

SOA Health 2007 Spring Meeting – Valuation and Reserving Techniques

Property & Casualty Reserving Techniques
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CAS Statement of Principles Regarding P&C Loss and Loss Adjustment Expense Reserves

- Definitions
 - Loss Reserve (Unpaid Losses or Loss Adjustment Expenses)
 - Case reserves
 - Future development on known claims
 - Reopened claims reserve
 - IBNR (incurred but not reported)
 - Claims in transit (incurred and reported but not recorded)

CAS Statement of Principles Regarding P&C Loss and Loss Adjustment Expense Reserves

- Considerations
 - Data Organization/Data Availability
 - Homogeneity/Credibility
 - Emergence/Settlement/Development Patterns
 - Policy Form (Occurrence vs. Claims made)

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CAS Statement of Principles Regarding P&C Loss and Loss Adjustment Expense Reserves

- Principles
 - “estimates derived from reasonable assumptions and appropriate actuarial methods”
 - “The most appropriate reserve within a range depends on...relative likelihood of estimates within a range and the financial reporting context..”

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Data Organization: What is in a Year?

- Calendar Year/Period Losses
 - Losses within a fixed period of time
- Report Year/Period Losses
 - Losses reported within a fixed period of time
- Accident Year/Period Loss
 - Losses on claims that occur during the accident year/period
- Policy Year/Period Loss
 - Losses on claims that occur during the policy year/period

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Development Patterns: The Loss Triangle

Incurred Loss Triangle							
Year	12	24	36	48	60	72	84
1999	1,500	2,625	3,938	5,119	6,143	7,064	7,770
2000	1,575	2,756	4,134	5,375	6,450	7,417	
2001	1,654	2,894	4,341	5,643	6,772		
2002	1,736	3,039	4,558	5,926			
2003	1,823	3,191	4,786				
2004	1,914	3,350					
2005	2,010						

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Purpose of Triangle		
	<ul style="list-style-type: none"> • Convenient way to present the data • Easier to see patterns and relationships in historic data • Easier to explain • Logical and Concise • Can be for any data that demonstrates a reasonable growth pattern 	
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Types of Triangles		
	<ul style="list-style-type: none"> • Incurred / Paid Loss • Claim counts: Open, closed, Closed w/ Pmt, etc. • Average Incurred / Paid Loss • Premium: Written, Earned, etc • Paid to Incurred Ratios, Closing ratios, etc 	
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Loss Triangle

Incurred Loss Triangle							
Year	12	24	36	48	60	72	84
1999	1,500	2,625	3,938	5,119	6,143	7,064	7,770
2000	1,575	2,756	4,134	5,375	6,450	7,417	
2001	1,654	2,894	4,341	5,643	6,772		
2002	1,736	3,039	4,558	5,926			
2003	1,823	3,191	4,786				
2004	1,914	3,350					
2005	2,010						

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The Real World

- Variability
 - Losses do not develop smoothly
 - Randomness
- Actuarial point estimate vs. Actuarial Range
 - “Actuaries are never right and rarely wrong”
- Process Error
 - Inherent variability in the underlying loss process
- Parameter Error
 - Error in estimating parameters used to model a process

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Actuarial Development Methods		
	<ul style="list-style-type: none"> • Loss Development Method • Expected Loss Method • Bornhuetter/Ferguson Method • Frequency/Severity Methods <ul style="list-style-type: none"> – Deterministic – Stochastic 	
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Development Factors		
	<ul style="list-style-type: none"> • Loss Development Factors may be based on industry or client data • Most actuarial methods make use of loss development factors in some way • In order to understand the methods, we must understand the loss development factors underlying those methods <ul style="list-style-type: none"> – You should “learn to walk before you run” 	
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Real World Triangle

Incurred Losses valued as of 12/31/2005							
Year	12	24	36	48	60	72	84
1999	1,500	2,500	4,000	4,900	5,800	6,300	7,250
2000	1,600	2,800	4,075	5,500	7,000	7,800	
2001	1,700	3,300	4,500	6,000	7,500		
2002	1,800	3,000	4,600	6,300			
2003	1,900	3,200	4,300				
2004	2,000	3,400					
2005	2,100						

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Real World Loss Development

Incurred Losses valued as of 12/31/2005							
Year	12	24	36	48	60	72	84
1999	1,500	2,500	4,000	4,900	5,800	6,300	7,250
2000	1,600	2,800	4,075	5,500	7,000	7,800	
2001	1,700	3,300	4,500	6,000	7,500		
2002	1,800	3,000	4,600	6,300			
2003	1,900	3,200	4,300				
2004	2,000	3,400					
2005	2,100						
Year	12-24	24-36	36-48	48-60	60-72	72-84	
1999	1.667	1.600	1.225	1.184	1.086	1.151	
2000	1.750	1.455	1.350	1.273	1.114		
2001	1.941	1.364	1.333	1.250			
2002	1.667	1.533	1.370				
2003	1.684	1.344					
2004	1.700						
	12-24	24-36	36-48	48-60	60-72	72-84	
Average	1.735	1.459	1.319	1.235	1.100	1.151	
Wtd Avg	1.733	1.451	1.322	1.238	1.102		
	12-24	24-36	36-48	48-60	60-72	72-84	
Selected To-Ult	1.715	1.450	1.350	1.250	1.100	1.075	
	5.210	3.038	2.095	1.552	1.242	1.129	1.050

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Selecting a Development Factor

- Data Considerations
 - Straight Averages
 - Weighted Averages
 - Averages excluding hi/low
- Other Considerations
 - Change in patterns (reserving, payments, etc.)
 - Distortions due to unusually bad experience (i.e. Very Large Loss)
 - Distortions caused by law changes
 - Distortions due to entering/exiting chapter 11
 - Distortions caused by problems with fronting/claim management companies
- For a given link ratio, if there is a consistent pattern by Policy Period, it may reflect an underlying trend
 - Continue the trend

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12-24 Link Ratio

Year	12-24
1999	1.667
2000	1.750
2001	1.941
2002	1.667
2003	1.684
2004	1.700
	12-24
Average	1.735
Wtd Avg	1.733
Selected	1.715

- Link Ratios
 - Higher in older years
 - Causes averages to be higher
 - Lower in last three years but shows an increasing trend
- Selection of 1.715
 - Lower than averages
 - Consistent with increasing trend in last three years
 - This selection represents ACTUARIAL JUDGMENT

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Actuarial Development Methods		
	<ul style="list-style-type: none"> • <u>Loss Development Method</u> • Expected Loss Method • Bornhuetter/Ferguson Method • Frequency/Severity Methods <ul style="list-style-type: none"> – Deterministic – Stochastic 	
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Chain Ladder Methods		
	<ul style="list-style-type: none"> • a.k.a. “Loss Projection Methods” • Can be done using paid or incurred data • Methodology can be applied to any data which is expected to develop in a systematic way <ul style="list-style-type: none"> – Claims reported – Claims paid – Radioactive decay 	
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Chain Ladder Methods (cont.)

