurred in a prior year, and thus are largely unaffected by the most recent inflation.[97]

In summary, the classical technique may not be appropriate for every situation. In particular, the classical technique may not be appropriate for:

- Long-tail lines of business
- Times of changing inflationary forces, either in the past or expected in the future
- When an insurer is experiencing a rapid change in volume (either expansion or decrease in the size of its portfolio)
- Where the 50/50 assumption is not an appropriate representation of the claims handling workflow

Kittel Refinement

In his 1973 paper, John Kittel describes a weakness in the classical technique:

> The concept upon which this method is based is to relate the paid unallocated loss adjustment expense cost to the work completed by the Loss Department measured in dollars of claim. Calendar year paid losses are used to represent the dollars of losses worked on by the Loss Department. There is an inconsistency here. The Loss Department, unfortunately, doesn't just close claims. It also opens them. Paid losses don't accurately represent the work done by the Loss Department since they do not take into account claims opened during the year which remain open at year end. This can be significant when loss reserves vary from year to year. A growing line with rapidly inflating loss costs could easily have loss reserves increasing at thirty to forty percent a year.[98]

[96] *CAS Discussion Paper Program*, 1981.

[97] *CAS Forum*, Fall 1999.
[98] *CAS Discussion Paper Program*, 1981.

Kittel refines the classical technique to explicitly recognize that ULAE is sustained as claims are reported even if no claim payments are made. The refinement recognizes that ULAE payments for a specific calendar year would not be expected to track perfectly with claim payments since actual ULAE is related to both the reporting and payment of claims. In contrast, the classical technique, by assuming a steady state, makes the implicit simplifying assumption that paid claims are approximately equal to reported claims, and thus the two quantities can be used interchangeably.

Key Assumptions of Kittel Refinement

Key assumptions of the Kittel refinement to the classical technique include:

- ULAE is sustained as claims are reported even if no claim payments are made.
- ULAE payments for a specific calendar year are related to both the reporting and payment of claims.

Thus, in the Kittel refinement to the classical technique, an insurer's ULAE-to-claim relationship is derived based on a review of the ratio of paid ULAE-to-the average of paid claims and incurred[99] claims to determine a reasonable approximation of the relationship of ultimate ULAE-to-ultimate claims. In the Kittel refinement, calendar year incurred claims are defined to be calendar year paid claims plus the change in total claim liabilities, including both case outstanding and IBNR.

Kittel derives his formula as follows:

> If we use the 50/50 assumption and ignore partial payments, the loss dollars processed with the calendar year paid unallocated loss adjustment expenses are:
>
> ½ unit of work x payments on prior outstanding reserves
> 1 complete unit x losses opened and paid during the year
> ½ unit of work x losses opened remaining open
>
> The ratio of calendar year paid unallocated loss adjustment expense to the dollars of loss as represented above should be used as a more accurate starting point.
>
> If reserves are accurate, calendar year incurred = accident year incurred = losses opened and paid + opened remaining open.
>
> So,
>
> Calendar paid = opened and paid + paid on prior outstanding reserves
> Calendar incurred = opened and paid + opened remaining opened
>
> ½ (calendar paid + incurred) = Losses opened and paid
> \+ ½ payments on prior outstanding
> \+ ½ losses opened remaining open

[99] It is important to note the use of the term *incurred claims*, which includes reported claims as well as IBNR.

the desired quantity.[100]

The second key assumption of the classical technique remains valid for the Kittel refinement. The relative volume and cost of future claims management activity on not-yet-reported claims and reported-but-not-yet-closed claims is expected to be proportional to the dollars of IBNR and case outstanding, respectively. Specifically, we assume that one-half of expenses are sustained when opening a claim and one-half of expenses when closing a claim.

Mechanics of the Kittel Refinement

We present the Kittel refinement to the classical technique in Exhibit II. There are four steps in this technique:

- Develop ratio of historical calendar year paid ULAE-to-average of calendar year paid and calendar year incurred claims
- Review historical ratios for trends or patterns
- Select a ratio of ULAE-to-claims applicable to future claims payments
- Apply 50% of the selected ULAE ratio to case outstanding and 100% of the selected ULAE ratio to IBNR

Using Kittel's refinement, we observe lower ULAE ratios than with the classical technique (traditional paid-to-paid approach). This is expected when incurred claims are greater than paid claims on a calendar year basis. For both techniques, we note that the ULAE ratios are lower for the two earliest years in the experience period (i.e., 2004 and 2005). Based on Kittel's refinement, we select a ULAE ratio of 0.040.

The final step of Kittel's refined technique is identical to the classical technique. Assuming that one-half of a claim's ULAE is sustained when the claim is reported and one-half when it is paid (i.e., closed), we estimate unpaid ULAE for XYZ Insurer to be $24.7 million using the formula with total IBNR and $18.8 million using the formula with an adjustment to determine pure IBNR.

$$\$24.7 \text{ million} = [(0.04 \times 50\% \times \$603 \text{ million}) + (0.04 \times 100\% \times \$316 \text{ million})]$$

$$\$18.8 \text{ million} = [(0.04 \times 50\% \times (\$603 \text{ million} + \$297 \text{ million})) + (0.04 \times 100\% \times \$19 \text{ million})]$$

The Kittel refinement does address the challenge identified in the classical technique related to sustaining ULAE for activities beyond simply paying a claim. However, the refinement does not explicitly address the issue associated with the definition of IBNR. Without specific modification of the formula to differentiate between IBNYR and IBNER, the Kittel technique could overstate the unpaid ULAE.

[100] *CAS Discussion Paper Program*, 1981.

When the Kittel Refinement Works and When it Does Not

Although the Kittel refinement addresses the distortion created when using the classical technique for a growing insurer, it maintains the traditional 50/50 assumption regarding ULAE expenditures. Therefore it does not allow for the particular allocation of ULAE costs between opening, maintaining, and closing claims which may vary from insurer to insurer. Finally, the issue related to the potential for different rates of inflation between ULAE and claims remains in the Kittel refinement.

Conger and Nolibos Method – Generalized Kittel Approach

In developing their generalized approach as part of a specific client assignment, Conger and Nolibos sought to define a procedure to estimate unpaid ULAE that would:

- Recognize an insurer's rapid growth
- Be consistent with patterns of the insurer's ULAE expenditures over the life of a claim
- Reproduce key concepts underlying the Johnson technique
- Use commonly available and reliable aggregate payment and unpaid claims data
- Include an extension to the Kittel refinement which would allow for alternatives to the traditional 50/50 rule

The generalized approach employs the concept of weighted claims, which recognizes that claims use up different amounts of ULAE at different stages of their life cycle, from opening to closing. Newly opened, open, and newly closed claims are each given different weights when determining the claims basis to which ULAE payments during a past or future calendar period are related. Since Conger and Nolibos believe that handling costlier claims warrants and requires relatively more resources than handling smaller claims, they use claim dollars instead of claim counts in their generalized approach.

