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?

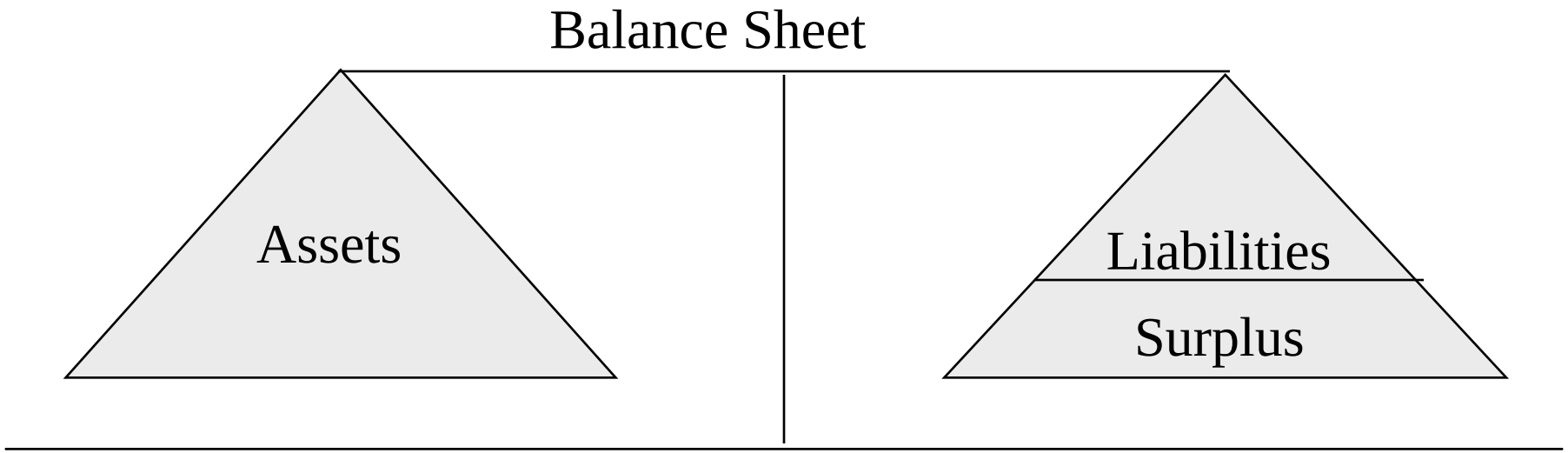
  Amount necessary to settle unpaid claims

- 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

4/2/01
Accident occurs

Pure IBNR

7/11/01
Accident reported

Claims in Transit

8/1/01
Accident entered into records as $1,000 Formula Reserve

10/5/01
Individual reserve established

$10,000 Case Reserve

1/1/02
Estimate revised

$25,000 Case Reserve

8/18/02
Settlement agreed

$30,000 Case Reserve

8/25/02
Payment sent

$30,000 Case Reserve

9/2/02
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) - $10,000

Reserve = $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

Accident Year	Cumulative Paid Losses ($000 Omitted) Development Stage in Months						Final Total Cost
	12	24	36	48	60	72	
1996	3,780	6,671	8,156	9,205	9,990	10,508	???
1997	4,212	7,541	9,351	10,639	11,536		???
1998	4,901	8,864	10,987	12,458			???
1999	5,708	10,268	12,699				???
2000	6,093	11,172					???
2001	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 to Ultimate
1996	1.765	1.223	1.129	1.085	1.052	???
1997	1.790	1.240	1.138	1.084		
1998	1.809	1.240	1.134			
1999	1.799	1.237				
2000	1.834					
2001						

Sample Calculation for Accident Year 1997:			
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 1997 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

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 to Ultimate
1996	1.765	1.223	1.129	1.085	1.052	???
1997	1.790	1.240	1.138	1.084		
1998	1.809	1.240	1.134			
1999	1.799	1.237				
2000	1.834					
2001						
Simple Average - All Years	1.799	1.235	1.134	1.085	1.052	
Simple Average - Latest 3 Years	1.814	1.239	1.134	XXX	XXX	
Simple Average - Excluding High & Low	1.799	1.239	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	1.070

Basic Reserving Techniques:
Application of Paid LDM

	Evaluation Interval in Months					
	12-24	24-36	36-48	48-60	60-72	72 to Ultimate
LDFs	1.800	1.235	1.134	1.085	1.052	1.070

Accident Year	Cumulative Paid Losses ($000 Omitted) Development Stage in Months						Final Total Cost
	12	24	36	48	60	72	
1996	3,780	6,671	8,156	9,205	9,990	10,508	11,244
1997	4,212	7,541	9,351	10,639	11,536	12,136	12,985
1998	4,901	8,864	10,987	12,458	13,517	14,220	15,215
1999	5,708	10,268	12,699	14,401	15,625	16,437	17,588
2000	6,093	11,172	13,797	15,646	16,976	17,859	19,109
2001	6,962	12,532	15,477	17,550	19,042	20,032	21,435