- Advantages
 - Easy to understand and explain by both actuaries and non-actuaries
 - Simple / Intuitive ($1+1=2$)
 - Gives 100% credibility to actual experience
- Disadvantages
 - Can be too responsive to data, thus unstable
 - Long tail lines – data may takes years to develop or report
 - Volatile lines – either a big loss or no loss
 - So simple, everyone thinks they're an expert

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Incurred Loss Projection

	Incurred	Dev	Ultimate
Year	to Date	Fct	Incurred
1999	7,250	1.050	7,613
2000	7,800	1.129	8,804
2001	7,500	1.242	9,312
2002	6,300	1.552	9,778
2003	4,300	2.095	9,010
2004	3,400	3.038	10,330
2005	2,100	5.210	10,942

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Ultimate Loss Development Factors

Age	12	24	36	48	60	72	84
To-Ult	5.210	3.038	2.095	1.552	1.242	1.129	1.050

- Ultimate Loss Development Factor at Age X
 - Applied to losses as of age X to produce an estimate of ultimate expected loss
- $\text{Loss}_X * \text{Ultimate LDF}_X = \text{Ultimate Loss}$
- $\text{Loss}_X / \text{Ultimate Loss} = 1 / \text{Ultimate LDF}_X$
- $\text{Loss}_X / \text{Ultimate Loss} = \% \text{ of Loss Reported at Time X}$
- $1 / \text{Ultimate LDF}_X = \% \text{ of Loss Reported at Time X}$
- Reciprocal of Ultimate LDF = Loss Reporting Pattern

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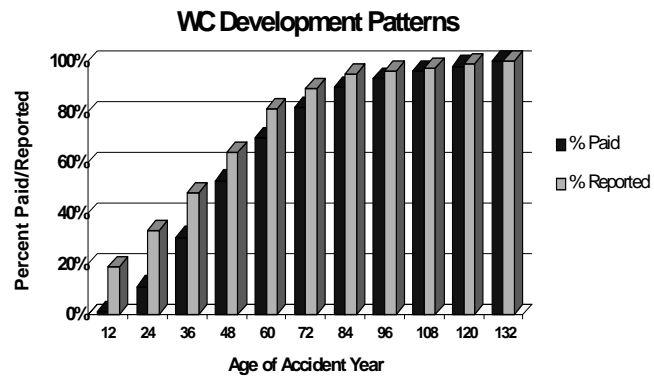
Ultimate Loss Development Factors

Age	12	24	36	48	60	72	84
To-Ult	5.210	3.038	2.095	1.552	1.242	1.129	1.050
% Rpt	19%	33%	48%	64%	81%	89%	95%

- Reciprocal of Ultimate Incurred LDFs
 - Loss Reporting Pattern
- Reciprocal of Ultimate Paid LDFs
 - Loss Payout Pattern
 - Commonly used for discounting of reserves

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Loss Development Pattern



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Actuarial Development Methods

- Loss Development Method
- Expected Loss Method
- Bornhuetter/Ferguson Method
- Frequency/Severity Methods

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Expected Loss Methods		
	<ul style="list-style-type: none"> • Expected Losses = Loss Rate * Exposure • Loss Rate based on <ul style="list-style-type: none"> – Historical loss rates trended to current period – Industry data – Judgment • Actual loss experience during the period is not used under this method • Estimate can only be revised if Loss Rate or Exposure is changed 	
		24

Expected Loss Methods (cont)		
	<ul style="list-style-type: none"> • Advantages <ul style="list-style-type: none"> – Stable, not subject to fluctuation due to loss reporting/payments – Unbiased, Easy to explain, intuitive – Useful for volatile lines of business • Disadvantages <ul style="list-style-type: none"> – Too Stable (Actual experience has no credibility) <ul style="list-style-type: none"> • Does not give credit for good experience • Does not penalize for bad experience 	
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Expected Loss Example		
	<ul style="list-style-type: none"> • Loss Rate = \$1.30 per \$100 of exposure • Exposure = \$100,000,000 • Expected Loss = $\\$1.30 * 1,000,000 = \\$1,300,000$ • Case 1: \$1,000,000 in Loss report <ul style="list-style-type: none"> – Ultimate loss estimate = \$1,300,000 – Reserves = $\\$1,300,000 - \\$1,000,000 = \\$300,000$ • Case 2: \$2,000,000 in Loss report <ul style="list-style-type: none"> – Ultimate loss estimate = \$1,300,000 – Reserves = $\\$1,300,000 - \\$2,000,000 = (-) \\$700,000$ 	
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Actuarial Development Methods		
	<ul style="list-style-type: none"> • Loss Development Method • Expected Loss Method • <u>Bornhuetter/Ferguson Method</u> • Frequency/Severity Methods 	
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Bornhuetter-Ferguson Method		
	<ul style="list-style-type: none"> • Well-known and widely used method <ul style="list-style-type: none"> – Second only to the Chain Ladder method in use • Hybrid or Blended Method <ul style="list-style-type: none"> – Combination of Chain Ladder & Expected Loss Method using percentage paid or incurred as weights • Has benefits of both the Chain Ladder & Expected Loss Methods 	
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Incurred Bornhuetter-Ferguson Method		
	<ul style="list-style-type: none"> • How does it work? <ul style="list-style-type: none"> – Calculates reserves rather than ultimates – Reserves = A Priori Ultimate Losses * Incurred IBNR Factor • A Priori Ultimate Losses <ul style="list-style-type: none"> – Initial estimate of ultimate expected losses – calculated using Expected Loss Methods • Incurred IBNR Factor <ul style="list-style-type: none"> – 1 - Reciprocal of incurred ultimate LDF – 1 - % Incurred – % Unreported 	
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Paid Bornhuetter-Ferguson Method

- Paid BF Method
 - Similar calculations as Incurred BF but uses paid data and factors
 - Unpaid Loss = A Priori Ultimate Losses * Paid IBNR Factor
- Paid IBNR Factor
 - 1 - Reciprocal of paid ultimate LDF
 - 1 - % Paid
 - % Unpaid

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Bornhuetter-Ferguson Derivation

- Chain Ladder Ultimate (CL) = $\text{Loss}_X * \text{Ultimate LDF}_X$
- Expected Losses (EL) = Loss Rate * Exposure
- BF Ult = $\text{CL} * w + \text{EL} * (1-w)$
 - w is the weighing factor
 - Specifically, w is % of losses reported
 - % of losses reported = $1 / \text{Ultimate LDF}$
- BF Ult = $\text{CL} * 1/\text{Ultimate LDF}_X + \text{EL} * (1 - 1/\text{Ultimate LDF}_X)$
- BF Ult = $\text{Loss}_X + \text{EL} * \text{IBNR Factor}_X$