The claim basis for a particular time period is defined to be the weighted average of the:

- Ultimate cost of claims reported during the period (ultimate includes reported amounts and future development on known claims)
- Ultimate cost of claims closed during the period (includes any future payment made after the closing of the claim)[101]
- Claims paid during the period

Conger and Nolibos compare the claims basis of the generalized approach to Kittel's introduction of a weighted average claims basis including incurred and paid claims. Kittel's weights are fixed

[101] Conger and Nolibos note that their approach assumes that there is no additional costs associated with reopening or reclosing a reopened claim. The formulas do provide, however, for the cost of maintaining reopened claims.

at 50% for incurred claims and 50% for paid claims. By comparison, the generalized method introduces a third claim measure that allows distinguishing the cost of maintenance from the cost of closing. This is an important distinction for lines of business where a claim can remain open for an extended period of time with regular claim activity, such as workers compensation. The generalized approach also allows for flexibility in selecting the weights appropriate to the insurer and to the particular segment of business.

Key Assumptions of Generalized Approach

Key assumptions of the generalized approach include:

- Expenditure of ULAE resources is proportional to the dollars of claims being handled. (This is in contrast to Johnson's assumption that ULAE costs are independent of claim size and nature.)

- ULAE amounts spent opening claims are proportional to the ultimate cost of claims being reported.

- ULAE amounts spent maintaining claims are proportional to payments made.

- ULAE amounts spent closing claims are proportional to the ultimate cost of claims being closed.

Conger and Nolibos state that the appropriateness and sensitivity of these assumptions warrant further analysis, both as a matter of general research, and for a particular application of either method. For their particular application, the dollar proportionality was an assumption that produced reasonable indications of unpaid ULAE.

Mechanics of Generalized Approach

In the generalized approach, Conger and Nolibos define $U_1 + U_2 + U_3 = 100\%$, where:

- U_1 – percentage of ultimate ULAE spent opening claims
- U_2 – percentage of ultimate ULAE spent maintaining claims
- U_3 – percentage of ultimate ULAE spent closing claims

In conducting an analysis of unpaid claims and expenses, the actuary would determine reasonable ranges for U_1, U_2, and U_3 and would test the sensitivity of the final estimate of unpaid ULAE to variations within those ranges.

It is worthwhile noting that the values of U_1, U_2, and U_3 could vary significantly from insurer to insurer and between lines of business. For example, a litigation-intense liability book of business might have a strong concentration of activity close to the time of claim settlement and payment. This contrasts with greater front-end costs associated with workers' compensation claims. Conger and Nolibos developed a range of values for U_1, U_2, and U_3 for a particular insurer and line of business based on interviews with claims personnel. They used the resulting ranges to test the consistency of the resulting ULAE ratios and the sensitivity of the ULAE ratios to different choices of U_1, U_2, and U_3. Time and motion studies, as described by Joanne Spalla,[102] could also be used to develop an empirical basis for the parameters.

For a particular time period T, Conger and Nolibos define M, the total amount spent on ULAE during a time period T, to be

$$M = (U_1 \text{ x } R \text{ x } W) + (U_2 \text{ x } P \text{ x } W) + (U_3 \text{ x } C \text{ x } W)\text{, where}$$

- R – ultimate cost of claims reported during T
- P – claims paid during T
- C – the ultimate cost of claims closed during T
- W – ratio of ultimate ULAE to ultimate claims (L)

Conceptually, the time period T could represent activity occurring between t_1 and t_2 related to a particular accident year or for all accident years, where t_1 and t_2 are selected points in time.

Conger and Nolibos algebraically derive the ratio $W = M / B$ by defining B, the claims basis for the time period T to be:

$$B = (U_1 \text{ x } R) + (U_2 \text{ x } P) + (U_3 \text{ x } C)$$

Thus, $M = B \text{ x } W$, and $W = M / B$.

Each component of the claims basis can be understood conceptually as the value of the claims underlying the ULAE payments. Thus,

- U_1 x R represents claims basis for ULAE spent setting up new claims
- U_2 x P represents claims basis for ULAE spent maintaining open claims
- U_3 x C represents claims basis for ULAE spent closing existing claims

In practice, insurers typically measure and report M, the ULAE payments during a period, on a calendar year basis. Once U_1, U_2, and U_3 are estimated or selected, the claims basis B can be calculated from claim amounts R, P, and C, that can typically be determined from data and calculations underlying an actuarial analysis for estimating unpaid claims. In particular, M (total ULAE payments) and B (claim basis) can be calculated for historical calendar periods. By computing the ratio W (equal to M / B, where both M and B are expressed on a calendar year basis), we obtain ratios of ULAE to claims by calendar year. We then select an overall ratio of ULAE-to-claims, identified as W^*, which is used in estimating future ULAE payments.

Ultimate ULAE (U) for a group of accident years can be estimated as:

$$U = W^* \text{ x } L\text{, where}$$

- W^* is the selected ultimate ULAE-to-claims ratio
- L is the independently estimated ultimate claims for the same group of accident years

Using this approach for estimating ultimate ULAE, Conger and Nolibos suggest three different ways to estimate unpaid ULAE for a group of accident years. First, they note that unpaid ULAE

[102] *CAS Forum*, Fall 1999.

could be calculated simply by subtracting the amount of ULAE already paid (M) from the estimate of ultimate ULAE (U).

$$\text{Unpaid ULAE} = (W^* \times L) - M$$

Conger and Nolibos do not prefer this method as it presents both practical and conceptual difficulties. From a practical perspective, it may be difficult to quantify the historical paid ULAE that corresponds only to the accident year claims represented by L. Conceptually, this approach has some similarities to, and shares the potential distortions of, an expected claims ratio approach to estimating unpaid claims. In the expected claim technique, unpaid claims are estimated based on a predetermined expected claims ratio multiplied by earned premium less claims paid to date. As the period matures, the unpaid claim estimate can become increasingly distorted if actual paid claims do not approach the predetermined value of expected ultimate claims.

