Introduction to Casualty Actuarial Science

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Casualty Actuarial Science

Two major areas are measuring

1. Written Premium Risk
   - Pricing
2. Earned Premium Risk
   - Reserving

Definitions

- What is a Loss Reserve?

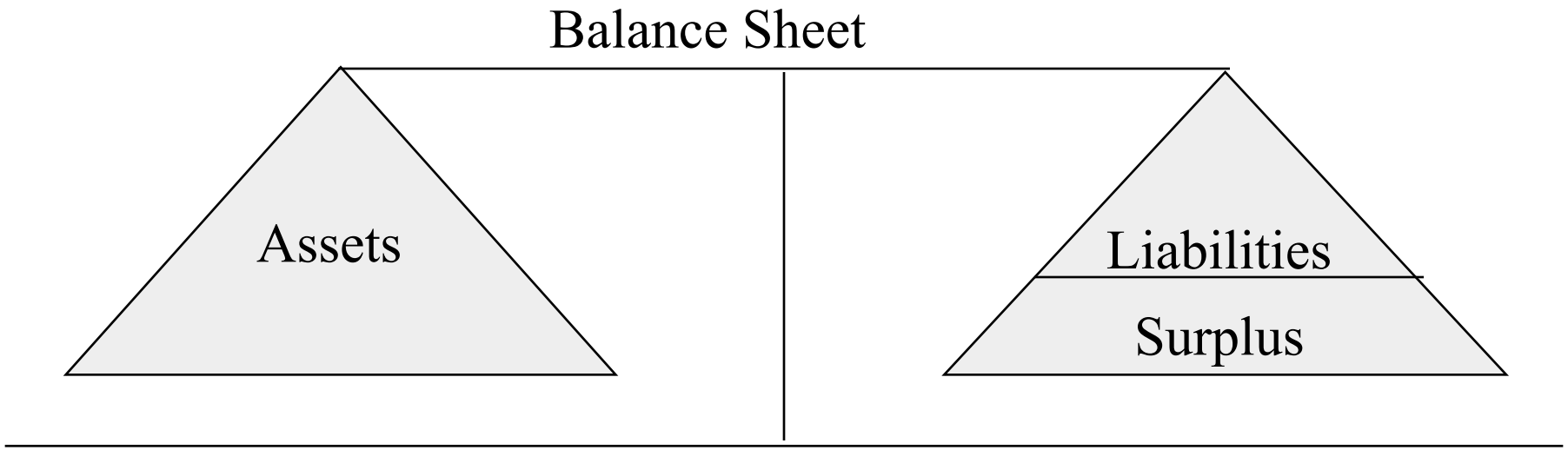
  Amount necessary to settle unpaid claims

- Why are Loss Reserves Important?

  Accurate evaluation of financial condition & underwriting income

Definitions

- Accounting Aspects of Loss Reserves



Definitions

- Case Reserves
  - » Claim reported but not yet paid
  - » Assigned a value by a claims adjuster or by formula
- Bulk + IBNR reserves include:
  - » Reserves for claims not yet reported (pure IBNR)
  - » Claims in transit
  - » Development on known claims
  - » Reserves for reopened claims

Life Cycle of a Claim Reserve

4/2/11
Accident occurs

Pure IBNR

7/11/11
Accident reported

Claims in Transit

8/1/11
Accident entered into records as $1,000 Formula Reserve

10/5/11
Individual reserve established

$10,000 Case Reserve

1/1/12
Estimate revised

$25,000 Case Reserve

8/18/12
Settlement agreed

$30,000 Case Reserve

8/25/12
Payment sent

$30,000 Case Reserve

9/2/12
Claim draft clears

Closed

Other Considerations

- Factors Affecting Loss Reserves
  - » External or Environmental
    - – Society
    - – Regulation
    - – Judiciary
    - – Seasonality
    - – Residual Market
    - – Inflation
    - – Economy

Basic Reserving Techniques

- Expected Loss Ratio Method
- Loss Development Method
- Bornhuetter/Ferguson Method

Expected Loss Ratio Method

EXPECTED LOSS RATIO (ELR)

The anticipated ratio of projected ultimate losses to earned premiums.