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Bornhuetter-Ferguson Method (example)								
	Age	12	24	36	48	60	72	84
	To-Ult	5.210	3.038	2.095	1.552	1.242	1.129	1.050
	% Rpt	19%	33%	48%	64%	81%	89%	95%
	Rpt Loss	2,010	3,350	4,786	5,926	6,772	7,417	7,770
	Exposure	12,150	11,625	10,300	11,400	10,900	10,350	9,500
	Loss Rate	0.90	0.90	0.87	0.87	0.87	0.85	0.85
	A Priori Loss	10,935	10,463	8,961	9,918	9,483	8,798	8,075
	% Unrpt	81%	67%	52%	36%	19%	11%	5%
	IBNR	8,836	7,019	4,684	3,528	1,845	1,003	385
	BF Ult Loss	10,846	10,369	9,470	9,453	8,618	8,421	8,155
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Actuarial Development Methods	
<ul style="list-style-type: none"> • Loss Development Method • Expected Loss Method • Bornhuetter/Ferguson Method • <u>Frequency/Severity Methods</u> 	
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Frequency/Severity Methods - Deterministic	
<ul style="list-style-type: none"> • Method explicitly calculates Frequency & Severity <ul style="list-style-type: none"> – Other methods combine Frequency & Severity implicitly • Frequency <ul style="list-style-type: none"> – Claims per exposure – Claims <ul style="list-style-type: none"> • May be reported, non-zero claims, paid w/ payment, etc – Exposure <ul style="list-style-type: none"> • Exposures may be expressed in hundreds, thousands, etc • Severity <ul style="list-style-type: none"> – Losses per claim – Losses should match types of claim – Losses may be on a reported, paid or ultimate basis 	34

Frequency/Severity Methods - Deterministic

Year	Exposure	Incurred Claims	Clm per Exp (000's)	Ultimate Losses	Average Severity	Loss Rate
1999	9,500	65	6.84	7,613	117	0.801
2000	10,350	75	7.25	8,804	117	0.851
2001	10,900	85	7.80	9,312	110	0.854
2002	11,400	80	7.02	9,778	122	0.858
2003	10,300	75	7.28	9,010	120	0.875
2004	11,625	85	7.31	10,330	122	0.889
2005	12,150	90	7.41	10,942	122	0.901
Average			7.27		119	
Selected			7.30		122	
<u>Using Selected</u>						
2006	13,000	94.90	7.30	11,578	122	0.891
<u>Using Average</u>						
2006	13,000	94.54	7.27	11,203	119	0.862

Loss Rate = Loss / Exposure

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Frequency/Severity Methods - Stochastic Modeling

- Deterministic models yield estimates near the center of a range of estimates
- Many clients are now understanding the importance of variation around the mean and are asking for confidence levels
 - To better understand appropriate retention levels
 - To increase probability of adequate funding
- Auditors also want to know confidence levels
 - Willing to accept booking at a 60 to 70% confidence level when losses are green
 - Concerned about manipulation of financial results

*From CAS CLRS 2005, "Loss Reserves Points, Ranges or Distributions", Gregory Alff, FCAS, MAAA, Willis

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Frequency/Severity Methods - Stochastic Modeling

Table 1

Aggregate Test Data Example

Workers Compensation
Loss and Exposure Adjustment to 7/1/05-06 Level
Losses including ALAE Limited to \$500,000

A. Loss Adjustment				
Accident Period	Selected Ultimate Losses	Benefit Level Change Factor	Inflation Trend Factor	Adjusted Losses
2001	\$5,390,000	1.025	1.313	\$7,253,997
2002	7,035,000	0.988	1.224	8,298,198 ¹
2003	6,403,000	0.963	1.141	7,035,508
2004	6,259,000	1.001	1.063	6,659,970
Total	25,087,000			29,247,673
B. Exposure Adjustment				
Accident Period	Payroll	Payroll Trend Factor	Adjusted Payroll (000's)	
2001	\$510,200,000	1.248	\$636,729,600	
2002	521,290,000	1.188	619,292,520	
2003	649,537,000	1.114	723,584,218	
2004	740,050,000	1.045	773,352,250	
Total	2,421,077,000		2,752,958,588	

¹ The two \$500,000 claims are not trended

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Frequency/Severity Methods - Stochastic Modeling

Table 2

Aggregate Test Data Example

Workers Compensation

Pure Loss Rate Selection and Loss Projection
Losses including ALAE Limited to \$500,000

A. Selection of Pure Loss Rate			
Accident Period	Adjusted Losses	Adjusted Payroll (000's)	Pure Loss Rate Per \$100 Payroll
2001	\$7,253,997	\$636,729,600	\$1.14
2002	8,298,198	619,292,520	1.34
2003	7,035,508	723,584,218	0.97
2004	6,659,970	773,352,250	0.86
Total	\$29,247,673	\$2,752,958,588	1.06
		Average	\$1.08
		Average of 6/30/02-03 and 6/30/03-04	1.16
		Selected	0.98
B. Loss Projection			
Accident Period	Projected Pure Loss Rate	Projected Payroll (000's)	Projected Losses
2005	\$0.98 ³	\$790,000,000	\$7,742,000

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Frequency/Severity Methods - Stochastic Modeling

Table 3

Aggregate Test Data Example

Workers Compensation

Claim Count Projection

A. Estimated Ultimate Claim Counts					
Policy Period	Reported Claim Counts as of 12/31/04	Months of Development	Claim Count Development Factor	Estimated Ultimate Claim Counts	Exposure Adjusted Claim Counts
2001	627	48	1.000	627	778
2002	628	36	1.000	628	801
2003	552	24	1.002	553	604
2004	535	12	1.150	615	628
B. Frequency Calculation					
Policy Period	Estimated Ultimate Number of Claims	Adjusted Payroll	Frequency (Per \$1,000,000 of Adjusted Payroll)		
2001	627	\$636,729,600	0.985		
2002	628	619,292,520	1.014		
2003	553	723,584,218	0.764		
2004	615	773,352,250	0.795		
		Average	0.89		
		4-Year Average	0.858		
		Selected Frequency	0.84		
C. Claim Count Projection					
Policy Period	Selected Frequency	Projected Payroll	Projected Claims		
2005	0.84	\$790,000,000	660		

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Frequency/Severity Methods - Stochastic Modeling

Table 4

Aggregate Test Data Example

Workers Compensation
Average Loss Severities
Losses including ALAE Limited to \$500,000

