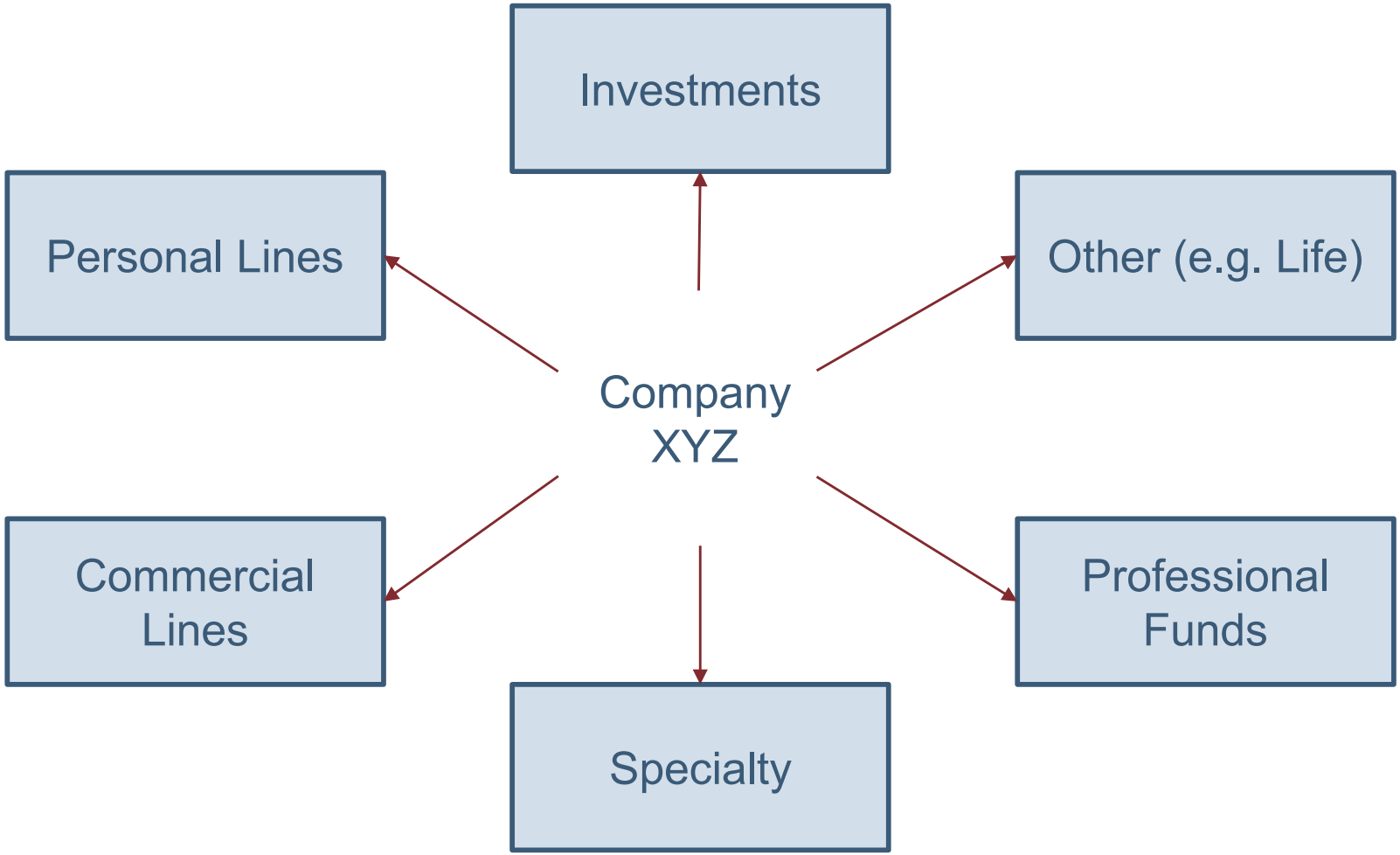
Overview of Insurance Terminology

Lines of Business

Lines of Business

Typical P&C Company LOB Structure:



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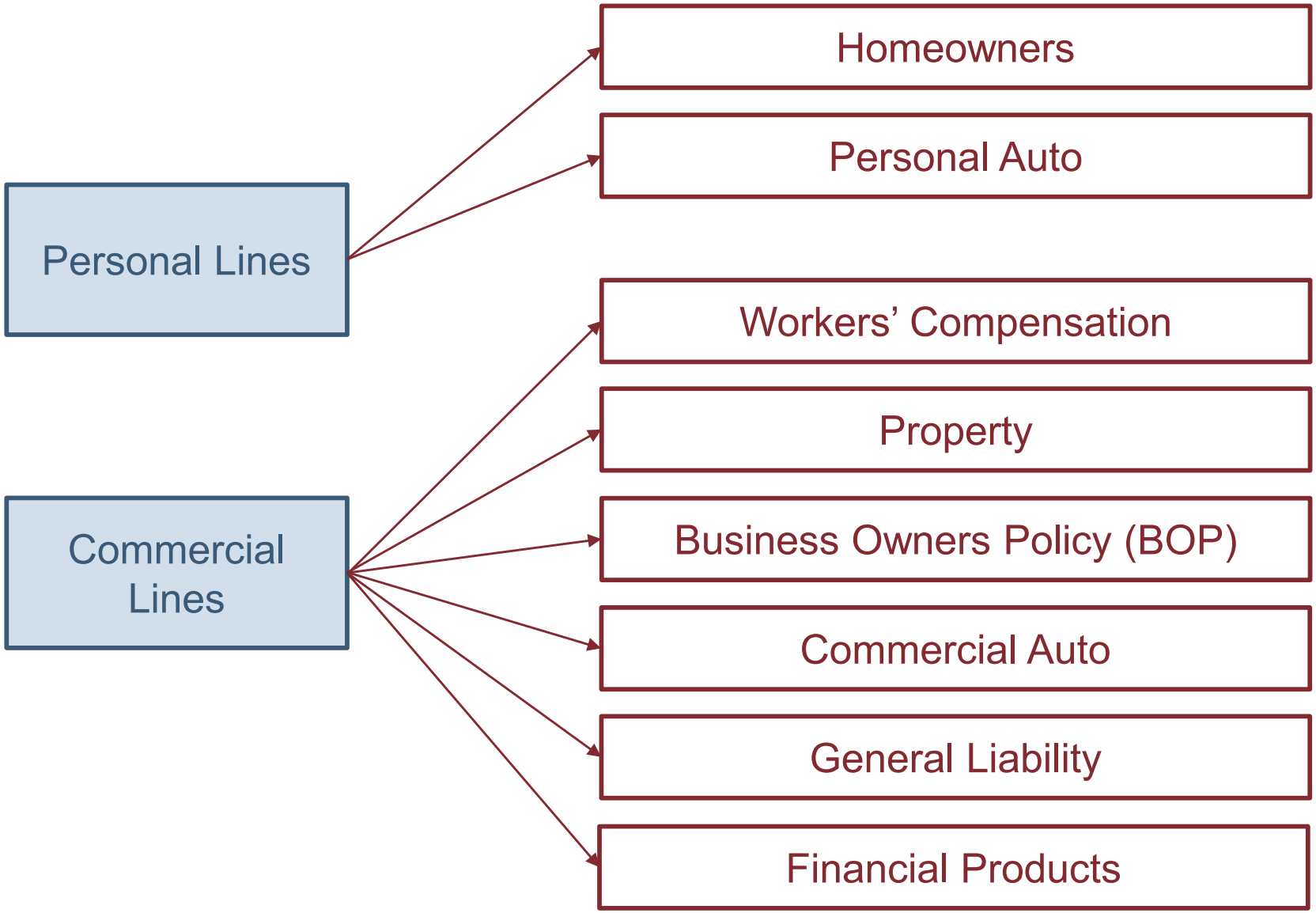

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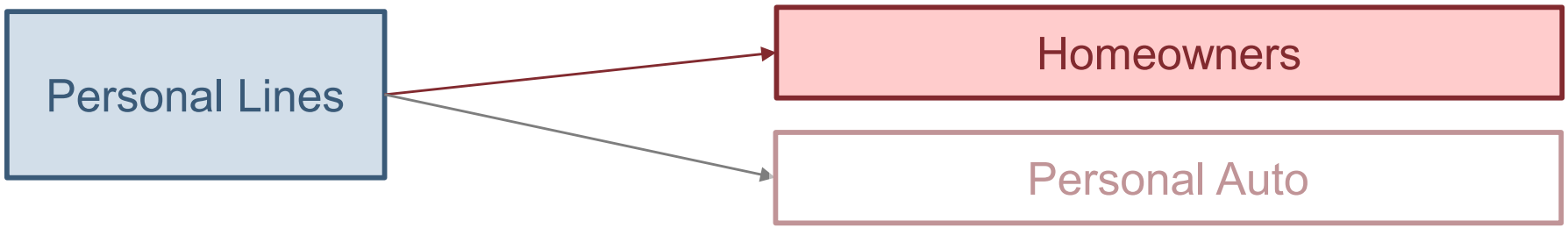
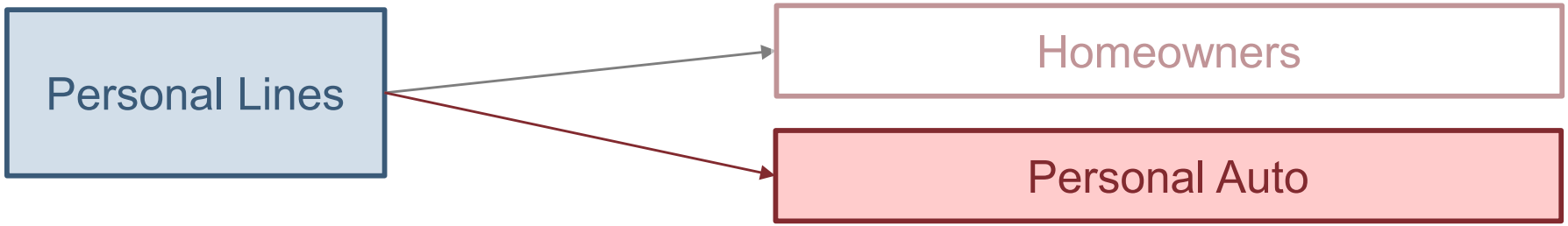


Coverages:

- Dwelling Coverage
- Personal Property Coverage
- Loss of Use
- Liability
- Medical Payments

- Renter's Insurance

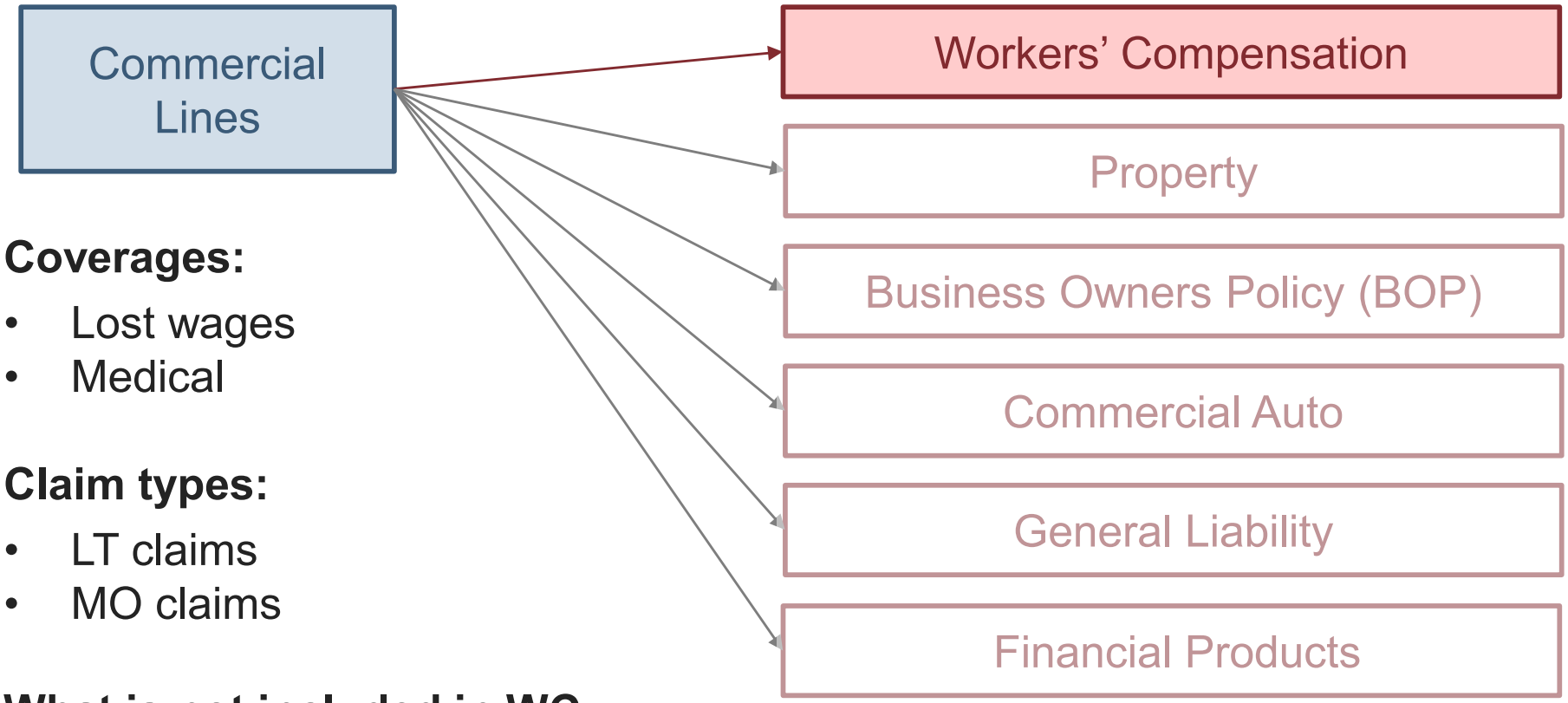
Lines of Business



Coverages:

- Bodily Injury Liability Coverage (BI)
- Property Damage Liability Coverage (PD)
- Medical Payments (MP) / Personal Injury Protection (PIP)
- Uninsured/Underinsured Motorist Coverage (UM/UDM)
- Other than Collision (COMP)
- Collision (COLL)

Lines of Business



Coverages:

- Lost wages
- Medical

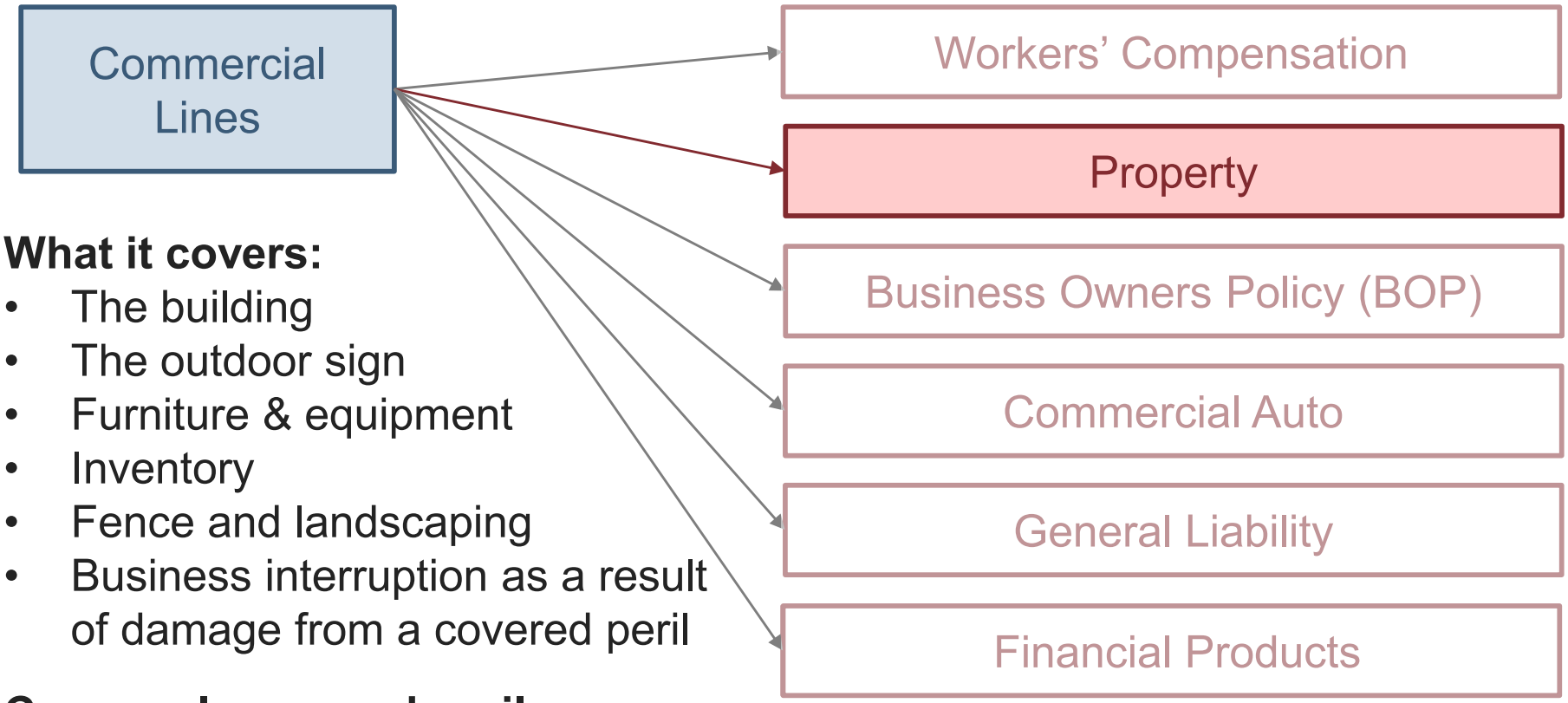
Claim types:

- LT claims
- MO claims

What is <u>not</u> included in WC:

- Pain and suffering
- Punitive damages

Lines of Business



What it covers:

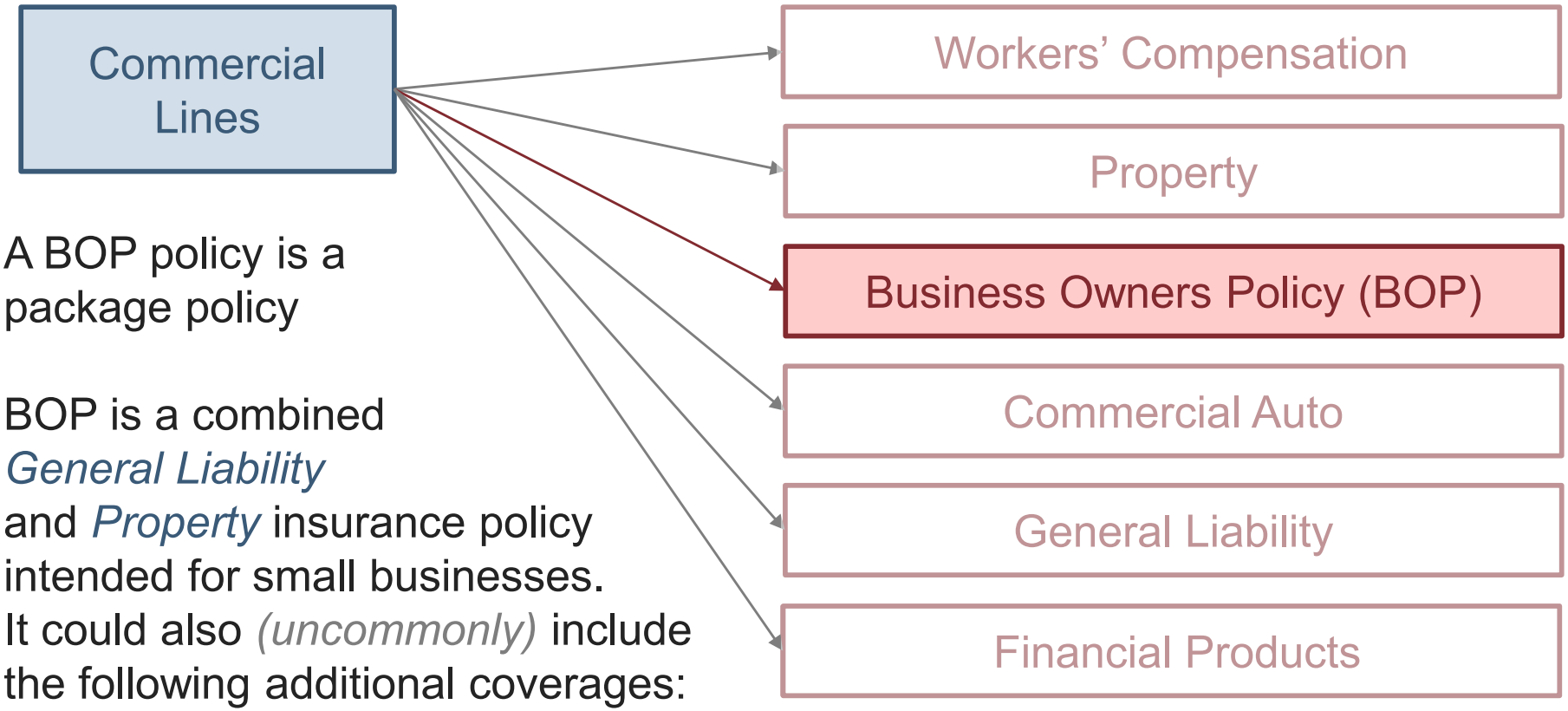
- The building
- The outdoor sign
- Furniture & equipment
- Inventory
- Fence and landscaping
- Business interruption as a result of damage from a covered peril

Commonly covered perils:

- Fires
- Windstorm
- Hail

Commonly Excluded Perils: Flood and war

Lines of Business

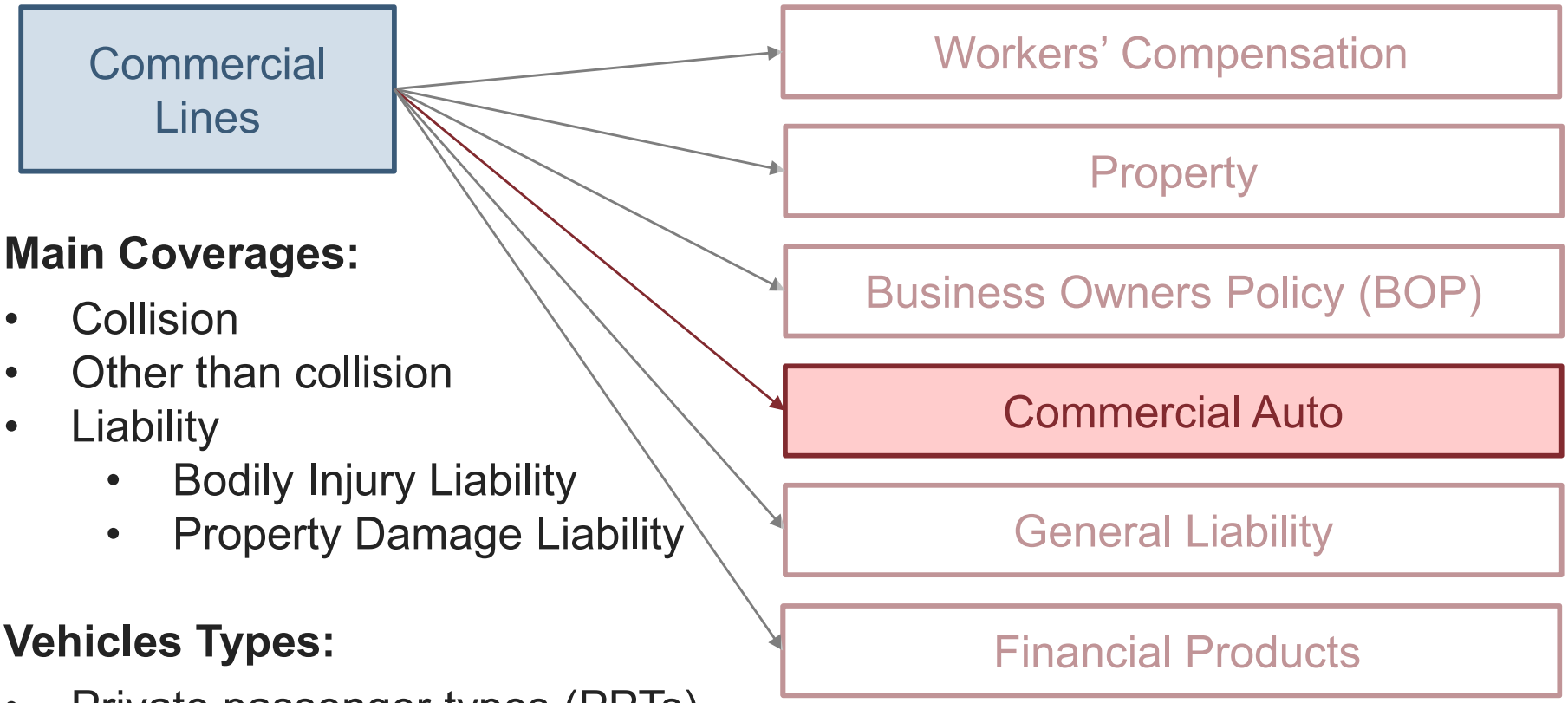


A BOP policy is a package policy

BOP is a combined *General Liability* and *Property* insurance policy intended for small businesses. It could also *(uncommonly)* include the following additional coverages:

- Cyber Liability
- Employment Practices
- Crime Insurance

Lines of Business



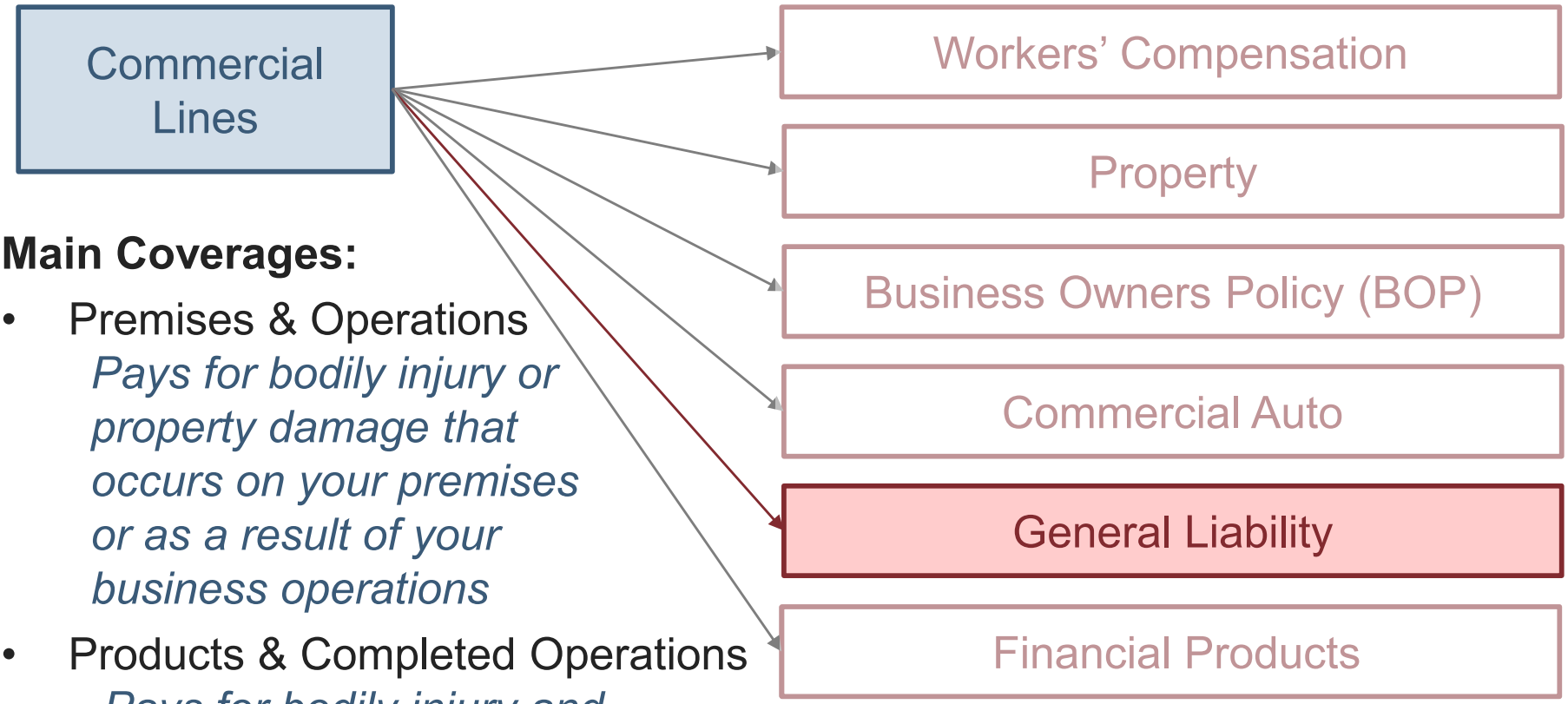
Main Coverages:

- Collision
- Other than collision
- Liability
  - Bodily Injury Liability
  - Property Damage Liability

Vehicles Types:

- Private passenger types (PPTs)
- Trucks, tractors, and trailers (TTTs)

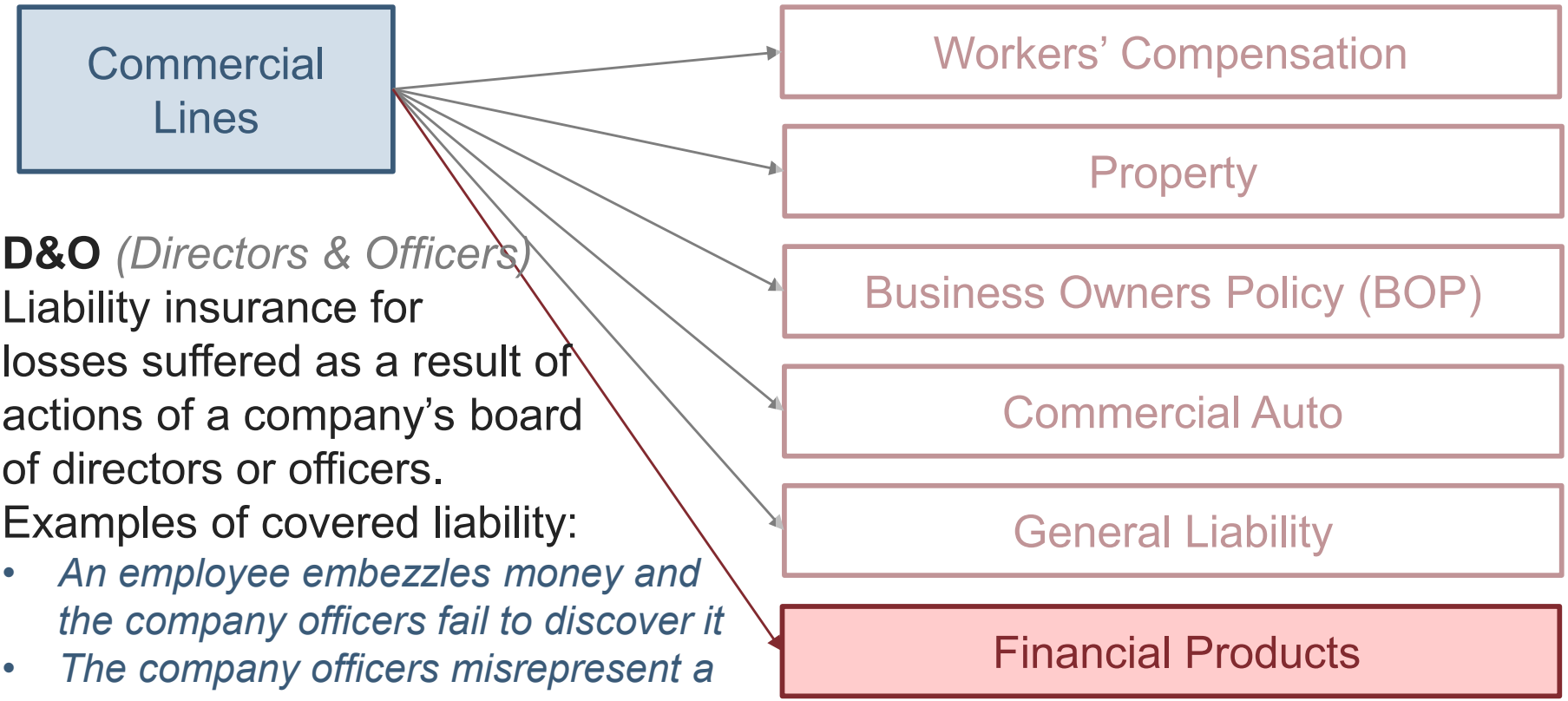
Lines of Business



Main Coverages:

- Premises & Operations
  Pays for bodily injury or property damage that occurs on your premises or as a result of your business operations
- Products & Completed Operations
  Pays for bodily injury and property damage that occurs away from your business premises and is caused by your products or completed work
- Advertising and Personal Injury Liability
  Pays for false arrest, malicious prosecution, wrongful eviction, slander, libel, and invasion of privacy

Lines of Business



D&O *(Directors & Officers)*
Liability insurance for losses suffered as a result of actions of a company's board of directors or officers.
Examples of covered liability:

- *An employee embezzles money and the company officers fail to discover it*
- *The company officers misrepresent a company's financial health*

E&O *(Errors & Omissions)*
Liability insurance that covers professionals against negligence claims due to services provided. Examples of covered liability losses include:

- *A software product fails to perform properly causing a client to lose money*
- *An engineer makes an error in designing a bridge causing it to collapse*

Market Segments

Market Segments

Typical Definition of Commercial Lines Market Segments

Small Commercial

Small businesses defined as businesses with an annual payroll under $XXM, revenues under $XXM, and property values less than $XXM per location

Middle Market

Midsize businesses defined as businesses whose payroll, revenue, and property values exceed the Small Commercial definition, but are not considered large/complex enough to be Large Commercial.

Large Commercial

The largest accounts written. Generally a risk is considered a Large Commercial account if it has more than XK employees or a workers' compensation manual premium greater than $XXXK. These accounts tend to be complex and are looked at on an account by account basis. Loss sensitive rating is common for this market segment.

Discussion

- Why do we separate business by market segment? How might insurance needs differ by market segment?

- What advantage might there be in specializing in small commercial risks?

Exposures

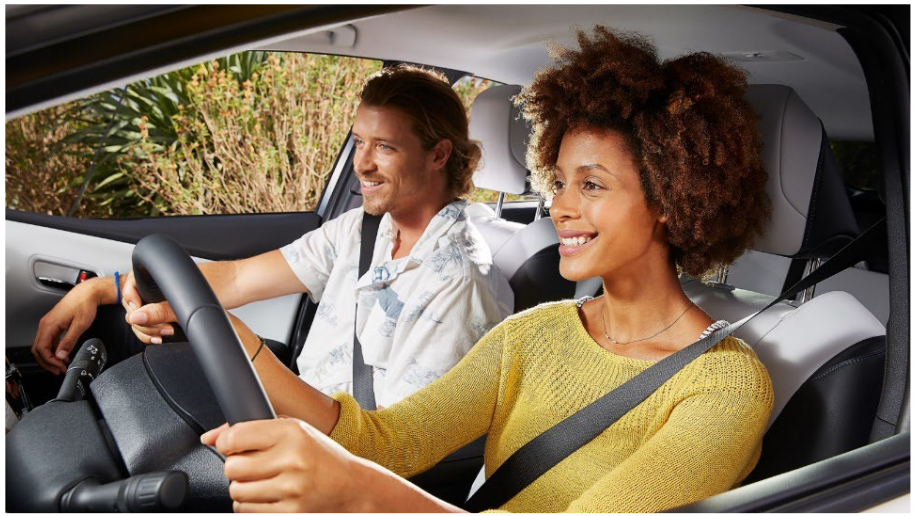
Exposures

exposure *noun*
basic unit of risk

Total Expected Loss = *Expected Loss Per Unit of Exposure* * *Exposure*

Probability of loss per vehicle * Expected Cost if a loss occurs

Number of vehicles



Using Telematics data would be a better representation of true exposure

Exposures

Ideal properties of an exposure base:

1. Directly proportional to expected loss
2. Practical
    - Objective
    - Verifiable and difficult to manipulate
    - Inexpensive to obtain
3. Historical precedence
4. Not against the law

Discussion

- What is a better exposure base for auto and why?:
    1. A single vehicle over a single year
    2. Mileage

- What is a better exposure base for workers' compensation and why?
    1. Number of employees
    2. Payroll

- What is a better exposure base for homeowners and why?
    1. A single home over a single year
    2. Square footage

Claim & Policy Terminology

Claim Terminology

Types of Losses

Three main types of losses:

- Paid Loss – *represents dollars that have already went out the door*
- Case Reserve/Case Outstanding – *claim handler's best estimate on the losses the insurer will pay in the future on a claim*
- Loss Adjustment Expense (LAE)
  - Allocated loss adjustment expense (ALAE) – *include legal defense costs and cost containment*
  - Unallocated loss adjustment expense (ULAE) – *includes things like claim adjuster salaries*

Claim Terminology

Salvage and Subrogation

- Salvage – *When an insurer pays an insured for a claim considered to be a total loss, the insurer acquires rights to the damaged property.*
  Salvage represents any amount the insurer is able to collect from the sale of such damage 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*

Claim Terminology

Reinsurance – Insurance for Insurance Companies

- **Reinsurance** – *the insurance purchased by primary insurance companies to transfer some of the financial risk they face*

- Two main types of reinsurance:
  - **Proportional reinsurance** – *the same proportion of losses and premium are transferred (i.e. "ceded") to the reinsurer (e.g. an insurer transfers over 20% of its losses and premium to the reinsurer (known as a quota share)*
  - **Non-proportional reinsurance** – *the reinsurer agrees to assume some predefined portions of the losses (e.g. the reinsurer will cover 50% of losses that exceed $15M up to $30M)*

Policy Terminology

- **Deductible** – *the amount below which the insured will pay for the claim, but the insurer will handle*
- **Self Insured Retention** – *the amount below which the insured will handle and pay for the claim*
- **Per Occurrence Limit** – *the max amount the insurer is liable for per event*
- **Aggregate limit** – *the max amount the insurer will pay for the total of all claims that occurred during the policy period*

Policy Terminology

- **Endorsement** – *a change made to the policy midterm*
- **Midterm Cancellation** – *a policy that has been ended prior to the policy expiration date*
- **Claims Made Policy** – *policies that provide coverage for claims reported during the policy period (rather than claims that occurred)*
- **Guaranteed Cost** – *policies where you pay a fixed fee upfront for a specific amount of coverage*
- **Loss Sensitive** - *policies that have variable rates depending on claims that occurred during the policy period*
- **Renewal** – *A policy from an existing customer that had business with us during the prior policy term*

Common Ratios

Common Ratios

Frequency

Frequency is a measure of the rate at which claims occur and is normally calculated as:

$$\text{Frequency} = \frac{\text{Number of Claims}}{\text{Number of Exposures}}.$$

Severity

Severity is a measure of the average cost of claims and is calculated as:

$$\text{Severity} = \frac{\text{Losses}}{\text{Number of Claims}}.$$

Pure premium (also known as loss cost or burning cost) is a measure of the average loss per exposure and is calculated as:

$$\text{Pure Premium} = \frac{\text{Losses}}{\text{Number of Exposures}} = \text{Frequency} \times \text{Severity}.$$

What are Reserves?

What are Reserves?

- What is an insurance liability?
  - An obligation for which the company is legally responsible
- Conditions necessary for a liability
  - A contractual event must have occurred (for unearned premiums, the policy has been sold; for loss reserves, the loss has happened)
  - The obligation has not yet been fully discharged
- The two most significant insurance liabilities:
  - Unearned Premium Reserve
  - Loss and Loss Adjustment Expense Reserves

What are Reserves?

- **Setting aside money to pay for the defense or indemnification of claims or lawsuits**

Jim

What are Reserves?

- **Setting aside money to pay for the defense or indemnification of claims or lawsuits**

Jim's Car

What are Reserves?

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Jim's Car ☹ Dwight's Car

What are Reserves?

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Pam

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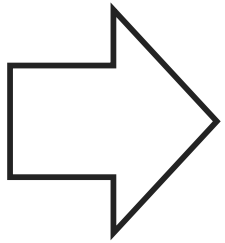

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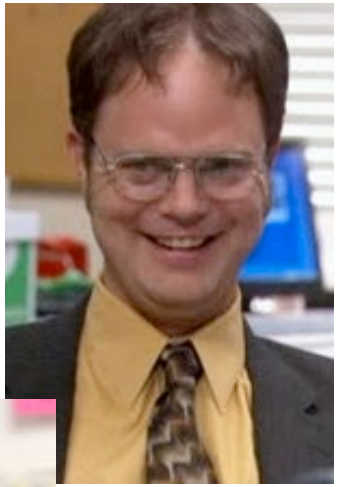
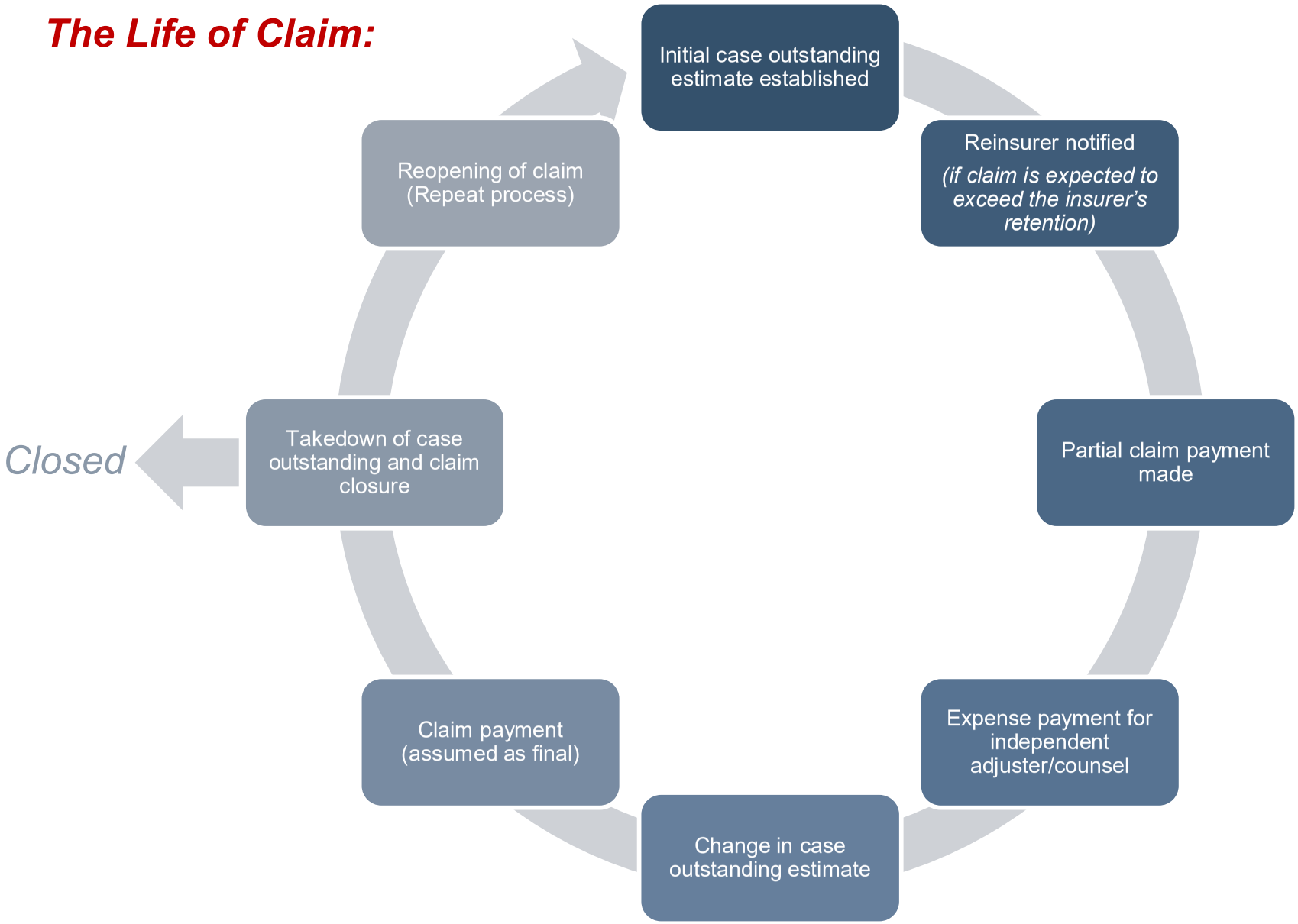


PAID

What are Reserves?

The Life of Claim:



What are Reserves?

Claims Professionals

- Claims professionals are responsible for estimating case outstanding for claims that have been reported to the insurer
- Companies employ a variety of approaches
  - Internal claims departments
  - Third party administrators (TPAs)
  - Independent adjusters

What are Reserves?

Example: Malpractice Claim

- Policy limits are $1 million per occurrence
- Legal counsel advises that there is an 80% chance that the claim will settle without any payment and a 20% chance that the claim will settle at the policy limit
- What should the claims adjuster record as the case reserve?

