



CAS Ratemaking and Product Seminar

Basic Ratemaking

Estimating Claim Liabilities

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Goal of Estimating Claim Liabilities

- Estimate the **Claim Liabilities** for setting **Loss Reserves**
- Claim Liabilities – the amount we need to pay for claims that have **Occurred** up to the valuation date
- Reserves – the amount on the balance sheet
- Standard Tool is the Loss Triangle

Estimating Claims Liabilities

Basics

Segmentation of Lines of Business

- Important to Segment Lines into **Homogenous** Groups
- Keep them Large enough to be statistically **Credible**

Segmentation of Indemnity and Expense

- Losses can be Split into **Indemnity** (to client or 3rd party)
- and **Expense** (for handling specific claims)
- Reviewed Together

Paid vs. Incurred

- Paid Loss Analysis
- Incurred Loss (Paid + Outstanding)

Accident Year Report Year Policy Year

- AY is useful for setting reserves
- RY is useful for setting reserves for Claims-Made Policies
- PY is useful for examining impact of U/W and Rate Changes

Estimating Claim Liabilities

Development Factor Method

- Assume Payment Pattern (or Reporting) of Losses is the same for each Accident Year
- Losses Paid in each Accident Year are Independent of other Years

Estimating Claim Liabilities

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AY \ Age	12	24	36	48
2011	30%	75%	90%	100%
2012	30%	75%	90%	
2013	30%	75%		
2014	30%			

Estimating Claim Liabilities

Development Factor Method

- Assume Payment Pattern (or Reporting) of Losses is the same for each Accident Year
- Losses Paid in each Accident Year are Independent of other Years

AY \ Age	12	24	36	48
2011	30%	75%	90%	100%
2012	30%	75%	90%	
2013	30%	75%		
2014	30%			
Cumulative LDF	3.333	1.333	1.111	1.000

	12-24	24-36	36-48	
Incremental LDF	2.500	1.200	1.111	

$$\frac{1}{LDF} = \% \text{ Paid to Date}$$

Sample Triangle

Incremental Paid Losses

AY \ Age	12	24	36	48
2010	643	343	134	26
2011	689	405	180	37
2012	594	602	40	
2013	703	294		
2014	802			

- 703 is the amount Paid for Claims Occurring in 2013, and Paid in that year
- 294 is the amount Paid for Claims Occurring in 2013, and Paid in the following year

Estimating Claims Liabilities

Time Increments

- In the US – Year by Year is Common
- Fast Paying Lines, Quarter by Quarter is useful
- You can also do Accident Year by Development Quarter

Claim Counts

- Useful to Review Claim Count Statistics
 - Frequency, Report Rate, Closure Rate

Closure Rates

- Higher Paid Claims may be due to higher Closure Rate

Sample Quarterly Triangle

Cumulative Paid Losses

AY \ Age	3	6	9	12	15
2014 Q1	63	164	210	210	210
2014 Q2	68	171	216	216	
2014 Q3	71	184	222		
2014 Q4	75	190			
2015 Q1	76				

Earned Premium
400
420
440
455
470

Sample Quarterly Triangle

Cumulative Paid Losses

AY \ Age	3	6		3/6	LDF
2014 Q1	63	164		38.4%	2.603
2014 Q2	68	171		39.8%	2.515
2014 Q3	71	184		38.6%	2.592
2014 Q4	75	190		39.5%	2.533
2015 Q1	76				
Wtd Avg				39.1%	2.560

Sample Quarterly Triangle

Cumulative Paid Losses

AY \ Age	6	9		9/6	LDF
2014 Q1	164	210		78.1%	1.280
2014 Q2	171	216		79.2%	1.263
2014 Q3	184	222		82.9%	1.207
2014 Q4	190				
2015 Q1					
Wtd Avg				80.1%	1.249

Sample Quarterly Triangle

Loss Development Factors (LDFs)