Policy Period	A. Loss and Claim Data				
	(A)	(B)	(C)	(D)	(E)
	Limited Incurred Losses as of 12/31/04	Estimated Ultimate Incurred Losses	Trended Estimated Ultimate Incurred Losses as of 12/31/04	Reported Claims as of 12/31/04	Estimated Ultimate Claims
2001	\$4,678,547	\$5,390,000	\$7,253,997	627	627
2002	5,673,741	7,035,000	8,298,198	628	628
2003	4,431,242	6,403,000	7,035,508	552	553
2004	2,842,360	6,259,000	6,659,970	535	615
2005		7,742,000	7,742,000		660

Policy Period	B. Average Severities		
	Reported Average Severity (A)/(D)	Estimated Ultimate Average Severity (B)/(E)	Trended Estimated Ultimate Average Severity (C)/(E)
2001	\$7,462	\$8,596	\$11,569
2002	9,035	11,202	13,214
2003	8,028	11,579	12,722
2004	5,313	10,177	10,829
2005	Projected	11,730	11,730

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Frequency/Severity Methods - Stochastic Modeling

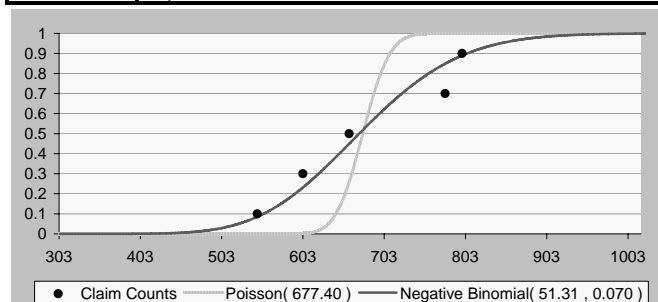
Table 5

Fitted Frequency Distribution

Exposure
Adjusted
Claim Counts

778
801
604
628
660

Distribution	Parameter	Value	Mean	Variance	Var/Mean	Std. Dev.	LR Test	Sigma
Poisson	u	677.40	677.40	677.40	1.00	26.03		
Negative Binomial	r	51.31	677.40	9,620.18	14.20	98.08	-52.46	4.4E-13
	p	0.070						



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Frequency/Severity Methods - Stochastic Modeling

Table 6

Partial Example Input of Detail Developed and Trended Claim Amounts

Accident Year	Acc.Date	Net Inc	Dev't Factor	Trend Factor	Developed & Trended Losses
2001	01/02/01	288	1.152	1.346	447
2001	01/03/01	208	1.152	1.346	322
2001	01/03/01	73,071	1.152	1.346	113,303
2001	01/03/01	176	1.152	1.346	272
2001	01/04/01	28,521	1.152	1.346	44,224
2001	01/04/01	417	1.152	1.346	646
2001	01/05/01	97	1.152	1.346	151
2001	01/05/01	782	1.152	1.346	1,212
2001	01/05/01	60,484	1.152	1.346	93,785
2001	01/06/01	342	1.152	1.346	531
2001	01/07/01	176,931	1.152	1.346	274,347
2001	01/08/01	1,641	1.152	1.346	2,545
2001	01/08/01	110,684	1.152	1.346	171,626
2001	01/08/01	69,055	1.152	1.346	107,076
2001	01/08/01	325	1.152	1.346	504
2001	01/09/01	584	1.152	1.346	906
2001	01/09/01	2,503	1.152	1.346	3,880
2001	01/09/01	2,894	1.152	1.346	4,487
2001	01/09/01	317,973	1.152	1.346	493,046

First lines of detail for 627+628+553+615 = 2,423 claims

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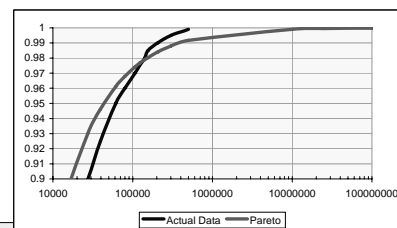
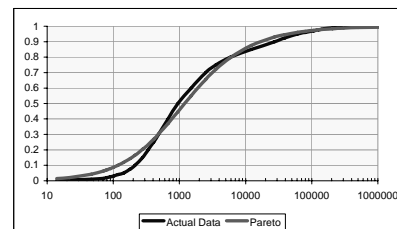
Frequency/Severity Methods - Stochastic Modeling

Table 7

From Fitted Distributions of Truncated Losses

Nsim		Monte Carlo Simulation	
2000		Aggregate Distribution	
Frequency	Negative Binomial	Mean	Standard Deviation
	677.4000 14.2016	677.40	98.08
Severity	Pareto		
	0.7404 772.8946		
Deductibles			
	250,000 500,000 Unlimited	\$ 10,379 \$ 13,005 Undefined	\$ 35,437 \$ 55,755 Undefined
Loss at deductible:			
	250,000 500,000 Unlimited	\$ 7,030,532 \$ 8,809,659 Undefined	\$ 1,373,650 \$ 1,932,057 Undefined

Pareto Cumulative Severity Distribution Plotted on Log Scale



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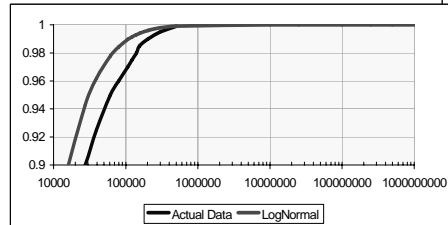
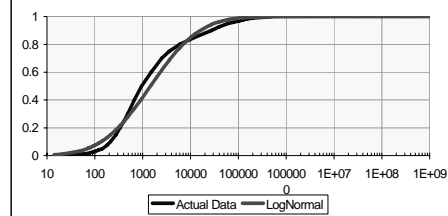
Frequency/Severity Methods - Stochastic Modeling

Table 9

From Fitted Distributions of Truncated Losses

		Nsim		2000	
Frequency	Negative Binomial	677.4000		98.08	
		14.2016			
Severity	Log Normal	8202.13		7.28	
		45417.43			
	Deductibles				
	250,000		\$ 7,417	\$ 22,041	
	500,000		\$ 7,804	\$ 27,395	
	Unlimited		\$ 8,202	\$ 45,417	
	Loss at deductible:				
	250,000		\$ 5,024,600	\$ 926,490	
	500,000		\$ 5,286,289	\$ 1,046,054	
	Unlimited		\$ 5,556,121	\$ 1,429,860	

Log Normal Cumulative Severity Distribution Plotted on Log Scale



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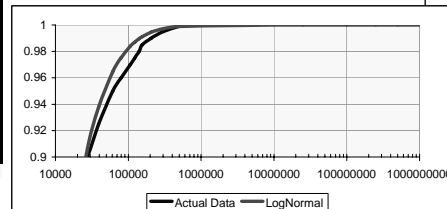
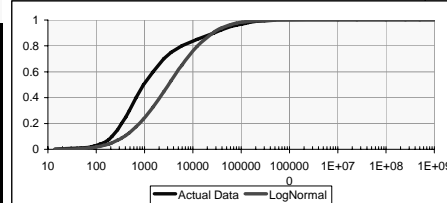
Frequency/Severity Methods - Stochastic Modeling