Company practices vary widely…

- *Alternative 1: Worst case scenario*

  Company records $1 million (policy limits)

- *Alternative 2: Most likely outcome*

  Company records $0 (modal value: 0 at 80%)

- *Alternative 3: Best estimate*

  *Company records $200,000 (expected value: $1M*20%)*

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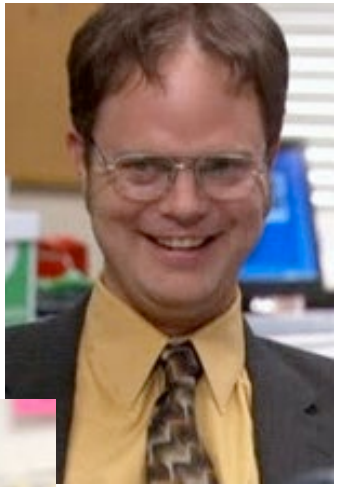

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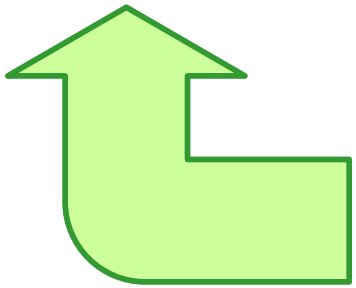

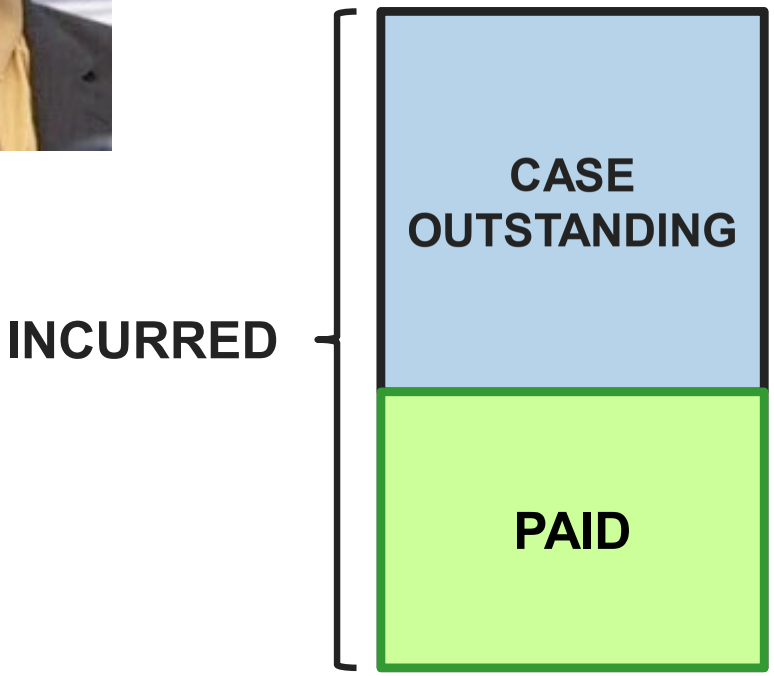

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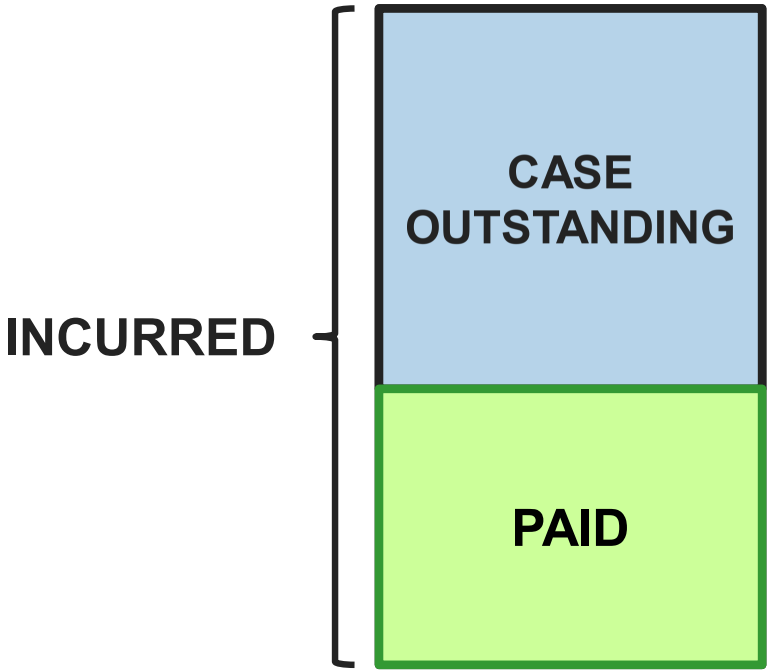
PAID + CASE = INCURRED



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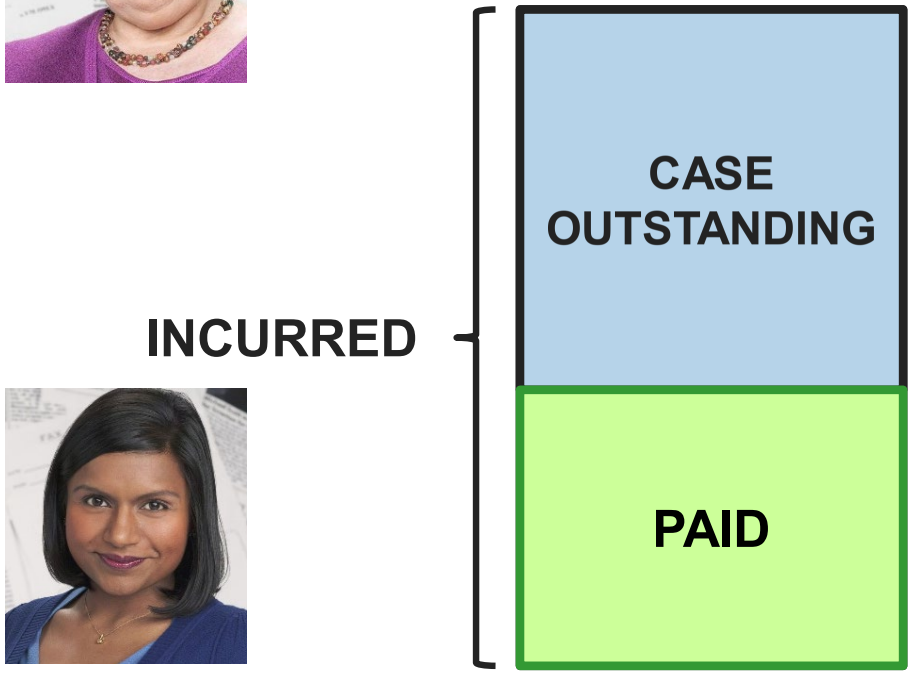

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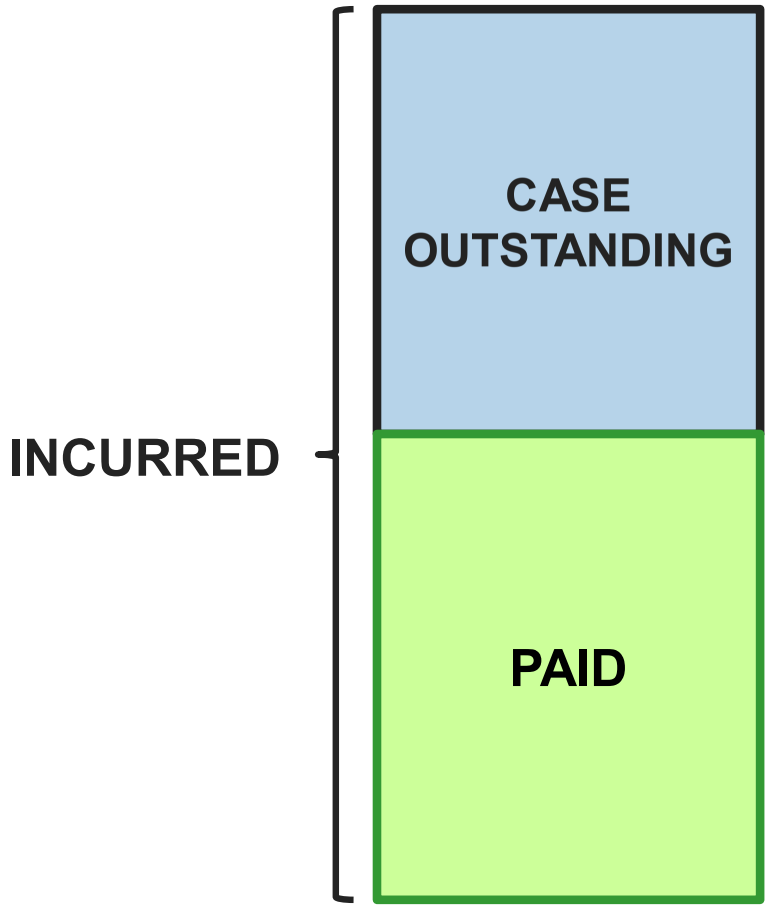
PAID + CASE = INCURRED

What are Reserves?

- **Setting aside money to pay for the defense or indemnification of claims or lawsuits**

PAID + CASE = INCURRED

Amount PAID during the time period
+ Δ CASE during the time period
= INCURRED during the time period *(CY)*



What are Reserves?

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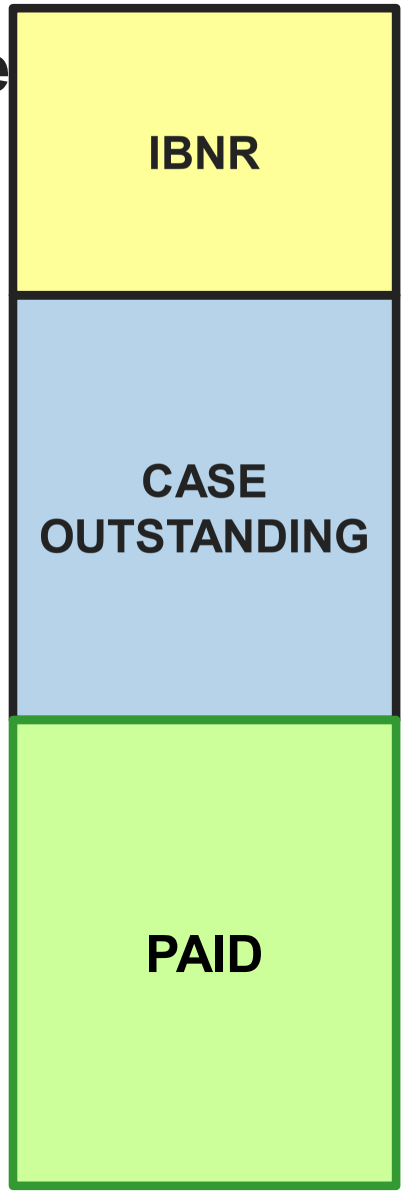
IBNR = Incurred but not reported = IBNER + IBNYR

IBNER
Incurred but not enough reported

- *Development on Known Claims*
- *Reopened Claims*
- *Claims in Transit*



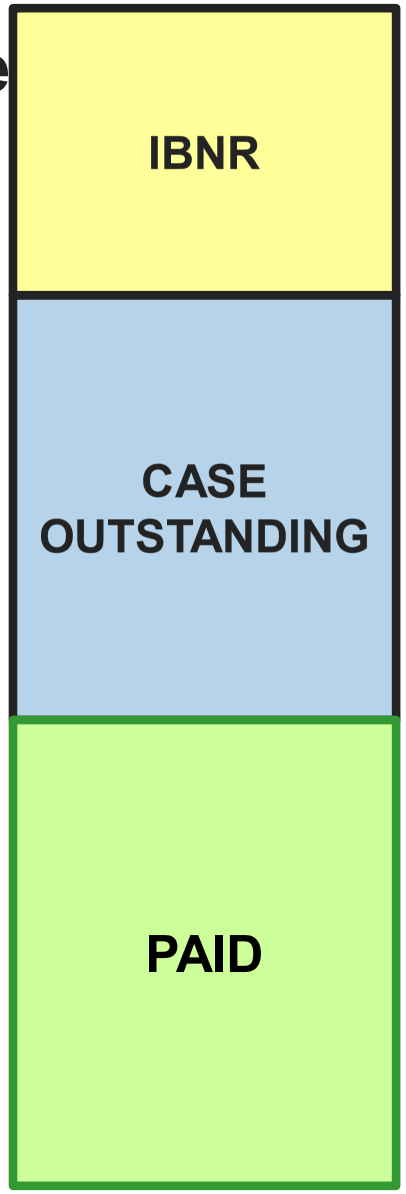
What are Reserves?

- **Setting aside money to pay for the defense or indemnification of claims or lawsuits**

IBNR = Incurred but not reported = IBNE

☹

IBNER
Incurred but not enough reported



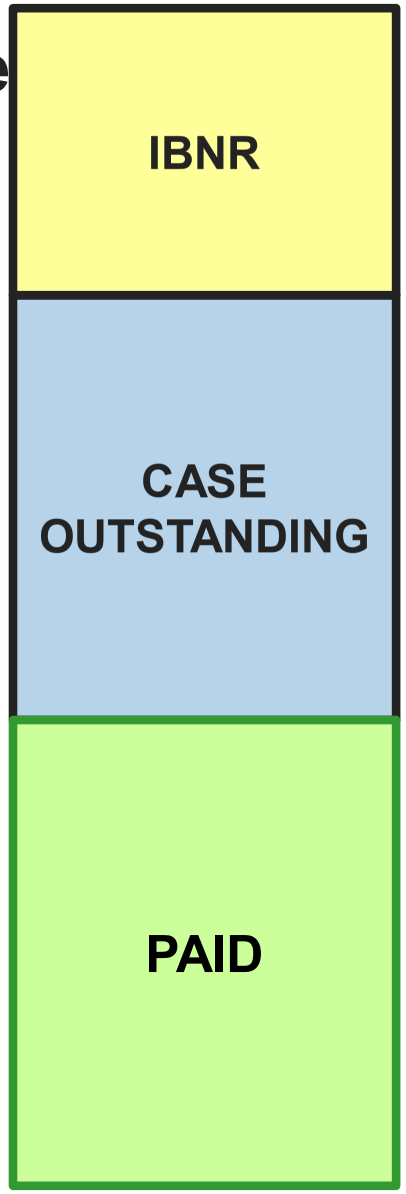
What are Reserves?

- **Setting aside money to pay for the defense or indemnification of claims or lawsuits**

IBNR = Incurred but not reported = IBNER + IBNYR

IBNYR *("Pure IBNR")*
Incurred but not yet reported

IBNER
Incurred but not enough reported



What are Reserves?

Setting aside money to pay for the defense or indemnification of claims or lawsuits

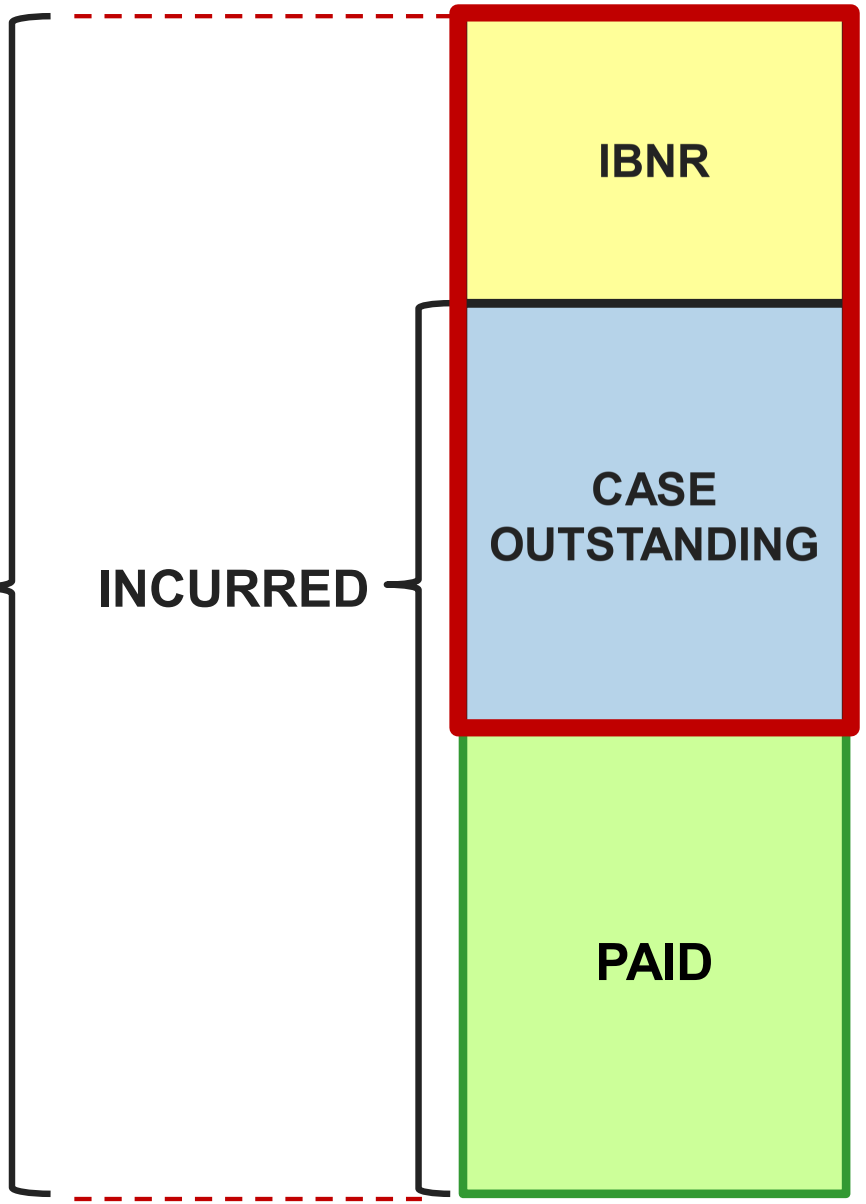
PAID + CASE = INCURRED

Amount PAID during the time period
+ Δ CASE during the time period
= INCURRED during the time period *(CY)*

ULTIMATE = INCURRED + IBNR

RESERVES = IBNR + CASE OUTSTANDING

= ULTIMATE – PAID



Practice

1. IBNR = $1000
   Ultimate Losses = $1500
   What is the incurred loss?

2. Incurred Loss = $500
   Ultimate Loss = $1000
   What is the IBNR?

3. Reserve = $1000
   IBNR = $500
   What is the case outstanding?

Practice - *Answers*

1. IBNR = $1000
   Ultimate Losses = $1500
   What is the incurred loss? *1500 – 1000 = $500*

2. Incurred Loss = $500
   Ultimate Loss = $1000
   What is the IBNR? *1000 – 500 = $500*

3. Reserve = $1000
   IBNR = $500
   What is the case outstanding?
   1000 – 500 = $500

Practice

- Problem 1
  - *Paid Loss = 500*
  - *Ultimate Loss = 1250*
  - *IBNR = 250*
  - *What are the case reserves (case o/s)?*
- Problem 2
  - *Reserve = 500*
  - *IBNR = 100*
  - *Paid Loss = 1000*
  - *What are the case reserves (case o/s)?*
- Problem 3
  - *Incurred Loss = 500*
  - *Reserve = 500*
  - *Case Reserves (case o/s) = 300*
  - *What is the ultimate loss?*

Practice - *Answers*

- Problem 1
  - *Paid Loss = 500*
  - *Ultimate Loss = 1250*
  - *IBNR = 250*
  - *What are the case reserves (case o/s)?* *1250 – 500 – 250 = 500*
- Problem 2
  - *Reserve = 500*
  - *IBNR = 100*
  - *Paid Loss = 1000*
  - *What are the case reserves (case o/s)?* *500 – 100 = 400*
- Problem 3
  - *Incurred Loss = 500*
  - *Reserve = 500*
  - *Case Reserves (case o/s) = 300*
  - *What is the ultimate loss?* *500 + (500 – 300) = 700*

Claim Terminology

Practice

Date	Transaction
4/1/2017	Case Reserve of $500K Established
5/1/2017	A $10K partial payment is made
6/1/2017	Case Reserve is increased by another $50K
7/1/2017	A $300K partial payment is made

1. What is the case reserve on the claim as of the latest transaction?

2. What is the incurred loss on the claim as of the latest transaction?

Practice - *Answers*

Date	Transaction
4/1/2017	Case Reserve of $500K Established
5/1/2017	A $10K partial payment is made
6/1/2017	Case Reserve is increased by another $50K
7/1/2017	A $300K partial payment is made

1. What is the case reserve on the claim as of the latest transaction?

   500 – 10 + 50 – 300 = $240K

2. What is the incurred loss on the claim as of the latest transaction?

   240 + 10 + 300 = $550K

What are Reserves?

Reported Claims (Incurred Claims)

- Term used in two contexts – incremental and cumulative
- Cumulative = Cumulative claim payments through a specific valuation date plus the case outstanding reserves as of that same point in time
- Incremental = the Change in Cumulative Reported Claims over a given period of time
  - *Mathematically equivalent to Incremental Paid + Change in Outstanding Reserves*

What are Reserves?

Naming Convention for This Course

- “Reported claims” will refer to cumulative reported claims
- “Paid claims” will refer to cumulative paid claims
- Same rule applies to reported and paid claim counts
- Any incremental triangles will be specifically labeled as incremental

What are Reserves?

Claim Related Expenses

- **ALAE** ~ ALLOCATED LOSS ADJUSTMENT EXPENSES
  - Expenses that the insurer is able to assign to a particular claim, such as legal costs and expert witness fees
- **ULAE** ~ UNALLOCATED LOSS ADJUSTMENT EXPENSES
  - Expenses that are not easily allocated to a specific claim, such as payroll, rent, and computer expenses for the claims department

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- **DCC** ~ DEFENSE & COST CONTAINMENT
  - Includes all defense litigation and medical cost containment expenses, whether provided internally or externally
- **A&O** ~ ADJUSTING AND OTHER
  - Includes all claims adjusting expenses

NOTE: Some actuaries now separately analyze DCC and A&O, while many continue to use ALAE and ULAE for analysis and then DCC and A&O for reporting

What are Reserves?

Practice

Date	Transaction
1/2/2017	$500 to buy a new laptop for a claim handler
2/28/2017	$10,000 for an expert witness to quantify property damage
3/2/2017	$15,000 for a staff attorney to defend a GL claim
3/15/2017	$500,000 rent for San Antonio claims office
4/18/2017	$20,000 for claim handling expenses for claim XYZ
5/15/2017	$1,000,000 in premium taxes
6/1/2017	$50,000 paid to a San Antonio property insurance agent
7/1/2017	$2,000,000 for a new claims management IT system
10/1/2017	$150 for a medical bill review for claim XYZ
12/31/2017	$2,000,000 in claim handler salaries fo the San Antonio claims office

1. What is the total ALAE in 2017?
2. What is the total ULAE in 2017?
3. What is the total DCC in 2017?
4. What is the total A&O in 2017?

What are Reserves?

Practice - *Answers*

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1/2/2017	$500 to buy a new laptop for a claim handler
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1. What is the total ALAE in 2017? *10,000 + 15,000 + 20,000 + 150 = $45,150*
2. What is the total ULAE in 2017? *500 + 500,000 + 2M + 2M = $4,500,500*
3. What is the total DCC in 2017? *10,000 + 15,000 + 150 = $25,150*
4. What is the total A&O in 2017? *500 + 500,000 + 20,000 + 2M + 2M = $4,520,500*

The Reserve Call

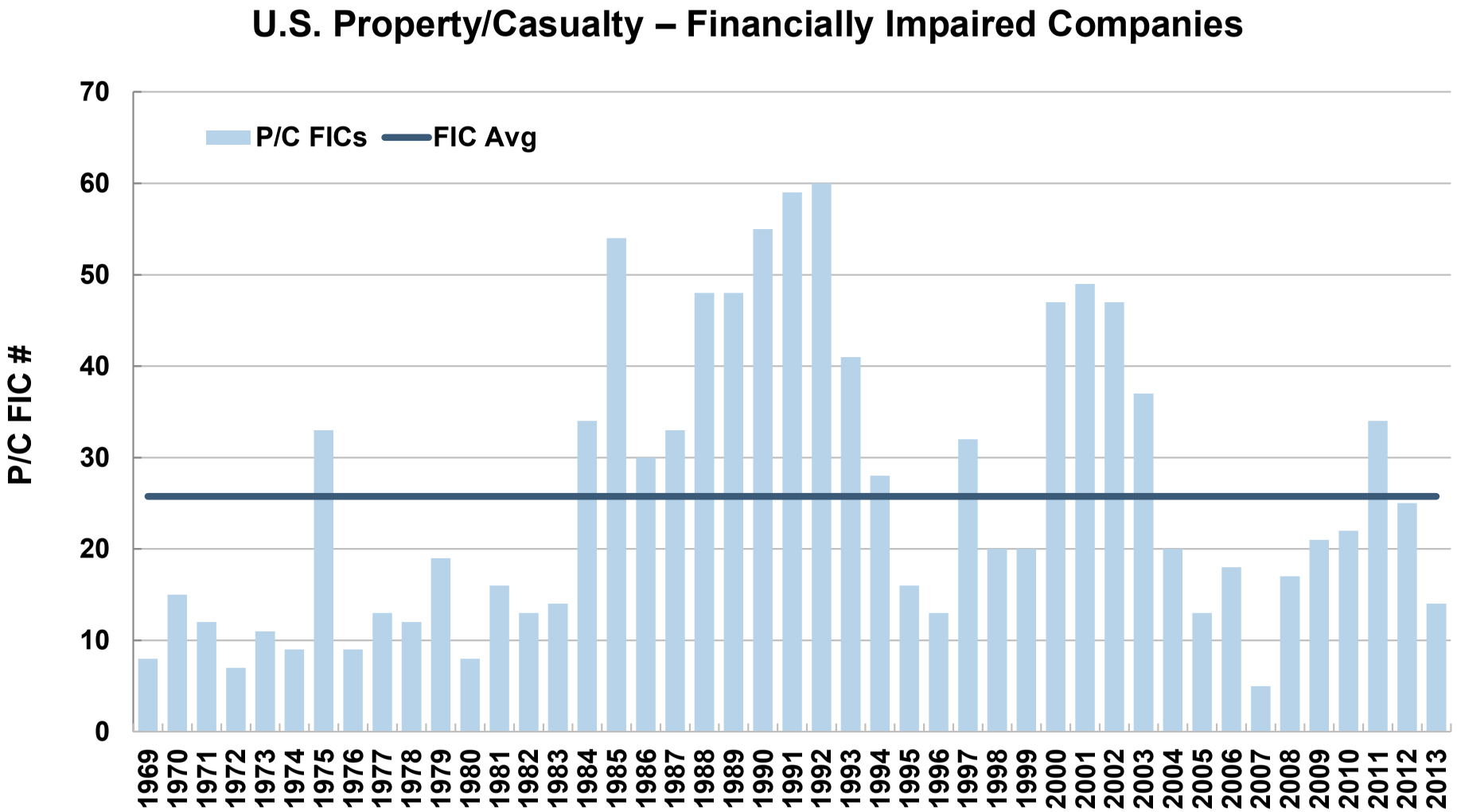
The Reserve Call

Why is accurate reserving important?