The method preferred by Conger and Nolibos is similar to a Bornhuetter-Ferguson technique in that an a priori provision of unpaid ULAE is calculated.

$$\text{Unpaid ULAE} = W^* \times (L - B)$$

To assist in understanding this method, Conger and Nolibos present the derivation of this estimate (for a particular group of accident years). Assume that

- $R(t)$ – ultimate cost of claims known at time t
- $P(t)$ – total amount paid at time t
- $C(t)$ – ultimate cost of claims closed at time t

Thus, unpaid ULAE can be estimated based on the following:

$$\text{Unpaid ULAE} = W^* \times \{U_1 \times [L - R(t)] + U_2 \times [L - P(t)] + U_3 \times [L - C(t)]\}, \text{ where}$$

Each component of the unpaid ULAE formula represents a provision for the ULAE associated with:

- Opening claims not yet reported

- Making payments on currently active claims and on those claims that will be reported in the future

- Closing "unclosed" claims (i.e., those claims that are open at time t and those claims that will be reported and opened in the future)

By mathematically rearranging the equation, Conger and Nolibos obtain:

$$\text{Unpaid ULAE} = W^* \times (L - B)$$

This methodology assumes that the amount of ULAE paid to date and the unpaid ULAE are not directly related, except to the extent that these payments influence the selection of the ratio W^*. This is similar to the assumption underlying the Bornhuetter-Ferguson technique.[103]

[103] See Chapter 9 for a complete presentation of the Bornhuetter-Ferguson technique.

The third and final method noted by Conger and Nolibos is similar to the claims development method. Unpaid ULAE could be estimated by the following formula:

Unpaid ULAE = M x (L / B – 1.00)

They note that such an approach implies that unpaid ULAE are proportional to paid amounts reported to date. Aside from the practical difficulty of establishing the ULAE amounts paid that correspond to accidents occurring during a particular period, this method, similar to the paid claims development method, may be overly responsive to random fluctuations in ULAE emergence.

Application of Generalized Approach to Claim Counts

Conger and Nolibos note that the generalized approach can also be used with claim counts or transaction counts. The formula for a claim count basis used in the determination of unpaid ULAE is:

$b = (v_1 \text{ x } r) + (v_2 \text{ x } o) + (v_3 \text{ x } c)$, where

- r represents reported claim counts
- o represents open claim counts
- c represents closed claim counts
- v_1 is the estimate of the relative cost of handling the reporting of a claim (for one year)
- v_2 is the estimate of the relative cost of managing an open claim (for one year)
- v_3 is the estimate of the relative cost of closing a claim (for one year)

As in Johnson's paper, Conger and Nolibos suggest that is not necessary to determine the actual costs of the various claim activities but instead their relative magnitudes. For example, Johnson assumes that $v_1 = 2$, $v_2 = 1$, and $v_3 = 0$.

Using estimated v_1, v_2, and v_3, we can then select w^* representing the ratio of ULAE to the claim count basis based on the historical data $w = M / b$, where M still represents ULAE payments. After selecting a value of w^* (or a series of w^*_i which reflect future inflation adjustments), the unpaid ULAE can be estimated as:

Unpaid ULAE = $\Sigma\, w^*_i \text{ x } [(v_1 \text{ x } r_i) + (v_2 \text{ x } o_i) + (v_3 \text{ x } c_i)]$, where

- r_i represents the number of claims to be reported in each calendar year i
- o_i represents the number of open claims at the end of calendar year i
- c_i represents the claims to be closed during calendar year i
- i represents the series of future calendar year-ends until all claims are closed

In each case, only claims occurring on or before the valuation date should be considered. Note that a claim that stays open for a number of years is counted multiple times in the summation. This is consistent with the assumption that there are ULAE payments each year as long as a claim stays open.

The above formula for claim counts is equivalent to that presented by Wendy Johnson. The formula could be adapted to reflect the Rahardjo and Mango-Allen concepts of cost varying over time by stratifying the claims activities more finely than just reporting, opening, and closing.

Simplification of Generalized Approach

Conger and Nolibos note that in many cases, the estimation of R (ultimate cost of reported claims) and C (ultimate cost of closed claims) may not be a trivial exercise.

Another way to think about the ultimate costs of reported claims (R) is as the ultimate for the accident period ending on that date, reduced for the pure IBNR amounts, which represent the ultimate cost of not yet reported claims. Analogously, the ultimate cost of closed claims (C) as of a certain evaluation point represents the final cost of claims that are closed as of the valuation date including any subsequent payments. (Many times this may simply be equal to the paid on closed if the line of business does not have subsequent payments.)

Conger and Nolibos present a simplification where estimates of R and C are not required. First, they use the estimate of ultimate claims for the accident year as a proxy for the ultimate costs of claims reported in the calendar year. The calendar year amount can be expressed exactly as the sum of the corresponding accident year ultimate claims and the pure IBNR at the beginning of the year less the pure IBNR at the end of the year. The actuary can evaluate the error in this approximation based on review of changes in exposures between accident years and the characteristics of the coverage being analyzed and make adjustments based on judgment as necessary. For example, given the minimal delay in the reporting of U.S. workers compensation claims, they state that one can often assume that the pure IBNR component of the ultimate is not likely to vary much from one accident year to the next. Thus, the accident year ultimate claims are likely a reasonable approximation for the true value of the parameter R.

Second, if no particular additional effort is required to close an existing claim, then they note that the actuary can assume that U_3 equals zero. This assumption is not appropriate for all lines of business; for example, professional liability or employment practices liability are lines of business where a significant portion of the claims-related expenses will be incurred with its settlement.

If it is appropriate, for a particular line of business, to assume that $U_3 = 0$, then $U_1 + U_2 =$ 100%, and we can approximate B, the claims basis for each calendar year as

$$Est.\ B = (U_1 \text{ x } A) + (U_2 \text{ x } P), \text{ where}$$

A represents the ultimate claims for the accident year. We then calculate observed W values for each year as

$$W = M \,/\, Est.\ B$$

After a review of these observed ULAE ratios, we select an appropriate ratio W^* for estimating unpaid ULAE. The next step is to estimate pure IBNR (perhaps by analyzing claim reporting patterns and ultimate severities) and deduct this estimate from L to obtain an estimate of the ultimate costs of claims reported to date (R). Unpaid ULAE is then calculated according to the formulas previously presented:

Unpaid ULAE = W^* x $\{L - [(U_1 \text{ x } R) + (U_2 \text{ x } P)]\}$, which can be expressed as

Unpaid ULAE = W^* x $[U_1 \text{ x } (L - R) + U_2 \text{ x } (L - P)\}$

Practical Difficulties with the Generalized Approach

The generalized approach is consistent with the assumption that the claims adjusting activities associated with reopening and reclosing a claim have no cost. An alternative approach is to assume that the ultimate cost of closed claims C equals the sum of total amounts paid on closed claims as of the evaluation date. Under this approach, the cost of reclosing a claim is assumed to be equal to the cost of closing a claim of the same size. However, this alternative approach still fails to capture the cost of reopening claims.

In cases where reopenings of claims are more than negligible, and the ULAE cost of such reopenings (and subsequent reclosings) is not immaterial, the actuary could obtain a separate provision for the cost of future claims handling activities related to claims that are closed as of the evaluation of unpaid ULAE. Conger and Nolibos suggest that this provision could perhaps be based on a study of the frequency of reopenings and average cost in ULAE of handling the reopened claims.