Sources:

- Pricing assumptions
- Industry data

Expected Loss Ratio Method

EXAMPLE OF ELR USING PRICING ASSUMPTIONS

Commissions	20%
Taxes	5%
General Expenses	12%
Profit	(2%)
Total	35%

Amount to pay for loss & loss expense ---- 65% of premium

Expected Loss Ratio Method

Estimating Reserves Based on ELR - Example

Earned Premium = $100,000
Expected Loss Ratio = 0.65
Paid Losses = $10,000

Total = ($100,000 x 0.65) = $65,000

Reserve = Total – Paid

= $65,000 - $10,000

= $55,000

Expected Loss Ratio Method

Estimating Reserves Based on ELR

Use when you have no history such as:

- New product lines
- Radical changes in product lines
- Immature accident years for long tailed lines

Can generate "negative" reserves if Ultimate Losses < Paid Losses

Basic Reserving Techniques: Definitions

- Loss Development

  The financial activity on claims from the time they occur to the time they are eventually settled and paid.

- Triangles

  Compiled to measure the changes in cumulative claim activity over time in order to estimate patterns of future activity.

- Loss Development Factor

  The ratio of losses at successive evaluations for a defined group of claims (e.g. accident year).

Basic Reserving Techniques:
Compilation of Paid Loss Triangle

- The losses are sorted by the year in which the accident occurred.
- The losses are summed at the end of each year.
- Losses paid to date are shown on the most recent diagonal.
- The data is organized in this way to highlight historical patterns.

Basic Reserving Techniques:
Compilation of Paid Loss Triangle

- The goal is to estimate the total amount that will ultimately be paid

Cumulative Paid Losses ($000)							
Accident Year	Development Stage in Months						Final Total Cost
	12	24	36	48	60	72	
2006	3,780	6,671	8,156	9,205	9,990	10,508	???
2007	4,212	7,541	9,351	10,639	11,536		???
2008	4,901	8,864	10,987	12,458			???
2009	5,708	10,268	12,699				???
2010	6,093	11,172					???
2011	6,962						???

Basic Reserving Techniques:
Paid Loss Development Factors

Accident Year	Evaluation Interval in Months					
	12-24	24-36	36-48	48-60	60-72	72-Ult
2006	1.765	1.223	1.129	1.085	1.052	???
2007	1.790	1.240	1.138	1.084		
2008	1.809	1.240	1.134			
2009	1.799	1.237				
2010	1.834					
2011						

Sample Calculation for Accident Year 2007:	
12-to-24 Months	1.790 = 7,541 / 4,212

From the end of the accident year (at 12 months) to the end of the following year (at 24 months), paid losses for 2007 grew 79%. During the next year (from 24 to 36 months), paid losses experienced an additional 24% growth (or development) and so forth.

Loss Development Factors (LDFs) are also known as Age-to-Age Factors or Link Ratios

Basic Reserving Techniques:
Paid Loss Development Factors

Accident Year	Evaluation Interval in Months					
	12-24	24-36	36-48	48-60	60-72	72-Ult
2006	1.765	1.223	1.129	1.085	1.052	???
2007	1.790	1.240	1.138	1.084		
2008	1.809	1.240	1.134			
2009	1.799	1.237				
2010	1.834					
2011						
Simple Average - All Years	1.799	1.235	1.133	1.085	1.052	
Simple Average - Latest 3 Years	1.814	1.239	1.133	XXX	XXX	
Simple Average - Excluding High & Low	1.799	1.238	1.134	XXX	XXX	
Weighted Average - All Years	1.803	1.235	1.134	1.085	1.052	
Selected Loss Development Factors	1.800	1.235	1.134	1.085	1.052	1.07

Basic Reserving Techniques:
Application of Paid LDM

Selected Loss Development Factors						
	12-24	24-36	36-48	48-60	60-72	72-Ult
	1.800	1.235	1.134	1.085	1.052	1.070