- **Ensure the company maintains adequate funds to uphold policy holder obligations**
  - If adequate reserves are held, and the company shut down the business today, there would be enough money to pay out all future liabilities and associated expenses
- **Promote stable and consistent earnings for the company**
  - If ultimate costs are not accurately estimated, unanticipated loss development from prior accident years can adversely impact the income statement for the current calendar period
  - Rating agencies monitor insurer surplus (excess of company assets over liabilities) as an indication of solvency; adverse prior year development can erode company surplus
- **Provide an accurate view of ultimate loss performance by coverage and segment that informs pricing & planning**
  - For most P&C lines of business, pricing & planning decisions must be responsive to loss performance in the most recent 3-5 policy/accident years
- **Provide an accurate view of payment patterns that inform investment strategy**
  - Investment income assumptions by line of business impact target combined ratios and premium rates

The Reserve Call

P&C company failures and impairments occur every year

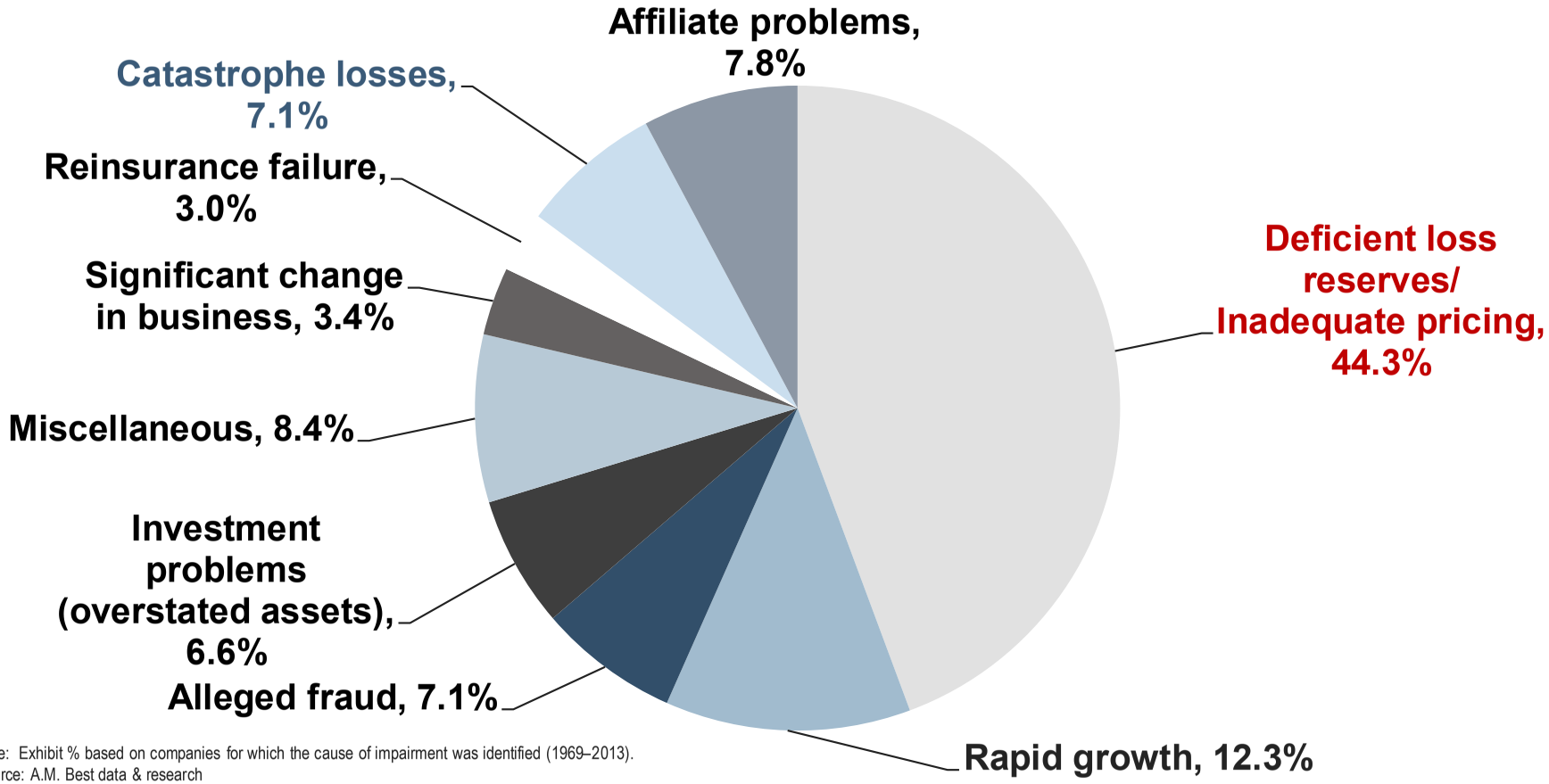


Source: A.M. Best data & research

The Reserve Call

Companies are more likely to fail for reasons other than catastrophes

U.S. Property/Casualty – Primary Cause of Financial Impairment, 1969-2013



Note: Exhibit % based on companies for which the cause of impairment was identified (1969–2013).
Source: A.M. Best data & research

The Reserve Call

Three Viewpoints

- **Internal Management**
  - Reserves influence virtually every area of a company's operations
  - Affect pricing, underwriting, strategic and financial decisions
  - Compensation dependent on results
- **Investors**
  - How strong is the balance sheet?
  - Is the Company profitable?
- **Regulators**
  - Solvency regulation is a key activity
  - In a risk-based framework, reserves are significant

The Reserve Call

The Regulator

- Insurance is a promise. Policyholders pay for service in advance and depend on the insurers to be there when the promises come due (i.e., to pay claims).
- The true cost of that promise is not known when the service is sold.
- Regulators have responsibility for solvency regulation; they monitor reserving practices to protect policyholders.
- The Appointed Actuary role was established by regulators and is key in reserve monitoring and regulation.

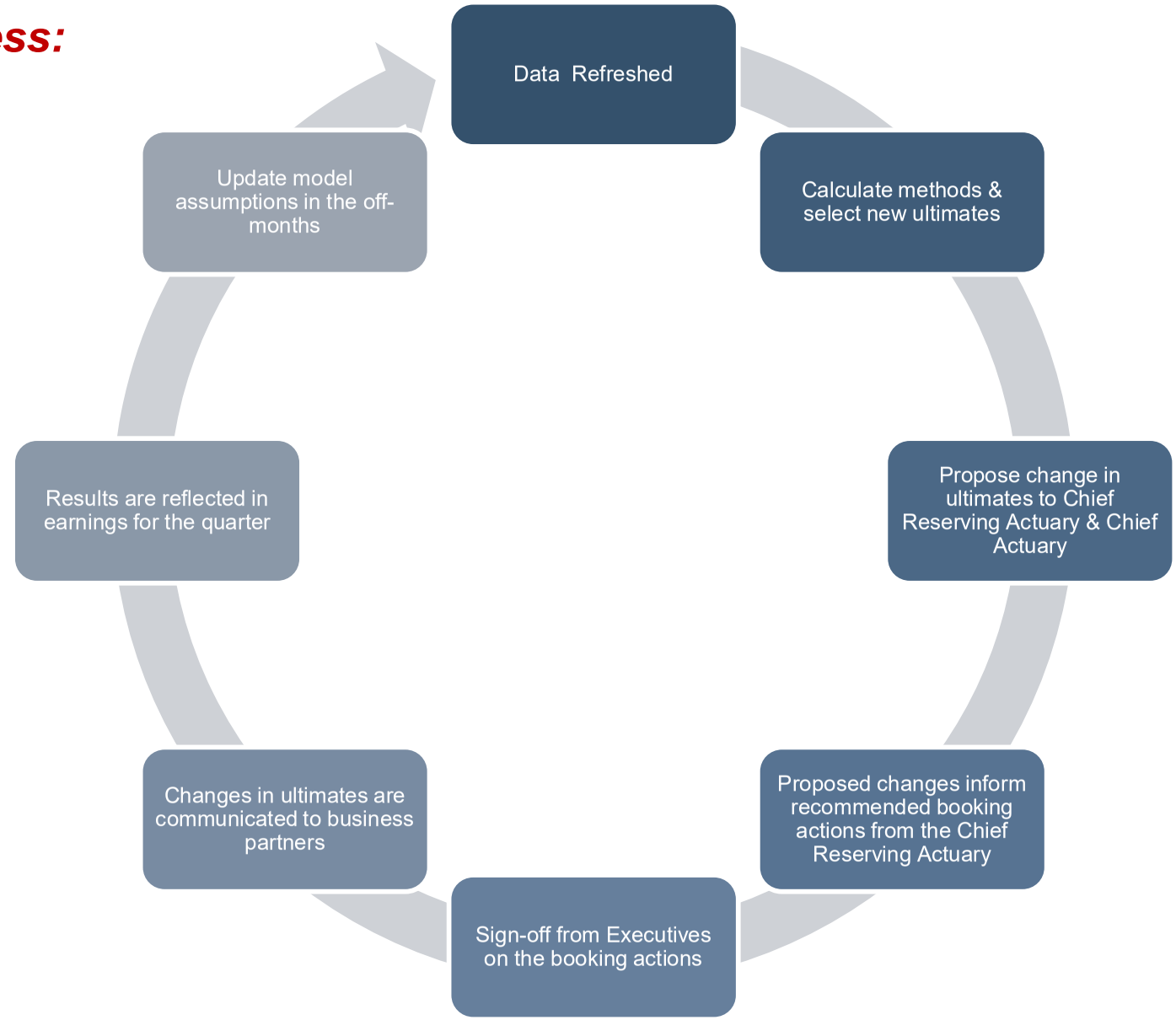
The Reserve Call

The Appointed Actuary *(e.g. Chief Reserving Actuary)*

- Appointed by Board of Directors
- May be an employee of the Company or a consultant
- Issues a formal Statement of Actuarial Opinion each year and prepares an Actuarial Report documenting findings.
- Required by state law to issue his/her report to the Board; Board must formally accept the report.
- Statement of Actuarial Opinion is included in the Company's Annual Statement filed with the state regulators.

The Reserve Call

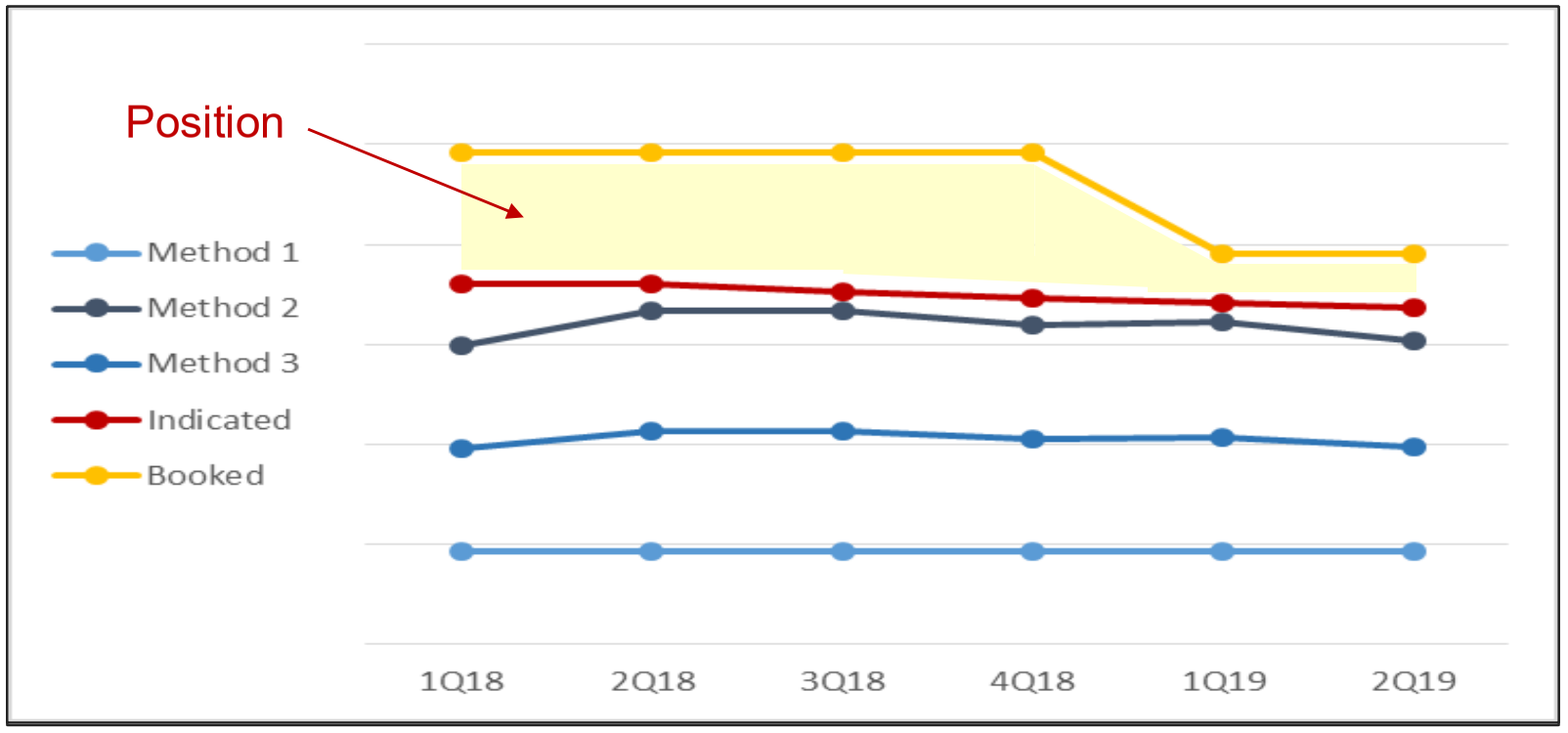
The Process:



The Reserve Call

Indicated vs Booked Reserves

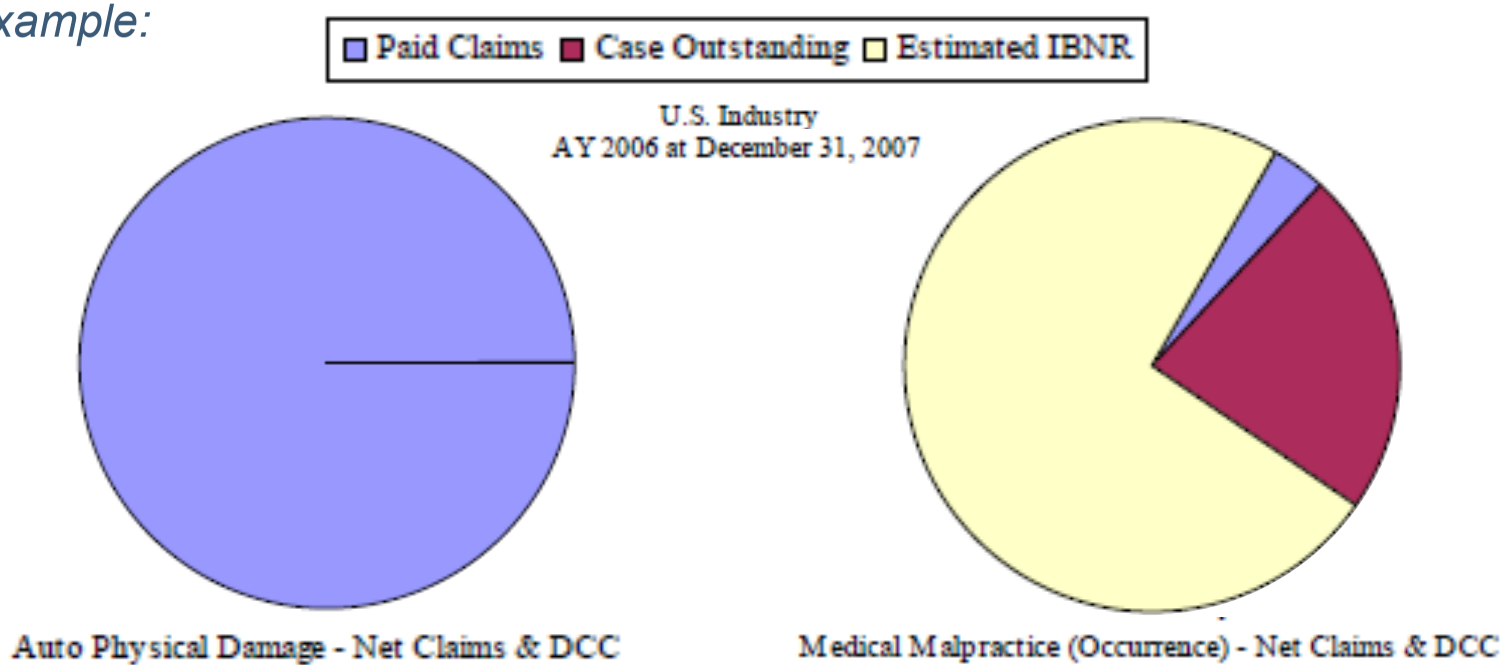
- Actuarial makes a recommendation on the Reserves to be held for each reserve line *(Reserve Indications)*
- The decision on what liabilities should be booked on the ledger lies with management
- The position is defined as the booked reserve minus the actuarial indicated reserve



Why Is Loss Reserving Difficult?

- Loss Reserves are an estimate of what will happen in the future – a future that for some lines of business extends decades

For example:



- Also…Implicit in any loss reserve estimate are assumptions regarding:
  - *Inflation*
  - *Technology*
  - *Longevity*
  - *Company operations*
  - *Legal and judicial environment*
  - *Regulatory climate*

The Reserve Call

Why Is Loss Reserving Difficult?

- Loss Reserves are an estimate of what will happen in the future – a future that for some lines of business extends decades

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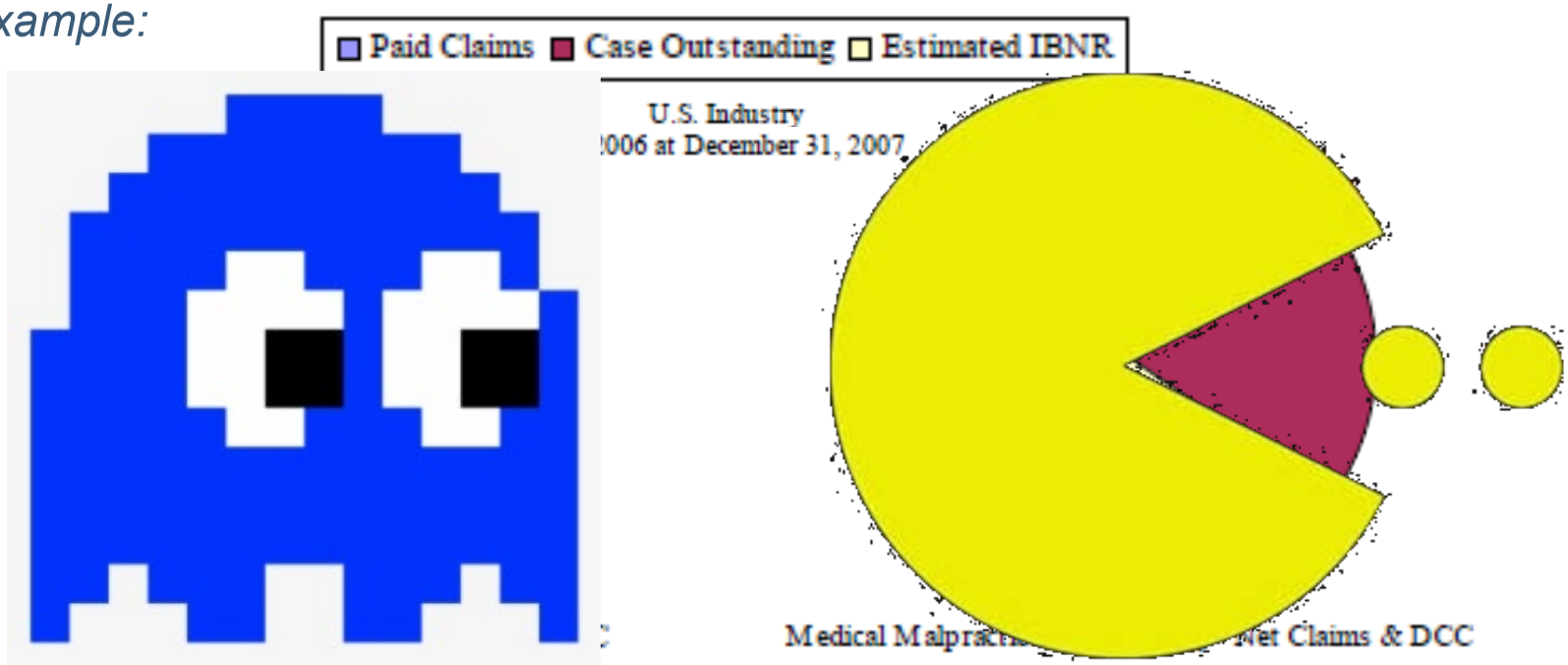

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  - *Inflation*
  - *Technology*
  - *Longevity*
  - *Company operations*
  - *Legal and judicial environment*
  - *Regulatory climate*

Actuarial Cycle

RESERVING

Ultimate Loss Projections for Prior AYs
- Reserve Ranges
- Reserving Diagnostics

Actual vs Estimate Loss Analysis
- Monitor period to period changes in AvE

PLANNING

PERFORMANCE ANALYSIS

INDICATIONS

Reserving Data

Reserving Data

Information Gathering

- Wiser's 4-phase approach to estimating unpaid claims?
    1. **Exploring the data**
        - **Key characteristics**
        - **Anomalies**
        - **Data Balancing to verified sources**
    2. Apply appropriate techniques for estimation
    3. Evaluating results
        - Reconcile conflicting results
        - Explain outcomes
    4. Monitoring projections
        - Comparing actual results to expected.

Sources of Data

- Internal
  - Large insurers
  - MIS systems with detailed claim data
- External
  - Small insurers
  - Insurers moving into a new product or a new area
  - Sources
    - ISO
    - NCCI
    - A.M. Best, etc.
  - Especially useful for tail factors, trend rates, ELRs, and reconciling the results of various methods

Reserving Data

Deciding Which Data to Use

- Homogeneity
  - Similarity of the data, product, losses

- Credibility
  - The predictive value given to a body of data
  - To increase credibility
    - *Increase homogeneity*
    - *….or increase volume*

      (but these two conflict with each other!!)