Table 9

Log Normal with Parameters Adjusted

Nsim		2000	
Frequency	Negative Binomial	660.00	96.81
Severity	Log Normal	\$ 12,135	\$ 45,417
	Deductibles		
	250,000	\$ 11,228	\$ 26,480
	500,000	\$ 11,733	\$ 32,264
	Unlimited	\$ 12,135	\$ 45,417
	Loss at deductible:		
	250,000	\$ 7,410,453	\$ 1,282,356
	500,000	\$ 7,743,929	\$ 1,406,202
	Unlimited	\$ 8,009,100	\$ 1,655,799

Adjusted Log Normal Cumulative Severity Distribution



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Frequency/Severity Methods - Stochastic Modeling

Table 10

From Monte Carlo Simulation of Adjusted Log Normal

Percentile	Aggregate Losses Distribution		
	\$250,000	\$500,000	unlimited
0.050	\$5,516,102	\$5,662,540	\$5,688,505
0.100	5,908,034	6,105,884	6,195,657
0.200	6,418,693	6,660,843	6,773,412
0.300	6,772,332	7,051,848	7,195,860
0.400	7,145,151	7,431,132	7,611,281
0.500	7,448,347	7,771,834	7,964,794
0.550	7,586,048	7,949,695	8,147,791
0.600	7,745,618	8,107,682	8,347,906
0.700	8,085,817	8,451,984	8,749,082
0.800	8,513,655	8,908,710	9,307,401
0.900	9,133,733	9,629,844	10,233,792
0.950	9,660,577	10,241,483	10,922,151
0.990	10,814,786	11,482,363	12,741,926
0.999	11,562,845	12,292,770	14,846,471

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Frequency/Severity Methods - Stochastic Modeling

The Challenge

We can arrive at statistically reasonable estimates of confidence levels for the current year

However

As losses are paid for completed years there is not a standard statistical method to define the reduction in variation around the current mean estimate as claims are closing. Work around: use simulation techniques applied to estimating IBNR on aged years with open claims.

Short cut: use an estimation, mainly judgmental to reduce the variation between confidence levels as policy periods age

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Recent Reserving Research



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Consultants and Actuaries

Recent Reserving Research

- Traditional Research
 - 2005 Group Term Life Waiver Reserve Table
 - IDEC Study
 - Other studies
- Ongoing SOA Research Projects
 - Statistical Tools for Health Actuaries
 - Comparison of IBNR Methodologies

Statistical Tools for Health Actuaries

- Background and Purpose
 - Increased scrutiny on financial reporting
 - Need to assess the likely range or confidence intervals of their estimates
 - Need for practical statistical methodologies for health actuaries

Current Practice

Table 2 Average Industry Margin in 12/2002 Liabilities ¹ As % of Original Liability Established	
Size of Liabilities	Average Margin as of 12/03
Less than \$5 million	9%
\$5 to \$10 million	12%
\$10 to \$20 million	11%
\$20 to \$50 million	11%
Over \$50 million	13%
Total	12%
<small>¹ Source: Summary of 431 NAIC Health Annual Statements as of 12/2003</small>	
<small>² The average of the 25th and 75th percentiles</small>	

- Margins historically set by rule-of-thumb
- Theoretical underpinning weak
- Don't seem to vary by size of company

Current Practice

<i>Table 1</i> <i>Deviation of Actual Paid from Liability Estimate</i> <i>As % of Original Liability Established</i>			
	Mean of Absolute Differences	65th Percentile	90th Percentile
Without Hindsight			
Large plans	11%	6%	17%
Small plans	30%	15%	48%
With One Month of Hindsight			
Large plans	9%	5%	15%
Small plans	22%	12%	34%

- Small plans versus large plans
- Desired confidence level important
- Hindsight leads to some improvement
- Management objectives versus actuary's work

Statistical Tools - Objectives

- Practical guide on statistical methods
- Areas could include estimating claim costs, reserve setting, rate development and margins
- Development of confidence intervals
- Basic software tools

Statistical Tools - Status

- Draft being reviewed
- Areas covered
 - Statistical screens for outliers in data
 - Standard deviation of lag or completion factors
 - Regression analysis for recent months
 - Variables to be considered
 - Confidence intervals for reserves
 - Technical appendix
 - Sample spreadsheet

Statistical Tools – Sample Table

Completion Factor Method
Calculation of the Coefficient of Variation

Lag	Completion Factor		
	Mean of Individual Months	Standard Deviation	Coefficient of variation (Std. Dev./Mean)
0	0.03215	0.02548	0.79237
1	0.58789	0.12032	0.20467
2	0.84632	0.06114	0.07225
3	0.92366	0.04414	0.04778
4	0.95917	0.02483	0.02588
5	0.97211	0.02271	0.02336
6	0.98437	0.01471	0.01494
7	0.98975	0.01410	0.01425
8	0.99223	0.01444	0.01455
9	0.99551	0.01460	0.01467
10	0.99645	0.01025	0.01028
11	0.99904	0.00293	0.00294
12	1.00000	-	-

Statistical Tools – Other Issues

- Coverages other than medical
- Non-random events
- Sample size of past data
- Role of surplus versus margin

Comparison of IBNR Methodologies

- A need for comparative information on the accuracy of various IBNR methodologies
- Completion factor methods, statistical methods, other should be considered
- Factors which could be important to choice:
 - Benefit Plan Variations
 - Need for margins/confidence intervals
 - Claim Backlogs
 - Propensity for Large Claims
 - Other

IBNR Methodologies - Status

- Status
 - Proposals submitted by March 30th, 2007
 - Selection of proposal expected soon
 - Work will commence upon selection

Valuation and Reserving Techniques



Individual A&H Product Reserves

Presented on June 13, 2007

By: Russ Willard, ASA, MAAA

Humana, Inc.