AY \ Age	3-6	6-9	9-12	12-15
2014 Q1	2.603	1.280	1.000	1.000
2014 Q2	2.515	1.263	1.000	
2014 Q3	2.592	1.207		
2014 Q4	2.533			

Earned Premium
400
420
440
455

Wtd Avg	2.560	1.249	1.000	1.000
Avg	2.561	1.250	1.000	1.000
Median	2.562	1.263	1.000	1.000

Sample Quarterly Triangle

Loss Development Factors (LDFs)

AY \ Age	3-6	6-9	9-12	12-15
Selected	2.560	1.249	1.000	1.000
Cumulative LDF	3.197	1.249	1.000	1.000
% Paid	31.3%	80.1%	100%	100%
% Unpaid	68.7%	19.9%	0%	0%

Sample Quarterly Triangle

Development Factor Method

AY \ Age	Paid to Date	Cumulative LDF	DFM	Unpaid Losses
2014Q1	210	1.000	210.0	-
2014 Q2	216	1.000	216.0	-
2014 Q3	222	1.000	222.0	-
2014 Q4	190	1.249	237.3	47.3
2015 Q1	76	3.197	243.0	167.0

214.3

Earned Premium	Loss Ratio
400	52.5%
420	51.4%
440	50.5%
455	52.2%
470	51.7%

Sample Quarterly Triangle

Development Factor Method

AY \ Age	Paid to Date	Cumulative LDF	DFM	Unpaid Losses
2014Q1	210	1.000	210.0	-
2014 Q2	216	1.000	216.0	-
2014 Q3	222	1.000	222.0	-
2014 Q4	190	1.249	237.3	47.3
2015 Q1	96	3.197	306.9	210.9

258.2

Earned Premium	Loss Ratio
400	52.5%
420	51.4%
440	50.5%
455	52.2%
470	65.3%

High Leverage on years with a high LDF

Estimating Claim Liabilities

Methods

Loss Development Method

- Assumes Rate at which losses are paid (or incurred) is constant
- Does not handle changing inflation, trend or mix of business well
- Can lead to volatile results

Bornhuetter-Ferguson

- Reduces Volatility in Claim Liability Estimate
- Ignores Recent Experience in estimating Claim Liability
- Not always clear what to use for *a priori*

Cape Cod Generalized Cape Cod

- Uses Experience to estimate the *a priori* Loss Ratio
- Allows the *a priori* to vary by Accident Year

Benktander

- Apply BF. Use the Ultimate from BF as *a priori*, and apply BF again
- Optimal – in the sense that it has very low MSE of the estimate vs. the actual result
- More Stable than LDF, and considers actual experience to date

Sample Quarterly Triangle

Cape Cod

AY \ Age	Paid to Date	Cumulative LDF	Earned Premium	% Paid	<i>EP</i> × %<i>Paid</i>
2014Q1	210	1.000	400	100%	400.0
2014 Q2	216	1.000	420	100%	420.0
2014 Q3	222	1.000	440	100%	440.0
2014 Q4	190	1.249	455	80.1%	364.5
2015 Q1	96	3.197	470	31.3%	147.1
	934				1,771.6

$$\frac{934}{1,771.6} = 52.7\%$$

Sample Quarterly Triangle

Bornhuetter-Ferguson with Cape Cod LR = 52.7%

AY \ Age	Paid to Date	Cumulative LDF	Earned Premium	<i>a priori</i>	BF	Unpaid Losses	Loss Ratio
2014Q1	210	1.000	400				52.5%
2014 Q2	216	1.000	420				51.4%
2014 Q3	222	1.000	440				50.5%
2014 Q4	190	1.249	455	239.8	237.8	47.8	52.2%
2015 Q1	96	3.197	470	247.7	266.2	170.2	65.3%