      - *If we divide the data into too many homogeneous groupings, there is a risk that the volume of data in the individual groups may become insufficient to perform a reliable analysis.*

Discussion

- Billy J Insurance Co. just launched an updated small commercial auto product. Losses have begun to be reported.
- To increase the credibility of their reserve analysis, Billy J Inc. should:
  - *A. Restrict the loss development analysis to only the small commercial auto policies.*
  - *B. Add in loss experience from large commercial accounts.*
  - *C. Add in loss experience from their personal auto policies.*
  - *D. Ignore their current data and leverage external sources to come up with their estimates.*

Reserving Data

Considerations for Separate Analyses *(homogeneity considerations)*

- Reporting patterns
- Claim development patterns
- Claim settlement patterns
- Frequency
- Severity
- Volume of claims
- Efficiency and time and resource requirements of performing separate analyses

Reserving Data

Types of Data:

Claims and Counts

- Incremental vs. Cumulative
- Paid vs. Reported vs. Case Outstanding
- Open vs. Closed
- Counts
  - *Open*
  - *Closed with payment*
  - *Closed with no payment*
  - *Reopened*

Reserving Data

Types of Data:

Large Claims

- Can distort some of the methods to estimate unpaid claims
- Often excluded during the analysis with a provision added back at the end
- Ways to define/Identify
  - *Volume of claims*
  - *Size relative to policy/reinsurance limits*
  - *Credibility of internal large claim data*
  - *External data availability*
- Different functions within a company may identify large claims differently

Claim related expenses

- ALAE vs ULAE
  - *How is each factored into the analysis?*
  - *Which is included with loss?*
  - *Which has to be evaluated separately?*

Reserving Data

Types of Data:

Recoveries

- Deductibles
  - *Treated differently in 1st party vs. 3rd party coverages*
- Salvage
- Subrogation
- Important for the actuary to know:
  - *Are recoveries tracked separately from claims?*
  - *Are claim payments recorded net of recoveries?*
  - *Is recovery data available?*

Reinsurance

- Analysis could be conducted for:
  - *Gross*
  - *Net*
  - *Ceded*
- Reinsurance collectability must be considered

Reserving Data

Types of Data:

Exposure Data

- Earned Premium is the most common
- Others
  - *Written premium*
  - *Number of policies*
  - *Policy limits in a region (Location, Occurrence, Aggregate, useful for CAT exposure)*
  - *Vehicles*
  - *Payroll*
- May want to on-level premium
- Self-insured entities exposures

Reserving Data

Data Verification

- ASOP data verification requirements
  - *Consistency with financial statement data*
  - *Consistency with prior data*
  - *Data reasonableness*
  - *Data definitions*

Reserving Data

Key Dates for a Claim

Accident Date/Occurrence Date – *the date the loss occurred*

Report Date – *the date that the insured reports the claim to the insurer*

Claim Create Date – *the date that the handler enters the claim information into our data systems*

Transaction Date – *date where a financial transaction is made on a claim*

Settlement Date/Closed Date – *the date that final payment has been sent to the insured for a claim and the case reserve is set to 0*

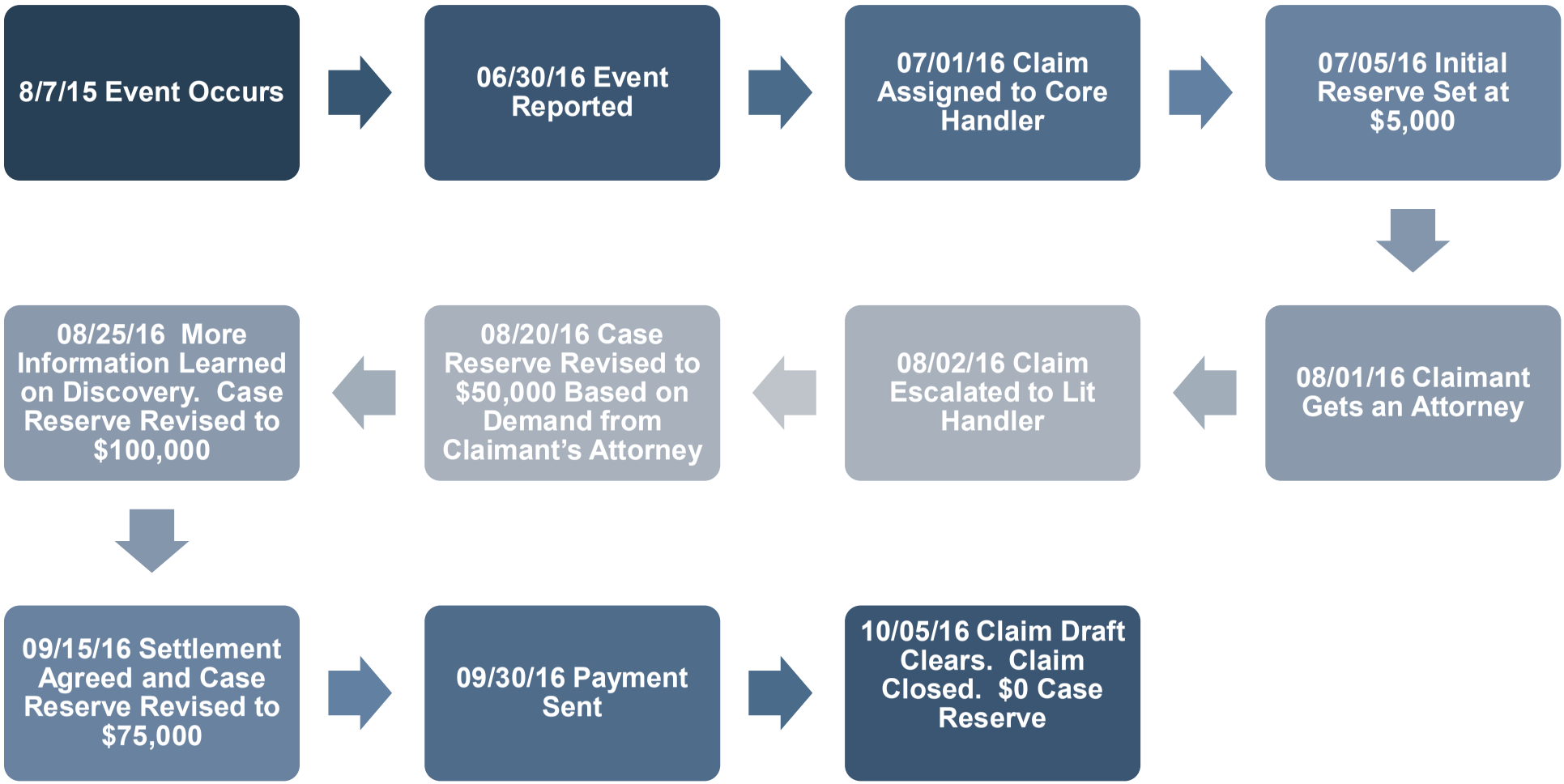
Reopened Date – *the date when a claim has been reopened*

Policy Effective Date – *The date that a policy goes into effect. Beginning of the coverage period.*

Policy Expiration Date – *The date that the policy became no longer effective. Ending of the coverage period.*

Discussion

Identify the Key Dates for the following claim:



Data Aggregation

Data Aggregation

Calendar Year

- Transactional Data
- Used in financial statements
- Used for aggregation of exposures and diagnostic testing with accident year claim data
- Advantages:
  - *No future development*
  - *Readily available*
- Disadvantages:
  - *Cannot address development*

Example:

Calendar year 2015 reported claims =

2015 paid claims + (2015 ending case o/s - 2015 beginning case o/s)

Data Aggregation

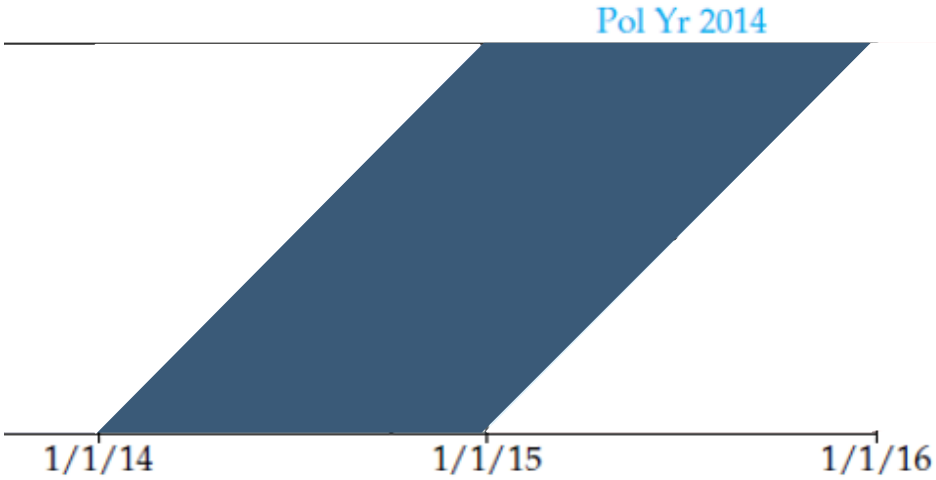
Accident Year

- Date of occurrence data
- Accident year, quarter, or month
- Which exposures are best used with accident year claims?
- Advantages:
  - *Easy to group and easy to understand*
  - *Shorter time to fully develop than policy year*
  - *Numerous industry benchmarks*
  - *Useful for economic changes or major claim events*
- Disadvantages:
  - *Potential mismatch between claims and exposures*

Data Aggregation

Policy Year

- Claims identified by the year the policy was written
- Claims occur over 24 months for 12-month policies



- Advantages:
  - *Direct match of exposures and claims*
  - *Useful for underwriting or pricing changes*
- Disadvantages:
  - *Long lag*
  - *Difficult to isolate single large events (CAT, court ruling)*

Data Aggregation

Report Year

- Grouped based on report date to the insurer
- Important for claims-made coverages
- Used for the ultimate value of known claims or adequacy of case outstanding over time
- Advantages:
  - *# of claims fixed at the end of the year*
  - *More stable data and thus, development patterns*
- Disadvantages:
  - *No provision for pure IBNR*
  - *Must use other methods to derive pure IBNR (the more difficult piece of unpaid claims to estimate)*

Practice

Find the following using the claim detail from the table below:

Note: Policy A was written on 7/1/2009 & Policy C was written on 7/1/2010

- *AY 2010 reported (incurred) claims @ 12/31/2010*
- *AY 2010 reported (incurred) claims @ 12/31/2011*
- *CY 2011 reported (incurred) claims*
- *PY 2009 reported (incurred) claims @ 12/31/2009*
- *PY 2010 reported (incurred) claims @ 12/31/2011*

Note that this is the Case Reserve as of the transaction date

Policy	Claim Number	Accident Date	Report Date	Transaction Date	Claim Status	Claim Chars	Loss Payment	Case Reserve
A	1	01/10/10	01/15/10	01/15/10	Open	…	$ -	$10,000
A	1	01/10/10	01/15/10	03/01/10	Open	…	$1,000	$9,000
A	1	01/10/10	01/15/10	05/01/10	Closed	…	$9,000	$ -
C	2	10/01/10	10/15/10	10/15/10	Open	…	$ -	$18,000
C	2	10/01/10	10/15/10	12/15/10	Open	…	$2,000	$17,000
C	2	10/01/10	10/15/10	03/01/11	Open	…	$7,000	$15,000
C	2	10/01/10	10/15/10	03/01/12	Closed	…	$15,000	$ -
C	3	02/01/11	02/15/11	02/15/11	Open	…	$ -	$15,000
C	3	02/01/11	02/15/11	12/01/11	Closed	…	$ -	$ -

Practice - *Answers*

Find the following using the claim detail from the table below:

Note: Policy A was written on 7/1/2009 & Policy C was written on 7/1/2010

- *AY 2010 reported (incurred) claims @ 12/31/2010* = *(1+9+2) + (0+17)* = ***$29K***
- *AY 2010 reported (incurred) claims @ 12/31/2011* = *(1+9+2 + 7) + (0+15)* = ***$34K***
- *CY 2011 reported (incurred) claims* = *(7+0+0) + (15-17 + 0-0)* = ***$5K***
- *PY 2009 reported (incurred) claims @ 12/31/2009* = ***$0***
- *PY 2010 reported (incurred) claims @ 12/31/2011* = *(2+7+0+0) + (15+0)* = ***$24K***

Policy	Claim Number	Accident Date	Report Date	Transaction Date	Claim Status	Claim Chars	Loss Payment	Case Reserve
A	1	01/10/10	01/15/10	01/15/10	Open	…	$ -	$10,000
A	1	01/10/10	01/15/10	03/01/10	Open	…	$1,000	$9,000
A	1	01/10/10	01/15/10	05/01/10	Closed	…	$9,000	$ -
C	2	10/01/10	10/15/10	10/15/10	Open	…	$ -	$18,000
C	2	10/01/10	10/15/10	12/15/10	Open	…	$2,000	$17,000
C	2	10/01/10	10/15/10	03/01/11	Open	…	$7,000	$15,000
C	2	10/01/10	10/15/10	03/01/12	Closed	…	$15,000	$ -
C	3	02/01/11	02/15/11	02/15/11	Open	…	$ -	$15,000
C	3	02/01/11	02/15/11	12/01/11	Closed		$ -	$ -

Practice

Given the following claim activity on an annual policy effective 12/29/2006:

Claim Number	Transaction Date	Incremental Payment	Case Reserve as of Transaction Date	Transaction Description
1	December 31, 2006			Claim occurred
1	December 31, 2006		$1,000	Claim reported and reserve established
1	October 5, 2007		$10,000	Case reserve increased
1	July 5, 2008		$25,000	Case reserve increased
1	January 25, 2009	$30,000	$0	Settlement made, Payment made, Claim closed
2	April 1, 2007			Claim occurred
2	April 5, 2007		$25,000	Claim reported and reserve established
2	July 1, 2008		$0	Claim closed without payment

- Calculate 2008 CY reported losses
- Calculate 2006 AY reported losses evaluated as of 12/31/2007
- Calculate 2006 PY reported losses evaluated as of 12/31/2007

Practice - *Answers*

Given the following claim activity on an annual policy effective 12/29/2006:

Claim Number	Transaction Date	Incremental Payment	Case Reserve as of Transaction Date	Transaction Description
1	December 31, 2006			Claim occurred
1	December 31, 2006		$1,000	Claim reported and reserve established
1	October 5, 2007		$10,000	Case reserve increased
1	July 5, 2008		$25,000	Case reserve increased
1	January 25, 2009	$30,000	$0	Settlement made, Payment made, Claim closed
2	April 1, 2007			Claim occurred
2	April 5, 2007		$25,000	Claim reported and reserve established
2	July 1, 2008		$0	Claim closed without payment

- Calculate 2008 CY reported losses *0 + (25,000 – 10,000)+ (0 – 25,000) = -$10K*
- Calculate 2006 AY reported losses evaluated as of 12/31/2007 *0 + 10K = $10K*
- Calculate 2006 PY reported losses evaluated as of 12/31/2007 *0+10K+25K=$35K*

Data Aggregation

Development triangle

Table that shows changes in value of various cohorts over time

- Use to estimate many different values
  - *reported claims*
  - *paid claims*
  - *claim-related expenses*
  - *reported claim counts*
- One of most common tools that actuaries use to organize data in order to identify and analyze patterns in historical data

Development - change in value for the cohort over time

- Actuaries interested in the *typical* development
- Look at the age (or maturity) of the cohort
  - *Generally measure in terms of time from start of cohort*
    e.g. AY 2008 eval'd at 12/31/2008 is at 12 months
- Development can be positive or negative

Data Aggregation

Triangle Structure *(P&C Customary Format)*

- Rows – experience period *(e.g. AY)*
  - *Can also be PY or RY*
- Columns – age or maturity *("as of" dates)*
- Diagonals – valuation date *(e.g. CY)*

Table 3 – Reported Claim Triangle

Accident Year	Reported Claims as of (months) 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			

AY

CY

Development Year (DY)

Practice

Using the data below, construct the following:

- *An AYxDY incremental paid triangle*
- *An AYxDY cumulative paid triangle*
- *An AYxDY case outstanding triangle*

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								

Practice - *Answer*

Construct an AYxDY incremental paid triangle:

Table 7 – Incremental Paid Claim Triangle

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

Practice - *Answer*

Construct an AYxDY cumulative paid triangle:

Table 8 – Cumulative Paid Claim Triangle

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

Practice - *Answer*

Construct an AYxDY case outstanding triangle:

Table 10 – Case Outstanding Triangle

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

Practice

- *Using the triangles just created, construct an AYxDY cumulative reported (incurred) triangle*
- *Using the data below, construct an AYxDY cumulative reported (incurred) claim counts triangle*

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
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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								

Practice - *Answer*

Construct an AYxDY cumulative reported (incurred) triangle:

Table 11 – Reported Claim Development Triangle

Accident Year	Reported Claims as of (months)			
	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			

- What was the IBNR for AY 2005 on 12/31/2006?
  (assume no development past 48 months)

Practice - *Answer*

Construct an AYxDY cumulative reported (incurred) claim count triangle:

Table 12 – Reported Claim Count Development Triangle

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

- What will be the final claim count for AY 2008?

Data Aggregation

Other Structures

- Other time intervals besides Accident Date
  - *Report year - used for analysis of claims-made coverages*
  - *Underwriting year - often used by reinsurers*
  - *Treaty year - period of 12 months covered by a reinsurance treaty or contract*
  - *Policy year - similar to underwriting year*

- Other time intervals besides yearly
  - *Quarterly, Monthly, Semi-annually*
  - *Considerations: Credibility and stability*

Data Aggregation

Follow-the-Code vs Current Coding

- Coding on claims can change over time
  - *In workers comp, benefits are medical and lost wages. A claim can start out as a medical-only claim. If the claimant later misses work due to the injury, the coding on the medical portion can change to lost time-medical.*
  - *An injury may be evaluated and coded correctly early on. If the injury becomes more complex, the coding may change over time.*
- When aggregating data into triangles, the question then arises about how to group the claims
- Follow-the-Code assigns the transaction (loss payment, reserve increase, etc.) to the coding at the time of the transaction
- Current Coding restates the history to the current codes used for the claim

Triangle Diagnostics

Types of Data Used in Triangles

- Common types
  - *Reported claims*
  - *Case outstanding*
  - *Cumulative total paid claims*
  - *Cumulative paid claims on closed claim counts*
    - *note: values may be problematic to obtain where partial payments present*
  - *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*

Triangle Diagnostics

Types of Adjusted Data Used in Triangles

- Triangles of ratios and average claim values *(provide insight into the relationships between data at various points in time)*
  - *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*
  - *Average case outstanding (case outstanding / outstanding claim counts)*
  - *Average paid on closed claims (cumulative paid on closed claims / closed with pay)*
  - *Average paid (cumulative total paid claims / total closed claim counts)*
  - *Average reported (reported claims / reported claim counts)*

Triangle Diagnostics

Understanding the Environment

- The actuary does not work in a vacuum
- The actuary must understand:
  - *the specific circumstances of the insurer's organization*
  - *Economic, social, legal and regulatory environments that will also affect the liability*
- Without a sound understanding of the environment, the actuary may not correctly interpret patterns and changes in the data.

How does the Actuary Gain Insight?

- The collection of data occurs in various ways
  - *Formal meetings*
  - *Informal conversations*
- All aspects of the operation are relevant
  - *Claims Executives*
  - *Underwriting Executives*
  - *Data Processing (IT)*
  - *Actuarial Partners*
  - *Economic / Legal Environment*

Triangle Diagnostics

Understanding the Environment *- An Iterative (and Continuous) Process*

- Initial conversations will set the stage for the actuary's analysis
- A review of the data may trigger specific questions concerning issues that manifest themselves in the data

- Meetings with management give the actuary an understanding of the environment and what may be expected when the data is reviewed
- A review of the data allows the actuary to affirm significant changes or to begin a further dialogue with management if the expectations are not evident in the data.
- This open dialogue gives the actuary a better framework within which to select techniques are that appropriate to the specific situation.

Triangle Diagnostics

Understanding the Environment *- An Iterative (and Continuous) Process*

Meeting with Claims Leadership:

- Specific objectives and guidelines for setting case reserves? (Current facts, inflation, LAE?)
- Any changes in the guidelines over the last five – seven years?
- Qualifications/experience of claims professionals and authority levels?
- Average caseload (and how it has changed)
- Trends in types of claims coming in
- When, in the life of a claim, is a claim file established?
- What are procedures for accidents with multiple claimants/coverages?
  - Is a claim file established for each claimant?
  - Is a claim file established for each coverage or for all coverages combined?
- Special procedures/reviews for large or catastrophic claims?

Triangle Diagnostics

Understanding the Environment *- An Iterative (and Continuous) Process*

Meeting with Claims Leadership:

- Procedures for reopened claims?
  - Original date of report or date of reopening?
  - How do you think reopening affect aggregate data for paid, open or reported claims, etc. Any changes in the guidelines over the last five – seven years?
- Management of legal expenses?
  - Who makes the decision to involve lawyers?
  - How are legal fees managed and paid?
- Periodic re-evaluation of claims
  - Systematic checks of adjuster actions?
  - Changes in the guidance?
- Fraudulent claims – Special Procedures?
- Performance Expectations - Metrics

Triangle Diagnostics

Understanding the Environment *- An Iterative (and Continuous) Process*

Meeting with Claims Leadership:

- Guidelines for closing claims?
  - At what limit are additional reviews required?
  - Changes in settlement rate? Causes?
- Shift from company adjusters to independent adjusters – or vice versa? Affect on operations?
- Claims call centers / office consolidations
- Results of recent claims audits (internal and external)
- Independent reviews of the claims department
- Use of tabular/formula reserves (frequency of review/revision)

Triangle Diagnostics

Understanding the Environment *- An Iterative (and Continuous) Process*

Meeting with Underwriting Leadership:

- Significant changes in the company's book of business and mix (5 – 7 year horizon)
- Any large risks that are not characteristic of the general book?
- Changes in Underwriting guidelines?
- Portion of the business attributable to excess coverages (and large deductibles). Distribution of business by line, retention limit, class, etc.
- New products or adjustments to existing products?

Triangle Diagnostics

Understanding the Environment *- An Iterative (and Continuous) Process*

Meeting with IT (Data Processing) Leadership:

- New data processing systems? How do you measure impact on rate of closing or length of time required from reporting to recording of claim?
- Changes in coding procedures?
- What data elements are available by claim/risk?
- By what criteria could historical claims by recompiled? (size of loss, type of claim, policy limit, deductible, state)
- To what extent is data audited and balanced?

Triangle Diagnostics

Understanding the Environment *- An Iterative (and Continuous) Process*

Meeting with Actuarial Partners (e.g. Product Management):

- Any changes in company operations or procedures that have caused you to depart from standard ratemaking techniques?
- What data is used?
- Have you seen shifts in the composition of business by type of risk or type of claim?
- What sources do you use to evaluate
  - External economic indices
  - Changes in state laws
  - Industry experience
  - Size of loss or cause of loss analyses

Triangle Diagnostics

Understanding the Environment *- An Iterative (and Continuous) Process*

Meeting with Actuarial Partners (e.g. Product Management):

- How are new products priced?
- Are you involved in decisions regarding new strategic initiatives?
- Changes in statutes, court decisions, extent of coverage that need to be considered in the rate analysis?
- Rate adequacy analyses/ rate changes

Triangle Diagnostics

Understanding the Environment *- An Iterative (and Continuous) Process*

Understanding the Economic & Legal Environment:

- Key econometrics?
  - Medical costs
  - Construction costs
  - Cost of tangible goods

- Legal changes?
  - New court rulings
  - Tort reform measures
  - Attorney involvement

Triangle Diagnostics

Example:

- Company XYZ writes private passenger automobile liability in a single state.
- Management tells us:
  - Significant changes in the claims operation
    - *New leadership*
    - *Strengthened case reserving (earlier recognition of ultimate values for claims that are reported)*
    - *New claims information system in the past three years*
    - *Speeded up claim reporting and settlement processes*
  - Legislative changes
    - *Tort reform (in 2016) resulting in caps on awards*
    - *Pricing restrictions and mandated rate level changes*
  - Company reducing its presence in the market.