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Presentation Objectives

Understand:

- ☐ **The Impact of Reserve Assumptions
Upon Product Profitability**
- ☐ **How GAAP Accounting Affects
Company Profits**
- ☐ **The Differences Between GAAP,
Statutory and Tax Reserves**

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Session Overview

Accident & Health Product Descriptions

- Short Term vs Long Term Products
- Short Duration vs Long Duration Liabilities

3

Session Overview

GAAP Reserves

- Basic GAAP Principles
- Benefit (or Policy) Reserves
- Deferred Acquisition Costs
- GAAP Assumptions – including PAD

4

Session Overview

GAAP Reserves Compared To:

- Statutory
 - Contract Reserves
 - Premium Reserves
- Tax
 - Other Than Claim Reserves
 - Claim Reserves

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Examples of Accident & Health Product Benefits

Short Term Benefits

- Group Major Medical
- Group Ancillary Coverages
- Medicare Advantage



Long Term Benefits

- Individual Major Medical
- Disability Income
- Long Term Care
- Medicare Supplement

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Examples of Accident & Health Product Liabilities

Short Duration Liabilities

- Major Medical Claim Liabilities
- Dental Claim Liabilities
- Premium Deficiencies



Long Duration Liabilities

- GAAP, Statutory and Tax Policy Reserves
 - Individual Major Medical
 - Individual Disability Income
 - Long Term Care
 - Medicare Supplement
- Claim Reserves
 - Disability Income
 - Premium Waiver
- DAC for All Products



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Basic GAAP Concepts



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GAAP for Accident & Health Products

Group Products

- Short Life Time
- Short Guarantees
- Level Acquisition Costs
- Aggregate Liabilities
- Fewer Rules

Individual Products

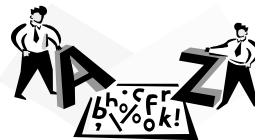
- Longer Life Time
- Longer Guarantees
- Substantial Acquisition Costs
- Individual Liabilities
- Highly Regulated

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GAAP for Accident & Health Products

GAAP Objective:

- Match Revenues and Expenses
- **Profits as a Level % of Premiums**



- Benefit Reserves
- Expense Reserves
- Deferred Acquisition Costs

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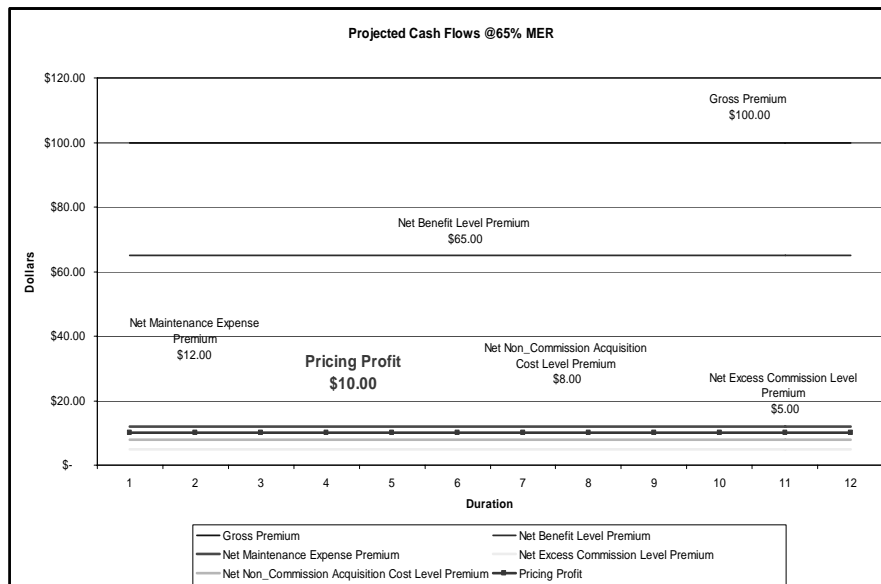
GAAP For Individual Products

Pricing Premium Example

Pricing Benefit Net Premium	\$	65.00
Pricing Maintenance Net Premium	\$	12.00
Pricing Excess Commission Net Premium	\$	5.00
Pricing Non-Commission Acquisition Costs		
Net Premium	\$	<u>8.00</u>
Total Net Premium	\$	90.00
Gross Premium	\$	100.00
Net to Gross Ratio		90.00%
Projected Pricing Profit as a % of Premium		10.00%

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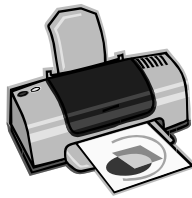
Management Expectations



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GAAP For Individual Products

Benefit Reserves₁
a.k.a., Policy or Active Life Reserves



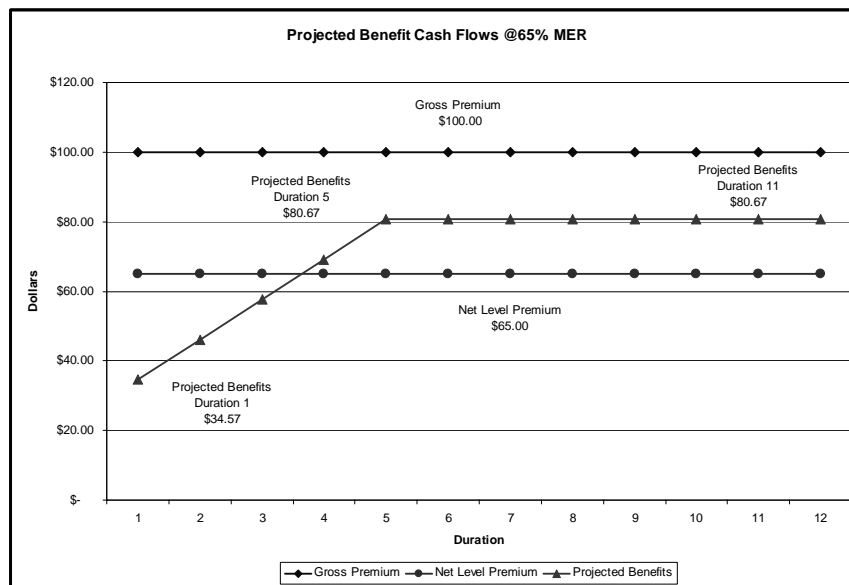
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GAAP For Individual Products

Benefit Reserves

- Pre-funding Concept:
 - Early premiums higher than necessary
 - e.g., Issue Age Premiums; or
 - Select Underwriting Curve
- Net Level Benefit Premium Methodology
 - Net Premiums Proportional
to Gross Premiums
 - Various Formulas To Choose From

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GAAP For Individual Products

Benefit Reserve - Development

- Select Platform
 - Worksheet
 - System Software
- Select Reserve Formula
 - Prospective
 - Retrospective
 - Fackler Accumulation
 - Commutation Functions