218.0

$$\text{BF Ultimate} = 96 + \left(1 - \frac{1}{3.197}\right) \cdot 247.7 = 266.2$$

$$\text{BF Reserve} = 68.7\% \cdot 247.7 = 170.2$$

Sample Quarterly Triangle

Benktander

AY \ Age	Paid to Date	LDF	DFM	BF	Benktander	Benktander Unpaid
2014Q1	210	1.000	210.0	210.0		
2014 Q2	216	1.000	216.0	216.0		
2014 Q3	222	1.000	222.0	222.0		
2014 Q4	190	1.249	237.3	237.8	237.4	47.4
2015 Q1	96	3.197	306.9	266.2	278.9	182.9
Unpaid			258.2	218.0	230.3	

$$\text{Benktander Ultimate} = 96 + \left(1 - \frac{1}{3.197}\right) \cdot 266.2 = 278.9$$

$$\text{BF Reserve} = 68.7\% \cdot 266.2 = 182.9$$

Sample Quarterly Triangle

Benktander

AY \ Age	Paid to Date	LDF	DFM	BF	Benktander	Benktander Unpaid
2015 Q1	96	3.197	306.9	266.2	278.9	182.9

A priori = 247.7

$$\frac{1}{LDF} = \% \text{ Paid} = 31.3\%$$

- BF is the weighted average of DFM and the Loss Ratio Method
- Benktander is weighted average of DFM and BF
- In both cases DFM gets the weight $\frac{1}{LDF} = \% \text{ Paid}$

$$306.9 \cdot 31.3\% + 247.7 \cdot 68.7\% = 266.2$$

$$306.9 \cdot 31.3\% + 266.2 \cdot 68.7\% = 278.9$$

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Estimating Claim Liabilities

Advanced

Inflation CY Trend

- DFM method assumes constant inflation historically and into the future
- Cannot handle changing CY Trend

Changing Patterns

- If LDF Patterns are changing – Find out Why
- Speak to Claims and Product
- Focus on Recent Experience

Know Your Market

- Read Articles, Journals about your Industry
- Keep informed of market trends
- Know your general economic environment

Estimating Claims Liabilities

Outliers

- May be reasonable to remove
- They can have an outside impact on the Weighted LDF

Exposures Bases

- Earned Premium is often used (maybe adjust for Net Trend (Premium – Loss))
- # of Vehicles, # of Homes
- Workers Compensation - \$ of Wages, # of Employees – or a mix of both

ULAE

- Paid to Paid Method
- Claim Counts Methods

Talk to Business

- If you see anomalies in the triangle, ask
- They know what is happening with their **Portfolio Mix** and **Claims**
- Better to find out something change before you submit results, then after

Estimating Claim Liabilities

Fisher-Lange

Estimating the Tail

3 way Parameters

Bootstrapping

- Forecast # of Unpaid Claims & Severity; Multiply
- Severity depends on Accident Year and Age
- Explicit Inflation assumptions can be used
- Curves
- Extrapolation
- Model 3 Dimensions: Row (AY), Column (Age), Diagonal (CY)
- Able to handle changes in CY Trend and portfolio mix
- Difficult to fit – since there can be so many parameters
- Given: Mean and Variance for Incremental Loss in each Cell
- Residuals: $\frac{A-E}{\sqrt{E}}$ for each historical cell
- Sample the residuals to create a **sampled** historical triangle
- Forecast Claim Liability based on the historical triangle (DFM, BF, etc.)
- Do this multiple times to determine a distribution of the Claim Liability

Estimating Claim Liabilities

Talk to Claims

- They are the closest to any changes in loss trends
- Inform you of any changes to their process
- Can work with them to gain knowledge of the Life of a Claim

Notes to the Actuary

- Listen to Product Management. They know changes to their product better than anyone else
- It's not good enough to say the LDF is higher – Why is it higher?
- If Product fights you, you will do better if you understand their business

Notes to the Product Manager

- Engage the actuary in discussions about your book
- You don't always know which bit of information is useful to her
- Be Respectful and Honest. The actuary will value your opinion

Segmentation Within a Line of Business

- Coverages may have different behavior (Auto PD vs TPL)
- A group of similar policies may have undue influence on the rest of the book