Cumulative Paid Losses ($000)							
Accident	Development Stage in Months						Final Total
Year	12	24	36	48	60	72	Cost
2006	3,780	6,671	8,156	9,205	9,990	10,508	11,244
2007	4,212	7,541	9,351	10,639	11,536	12,136	12,985
2008	4,901	8,864	10,987	12,458	13,517	14,220	15,215
2009	5,708	10,268	12,699	14,401	15,625	16,437	17,588
2010	6,093	11,172	13,797	15,646	16,976	17,859	19,109
2011	6,962	12,532	15,477	17,550	19,042	20,032	21,435

Sample Calculations for Accident Year 2011:

At 24 Months: 12,532 = 6,962 x 1.800
At 36 Months: 15,477 = 12,532 x 1.235
or 15,477 = 6,962 x 1.800 x 1.235

Cumulative Loss Development Factors						
	12-Ult	24-Ult	36-Ult	48-Ult	60-Ult	72-Ult
	3.079	1.710	1.385	1.221	1.126	1.070

Basic Reserving Techniques:
Paid LDM Projections & Reserves

- Loss Reserve Estimate @ 12/31/2011 = $32.241 million

(1) Accident Year	(2) Actual Paid Losses @12/2011	(3) Selected LDFs	(4) Cumulative Dev Factors to Ult	(5)=(2)x(4) Estimated Ultimate Losses	(6)=(5)-(2) Estimated Loss Reserves
2006	10,508	1.070	1.070	11,244	736
2007	11,536	1.052	1.126	12,985	1,449
2008	12,458	1.085	1.221	15,215	2,757
2009	12,699	1.134	1.385	17,588	4,889
2010	11,172	1.235	1.710	19,109	7,937
2011	6,962	1.800	3.079	21,435	14,473
Total	65,335			97,576	32,241

BORNHUETTER-FERGUSON APPROACH APPLIED TO A NON-INSURANCE EXAMPLE

Given the following, how many home runs will Albert Pujols hit this year?

① You initially expected he would hit 40 home runs this year

① He has hit 20 home runs through 40 games

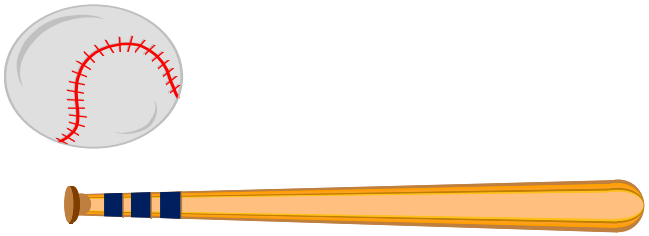
② There are 160 games in a season

Three pieces of information are need to perform a Bornhuetter-Ferguson (B-F) projection:

① Expected Ultimate Value

② Cumulative Loss Development Factor

③ Amount Incurred To Date



BORNHUETTER-FERGUSON APPROACH APPLIED TO A NON-INSURANCE EXAMPLE

The three pieces of information for our example :

① Before the season started, how many home runs would we have expected Albert Pujols to hit?

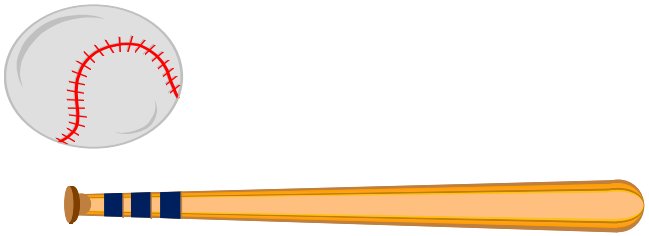
Expected Ultimate Value = 40

② To project season total from current statistics, multiply the current statistics by 4 since the season is 1/4 completed.

Cumulative Loss Development Factor = 4.000

③ He has already hit 20 home runs.