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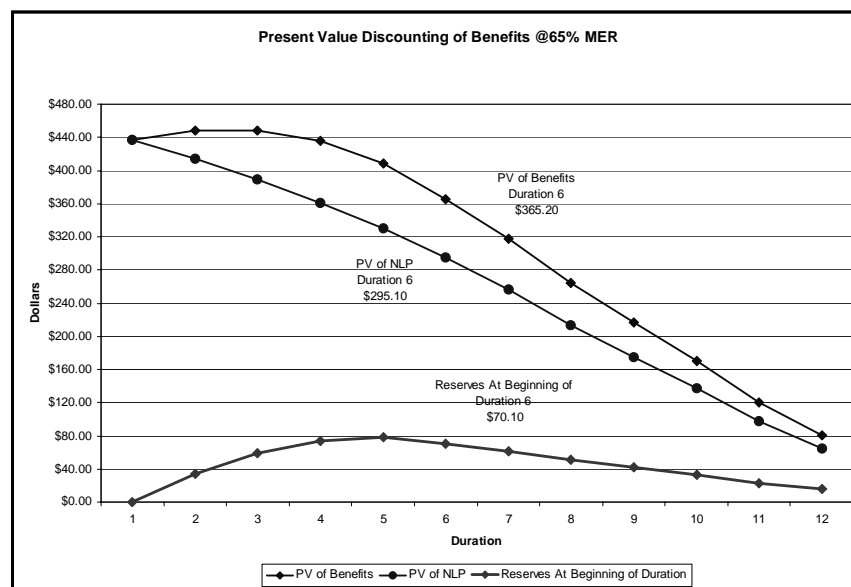
Policy Reserves Prospective Reserve Calculation

${}_tV_x$ = Terminal Reserve at Duration t , for a Benefit Issued at Age x

$${}_tV_x = PVFB(x+t) - PVFNP(x+t)$$

$$= A_{x+t} - P_x * \ddot{a}_{x+t}$$

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GAAP For Individual Products

Active Life Benefit Reserve Assumptions

- **Best Estimate Assumptions plus PAD***

- Morbidity
- Discount Rate of Interest
- Persistency or Lapse Rates
- Maintenance Expenses
- Mortality

**PAD - Provision for Adverse Deviation*

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GAAP For Individual Products PAD Discussion

- FAS 60 Margin
- Applies To All Assumptions; except
- Persistency
 - Difficult to Determine Impact
 - Timing
- Consider Reasonableness by Assumption; and
- In Total

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GAAP For Individual Products

Pricing Premium Example

Pricing Benefit Net Premium	\$	65.00
Pricing Maintenance Net Premium	\$	12.00
Pricing Excess Commission Net Premium	\$	5.00
Pricing Non-Commission Acquisition Costs		
Net Premium	\$	<u>8.00</u>
Total Net Premium	\$	90.00
Gross Premium	\$	100.00
Net to Gross Ratio		90.00%
Projected Pricing Profit as a % of Premium		10.00%

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GAAP For Individual Products

GAAP Premium Example

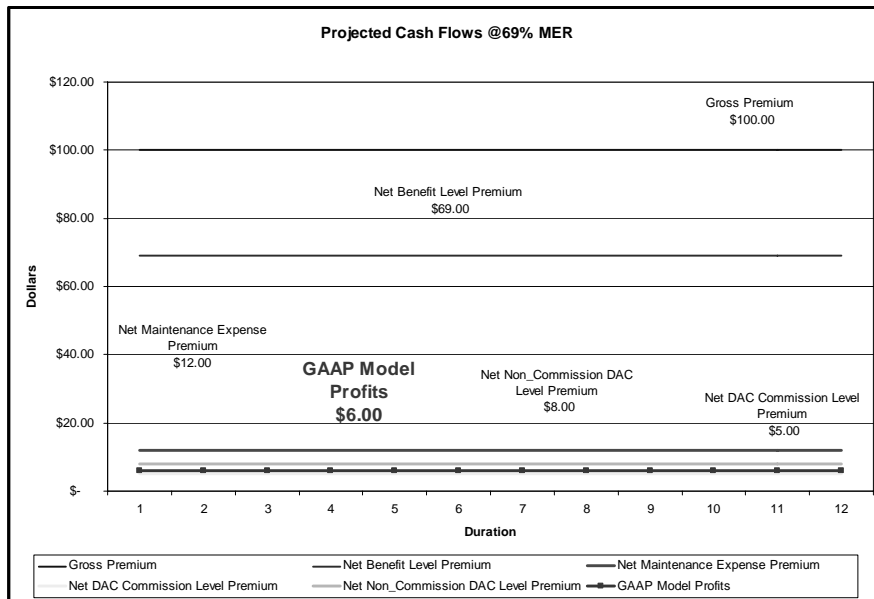
GAAP Benefit Net Premium	\$	69.00
GAAP Maintenance Net Premium	\$	12.00
GAAP Commission DAC Net Premium	\$	5.00
GAAP Non-Commission DAC Net Premium	\$	<u>8.00</u>
Total Net Premium	\$	94.00
Gross Premium	\$	100.00
Net to Gross Ratio		94.00%
Projected GAAP Profit as a % of Premium		6.00%

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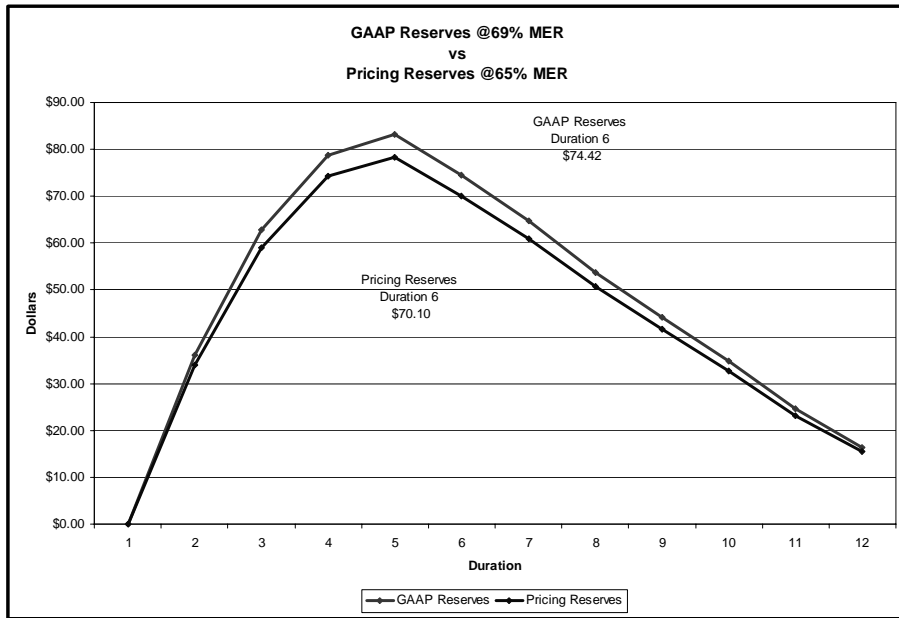
GAAP For Individual Products Example Assumptions

- Benefits Paid at End of Period
- Lapses Occur After Benefits Paid
- Discount Rate @ 3.5%
- Gross Premium = \$100.00
- Time Horizon = 12 Durations
- Expenses are Ignored (for now...)
- Mortality is Ignored as Immaterial