How Might These Changes Manifest?

- *Earned Premium*
- *Exposures*
- *Reported Claims*
- *Paid Claims*
- *Reported Claim Counts*
- *Paid Claim Counts*
- *Average Case Outstanding*
- *Ratio of Paid Claim Count to Reported Claim Count*

Triangle Diagnostics

Earned Premium

Calendar Year	Earned Premium ($000)	Change
2012	61,183	
2013	69,175	13.1%
2014	99,322	43.6%
2015	138,151	39.1%
2016	107,578	-22.1%
2017	62,438	-42.0%
2018	47,797	-23.4%

- *Decline in Earned Premium for CY 2017 and 2018 support management's assertion that it is reducing its presence in the market*
- *BUT, there were mandated rate decreases for 2016 – 2018*
- *Are the premium declines indicative of a change in exposures?*
- *We might want to ask for effective rate changes (and indications)*

Triangle Diagnostics

Exposures

Calendar Year	Earned Premium ($000)	Rate Changes	Cumulative Average Rate Level	Annual Exposure Change
2012	61,183			
2013	69,175	5.0%	5.0%	7.7%
2014	99,322	7.5%	12.9%	33.6%
2015	138,151	15.0%	29.8%	21.0%
2016	107,578	10.0%	42.8%	-29.2%
2017	62,438	-20.0%	14.2%	-27.5%
2018	47,797	-20.0%	-8.6%	-4.3%

- *Are the 20% decreases "real" or are they mandated decreases? If so, the reduction in exposures will be not quite as dramatic.*

Triangle Diagnostics

Reported *(Incurred)* ***Claims***

Reported Claims ($000) as of (months)							
Accident Year	**12**	**24**	**36**	**48**	**60**	**72**	**84**
2012	12,811	20,370	26,656	37,667	44,414	48,701	48,169
2013	9,651	16,995	30,354	40,594	44,231	44,373	
2014	16,995	40,180	58,866	70,707	70,288		
2015	28,674	47,432	70,340	70,655			
2016	27,066	46,783	48,804				
2017	19,477	31,732					
2018	18,632						

- *What happened in AY 2013 for 12 & 24 month developments?*
- *What happened in AY 2014 from 36 months + ?*
- *Why so high at 12 months for AY 2015 & 2016?*
- *Why does it decrease so much for AY 2017 & 2018?*

Triangle Diagnostics

Paid Claims

Paid Claims ($000) as of (months)							
Accident Year	12	24	36	48	60	72	84
2012	2,318	7,932	13,822	22,095	31,945	40,629	44,437
2013	1,743	6,240	12,683	22,892	34,505	39,320	
2014	2,221	9,898	25,950	43,439	52,811		
2015	3,043	12,219	27,073	40,026			
2016	3,531	11,778	22,819				
2017	3,529	11,865					
2018	3,409						

- *Seeing similar patterns to the Reported Claims triangle, except AY 2017 & 2018 do not go back down (maybe something to do with Case Reserves for those years?).*

Triangle Diagnostics

Ratio of Paid Claims to Reported Claims

Accident Year	Ratio of Paid Claims-to-Reported Claims as of (months)						
	12	24	36	48	60	72	84
2012	0.181	0.389	0.519	0.587	0.719	0.834	0.923
2013	0.181	0.367	0.418	0.564	0.780	0.886	
2014	0.131	0.246	0.441	0.614	0.751		
2015	0.106	0.258	0.385	0.566			
2016	0.130	0.252	0.468				
2017	0.181	0.374					
2018	0.183						

- *AY 2014 – 2016 appear lower than the other years, particularly @ 12 and 24*
- *Difficult to see a real trend (2017 & 2018 appear to have returned to historical)*
- *What trends underlie the results?*
- *Are claims being paid faster (change in settlement?)*
- *Are case outstanding amounts closer to ultimate?*
- *Is it a combination of the two factors? (both numerator and denominator affected)*

Triangle Diagnostics

Claim Counts

- Consider reported claim counts (all other things being equal, they should follow the underlying exposure trends)
- Now consider closed claim counts
  - *First, understand the company process for counting*
  - *How does the company record claims closed without payment?*
    - *Are they excluded from the triangles?*
    - *What happens to the claim that has no loss payment but that has legal fees?*

Triangle Diagnostics

Evaluating Speedup of Claim Settlement

Ratio of Closed-to-Reported Claim Counts

Accident Year	12	24	36	48	60	72	84
2012	0.151 →	0.401	0.543	0.699	0.857	0.943	0.980
2013	0.132 →	0.380	0.577	0.777	0.925	0.963	
2014	0.122 →	0.391	0.645	0.823	0.899		
2015	0.143 →	0.488	0.703	0.814			
2016	0.208 →	0.551	0.725				
2017	0.276 →	0.626					
2018	0.266						

- *Clear speedup in claims payments, particularly for the earlier development periods*
- *Not so evident in the later development periods. WHY?*

Triangle Diagnostics

Considerations

- In any scenario, the easier (and less costly) claims will be paid first
- If there is a change in claims settlement, then the more difficult claims are being paid earlier.
- How would that affect the average paid claim development triangle? The average reported claim triangle?
- Has there been a change in the type of claim that is being closed at each age?

Triangle Diagnostics

Average Definitions

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	$\frac{\text{Reported claim triangle} - \text{paid claim triangle}}{\text{Reported claim count triangle} - \text{closed claim count triangle}}$

This calculated triangle will help us investigate Case Reserve Strengthening

Triangle Diagnostics

Is There Case Reserve Strengthening?

Accident Year	Average Case Outstanding as of (months) 12	24	36	48	60	72	84
2012	9,213	13,714	18,151	33,273	56,167	91,729	120,366
2013	6,634	10,733	25,647	48,766	79,718	82,826	
2014	8,706	22,941	41,561	71,204	76,320		
2015	14,464	29,994	61,547	69,893			
2016	20,185	47,368	56,984				
2017	18,480	42,002					
2018	20,031						

- *There appears to be Case Reserve strengthening for the latest 3 Calendar Years*

Triangle Diagnostics

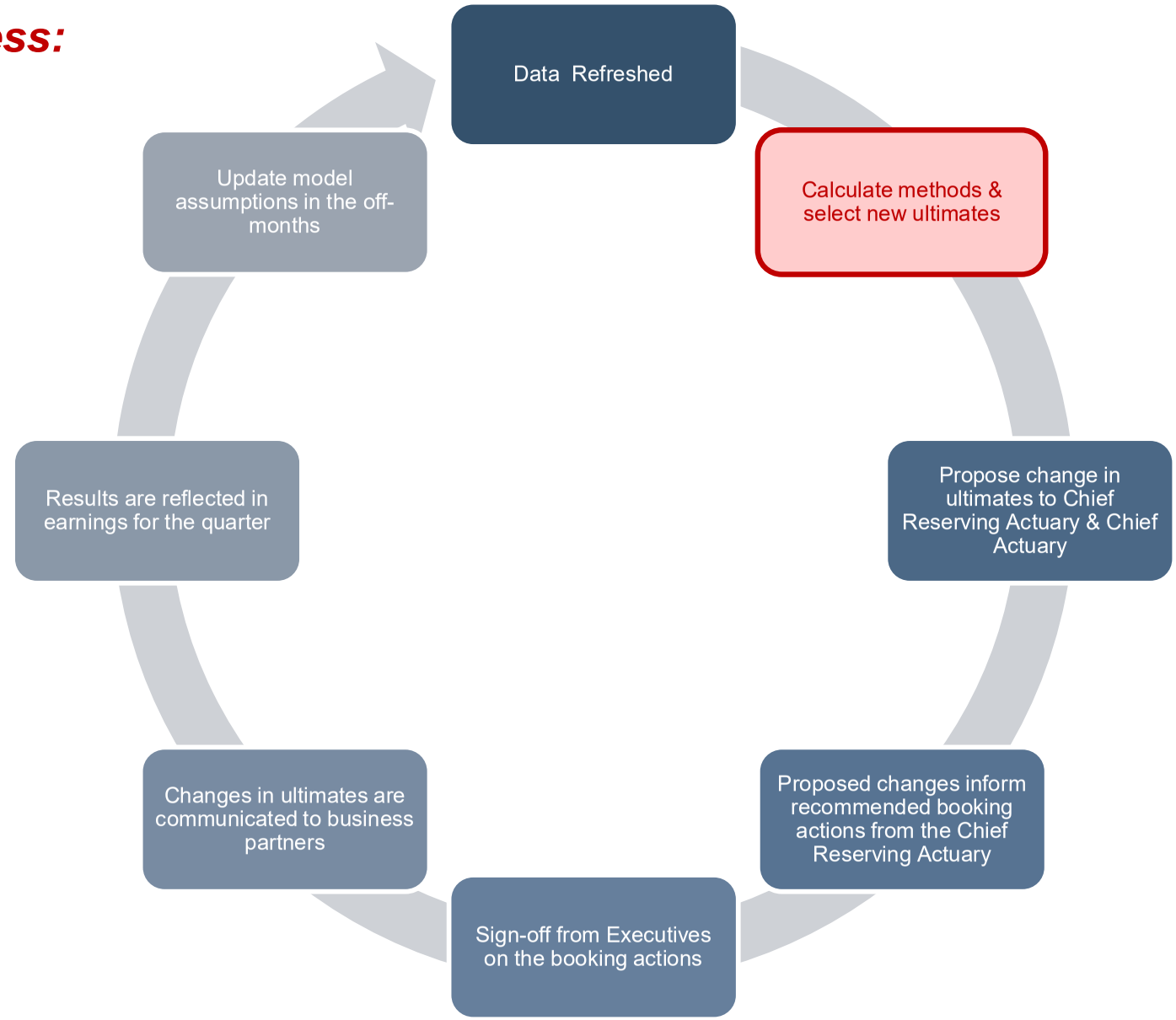
Summary of example:

- XYZ has experienced change over the past several years
- Management has communicated the changes and every claim development diagnostic shows that that changes are evident in the data.
- These changes should be considered in the actuary's choice of:
  - *estimation techniques*
  - *types of data*
  - *actuarial factors within the data*

Common Methods

The Reserve Call

The Process:



Common Methods

- Development Technique
- Expected Claims Technique
- Bornheutter-Ferguson
- Benktander (Iterative B-F)
- Cape Cod
- Frequency Severity
  - *Simple Development Method*
  - *Exposure Method*
  - *Disposal Rate Method*
- Case Outstanding
  - *Incremental Paid to Case O/S*
  - *Industry LDFs*
- Berquist Sherman Adjustments
  - *Case Reserve Adequacy Changes*
  - *Settlement Rate Changes*

Common Methods

Examples: *Changing Environment – Loss Ratios and Case O/S Adequacy*

- Scenario 1: Steady State Environment

  Loss ratios are stable and there are no changes from historical levels of case outstanding strength

- Scenario 2: Loss Ratios Up with Case O/S Strength Steady

  Increasing loss ratios and no change in case outstanding strength

- Scenario 3: Stable Loss Ratios with Increasing Case O/S Strength

  Stable loss ratios with an increase in case outstanding strength

- Scenario 4: Increasing Loss Ratios with Increasing Case Outstanding Strength

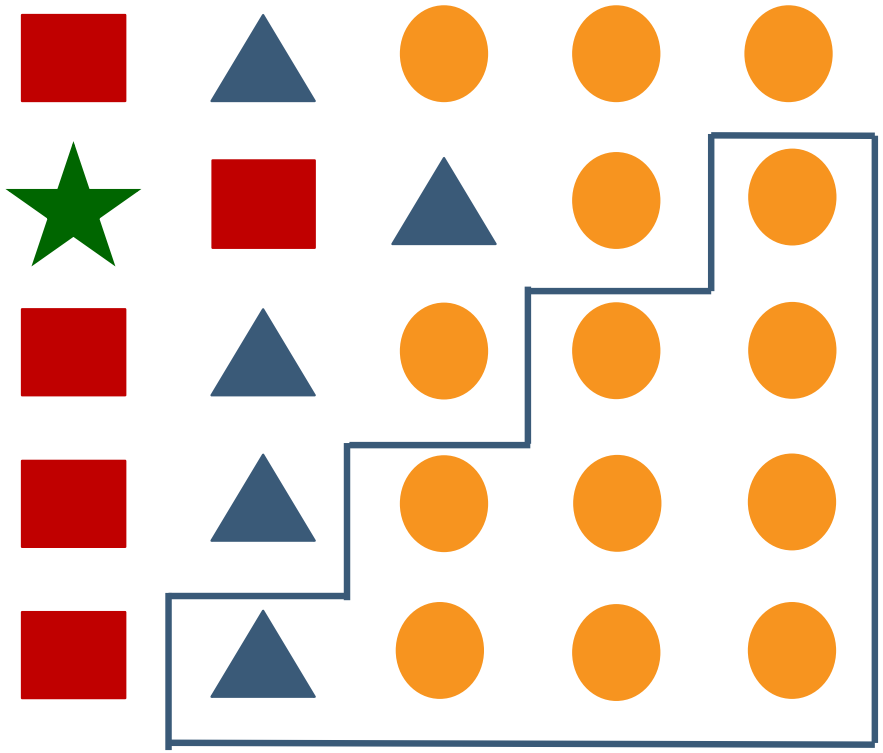
  Increases in both loss ratios and case outstanding strength

- Mix of Personal Auto and Commercial Auto is changing

  A portfolio of business in which we combine Personal and Commercial Auto for estimating claims.

Common Methods:
The Development Technique

Common Methods ~ *The Development Technique*



Common Methods ~ *The Development Technique*

- Also known as the "*chain-ladder*" technique
- One of the most frequently used methods

Key Assumptions

- **Future claims' development is similar to prior years' development**

  Claims recorded to date will continue to develop in a similar manner in the future (Past is indicative of the future)
  Relative change in a given year's claims from one evaluation to next is similar to the relative change in prior years' claims at similar evaluation points

- **Implicitly assumes claims observed for an immature AY tell you something about claims yet to be observed**

  This is not assumed in the expected claims technique, BF, or Cape Cod

- **Other important assumptions**
  - *Consistent claims processing*
  - *Stable mix of claims types*
  - *Stable policy limits*
  - *Stable reinsurance retention limits throughout experience period*

Common Methods ~ *The Development Technique*

Mechanics

- Step 1 – Compile claims data in a development triangle
- Step 2 – Calculate age-to-age factors *(link ratios)*
- Step 3 – Calculate averages of the age-to-age factors
- Step 4 – Select loss development factors *(LDFs)*
- Step 5 – Select tail factor
- Step 6 – Calculate cumulative loss development factors *(CDFs)*
- Step 7 – Project ultimate claims

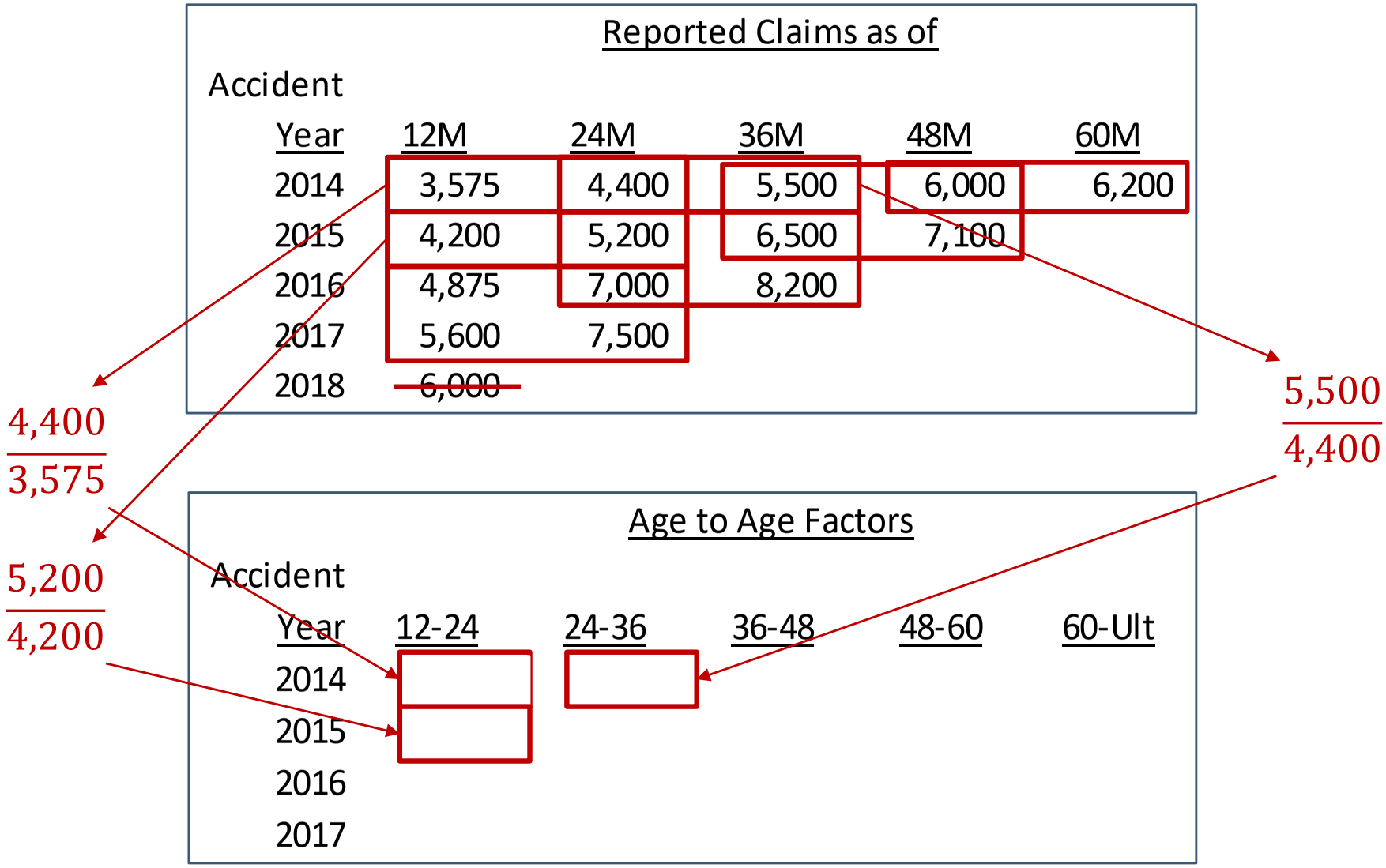
Common Methods ~ *The Development Technique*

Step 1 – Compile claims data in a development triangle *(we did this yesterday…)*

	Reported Claims as of *(cumulative)*				
Accident Year	12M	24M	36M	48M	60M
2014	3,575	4,400	5,500	6,000	6,200
2015	4,200	5,200	6,500	7,100	
2016	4,875	7,000	8,200		
2017	5,600	7,500			
2018	6,000				

Common Methods ~ *The Development Technique*

Step 2 – Calculate age-to-age factors (link ratios)



Common Methods ~ *The Development Technique*

Step 3 – Calculate averages of the age-to-age factors

	Age to Age Factors				
Accident Year	12-24	24-36	36-48	48-60	60-Ult
2014	1.23	1.25	1.09	1.03	
2015	1.24	1.25	1.09		
2016	1.44	1.17			
2017	1.34				
Average	1.31	1.22	1.09	1.03	
Avr xHiLow	1.29	1.25	1.09	1.03	
Avr 2yr	1.39	1.21	1.09	1.03	

Common Methods ~ *The Development Technique*

Step 3 – Calculate averages of the age-to-age factors

- Simple Average – *arithmetic mean, which years to use*
- Medial Average – *xHiLo*
- Volume Weighted Average
  - *Use prior claims at earlier valuations as weights*
  - *Sum of claims at later valuation divided by sum of claims at earlier valuation*
  - *This is the quickest way using a calculator, but risky, as you could end up using a wild year (one where development is markedly different)*
- Geometric mean/average
- Note: Stability vs. Responsiveness
  - *Most recent experience most likely reflects the effect of latest changes in environment*
  - *Greater number of experience periods increases stability*

Common Methods ~ *The Development Technique*

	Reported Claims as of				
Accident Year	12M	24M	36M	48M	60M
2014	3,575	4,400	5,500	6,000	6,200
2015	4,200	5,200	6,500	7,100	
2016	4,875	7,000	8,200		
2017	5,600	7,500			
2018	6,000				

- Simple Average

$$12\text{to}24 = \left(\frac{4{,}400}{3{,}575} + \frac{5{,}200}{4{,}200} + \frac{7{,}000}{4{,}875} + \frac{7{,}500}{5{,}600}\right) / 4 = 1.31$$

- Volume Weighted Average

$$12\text{to}24 = \frac{(4{,}400 + 5{,}200 + 7{,}000 + 7{,}500)}{(3{,}575 + 4{,}200 + 4{,}875 + 5{,}600)} = 1.32$$

Common Methods ~ *The Development Technique*

Age to Age Factors					
Accident Year	12-24	24-36	36-48	48-60	60-Ult
2014	1.23	1.25	1.09	1.03	
2015	1.24	1.25	1.09		
2016	1.44	1.17			
2017	1.34				

- Simple Average

  12to24 = (1.23 + 1.24 + 1.44 + 1.34) / 4 = 1.31

- Medial Average *(xHiLo)*

  12to24 = (~~1.23~~ + 1.24 + ~~1.44~~ + 1.34) / 2 = 1.29

- Geometric mean/average

  12to24 = (1.23 * 1.24 * 1.44 * 1.34) ^ $\frac{1}{4}$ = 1.31

Step 4 – Select loss development factors (LDFs)

	Age to Age Factors				
Accident Year	12-24	24-36	36-48	48-60	60-Ult
2014	1.23	1.25	1.09	1.03	
2015	1.24	1.25	1.09		
2016	1.44	1.17			
2017	1.34				
Average	1.31	1.22	1.09	1.03	
Avr xHiLow	1.29	1.25	1.09	1.03	
Avr 2yr	1.39	1.21	1.09	1.03	
Selected	1.31	1.22	1.09	1.03	

Step 4 – Select loss development factors (LDFs)

When selecting dev factors, review experience for following characteristics:

- Smooth progression of age-to-age factors across development periods - Ideally, pattern should steadily decrease with age
- Stability of age-to-age factors for the same development period
  Greatest variability in age-to-age factors at earlier ages
- Credibility of experience
  If limited due to claims volume, organizational changes or other factors, may be necessary to use benchmarks
- Changes in patterns
  Systematic patterns may suggest changes in internal operations or external environment
- Applicability of historical experience
  Based on qualitative info regarding changes in book or business and operations
- Also consider effect of external changes not in the data

Step 5 – Select tail factor

Accident Year	Age to Age Factors 12-24	24-36	36-48	48-60	60-Ult
2014	1.23	1.25	1.09	1.03	
2015	1.24	1.25	1.09		
2016	1.44	1.17			
2017	1.34				
Average	1.31	1.22	1.09	1.03	
Avr xHiLow	1.29	1.25	1.09	1.03	
Avr 2yr	1.39	1.21	1.09	1.03	
Selected	1.31	1.22	1.09	1.03	60-Ult 1.01

Common Methods ~ *The Development Technique*

Step 5 – Select tail factor

- When data is available, should analyze development out to point where ceases
  Number of periods varies by line, jurisdiction, and data type
- Sometimes most mature development period in data has factors greater than 1.0
  Actuary will need to determine tail factor
- Tail factor can be difficult to select due to limited availability of relevant data
  Some med mal and WC claims take more than 15 years to reach final settlement
- Tail factor is crucial because it affects unpaid estimate for all accident years
  Can create disproportionate leverage on the total estimated unpaid claims
- Tail factor plays an important role in almost every technique to estimate unpaid claims