As noted previously, the estimation of R and C, the ultimate cost of reported and closed claims, may not be trivial. Conger and Nolibos state that they have not attempted to measure the relative accuracy of the generalized method (as compared to other dollar-based methods) in an inflationary environment. They also identify two other issues that warrant further investigation: the effect of reopened claims on the accuracy of the estimates of unpaid ULAE, and how to modify the approach to properly reflect the change over time in the quantity or cost of resources dedicated to the handling of a claim, as that claim ages.

Mango-Allen Refinement

Donald F. Mango and Craig A. Allen discuss a variation of the Kittel refinement to the classical technique in their 1999 paper.[104] They specifically suggest a possible variation on the application of the formula when the actuary is working with a line of business where the actual historical calendar period claims are volatile, perhaps due to the random timing associated with the reporting or settlement of large claims. In this case, Mango and Allen suggest replacing the actual calendar period claims with expected claims for those historical calendar periods. They explain that the actuary can estimate the expected paid claims by applying selected reporting and payment patterns to a set of accident year estimated ultimate claims. This type of adjustment would be most useful for lines of business with a relatively small number of claims of widely varying sizes.

[104] *CAS Forum*, Fall 1999.

Key Assumptions of Mango-Allen Refinement to the Classical Technique

One key assumption of the Mango-Allen refinement of the classical technique is that an insurer's ULAE-to-claim relationship is derived based on a review of the ratio of paid ULAE-to-*expected* paid claims. This differs from the classical technique where paid ULAE is compared to *actual* paid claims.

The second key assumption of the classical technique remains valid for the Mango-Allen refinement. The relative volume and cost of future claims management activity on not-yet-reported claims and reported-but-not-yet-closed claims is expected to be proportional to the dollars of IBNR and case outstanding, respectively. Specifically, we assume that one-half of expenses are sustained when opening a claim and one-half of expenses when closing a claim.

Mechanics of Mango-Allen Refinement to the Classical Technique

We present the Mango-Allen refinement to the classical technique in Exhibit III for New Small Insurer, a new insurer specializing in lawyers' professional liability coverage. There are five steps in this technique:

- Estimate calendar year expected paid claims
- Develop ratio of historical calendar year paid ULAE-to-expected calendar year paid claims
- Review historical ratios for trends or patterns
- Select a ratio of ULAE-to-claims applicable to future claims payments
- Apply 50% of the selected ULAE ratio to case outstanding and 100% of the selected ULAE ratio to IBNR

In Exhibit III, Sheet 1, we begin the analysis by estimating expected paid claims for each of the four calendar years in the experience period (i.e., 2005 through 2008). Expected calendar year payments are based on direct earned premium multiplied by an expected claims ratio and the percentage expected to be paid in each year. Since New Small Insurer is a new company without credible historical claims experience, we rely on the claims ratio underlying the pricing analyses as well as insurance industry benchmark payment patterns.

Once calendar year expected paid claims are determined, the analysis proceeds in a similar fashion as the classical technique. (See Exhibit III, Sheet 2.) We observe that the ratios of paid ULAE-to-actual paid claims are much more volatile than the ratios of paid ULAE-to-expected paid claims. We observe a pronounced downward trend in the paid ULAE-to-expected paid claims ratios. We seek to understand the reasons behind this trend by reviewing the assumptions underlying the development of expected paid claims and through discussions with management about actual paid ULAE.

One explanation could be that the industry-based payments pattern for developing expected paid claims may be too fast for this particular insurer. We recognize that until a sufficient volume of credible experience is developed, we are challenged in the selection of appropriate development patterns. Another explanation of the variability and downward trends could be related to large claims. We know from a review of claims data that there are several open claims for the most recent accident years in litigation with large case outstanding values and minimal payments to date.

After discussion with management about the specific categories of costs underlying the paid ULAE, its expectations for the upcoming several years, and a review of current claims data, we select a ratio of 0.07 for estimating unpaid ULAE. Thus, for New Small Insurer, we estimate unpaid ULAE at 12/31/08 of $457,975 using total IBNR and $236,761 using pure IBNR.

$$\$457,975 = [(0.070 \times 50\% \times \$225,000) + (0.070 \times 100\% \times \$6,430,000)]$$

$$\$236,761 = \{[0.070 \times 50\% \times (\$225,000 + (6,430,000 - 109,588))] + [0.070 \times 100\% \times \$109,588]\}$$

When the Mango-Allen Refinement Works and When it Does Not

The Mango-Allen refinement is a valuable alternative for insurers with limited experience or highly volatile claims payment experience. For such insurers, a method using reported claims instead of paid claims may provide a more stable base for projection purposes. However, for organizations with a sufficient volume of paid claims experience, the additional calculations required to estimate expected paid claims may not be necessary as the relative improvement to the accuracy of projected unpaid ULAE may not justify the time and costs involved.

Count-Based Techniques

Mango and Allen describe two major drawbacks of the use of claims as a base for comparison relative to the use of claim counts for estimating unpaid ULAE.[105] First, the amount of ULAE is not solely dependent on the magnitude of the accompanying claim dollars. ULAE is also dependent on the average claim size. For example, we expect that the ULAE required to settle a one million-dollar claim is probably less than the ULAE required to settle ten $100,000 claims. However, the classical technique with its use of a paid-to-paid ratio does not recognize this difference.

The second disadvantage noted by Mango and Allen is that the estimate of unpaid ULAE becomes a "rider" on the estimate of unpaid claims, responding to whatever volatility is present in the estimate of ultimate claims. In practice, we do not expect the unpaid ULAE to respond fully to fluctuations in claim amounts. Mango and Allen cite the example of a sudden drop in claim counts or in the value of claims. We would not expect an immediate drop in the overhead expenses or the number of claims management personnel.

In this section, we briefly describe several approaches that have been developed since the mid-1960s. One of the most significant challenges an actuary faces in using count-based techniques is the availability of accurate and consistent claim count data or refined transaction and expense information for an insurer.

A key assumption in count-based techniques is that the same kind of transaction costs the same amount of ULAE regardless of the claim size. Conger and Nolibos note that because count-based

[105] *CAS Actuarial Society Forum*, Fall 1999.

techniques typically include some parameter to reflect the cost of ongoing management and maintenance of claims, they also imply that a claim that stays open longer will cost proportionately more than a quick-closing claim, at least with respect to some component of ULAE.