Amount Incurred To Date = 20



BORNHUETTER-FERGUSON APPROACH APPLIED TO A NON-INSURANCE EXAMPLE

B-F Projection: Ultimate Value = (Expected Value*IBNR Factor)+(Inc. to Date)

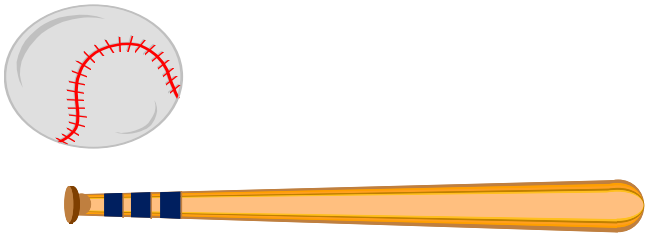
IBNR Factor = 1.000 - (1.000/LDF) = 1.000 - (1.000/4.000) = .75

(In Other Words, 75% of the season is left to be played)

Ultimate Value = (40 * .75) + 20 = 50

The B-F Method projects that Albert Pujols will hit 50 home runs this year.

Games 0-40	Games 41-80	Games 81-120	Games 121-160
20 Home Runs	10 Home Runs	10 Home Runs	10 Home Runs



BORNHUETTER-FERGUSON APPROACH APPLIED TO A NON-INSURANCE EXAMPLE

Comparison of B-F with Two Other Methods

① **Incurred Loss Development Method**

Ultimate Value = Incurred To Date * Cumulative LDF

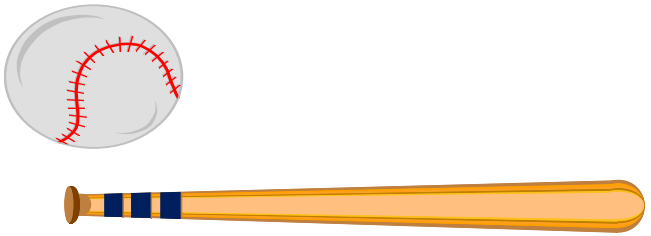
= 20 * 4.000 = 80 Home Runs

Games 0-40	Games 41-80	Games 81-120	Games 121-160
20 Home Runs	20 Home Runs	20 Home Runs	20 Home Runs

① **Expected Loss Ratio Method**

Ultimate Value = Expected Value = 40 Home Runs

Games 0-40	Games 41-80	Games 81-120	Games 121-160
10 Home Runs	10 Home Runs	10 Home Runs	10 Home Runs



Example

Example

You are given the following losses evaluated at 12/31/2011. Use the paid loss development method to estimate the required reserves by accident year. Assume all losses are fully developed at 60 months.

Cumulative Paid Losses ($000)					
Accident Year	Development Stage in Months				
	12	24	36	48	60
2007	3,000	6,000	9,000	10,800	11,340
2008	3,200	6,400	9,600	11,520	
2009	3,500	7,000	10,500		
2010	3,800	7,600			
2011	5,000				

Solution

Age-to-Age Development Factors				
12-24	24-36	36-48	48-60	60-Ult
2.000	1.500	1.200	1.050	1.000

Cumulative Development Factors				
12-Ult	24-Ult	36-Ult	48-Ult	60-Ult
3.780	1.890	1.260	1.050	1.000

Accident Year	(1) Paid Losses @12/2011	(2) Dev Factors to Ult	(3)=(1)*(2) Estimated Ultimate Losses	(4)=(3)-(1) Estimated Loss Reserve
2007	11,340	1.000	11,340	0
2008	11,520	1.050	12,096	576
2009	10,500	1.260	13,230	2,730
2010	7,600	1.890	14,364	6,764
2011	5,000	3.780	18,900	13,900

Further Reading

For additional information on Loss Reserving, see the following references at www.casact.org

Friedland, J.F., *Estimating Unpaid Claims Using Basic Techniques,* Casualty Actuarial Society, Third Version, July 2010.

http://www.casact.org/pubs/Friedland_estimating.pdf

Brosius, E., "Loss Development Using Credibility," CAS Study Note, March 1993.

http://www.casact.org/library/studynotes/brosius6.pdf