Several approaches

(1) Use industry benchmark development factors

(2) Fit a curve to selected or observed development factors and extrapolate
- *Exponential decay is a common assumption*

(3) For paid development when reported development is considered at ultimate, use reported-to-paid ratios at the latest observed paid development period

Step 6 – Calculate cumulative loss development factors (CDFs)

	Age to Age Factors				
Accident Year	12-24	24-36	36-48	48-60	60-Ult
2014	1.23	1.25	1.09	1.03	
2015	1.24	1.25	1.09		
2016	1.44	1.17			
2017	1.34				
Average	1.31	1.22	1.09	1.03	
Avr xHiLow	1.29	1.25	1.09	1.03	
Avr 2yr	1.39	1.21	1.09	1.03	
Selected Age-to-Ult CDF	1.31	1.22	1.09	1.03	1.01

*1.31 * 1.22 * 1.09 * 1.03 * 1.01*

*12-Ultimate = 12-24 * 24-36 * 36-48 * 48-60 * 60-Ult*

Common Methods ~ *The Development Technique*

Step 7 – Project ultimate claims

Accident Year	Reported Claims as of *(cumulative)* 12M	24M	36M	48M	60M	Projected Ultimates
2014	3,575	4,400	5,500	6,000	6,200	*6,262*
2015	4,200	5,200	6,500	7,100		*7,384*
2016	4,875	7,000	8,200			*9,266*
2017	5,600	7,500				*10,350*
2018	6,000					*10,860*

	12-Ult	24-Ult	36-Ult	48-Ult	60-Ult
Age-to-Ult CDF	1.81	1.38	1.13	1.04	1.01

*6,200 * 1.01 = 6,262*

*7,100 * 1.04 = 7,384*

Common Methods ~ *The Development Technique*

Step 7 – Project ultimate claims

	Reported Claims as of *(cumulative)*					
Accident Year	12M	24M	36M	48M	60M	Projected Ultimates
2014	3,575	4,400	5,500	6,000	6,200	*6,262*
2015	4,200	5,200	6,500	7,100		*7,384*
2016	4,875	7,000	8,200			*9,266*
2017	5,600	7,500				*10,350*
2018	6,000					*10,860*

AY 2014 IBNR = *6,262 – 6,200 =* ***62***

AY 2015 IBNR = *7,384 – 7,100 =* ***284***

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AY 2018 IBNR = ***4,860***

Practice

- *Using the reported triangle below, calculate the Ultimates and the IBNR for each AY using the Development Method. Use a simple average for LDF selections.*
  - *Assume a tail factor (48-Ult) of 1.02*

Table 11 – Reported Claim Development Triangle

Accident Year	Reported Claims as of (months)			
	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			

Practice - *Answer*

- *Using the reported triangle below, calculate the Ultimates and the IBNR for each AY using the Development Method. Use a simple average for LDF selections.*
  - *Assume a tail factor (48-Ult) of 1.02*

Table 11 – Reported Claim Development Triangle

Accident Year	Reported Claims as of (months)							Ults
	12		24		36		48	
2005	1,500	*1.61*	2,420	*1.12*	2,720	*1.11*	3,020	*3,080*
2006	1,150	*1.60*	1,840	*1.125*	2,070			*2,339*
2007	1,650	*1.60*	2,640					*3,353*
2008	1,740							*3,532*

LDFs: *1.6* *1.12* *1.11* *1.02*

CDFs: *2.03* *1.27* *1.13* *1.02*

IBNR = Ult – Reported:

2005 = 60 2006 = 269 2007 = 713 2008 = 1,792

Practice

- *Using the reported triangle below and the Development Method, calculate the total indicated reserve for each accident year given. Use a volume weighted average for LDF selections.*
  - *Assume a tail factor of 1.02*

Total Paid Losses	Accident Year	Reported Claims as of 12M	24M	36M	48M	60M
5,900	2014	3,575	4,400	5,500	6,000	6,200
6,100	2015	4,200	5,200	6,500	7,100	
7,800	2016	4,875	7,000	8,200		
6,800	2017	5,600	7,500			
4,200	2018	6,000				

Practice - *Answers*

- *Using the reported triangle below and the Development Method, calculate the total indicated reserve for each accident year given. Use a volume weighted average for LDF selections.*
  - *Assume a tail factor of 1.02*

Reserve = Ult - Paid

Total Paid Losses	Accident Year	Reported Claims as of 12M	24M	36M	48M	60M	*Ults*	*Rsrv*
5,900	2014	3,575	4,400	5,500	6,000	6,200	*6,324*	*424*
6,100	2015	4,200	5,200	6,500	7,100		*7,483*	*1,383*
7,800	2016	4,875	7,000	8,200			*9,438*	*1,638*
6,800	2017	5,600	7,500				*10,500*	*3,700*
4,200	2018	6,000					*11,100*	*6,900*

Vol Wtd-> 12-24 = (4,400+5,200+7,000+7,500) / (3.575+4,200+4,875 + 5,600) = 1.32

LDFs:	*1.321*	*1.217*	*1.092*	*1.033*	*1.02*
CDFs:	*1.850*	*1.400*	*1.151*	*1.054*	*1.02*

Common Methods ~ *The Development Technique*

"Completing the Square"

Accident Year	Reported Claims as of *(cumulative)* 12M	24M	36M	48M	60M	Projected Ultimates
2014	3,575	4,400	5,500	6,000	6,200	*6,262*
2015	4,200	5,200	6,500	7,100	*7,313*	*7,384*
2016	4,875	7,000	8,200	*8,938*	*9,206*	*9,266*
2017	5,600	7,500	*9,150*	*9,974*	*10,273*	*10,350*
2018	6,000 →	*7,860* →	*9,589* →	*10,452* →	*10,766*	*10,860*

*6,000 * 1.31 = 7,860*

*7,860 * 1.22 = 9,589*

	12-24	24-36	36-48	48-60	60-Ult
Selected	1.31	1.22	1.09	1.03	1.01
	12-Ult	24-Ult	36-Ult	48-Ult	60-Ult
Age-to-Ult	1.81	1.38	1.13	1.04	1.01
CDF					

Common Methods ~ *The Development Technique*

Expected CY Development

Accident Year	Reported Claims as of *(cumulative)* 12M	24M	36M	48M	60M	Projected Ultimates
2014	3,575	4,400	5,500	6,000	6,200	*6,262*
2015	4,200	5,200	6,500	7,100	*7,313*	*7,384*
2016	4,875	7,000	8,200	*8,938*	*9,206*	*9,266*
2017	5,600	7,500	*9,150*	*9,974*	*10,273*	*10,350*
2018	6,000	*7,860*	*9,589*	*10,452*	*10,766*	*10,860*

Expected Development in CY 2019

(assuming AY 2014 hits Ultimate during CY 2019) =

7,860 – 6,000 + 9,150 – 7,500 + 8,938 – 8,200 + 7,313 – 7,100 + 6,262 – 6,200 = ***4,523***

Practice

- *Using the ultimates and LDFs given, complete the square for the below triangle (through 48months) AND calculate the 2009 CY expected development, assuming AY 2005 reaches ultimate during CY 2009:*

Table 11 – Reported Claim Development Triangle

Accident Year	Reported Claims as of (months) 12	24	36	48	*Ults*
2005	1,500	2,420	2,720	3,020	*3,080*
2006	1,150	1,840	2,070		*2,339*
2007	1,650	2,640			*3,353*
2008	1,740				*3,532*
LDFs:	*1.6*	*1.12*	*1.11*	*1.02*	
CDFs:	*2.03*	*1.27*	*1.13*	*1.02*	

Practice - *Answers*

- *Using the ultimates and LDFs given, complete the square for the below triangle (through 48months) AND calculate the 2009 CY expected development, assuming AY 2005 reaches ultimate during CY 2009:*

*2,640 * 1.12 = 2,957*

Table 11 – Reported Claim Development Triangle

Accident Year	Reported Claims as of (months) 12	24	36	48	*Ults*
2005	1,500	2,420	2,720	3,020	*3,080*
2006	1,150	1,840	2,070	*2,298*	*2,339*
2007	1,650	2,640	*2,957*	*3,282*	*3,353*
2008	1,740	*2,784*	*3,118*	*3,461*	*3,532*
LDFs:	*1.6*	*1.12*	*1.11*	*1.02*	
CDFs:	*2.03*	*1.27*	*1.13*	*1.02*	

2009 CY Expected Development =

(3,080 – 3,020) + (2,298 – 2,070) + (2,957 – 2,640) + (2,784 – 1,740) = 1,649

Reporting and Payment Patterns

- Common to see decreasing incremental reported and paid percentages with increasing age
  - *When underlying development is erratic, actuarial judgment often applied to select claim development patterns that exhibit a steady, decreasing pattern*
- Payment and reporting patterns imply different patterns for each accident year
  - *Due to fact that emerged portion of each AY does not precisely fit selected age-to-age factors*
- Patterns may be valuable input for other calculations, monitoring development throughout the year, and used for present value calculations

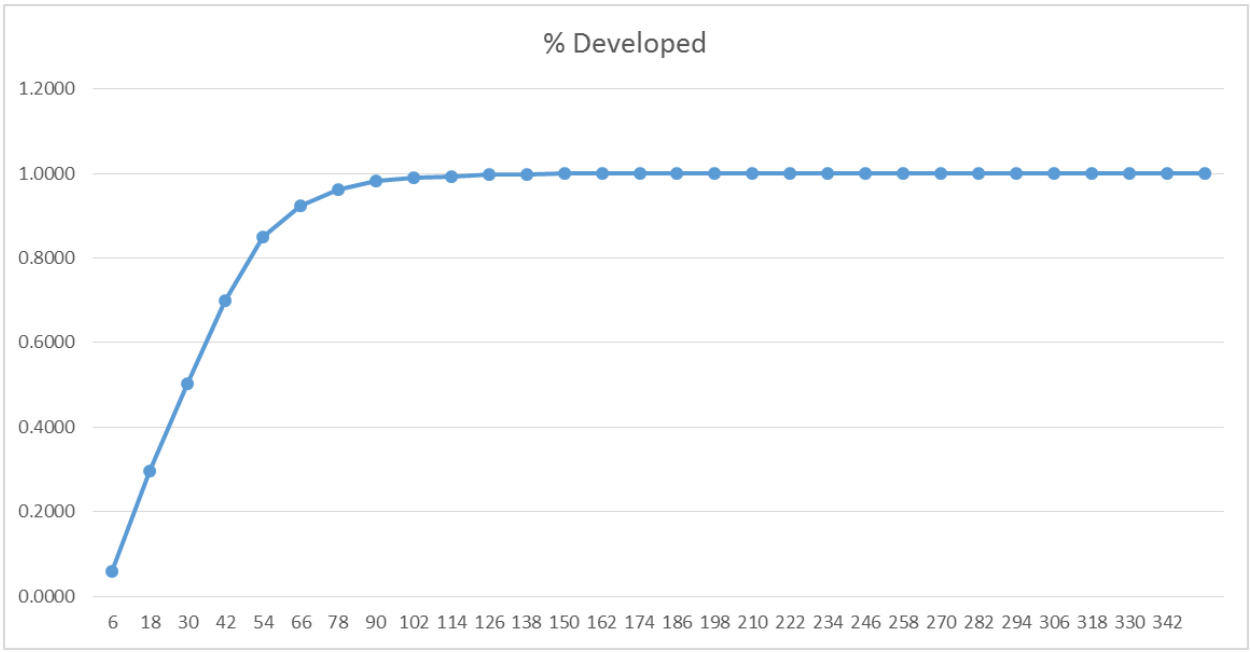
Reporting and Payment Patterns

- We derive implied reporting patterns from the cumulative reported claim development factors
  - ***Percentage Reported = 1 / Cumulative CDF***
  - *Incremental percentage reported equals the difference in the cumulative percentage reported*
- Can also determine an implied payment pattern based on the cumulative paid CDFs

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%

Common Methods ~ *The Development Technique*

- Looking at the 1/CDF over all ages, we get a curve that goes from 0% to 100%, which is many times referred to as a time curve
- This curve is helpful in comparing very different lines since all the lines will go from 0% to 100%



Practice

- *Using the reported triangle below, calculate the reported pattern and graph the time-curve using the Development Method. Use a simple average for LDF selections.*
  - *Assume a tail factor (48-Ult) of 1.03*

Table 11 – Reported Claim Development Triangle

Accident Year	Reported Claims as of (months)			
	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			

Practice - *Answer*

- *Using the reported triangle below, calculate the reported pattern and graph the time-curve using the Development Method. Use a simple average for LDF selections.*
  - *Assume a tail factor (48-Ult) of 1.0 (i.e. no tail)*

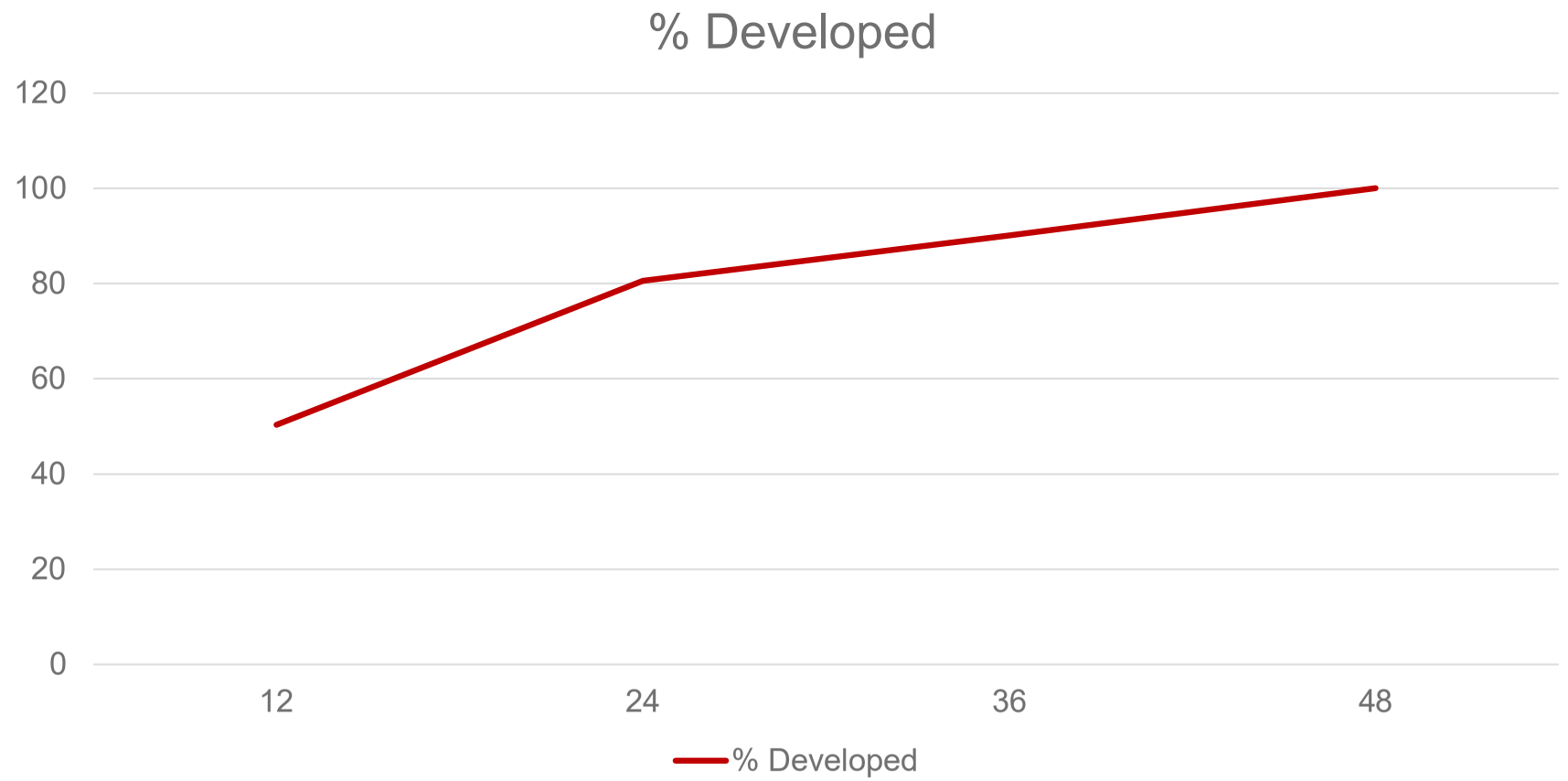
Table 11 – Reported Claim Development Triangle

Accident Year	Reported Claims as of (months)						
	12		24		36		48
2005	1,500	*1.61*	2,420	*1.12*	2,720	*1.11*	3,020
2006	1,150	*1.60*	1,840	*1.125*	2,070		
2007	1,650	*1.60*	2,640				
2008	1,740						

LDFs:	*1.6*	*1.12*	*1.11*	*1.00*
CDFs:	*1.99*	*1.24*	*1.11*	*1.00*
Cumulative % Rprtd:	*50.3%*	*80.6%*	*90.1%*	*100%*

Practice - *Answer*

	12	24	36	48
CDFs:	*1.99*	*1.24*	*1.11*	*1.00*
Cumulative % Rprtd:	*50.3%*	*80.6%*	*90.1%*	*100%*



Common Methods ~ *The Development Technique*

Development Technique *- When it Works…and Doesn't Work*

- May not work well when there are changes in **insurer's operations**
  - *Consider alternative techniques or* ***adjust development factors***
- Works best when presence or absence of **large claims** does not greatly distort the data
- Insufficient **volume of credible data**
- Works well with **high-freq, low-severity lines** with stable and timely reporting of claims
- **Leveraged effect** of large claim development factors:
  - *Long-tail lines (e.g. WC and GL) may have large cumulative CDFs at early valuations*
  - *Highly leveraged factors result in projections that are very sensitive to current value of claims*
  - *Any unusual change in reporting or settlement may result in unreasonable projections of ultimate claims*
  - *Often seek alternative techniques*

Changing Environment – Claim Ratios and Case O/S Adequacy

- Scenario 1: Steady State Environment

  Loss ratios are stable and there are no changes from historical levels of case outstanding strength

- Scenario 2: Loss Ratios Up with Case O/S Strength Steady

  Increasing loss ratios and no change in case outstanding strength

- Scenario 3: Stable Loss Ratios with Increasing Case O/S Strength

  Stable loss ratios with an increase in case outstanding strength

- Scenario 4: Increasing Loss Ratios with Increasing Case Outstanding Strength

  Increases in both loss ratios and case outstanding strength

- Mix of Personal Auto and Commercial Auto is changing

  A portfolio of business in which we combine Personal and Commercial Auto for estimating claims.

Changing Environment – Claim Ratios and Case O/S Adequacy

- Scenario 1: Steady State Environment
  - *Reported and Paid provide the same ultimate claims estimate*
- Scenario 2: Claim Ratios Up with Case O/S Strength Steady
  - *No changes in age-to-age factors*
  - *Paid and Reported give the same estimates, but higher than in Scen 1*
  - *Development Technique is responsive to changes in claim ratios, assuming no change in reporting pattern or payment pattern*
- Scenario 3: Stable Claim ratios with Increasing Case O/S Strength
  - *Case O/S adequacy affects the diagonals (calendar years)*
  - *Age-to-age factors increase for the two most recent calendar years*
  - *True ultimate claims have not increased, though*
  - *IBNR should decrease, but with higher reported and higher CDFs, IBNR increases*
  - *Must judgmentally adjust the factors, or turn to the paid method*
  - *Paid method factors are highly leveraged, though.*

Changing Environment – Claim Ratios and Case O/S Adequacy

- Scenario 4: Increasing Claim Ratios with Increasing Case Outstanding Strength
  - *Paid produces the correct value for IBNR*
  - *Reported claim development is responsive to the increasing claim ratios, but overstates the estimate of unpaid claims due to changing case reserve adequacy*

- Mix of Personal Auto and Commercial Auto is changing
  - *Commercial takes longer to develop than Personal*
  - *Commercial represents an increasingly larger share of the book*
  - *As commercial volume increases in most recent AYs, those a-a factors will increase*
  - *The averages will mute this increase effect and a-a will be low*
  - *IBNR will be understated*
  - *Using more recent experience (3-year vs. 5-year) helps, but still understates IBNR*
  - *Reported is more responsive than paid*

  - *Within a single line of insurance, you can see the same effect with changes in types of claims.*

Common Methods ~ *The Development Technique*

Summary

Loss Development Method works well for:

- Short Tail lines (low leverage)
- Credible volume of data and a Stable environment
- Deteriorating/Improving claims ratios, Responsive to claims activity

Loss Development Method will be distorted by:

- Case Reserve Adequacy changes impact reported loss development method
  - Strengthening = overstate ultimates
  - Weakening = understate ultimates
  - Paid loss development method not effected
- Settlement Rate changes impact both paid/reported loss development methods
  - Speed Up = Overstate ultimates
  - Slow down = Understate ultimates
- Changes in product mix or claim mix
  - Shift to longer tail exposure = understate ultimates
  - Shift to shorter tail exposure = overstate ultimates

Common Methods:
Expected Claims Technique

Common Methods ~ *Expected Claims Technique*

The Method

Ultimate Claims = Selected Expected Loss Cost x Exposure

Unpaid Claim Estimate = ultimate claims less paid claims

- Common exposure bases
  - *Most common: Earned Premium*
  - *Self-Insureds may use other exposure measures (payroll, # of vehicles, sales, property values, etc)*

- Most common approach:

  Ultimate Claims = Selected Expected Loss Ratio x Earned Premium

Common Methods ~ *Expected Claims Technique*

Basic Method Example

AY 2010 EPAPR @ 12/31/2010 = $2,500,000

Expected Loss Ratio for 2010 from Planning *(LRP)* = 75%

Use the expected claim technique to estimate ultimate claims for AY 2010.

*$2,500,000 * 75% = $1,875,000*

Common Methods ~ *Expected Claims Technique*

Adjusting Claims and Exposures

- Objective is to estimate claims for **most recent year**
- Premiums and Claims need to be adjusted to the cost levels expected in the year that is being projected.
  - *Historical losses need to be adjusted for:*
    - *Inflation*
    - *Tort reform*
  - *Premiums need to be adjusted for rate changes (on-level premium) during the experience period*

Common Methods ~ *Expected Claims Technique*

Mechanics

1) Calculate reported and paid development w/ development technique and average them for the initial selected ultimates.
2) Divide ultimates by your exposure measure
3) Trend items (on-level premium, trend claims)
4) Averages of ratios leads to selected Expected Loss Ratio or Loss Rate
5) Multiply selected ratio or rate by the exposure measure of the period in question to get Ultimate Claims

Common Methods ~ *Expected Claims Technique*

Example

Given the following information as of December 31, 2010:

AY	EP	Paid Claims	OLEP factors
2007	$21,000,000	$11,700,000	1.093
2008	$22,050,000	$8,200,000	1.061
2009	$23,152,500	$4,900,000	1.03
2010	$23,525,000	$1,900,000	1

Paid Loss Development Factors

12-24	24-36	36-48	48-60	60-Ult
2.4	1.8	1.5	1.2	1.02

Loss trend is 4% per year

Use the expected claim technique to estimate ultimate claims for AY 2010.