Early Count Techniques

Conger and Nolibos discuss a 1967 proposal for a count-based ULAE technique by R.E. Brian in the Insurance Accounting and Statistical Association Proceedings. Brian suggested breaking the ULAE process into five kinds of transactions:

- Setting up new claims
- Maintaining outstanding claims
- Making a single payment
- Closing a claim
- Reopening a claim

In the Brian technique, the actuary projects the future number of each type of transaction. Brian estimated that each of these transactions would carry a similar cost, and suggested estimating the cost per transaction using ratios of historical ULAE expenditures to the number of claim transactions occurring during the same calendar periods.

The primary assumption of this technique, which Conger and Nolibos identify as a weakness is that each of the five kinds of claims transactions requires similar ULAE resources and expenditures. The weakness of this assumption could easily be remedied by refining the formula to allow for different costs for the different types of transactions. A more significant weakness of this technique is the practical difficulty in estimating both the number of future transactions and the average cost of each transaction. Data supporting these projections (reliable and consistent claim count and claim transaction data) is often not readily available.

Wendy Johnson Technique

In her paper "Determination of Outstanding Liabilities for Unallocated Loss Adjustment Expenses,"[106] Wendy Johnson follows a similar approach to Brian's but focuses on two key transactions: reporting and maintenance. Johnson, like Brian, then projects the future number of newly reported claims, as well as the number of claims that will be in a pending status each year – and thus will require maintenance work during the year. Also like Brian, Johnson estimates the cost of each transaction by comparing historical aggregate ULAE expenditures to the number of transactions occurring in the same time period.

The Johnson technique allows for an explicit differential in the amount of ULAE resource or cost required for different types of claim transactions. She provides a specific medical malpractice example in which, based on qualitative input, the process of opening a claim costs $\$x$ and the process of maintaining existing claims costs an additional $\$x$.

[106] *CAS Discussion Paper Program*, May 1988.

Alternative weights as well as additional transaction types could be introduced directly into Johnson's formula. The benefit of Johnson's approach is that it only requires the actuary to estimate the *relative* amount of resources required for each transaction type and does not require the actuary to perform detailed time-and-motion studies to calculate the *actual* cash cost of each transaction type.

The mechanics of the Johnson technique involve estimating the ULAE cost per claim activity by calculating weighted claim counts (using the relative transaction costs as weights) based on historical data and comparing those weighted claim counts to the total ULAE costs in the same historical period. In this technique, we then obtain the estimate of unpaid ULAE by projecting the number of, and the ULAE cost associated with, weighted claim counts at each subsequent year-end, related only to claims occurring prior to the reserve valuation date.

Mango-Allen Claim Staffing Technique

Mango and Allen introduce a claim staffing technique to respond to shortcomings they observed in the Johnson method.[107] They state that the technique is closer to a "transaction-based method." They calculate estimated unpaid ULAE using future claim staff workload levels and a new projection base, which is equal to the sum of calendar year opened, closed, and pending claims (OCP claims).
Actuaries using the claim staffing technique project the following four components:

- Future calendar year OCP claims
- Future calendar year claim staff workloads, which are expressed as OCP claims per staff member
- Future calendar year claim staff count
- Future calendar year ULAE per claim staff member

Future calendar year ULAE payments, which include consideration of inflation, are equal to the product of future claim staff count and future ULAE per claim staff member. The estimated unpaid ULAE is the sum of future calendar year ULAE payments.

Mango and Allen cite three characteristics of OCP claims that make their use as a base for the claim staffing method appealing:

1. *It is a reasonable proxy for claims department activity.* It is arguably directly proportional to levels of claim activity, especially number of staff and workload levels of the staff.
2. *It is claim count based.* As mentioned above, paid loss is not a particularly effective or responsive base for projecting ULAE. Claims counts (if case complexity issues are addressed) bear a more direct relationship to claim staff activity.
3. *It is derivable from typical reserve study information.* Projected opened, closed and pending claims are derivable from ultimate claim counts, a claim reporting pattern and a claim closing pattern.[108]

[107] *CAS Forum*, Fall 1999.
[108] *CAS Forum*, Fall 1999.

Conger and Nolibos note that the estimate of unpaid ULAE is likely to be quite sensitive to the magnitude of the selected parameters. In addition, the estimates will be influenced by parameters not explicitly considered in the article, such as the implicit assumption that equal amounts of ULAE resources are required to open, close, and handle one average claim for a year.

Rahardjo

In her paper "A Methodology for Pricing and Reserving for Claim Expenses in Workers Compensation,"[109] Kay Kellogg Rahardjo discusses the fact that different levels of work effort are required for handling claims in the first 30 days than for claims that have been open for five years. One focus of Rahardjo's paper is the length of time for which workers compensation claims remain open, which she defines to be the "duration." She states: "As duration increases, so does the expense of handling the claim for the remainder of the claim's life."

Rahardjo also presents a methodology for pricing claims-handling services which is applicable to third-party claims administrators (TPAs). Self-insurance and large deductible plans are now commonplace means of financing risk. However, few self-insureds handle their own risks; instead they outsource those responsibilities to TPAs. Thus, Rahardjo's technique could be useful to such organizations in need of a method for estimating the cost of future TPAs claims handling (i.e., unpaid ULAE).

Spalla

Joanne Spalla asserts that manual time-and-motion studies are no longer necessary to determine the costs of various claim-related activities and transactions. Since so many claims-related activities are computer-supported, she suggests using modern claim department information systems to track the time spent on individual claims by level of employee.

By combining individual claim management activities into somewhat more macroscopic transactions, it is feasible to calculate the average cost of each type of claim transaction. These average claim costs, loaded for overhead and other costs that are not captured by the computerized tracking systems, can be applied within analytical frameworks as described by Rahardjo and Mango-Allen (claim staffing technique).

A benefit of working with the underlying cost data that Spalla describes is that it allows for more detailed analysis of the claim activity costs. Using the detailed information, the actuary can determine which types of claim transactions and which stages of the claim life cycle have relatively similar (or different) costs. This insight can then assist the actuary in selecting different costs for different transactions for the purpose of estimating unpaid ULAE.

Conger and Nolibos suggest "that the actuary using Spalla's method consider an equally important additional step as a 'reality check': if the selected costs per transaction were applied to the numbers of transactions that were undertaken last year, would the result match that period's actual total ULAE expenditures?"

While Spalla describes determining the actual cost, the approach could also be used to quantify the relative amount of cost per transaction as compared to the cost of other kinds of claim

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[109] *CAS Forum*, Summer 1996.

transactions. This relativity is less subject to annual change than the dollar cost per transaction or per activity. With relativities, the actuary could then use the general approaches described in Rahardjo and Mango-Allen, but now with some quantitative basis for the magnitude of the parameters.