Sample Calculations for Accident Year 2001:

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 Development Factors					
12 to Ult	24 to Ult	36 to Ult	48 to Ult	60 to Ult	72 to Ult
3.079	1.710	1.385	1.221	1.126	1.070

Basic Reserving Techniques:
Paid LDM Projections & Reserves

- Loss Reserve Estimate @ 12/31/01 = $32.241 million

Accident Year	Actual Paid Losses @ 12/31/01	Selected LDFs	Cumulative Development Factors to Ultimate	Estimated Ultimate Losses [(2) x (4)]	Actual Paid Losses @ 12/31/01	Estimated Loss Reserves {(5) - (6)}
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1996	10,508	1.070	1.070	11,244	10,508	736
1997	11,536	1.052	1.126	12,985	11,536	1,449
1998	12,458	1.085	1.221	15,215	12,458	2,757
1999	12,699	1.134	1.385	17,588	12,699	4,889
2000	11,172	1.235	1.710	19,109	11,172	7,937
2001	6,962	1.800	3.079	21,435	6,962	14,473
Total	65,335			97,576	65,335	32,241

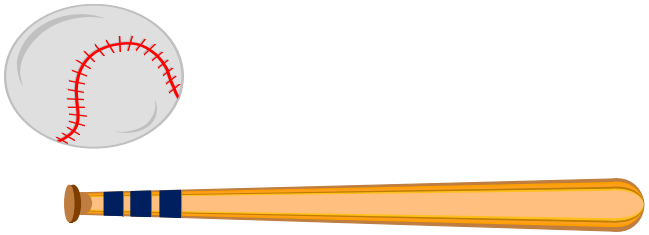
BORNHUETTER-FERGUSON APPROACH APPLIED TO A NON-INSURANCE EXAMPLE

Given the following, how many home runs will Barry Bonds hit this year?

- You initially expected he would hit 40 home runs this year
- He has hit 20 home runs through 40 games
- There are 160 games in a season

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

- Expected Ultimate Value
- Cumulative Loss Development Factor
- Amount Incurred To Date



BORNHUETTER-FERGUSON APPROACH APPLIED TO A NON-INSURANCE EXAMPLE

The three pieces of information for our example :

- Before the season started, how many home runs would we have expected Barry Bonds to hit?

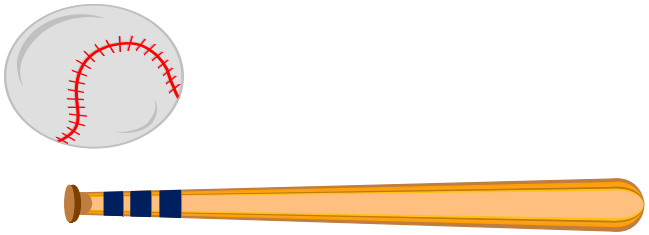
  Expected Ultimate Value = 40

- 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

- 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)

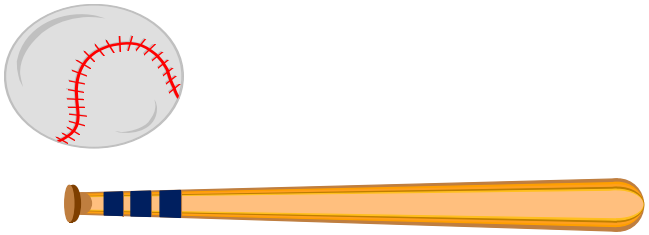
IBNR Factor = 1.000 - (1.000/LDF) = 1.000 - (1.000/4.000) = .75

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

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

The B-F Method projects that Barry Bonds 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

- **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

- **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 12/31/2006. Use the paid loss development method to estimate the required reserves by accident year. Assume all losses are fully developed at 60 months.

Accident Year	Cumulative Paid Losses ($000 Omitted) Development Stage in Months				
	12	24	36	48	60
2002	3,000	6,000	9,000	10,800	11,340
2003	3,200	6,400	9,600	11,520	
2004	3,500	7,000	10,500		
2005	3,800	7,600			
2006	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 to Ult	24 to Ult	36 to Ult	48 to Ult	60 to Ult
3.780	1.890	1.260	1.050	1.000

Accident Year	(1) Paid Losses @ 12/06	(2) Dev Factors to Ult	(3)=(1)*(2) Estimated Ultimate Losses	(4)=(3)-(1) Estimated Loss Reserve
2002	11,340	1.000	11,340	-
2003	11,520	1.050	12,096	576
2004	10,500	1.260	13,230	2,730
2005	7,600	1.890	14,364	6,764
2006	5,000	3.780	18,900	13,900

Further Reading

For additional information on Loss Reserving, see the following references at www.casact.org/admissions/syllabus/exam6.pdf

Wiser, et al., "Loss Reserving," *Foundations of Casualty Actuarial Science* (Fourth Edition), Casualty Actuarial Society, 2001, Chapter 5, pp. 197-285.

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

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