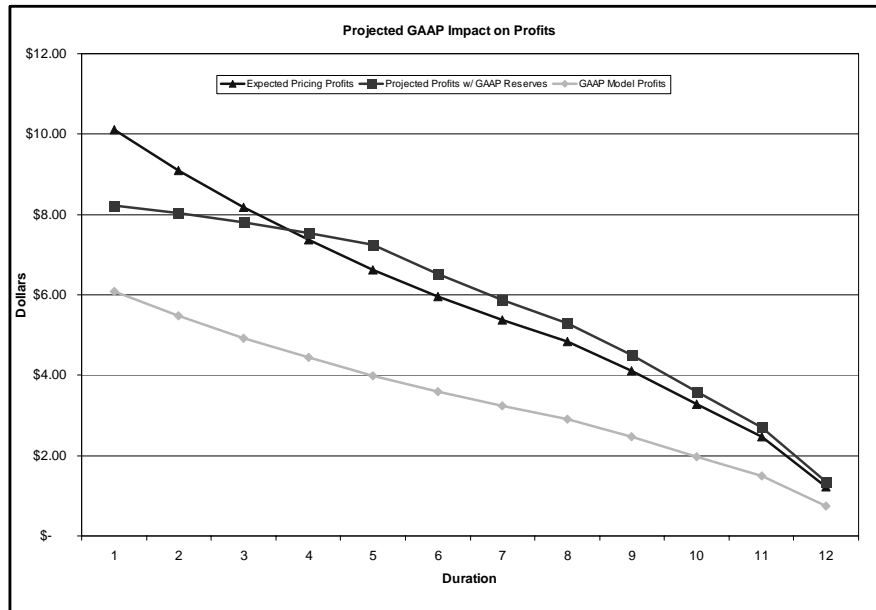
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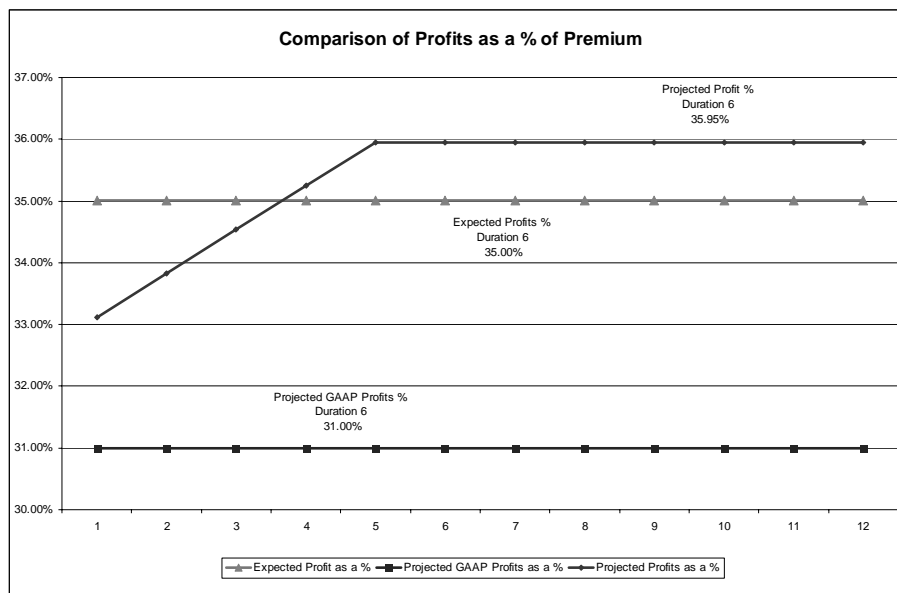
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GAAP For Individual Products

Maintenance Expense Reserves

- For Example
 - Customer Service,
 - Claim Processing,
 - Premium Billing, ...
- Similar to Benefit Reserves
 - Net Level Maintenance Expense Premium
 - May Be Combined with Benefit Reserves
- Often Immaterial



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GAAP For Individual Products

Deferred Acquisition Costs (DAC)

- Deferrable Expenses
 - Excess Commission
 - Non-Commission Expenses Prior To Issue
- Must be Recoverable!
- Actuarial Formula -
 - Net Level DAC Premium
 - Similar to Benefit Reserves
- PAD
 - Time Horizon
 - Interest Discount Rate

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GAAP For Individual Products

DAC Recoverability

- DAC Recoverability - Current Year
 - Actual Expenses to Assumed Expenses Capitalized
 - Adequacy of Future Revenues
- Loss Recognition - Aggregate Business
 - Adequacy of Future Revenues
 - All Business Written To Date
 - To Support Total DAC Balance; and,
 - Future Benefits and Expenses



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GAAP vs Statutory Reserves



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GAAP vs Statutory Reserves

- Benefit Reserves vs Contract Reserves
- Unearned Premium Reserves
- Claim Reserves / IBNR / Loss Reserves
- Premium Deficiency Reserves
- Loss Adjustment Expense (LAE)

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Statutory Contract Reserves

Assumptions

- Regulatory Minimum Standards
 - Morbidity
 - Varies by Product Type
 - Minimal Guidance
 - e.g., Nelson Warren Tables, 1985 CIDA
 - Mortality – Consistent with Life Insurance
 - Interest Discount Rate
 - Whole Life Rate – 4.5% in 2005 and 4.00% in 2006
 - Persistency
 - Often Limited or Not Allowed at All

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GAAP vs Tax Reserves



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Tax Reserve Calculations

Tax Reserves

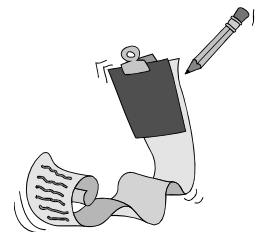
- **Statutory vs Tax:**
 - Tax < or = Statutory
- **Contract Reserves**
 - Prevailing Tables
 - FPIR
 - Minimum Reserve
- **Premium Reserves**
 - NO Deficiency Reserves
- **Claim Reserves**
 - Test the Statutory Reserves Against Claim Run Out.



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GAAP and Statutory Reserves Practical Considerations

- Policy Coverage Changes
- Rate Actions
- Tighten Assumptions
- Be Conscious of Precedence
- Internal Communications
- Product Design
 - Durational Rating
 - Termination Age



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Presentation Objectives

Understand:

- ✓ **The Impact of Reserve Assumptions Upon Product Profitability**
- ✓ **How GAAP Accounting Affects Company Profits**
- ✓ **The Differences Between GAAP, Statutory and Tax Reserves**

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Resources

- Financial Accounting Standards
- Statutory Accounting Practices
- Internal Revenue Code
- Actuarial Standards of Practice (ASOPs)
- AAA Practice Notes
- General Professional Literature
- Consultants
- Auditors
- Peers



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