Triangle-Based Techniques

Actuaries can also estimate ULAE using triangle-based development techniques. A key difference between triangle analysis of claims experience and ULAE experience is the method used to assign ULAE to individual cells (accident year by evaluation year) of the triangle. Since "actual" ULAE by accident year is not observable, at least not for all categories of ULAE, the actuary will need to formulate assumptions for the creation of the paid ULAE triangle. This allocation of ULAE payments is typically based on the pattern of claim payments, which can be observed. It is important to recognize, however, that the accident year triangles of ULAE may be distorted if either the method of allocating calendar ULAE to accident years changes over time or if the claims payment patterns change.

In the paper "Testing of Loss Adjustment (Allocated) Expense Reserves,"[110] R.S. Slifka suggests using a time-and-motion study to estimate the claim department's allocation of resources between current accident year claims and prior accident year claims. This relationship between the "cost" of current year's claim management activities and prior years' claim management activities can be used then to estimate the future payment activities. Assume for example that a time and motion study suggests that:

- 60% of the current accident year's ULAE remains unpaid
- 15% of the prior accident year's ULAE remains unpaid
- 5% of the second prior accident year's ULAE remains unpaid

The total unpaid ULAE is estimated as 80% (60% + 15% + 5%) of a typical calendar year's ULAE payment. Conger and Nolibos note that although this technique presumes a steady state, it can be refined to reflect volume growth as well as the effects of inflation.

A third technique is the construction of paid ULAE triangles based on time and motion studies. For example, assume that time and motion studies suggest that 50% of ULAE is paid at the time a claim is reported and the remaining 50% is paid in proportion to claim payments. An actuary can then assign historical calendar ULAE to accident year-calendar year cohorts: 50% according to the distribution of reported claims across current accident year, prior accident year, second prior accident year, and so on; and 50% according to the distribution of paid claims, as indicated by an appropriate accident year claims payment pattern. Once the ULAE triangle is constructed, the actuary can apply the traditional development technique to estimate ultimate ULAE and indicated unpaid ULAE.

While triangular methods can theoretically be used to project ultimate ULAE and indicated unpaid expenses, in practice, ULAE triangle projections are rarely used by actuaries.

[110] *Proceedings of the IASA*, 1968.

Comparison Example

In their paper "Estimating ULAE Liabilities: Rediscovering and Expanding Kittel's Approach," Conger and Nolibos provide an example of a U.S. workers compensation insurer who has been in operations for six years. In Exhibit IV, Sheet 1, we summarize the calendar year and accident year experience data from their example and have named it PQR Insurer.

Over the course of its six years of operations, paid ULAE averaged approximately 18% of claims. Observing the downward trend in the paid-to-paid ratios in Exhibit IV, Sheet 2, Column (6), an actuary using the traditional technique may select a ULAE ratio of 16% and derive estimated unpaid ULAE of $41.6 million. In Column (7), we use the Kittel refinement and estimate unpaid ULAE of $29.9 million.

For PQR Insurer, Conger and Nolibos found that ULAE expenditures are concentrated more heavily towards the front end of the claim than are the claim payments. Consider a hypothetical extreme, in which all ULAE is incurred at the moment the claim occurs, with the amount of the ULAE being proportional to the size of the claim. In this hypothetical situation, the appropriate relationship to examine would be the ratio of ULAE to ultimate claims for an accident period.[111] They also observe that the growth of PQR Insurer will result in an overstatement of the estimated unpaid ULAE using the traditional technique.

Interviews with management of PQR Insurer and examination of the flows of work and allocation of resources in the claims department suggested that approximately 60% to 70% of the work for a claim is concentrated at the time the claim is reported, and 30% to 40% of the work is spread over the remaining life of the claim. For PQR Insurer, no particular extra degree of effort is required to close the claim. Since ULAE expenditures are heavier at the beginning of the claim's life cycle, it is not surprising that the estimated unpaid ULAE using the Kittel refinement results in a lower estimate of unpaid ULAE ($29.9 million) than the traditional technique ($41.6 million).

In Exhibit IV, Sheet 3, we present the Conger and Nolibos generalized method with U_1 equal to 60%, U_2 equal to 40%, and U_3 equal to 0%. Columns (2) through (4) are based on the calendar year historical experience presented in Exhibit IV, Sheet 1. The claims basis in Column (5) is equal to 60% of the ultimate on claims reported in the year (*R*) and 40% of paid claims (*C*). The ULAE ratio in Column (6) is equal to paid ULAE in column (2) divided by the claims basis in Column (5). A ULAE ratio of 10% is selected based on a review of the historical experience by year. The estimated unpaid ULAE is calculated in Line (9) using the three approaches described in the previous section:

- Expected claim method = [(selected ULAE ratio x ultimate claims) – total paid ULAE to date]

- Bornhuetter-Ferguson method = [selected ULAE ratio x (ultimate claims – total claims basis)]

- Development method = {[(ultimate claims / total claims basis) – 1.00] x total paid ULAE to date}

[111] The reader should recognize elements of the suggested simplification of the generalized method in the discussion of this extreme situation.

In Exhibit IV, Sheet 4, we present similar calculations assuming that U_1 equal to 70%, U_2 equal to 30%, and U_3 equal to 0%.

The final exhibit presents the Conger and Nolibos simplified generalized approach. We present a range of estimated unpaid ULAE assuming that pure IBNR is equal to either 4% of the latest accident year ultimate claims or 6% of the latest accident year ultimate claims.

In practice, many actuaries only use one method to estimate unpaid ULAE. In determining which method to use, an actuary should have a selection criterion for assessing the various alternative methods. One approach many actuaries rely on is to evaluate the results in terms of the number of years of payments indicated by the unpaid estimate. The expected number of future year payments will vary depending on the types of insurance in insurer's portfolio. For example, for short-tail lines of insurance, the actuary may expect the estimate of unpaid ULAE to represent one to two years of additional calendar year payments. However, for long-tail lines of coverage, the estimated unpaid ULAE may be expected to represent three to four years of payments.

Chapter 17 - Unallocated Loss Adjustment Expenses Exhibit I
XYZ Insurer - Classical Technique
Development of Unpaid ULAE

Calendar Year	Paid ULAE	Paid Claims	Ratio of Paid ULAE to Paid Claims
(1)	(2)	(3)	(4)
2004	14,352,000	333,000,000	0.043
2005	15,321,000	358,000,000	0.043
2006	16,870,000	334,000,000	0.051
2007	17,112,000	347,000,000	0.049
2008	17,331,000	391,000,000	0.044
Total	80,986,000	1,763,000,000	0.046

(5) Selected ULAE Ratio	0.045
(6) Case Outstanding at 12/31/08	603,000,000
(7) Total IBNR at 12/31/08	316,000,000
(8) Pure IBNR at 12/31/08	19,000,000
(9) Estimated Unpaid ULAE at 12/31/08 Using Total IBNR	27,787,500
(10) Estimated Unpaid ULAE at 12/31/08 Using Pure IBNR	21,105,000

Column and Line Notes:
(2) and (3) Based on data from XYZ Insurer.
(4) = [(2) / (3)].
(5) Selected based on ULAE ratios in (4).
(6) Based on data from XYZ Insurer.
(7) Based on actuarial analysis at 12/31/08 for all lines combined.
(8) Estimated assuming pure IBNR is equal to 5% of accident year 2008 ultimate claims. Ultimate claims for all lines combined for accident year 2008 are $380 million for XYZ Insurer.
(9) = {[(5) x 50% x (6)] + [(5) x 100% x (7)]}.
(10) = {[(5) x 50% x ((6) + (7) - (8))] + [(5) x 100% x (8)]}.