Common Methods ~ *Expected Claims Technique*

Example

*16,056,309 = 11,700,000*1.22*(1.04^3)*

Given the following information as of December 31, 2010:

AY	EP	Paid Claims	OLEP factors	*Ult Trended*	*EPAPR*	*Adj LR*
2007	$21,000,000	$11,700,000	1.093	*16,056,309*	*22,953,000*	*70%*
2008	$22,050,000	$8,200,000	1.061	*16,319,181*	*23,395,050*	*70%*
2009	$23,152,500	$4,900,000	1.03	*16,816,800*	*23,847,075*	*71%*
2010	$23,525,000	$1,900,000	1	*15,067,000*	*23,525,000*	*64%*

Selected: 70%

Paid Loss Development Factors

12-24	24-36	36-48	48-60	60-Ult
2.4	1.8	1.5	1.2	1.02
CDF:7.93	*3.3*	*1.84*	*1.22*	*1.02*

Loss trend is 4% per year

Use the expected claim technique to estimate ultimate claims for AY 2010.

Proj Ult = $16,467,500 ⟶ *Unpaid estimate for AY 2010 = $14,567,500*

Practice

Use the expected claim technique to estimate IBNR for AY 2010.

Given the following information as of December 31, 2010:

AY	EP	Reported Losses	OLEP factors
2007	$21,000,000	$11,700,000	1.093
2008	$22,050,000	$8,200,000	1.061
2009	$23,152,500	$4,900,000	1.03
2010	$23,525,000	$1,900,000	1

Reported Loss Development Factors

12-24	24-36	36-48	48-60	60-Ult
2.25	1.75	1.45	1.15	1.01

Loss trend is 3% per year

Practice - *Answer*

*14,830,490 = 11,700,000*1.16*(1.03^3)*

Use the expected claim technique to estimate IBNR for AY 2010.

Given the following information as of December 31, 2010:

AY	EP	Reported Losses	OLEP factors	*Ult Trended*	*EPAPR*	*Adj LR*
2007	$21,000,000	$11,700,000	1.093	*14,830,490*	*22,953,000*	*65%*
2008	$22,050,000	$8,200,000	1.061	*14,614,958*	*23,395,050*	*62%*
2009	$23,152,500	$4,900,000	1.03	*14,888,650*	*23,847,075*	*54%*
2010	$23,525,000	$1,900,000	1	*12,597,000*	*23,525,000*	*54%*

Selected: 60%

Reported Loss Development Factors

12-24	24-36	36-48	48-60	60-Ult
2.25	1.75	1.45	1.15	1.01
CDF: 6.63	*2.95*	*1.68*	*1.16*	*1.01*

Loss trend is 3% per year

*Proj Ult = $23,525,000 * 60% = $14,115,000*

→ *IBNR estimate for AY 2010 = $12,215,000*

Common Methods ~ *Expected Claims Technique*

Pros and Cons

- PRO
  - Stability of estimates (not affected by blips in interim experience)
  - Allows actuary to judgmentally anticipate the impact of changes in the environment (where those changes are not yet evident in the data)
- CON
  - Not responsive to actual claims experience
    - Inaccurate when actual claims experience differs from the expected.

Common Methods ~ *Expected Claims Technique*

When Is This Method Appropriate?

- An insurer enters a new line of business or a new territory
- Operational or environmental changes make recent historical data irrelevant
- Where development methods are too highly leveraged (lines with longer emergence and settlement patterns)
- Data is unavailable for the other methods

Common Methods ~ *Expected Claims Technique*

Accuracy

Expected Claims Technique works well:

- *Claims ratios / loss rates are stable and predictable*
  - *Even if case reserve adequacy or settlement rates are changing*
- *Used for early evaluations of long tail lines*
- *Used in situations development data doesn't exist or can't be relied upon*

Expected Claims Technique will be inaccurate:

- *Claims ratios / loss rates come in different than expected*
  - *Not responsive to actual claims experience in the year*
  - *Product mix changes*
  - *Shifts in the types of claims*

Common Methods ~ *Expected Claims Technique*

Changing Environment – Claim Ratios and Case O/S Adequacy

- Scenario 1: Steady State Environment

  Loss ratios are stable and there are no changes from historical levels of case outstanding strength

- Scenario 2: Loss Ratios Up with Case O/S Strength Steady

  Increasing loss ratios and no change in case outstanding strength

- Scenario 3: Stable Loss Ratios with Increasing Case O/S Strength

  Stable loss ratios with an increase in case outstanding strength

- Scenario 4: Increasing Loss Ratios with Increasing Case Outstanding Strength

  Increases in both loss ratios and case outstanding strength

- Mix of Personal Auto and Commercial Auto is changing

  A portfolio of business in which we combine Personal and Commercial Auto for estimating claims.

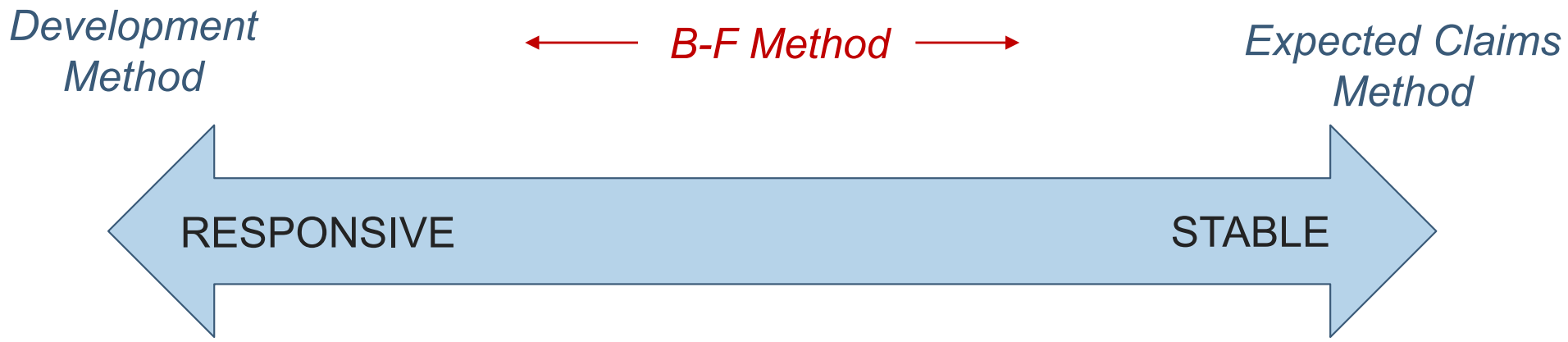
Common Methods ~ *Expected Claims Technique*

Changing Environment – Claim Ratios and Case O/S Adequacy

- Scenario 1: Steady State Environment
  - *Expected claim technique provides an appropriate estimate of IBNR in the steady state.*
- Scenario 2: Claim Ratios Up with Case O/S Strength Steady
  - *Without a change to the expected claim ratio, this method is unresponsive to increasing claims ratios.*
  - *IBNR will be understated*
- Scenario 3: Stable Claim ratios with Increasing Case O/S Strength
  - *Increasing case O/S strength has no effect on this method as actual claim experience does not enter into the estimate of ultimate.*
- Scenario 4: Increasing Claim Ratios with Increasing Case Outstanding Strength
  - *Similar to scenario 2, this method is unresponsive to increasing claim ratios*
- Mix of Personal Auto and Commercial Auto is changing
  - *Without an acknowledgment of the changing mix of business, the ECR method will not adequately provide for IBNR.*

Common Methods:
Bornheutter-Ferguson Method

Common Methods ~ *Bornheutter-Ferguson Method*



- BF technique is a blend of the development and expected claims techniques
  - Splits ultimate claims into two components:
    1. *Actual reported (or paid) claims*
    2. *Expected unreported (or unpaid) claims*

- Credibility weighting between Development and Expected Claims methods
  - *Credibility equals percentage of claims developed at a particular stage of maturity (Z = 1 / CDF)*
  - As experience matures, more weight given to actual claims

Common Methods ~ *Bornheutter-Ferguson Method*

Key Assumptions

- Unreported (or unpaid) claims will develop based on expected claims
  - *claims reported to date give no information about claims yet-to-be reported*

- Reporting and payment patterns are the same as selected in the development method

Common Methods ~ *Bornheutter-Ferguson Method*

Mechanics

Ultimate Claims

= *Actual Reported Claims + Expected Unreported Claims*

= *Actual Reported Claims + Expected Claims * % Unreported*

% Unreported = 1 - % Reported = 1 – 1 / CDF

Note: Can also use with paid by swapping reported with paid

OR…

= *Development Method Ult * % Reported + Expected Claims Ult * % Unreported*

because…

*Development Method Ult * (1/CDF) = Actual Reported Claims*

Common Methods ~ *Bornheutter-Ferguson Method*

Example

You are given the following data:

		Cumulative Paid Claims						
AY	EP	12 mos	24 mos	36 mos	48 mos	*% Unpaid*	*Expected Unpaid*	*Ultimate*
1992	19,500	4,621	9,450	13,710	15,723	*4.76%*	*789*	*16,512*
1993	20,000	4,453	9,060	12,988		*17.36%*	*2,951*	*15,939*
1994	20,800	5,106	10,100			*42.86%*	*7,578*	*17,678*
1995	21,000	5,242				*71.43%*	*12,750*	*17,992*
								68,121

71.43% = (1-1/3.5)

*12,750 = 21,000*85%*71.43%*

	Selected Link Ratios		
12-24	24-36	36-48	48-60
2	1.45	1.15	1.05
CDF: 3.5	*1.75*	*1.21*	*1.05*

i) Assume no development beyond 60 months

ii) The expected loss ratio is 85%

Calculate the total indicated outstanding losses as of 12/31/95 based on the Bornhuetter-Ferguson technique.

68,121 – latest diagonal (cumulative) = 24,068

Practice

You are given the following data:

Accident Year	Earned Premium	Cumulative Reported Claims as of: 12 mos.	24 mos.	36 mos.	48 mos.
2012	34,000	8,000	16,500	24,000	27,500
2013	35,000	7,800	15,500	20,000	
2014	36,500	9,000	17,500		
2015	37,000	9,200			

Selected Link Ratios			
12-24	24-36	36-48	48-60
2.000	1.450	1.150	1.050

i) Assume no development beyond 60 months
ii) The expected claim ratio is 85%

a. Calculate the total indicated IBNR as of 12/31/2015 based on the Bornhuetter-Ferguson technique.

Practice - *Answer*

You are given the following data:

71.44% = (1-1/3.502)

Accident Year	Earned Premium	Cumulative Reported Claims as of: 12 mos.	24 mos.	36 mos.	48 mos.	% Unpaid	Expected Unreported	Ultimate
2012	34,000	8,000	16,500	24,000	27,500	*4.76%*	*1,376*	*28,876*
2013	35,000	7,800	15,500	20,000		*17.18%*	*5,112*	*25,112*
2014	36,500	9,000	17,500			*42.89%*	*13,305*	*30,805*
2015	37,000	9,200				*71.44%*	*22,469*	*31,669*
								116,463

Selected Link Ratios			
12-24	24-36	36-48	48-60
2.000	1.450	1.150	1.050
CDF: 3.502	*1.751*	*1.208*	*1.050*

*22,469 = 37,000*85%*71.44%*

i) Assume no development beyond 60 months
ii) The expected claim ratio is 85%

a. Calculate the total indicated IBNR as of 12/31/2015 based on the Bornhuetter-Ferguson technique.

116,463 – latest diagonal (cumulative) ~ or ~ Sum of Exp Unreported = 42,263

Practice

Given the following information as of December 31, 2009:

Accident Year	On-Level Earned Premium	Reported Claims	Expected Percentage Unreported
2006	$100,000	$62,000	0%
2007	120,000	60,000	10%
2008	140,000	50,000	X%
2009	160,000	40,000	40%
Total	520,000	212,000	

- The expected claim ratio is 65%.
- The projected ultimate claims using the Bornhuetter-Ferguson technique is $279,600 for all years combined.

Calculate X, the expected percentage unreported for accident year 2008.

Practice - *Answer*

Given the following information as of December 31, 2009:

Accident Year	On-Level Earned Premium	Reported Claims	Expected Percentage Unreported	*Expected Unreported*	*Ultimate*
2006	$100,000	$62,000	0%	*0*	*62,000*
2007	120,000	60,000	10%	*7,800*	*67,800*
2008	140,000	50,000	X%	*140,000*0.65*X%*	*50,000 + 140,000*0.65*X%*
2009	160,000	40,000	40%	*41,600*	*81,600*
Total	520,000	212,000			

- The expected claim ratio is 65%.
- The projected ultimate claims using the Bornhuetter-Ferguson technique is $279,600 for all years combined.

Calculate X, the expected percentage unreported for accident year 2008.

*279,600 = 62,000 + 67,800 + (50,000 + 140,000*0.65*X%) + 81,600*

→ *X% = 20%*

Common Methods ~ *Bornheutter-Ferguson Method*

Common Uses

- Frequently used with reported and paid claims
  - *Can also be used with claim counts and ALAE*
- Used for all lines of insurance
- Works with many time intervals - AY, PY, U/W year, Rpt year, Fiscal yr
- May organize data by year, half-year, quarter, or month

Common Methods ~ *Bornheutter-Ferguson Method*

Accuracy

- Advantage of method is that random fluctuations at early maturities do not significantly distort the projections

  An exceptionally large claim should not be allowed to distort the IBNR reserves

- Frequently used for long-tail lines of insurance

  Particularly for most immature years due to highly leveraged CDFs

- Used when data is extremely thin or volatile or both

  E.g. new line of business or new territory when volume of data is not credible

  May rely on benchmarks for development patterns and expected loss ratios

Common Methods ~ *Bornheutter-Ferguson Method*

Changing Environment – Claim Ratios and Case O/S Adequacy

- Scenario 1: Steady State Environment
  Loss ratios are stable and there are no changes from historical levels of case outstanding strength
- Scenario 2: Loss Ratios Up with Case O/S Strength Steady
  Increasing loss ratios and no change in case outstanding strength
- Scenario 3: Stable Loss Ratios with Increasing Case O/S Strength
  Stable loss ratios with an increase in case outstanding strength
- Scenario 4: Increasing Loss Ratios with Increasing Case Outstanding Strength
  Increases in both loss ratios and case outstanding strength
- Mix of Personal Auto and Commercial Auto is changing
  A portfolio of business in which we combine Personal and Commercial Auto for estimating claims.

Common Methods ~ *Bornheutter-Ferguson Method*

Changing Environment – Claim Ratios and Case O/S Adequacy

- Scenario 1: Steady State Environment
  - *Generates accurate estimate of IBNR in steady-state*
- Scenario 2: Claim Ratios Up with Case O/S Strength Steady
  - *Weakness of expected claims method is also a weakness of the BF method*
  - *It lacks responsiveness*
  - *Expected claims do not change, so expected unreported and unpaid do not either*
  - *IBNR estimate is same as steady-state*
  - *Must make deliberate change in expected clm ratio to respond to increasing clm ratios*
  - *Note: In real life, actuaries will make changes to expected claims based on internal and external changes*
  - *Paid BF performs even worse than Reported BF*
  - *Due to longer-term nature of paid pattern vs. reporting pattern*
  - *Unless actuary changes ELR assumption, the increasing claim ratios will cause method to understate IBNR*

Common Methods ~ *Bornheutter-Ferguson Method*

Changing Environment – Claim Ratios and Case O/S Adequacy

- Scenario 3: Stable Claim ratios with Increasing Case O/S Strength
  - *Reported BF method overstates the IBNR*
  - *Increases in reported CDFs lead to increases in % unrpt with no change to expected*
  - *Therefore, this leads to an increase in IBNR when a decrease is called for*
  - *Note: the overstatement is less for the reported BF than for reported CDF method due to the fact that the expected claims do not change using BF where in the development method, the higher CDFs are multiplied by higher rpt claims*
  - *Paid BF is unaffected by changes in case outstanding strength, similar to the paid development method*
  - *Paid BF generates an accurate estimate of IBNR*

Common Methods ~ *Bornheutter-Ferguson Method*

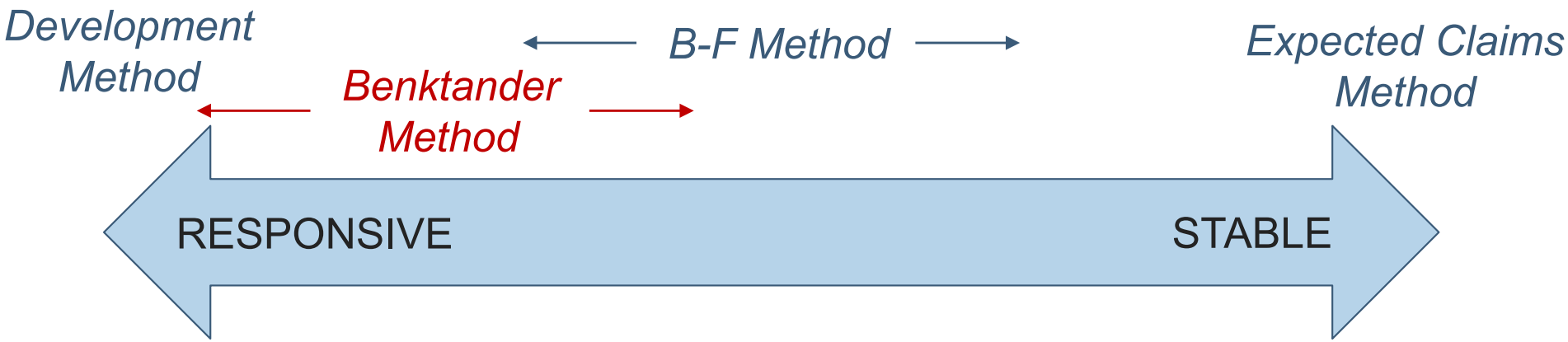
Changing Environment – Claim Ratios and Case O/S Adequacy

- Scenario 4: Increasing Claim Ratios with Increasing Case Outstanding Strength
  - *Paid BF understates IBNR due to the lack of responsiveness to increasing claim ratios and no effect from the increasing case strength*
  - *Reported BF has two factors working against each other*
  - *(1) Increasing claim ratios causes reported BF to understate IBNR*
  - *(2) Increasing case strength causes reported BF to overstate IBNR*
  - *Difference from the actual IBNR using the BF method could be positive or negative*
  - *Reserve adequacy depends on the mix of loss ratio and reserve adequacy changes, which offset each other*
- Mix of Personal Auto and Commercial Auto is changing
  - *Since volume of commercial auto is increasing at a greater rate and has a higher ultimate claim ratio, the expected is understated*
  - *Method will understate IBNR without a change in the expected claim ratio*
  - *Reported and payment patterns will lengthen due to increasing proportion of commercial auto*
  - *Increased commercial volume will increase age-to-age factors, but not by enough*
  - *Will also contribute to understatement*

Common Methods:

Benktander (Iterative B-F)

Common Methods ~ *Benktander (Iterative B-F)*



- Credibility-weighted average of BF and Development method
  Advantage - more responsive than BF and more stable than development method
  Also referred to as Iterative BF method
    - *Uses BF estimate as the initial expected losses to run BF again*
- Significantly **more** responsive to changes in underlying claim ratio but **less** responsive to changes in case outstanding adequacy
    - Benktander always gives greater credibility than BF does to the development technique
    - When no change in underlying claim development patterns, expect Benktander to be more responsive than BF
    - When claim development patterns are changing, Benktander may not produce most appropriate estimate
    - Similar for changing product mix

Common Methods ~ *Benktander (Iterative B-F)*

Example

You are given the following information:

Accident Year	Earned Premium	Expected Loss Ratio	Paid Age to Ultimate Factor	Paid Losses as of December 31, 2003
2002	$25,000	65%	2.30	$7,200
2003	15,000	75%	4.00	3,375

Use the Benktander method to estimate the ultimate losses for accident years 2002 and 2003. Show all work.

BF Ultimate:
*7,200 + 25,000*65%*(1-1/2.3) = 16,385*
*3,375 + 15,000*75%*(1 - 1/4) = 11,813*

Benktander Ultimate:
7,200 + 16,385(1-1/2.3) = 16,461*
3,375 + 11,813(1 - 1/4) = 12,235*

Common Methods ~ *Benktander (Iterative B-F)*

Practice

You are given the following information:

Accident Year	Earned Premium	Expected Loss Ratio	Paid Age to Ultimate Factor	Paid Losses as of December 31, 2003
2002	$30,000	90%	3.10	$8,400
2003	17,000	95%	4.20	4,025

Use the Benktander method to estimate the ultimate losses for accident year **2002 using 3 iterations.**

Practice - *Answer*

You are given the following information:

Accident Year	Earned Premium	Expected Loss Ratio	Paid Age to Ultimate Factor	Paid Losses as of December 31, 2003
2002	$30,000	90%	3.10	$8,400
2003	17,000	95%	4.20	4,025

Use the Benktander method to estimate the ultimate losses for accident year **2002 using 3 iterations.**

*BF Ult for 2002 = 8,400 + 30,000 * 90% * (1 – 1/3.10) = 26,690*

Iteration 1:

*8,400 + 26,690 * (1 – 1/3.10) = 26,481*

Iteration 2:

*8,400 + 26,481 * (1 – 1/3.10) = 26,338*

Iteration 3:

8,400 + 26,338 (1 – 1/3.10) = 26,242*

*Note: CL Ult for 2002 = 8400 * 3.1 = 26,040*

Common Methods ~ *Benktander (Iterative B-F)*

Practice

The following information is provided for an unpaid claims analysis with data evaluated as of June 30, 2014.

Accident Year	Paid Claims	Reported Claims	Paid Development Technique	Reported Development Technique	Paid Bornhuetter-Ferguson Technique	Selected Ultimate Claims
2012	7.0	7.8	14.0	10.9	12.0	13.8
2013	3.1	5.0	8.7	11.0	9.5	10.2
2014	1.5	1.9	12.0	5.7	10.3	7.1

- All figures are in millions of dollars.
- The a priori ultimate claims estimate is the same for all accident years. = ***10.0***
- There is no development of claims after 48 months.

Estimate ultimate claims for accident year 2014 using one iteration of the reported Benktander technique.

Explain how the unpaid claim estimate for accident year 2014 will change during successive iterations of the reported Benktander technique.

*BF Ult for 2014 = Reported to date + (10 * % unreported)*
CDF for 2014 = 5.7 / 1.9 = 3.0 thus, % unreported = (1 – 1/3) = 2/3
*BF Ult for 2014 = 1.9 + (10 * 2/3) = 8.567*

Common Methods ~ *Benktander (Iterative B-F)*

Practice - *Answers*

The following information is provided for an unpaid claims analysis with data evaluated as of June 30, 2014.

Accident Year	Paid Claims	Reported Claims	Paid Development Technique	Reported Development Technique	Paid Bornhuetter-Ferguson Technique	Selected Ultimate Claims
2012	7.0	7.8	14.0	10.9	12.0	13.8
2013	3.1	5.0	8.7	11.0	9.5	10.2
2014	1.5	1.9	12.0	5.7	10.3	7.1

- All figures are in millions of dollars.
- The a priori ultimate claims estimate is the same for all accident years.= ***10.0***
- There is no development of claims after 48 months.

Estimate ultimate claims for accident year 2014 using one iteration of the reported Benktander technique.

*Benktander Ultimate = Reported to date + (BF Ult * % unreported)*
*2014 Ult = 1.9 + (8.5666 * (2/3) = 7.6*

Explain how the unpaid claim estimate for accident year 2014 will change during successive iterations of the reported Benktander technique.

The unpaid claim estimate for AY 2014 will continue to decrease during successive iterations of the reported Benktander technique. Eventually, this technique will converge and be equal to the reported development technique estimate.

Summary

B-F Technique

- Credibility weighting between Expected Claims and Loss Development Techniques
- More responsive than the Expected Claims Technique
- More Stable than the Loss Development Technique

Benktander Technique:

- Credibility weighting between B-F and Loss Development Techniques
- More responsive than the B-F Technique, significantly more responsive than the Expected Claims Technique
- Still more Stable than the Loss Development Technique