XYZ Insurer - Kittel Technique
Development of Unpaid ULAE

Calendar Year	Paid ULAE	Paid Claims	Incurred Claims	Average Paid and Inc. Claims	ULAE Ratio - Paid ULAE to Paid Claims	ULAE Ratio - Paid ULAE to Avg Paid and Inc. Claims
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2004	14,352,000	333,000,000	535,213,000	434,106,500	0.043	0.033
2005	15,321,000	358,000,000	492,265,000	425,132,500	0.043	0.036
2006	16,870,000	334,000,000	435,985,000	384,992,500	0.051	0.044
2007	17,112,000	347,000,000	432,966,000	389,983,000	0.049	0.044
2008	17,331,000	391,000,000	475,300,000	433,150,000	0.044	0.040
Total	80,986,000	1,763,000,000	2,371,729,000	2,067,364,500	0.046	0.039

(8) Selected ULAE Ratio	0.040
(9) Case Outstanding at 12/31/08	603,000,000
(10) Total IBNR at 12/31/08	316,000,000
(11) Pure IBNR at 12/31/08	19,000,000
(12) Estimated Unpaid ULAE at 12/31/08 Using Total IBNR	24,700,000
(13) Estimated Unpaid ULAE at 12/31/08 Using Pure IBNR	18,760,000

Column and Line Notes:
(2) through (4) Based on data from XYZ Insurer.
(5) = [Average of (3) and (4)].
(6) = [(2) / (3)].
(7) = [(2) / (5)].
(8) Selected based on ULAE ratios in (7).
(9) Based on data from XYZ Insurer.
(10) Based on actuarial analysis at 12/31/08 for all lines combined.
(11) Estimated assuming pure IBNR is equal to 5% of accident year 2008 ultimate claims.
Ultimate claims for all lines combined for accident year 2008 are $380 million for XYZ Insurer.
(12) = {[(8) x 50% x (9)] + [(8) x 100% x (10)]}.
(13) = {[(8) x 50% x ((9) + (10) - (11))] + [(8) x 100% x (11)]}.

Chapter 17 - Unallocated Loss Adjustment Expenses
New Small Insurer - Mango-Allen Refinement Technique
Development of Expected Paid Claims in Calendar Year

Exhibit III
Sheet 1

Accident Year	Direct Earned Premium	Expected Claims Ratio	Expected Claims	Expected Payment Percentage in Calendar Year 2005	2006	2007	2008	Expected Claims Paid in Calendar Year 2005	2006	2007	2008
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2005	4,300,000	55%	2,365,000	12%	15%	15%	15%	283,800	354,750	354,750	354,750
2006	4,250,000	55%	2,337,500		12%	15%	15%		280,500	350,625	350,625
2007	4,420,000	55%	2,431,000			12%	15%			291,720	364,650
2008	3,985,000	55%	2,191,750				12%				263,010
Total	16,955,000		9,325,250					283,800	635,250	997,095	1,333,035

Column Notes:
(2) Based on information provided by New Small Insurer.
(3) Based on actuarial analysis conducted for pricing purposes.
(4) = [(2) x (3)].
(5) through (8) Based on actuarial analysis of insurance industry benchmark paid claims development experience.
(9) = [(4) x (5)].
(10) = [(4) x (6)].
(11) = [(4) x (7)].
(12) = [(4) x (8)].

Chapter 17 - Unallocated Loss Adjustment Expenses Exhibit III
New Small Insurer - Mango-Allen Refinement Technique Sheet 2
Development of Unpaid ULAE

Calendar Year	Paid ULAE	Paid Claims Actual	Paid Claims Expected	ULAE Ratio Paid ULAE-to-Paid Claims Actual	ULAE Ratio Paid ULAE-to-Paid Claims Expected
(1)	(2)	(3)	(4)	(5)	(6)
2005	55,000	1,253,450	283,800	0.044	0.194
2006	62,500	86,000	635,250	0.727	0.098
2007	70,000	410,650	997,095	0.170	0.070
2008	80,000	309,600	1,333,035	0.258	0.060
Total	267,500	2,059,700	3,249,180	0.130	0.082

(7) Selected ULAE Ratio	0.070
(8) Case Outstanding at 12/31/08	225,000
(9) Total IBNR at 12/31/08	6,430,000
(10) Pure IBNR at 12/31/08	109,588
(11) Estimated Unpaid ULAE at 12/31/08 Using Total IBNR	457,975
(12) Estimated Unpaid ULAE at 12/31/al Using Pure IBNR	236,761

Column and Line Notes:
(2) and (3) Based on data from New Small Insurer.
(4) Developed in Exhibit III, Sheet 1.
(5) = [(2) / (3)].
(6) = [(2) / (4)].
(7) Selected based on ULAE ratios in (6) and input of management of New Small Insurer.
(8) Based on claims data from New Small Insurer.
(9) Based on actuarial analysis at 12/31/08.
(10) Estimated assuming pure IBNR is equal to 5% of accident year expected claims.
(11) = {[(7) x 50% x (8)] + [(7) x 100% x (9)]}.
(12) = {[(7) x 50% x ((8) + (9) - (10))] + [(7) x 100% x (10)]}.

Chapter 17 - Unallocated Loss Adjustment Expenses Exhibit IV
PQR Insurer Sheet 1
Summary of Input Parameters ($000)

	Calendar Year			Ult on Claims	Accident Year		
Year	Paid ULAE	Paid Claims	Reported Claims	Reported in Calendar Year	Ultimate Claims	IBNR at 12/31/08	Reported Claims
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2003	1,978	4,590	19,534	27,200	28,600	257	28,343
2004	4,820	14,600	57,125	76,700	79,200	1,742	77,458
2005	8,558	38,390	85,521	106,900	108,400	5,095	103,305
2006	12,039	58,297	128,672	154,300	156,700	16,140	140,560
2007	13,143	86,074	145,070	163,100	163,400	34,477	128,923
2008	15,286	105,466	163,626	176,400	177,100	56,141	120,959
Total	55,824	307,417	599,548	704,600	713,400	113,852	599,548

Note: Claims include allocated claim adjustment expenses.

Column Notes:
(2) through (4) Based on data from PQR Insurer. Reported claims represent paid claims, case outstanding, and estimated IBNR.
(5) through (7) Based on actuarial analysis at year-end 2008.
(8) Based on data from PQR Insurer. Includes paid claims, case outstanding, and estimated IBNR.

Chapter 17 - Unallocated Loss Adjustment Expenses
PQR Insurer
Classical and Kittel Techniques ($000)

Exhibit IV
Sheet 2

Calendar Year	Paid ULAE	Paid Claims	Reported Claims	Average of Paid and Rptd Claims	ULAE Ratio - Paid ULAE to Paid Claims Traditional	ULAE Ratio - Paid ULAE to Avg Paid & Rptd Claims Kittel
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2003	1,978	4,590	19,534	12,062	0.431	0.164
2004	4,820	14,600	57,125	35,863	0.330	0.134
2005	8,558	38,390	85,521	61,956	0.223	0.138
2006	12,039	58,297	128,672	93,485	0.207	0.129
2007	13,143	86,074	145,070	115,572	0.153	0.114
2008	15,286	105,466	163,626	134,546	0.145	0.114
Total	55,824	307,417	599,548	453,484	0.182	0.123

	Paid Claims Traditional	Avg Paid & Rptd Claims Kittel
(8) Selected ULAE Ratio	0.160	0.115
(9) Case Outstanding at 12/31/08	292,130	292,130
(10) IBNR at 12/31/08	113,853	113,853
(11) Estimated Unpaid ULAE at 12/31/08	41,587	29,891

Column and Line Notes:
(2) through (4) From Exhibit IV, Sheet 1.
(5) = [Average of (3) and (4)].
(6) = [(2) / (3)].
(7) = [(2) / (5)].
(8) Selected based on ULAE ratios in (6) and (7).
(9) Based on data from PQR Insurer.
(10) Based on actuarial analysis at 12/31/08 for all lines combined.
(11) = {[(8) x 50% x (9)] + [(8) x 100% x (10)]}.

Conger and Nolibos Generalized Approach - 60/40 Assumption ($000)

Calendar Year	Paid ULAE	Ult on Claims Reported in Calendar Year	Paid Claims	Claims Basis	ULAE Ratio
(1)	(2)	(3)	(4)	(5)	(6)
2003	1,978	27,200	4,590	18,156	0.109
2004	4,820	76,700	14,600	51,860	0.093
2005	8,558	106,900	38,390	79,496	0.108
2006	12,039	154,300	58,297	115,899	0.104
2007	13,143	163,100	86,074	132,290	0.099
2008	15,286	176,400	105,466	148,026	0.103
Total	55,824	704,600	307,417	545,727	0.102

(7) Selected ULAE Ratio	0.100
(8) Ultimate Claims	713,400
(9) Indicated Unpaid ULAE Using:	
(a) Expected Claim Method	15,516
(b) Bornhuetter-Ferguson Method	16,767
(c) Development Method	17,152

Column and Line Notes:
(2) through (4) From Exhibit IV, Sheet 1.
(5) = {[(3) x 60%] + [(4) x 40%]}.
(6) = [(2) / (5)].
(7) Selected based on ULAE ratios in (6).
(8) From Exhibit IV, Sheet 1.
(9a) = {[(7) x (8)] - (Total in (2))}.
(9b) = {(7) x [(8) - (Total in (5))]}.
(9c) = {{[(8) / (Total in (5))] - 1.00} x (Total in (2))}.

Conger and Nolibos Generalized Approach - 70/30 Assumption ($000)

Calendar Year	Paid ULAE	Ult on Claims Reported in Calendar Year	Paid Claims	Claims Basis	ULAE Ratio
(1)	(2)	(3)	(4)	(5)	(6)
2003	1,978	27,200	4,590	20,417	0.097
2004	4,820	76,700	14,600	58,070	0.083
2005	8,558	106,900	38,390	86,347	0.099
2006	12,039	154,300	58,297	125,499	0.096
2007	13,143	163,100	86,074	139,992	0.094
2008	15,286	176,400	105,466	155,120	0.099
Total	55,824	704,600	307,417	585,445	0.095

(7) Selected ULAE Ratio	0.100
(8) Ultimate Claims	713,400
(9) Indicated Unpaid ULAE Using:	
(a) Expected Claim Method	15,516
(b) Bornhuetter-Ferguson Method	12,795
(c) Development Method	12,201

Column and Line Notes:
(2) through (4) From Exhibit IV, Sheet 1.
(5) = {[(3) x 70%] + [(4) x 30%]}.
(6) = [(2) / (5)].
(7) Selected based on ULAE ratios in (6).
(8) From Exhibit IV, Sheet 1.
(9a) = {[(7) x (8)] - (Total in (2))}.
(9b) = {(7) x [(8) - (Total in (5))]}.
(9c) = {{[(8) / (Total in (5))] - 1.00} x (Total in (2))}.

Conger and Nolibos Simplified Generalized Approach - 60/40 Assumption ($000)

Year	Cal Year Paid ULAE	Acc Year Ultimate Claims	Cal Year Paid Claims	Claims Basis	ULAE Ratio
(1)	(2)	(3)	(4)	(5)	(6)
2003	1,978	28,600	4,590	18,996	0.104
2004	4,820	79,200	14,600	53,360	0.090
2005	8,558	108,400	38,390	80,396	0.106
2006	12,039	156,700	58,297	117,339	0.103
2007	13,143	163,400	86,074	132,470	0.099
2008	15,286	177,100	105,466	148,446	0.103
Total	55,824	713,400	307,417	551,007	0.101

(7) Selected ULAE Ratio	0.100
(8) Ultimate Claims	713,400
(9) Estimated Pure IBNR Based on	
(a) 4% of Latest Accident Year Ultimate Claims	7,084
(b) 6% of Latest Accident Year Ultimate Claims	10,626
(10) Indicated Unpaid ULAE Using	
(a) 4% of Latest Accident Year Ultimate Claims	16,664
(b) 6% of Latest Accident Year Ultimate Claims	16,877

Column and Line Notes:
(2) through (4) From Exhibit IV, Sheet 1.
(5) = {[(3) x 60%] + [(4) x 40%]}.
(6) = [(2) / (5)].
(7) Selected based on ULAE ratios in (6).
(8) From Exhibit IV, Sheet 1.
(9a) = [4% x (accident year 2008 ultimate claims in (3))].
(9b) = [6% x (accident year 2008 ultimate claims in (3))].
(10a) = {(7) x [60% x (9a)] + {40% x [(8) - (Total in (4))]}}.
(10b) = {(7) x [60% x (9b)] + {40% x [(8) - (Total in (4))]}}.