BASIC RESERVING WORKSHOP

2 April 2019

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Basic Loss Reserving

- Groundwork and Basics
  - Definitions
  - Considerations
- Basic Reserving Techniques
  - Paid Loss Development Method (PLDM)
  - Incurred Loss Development Method (ILDM)

Definitions

- What is a Loss Reserve?

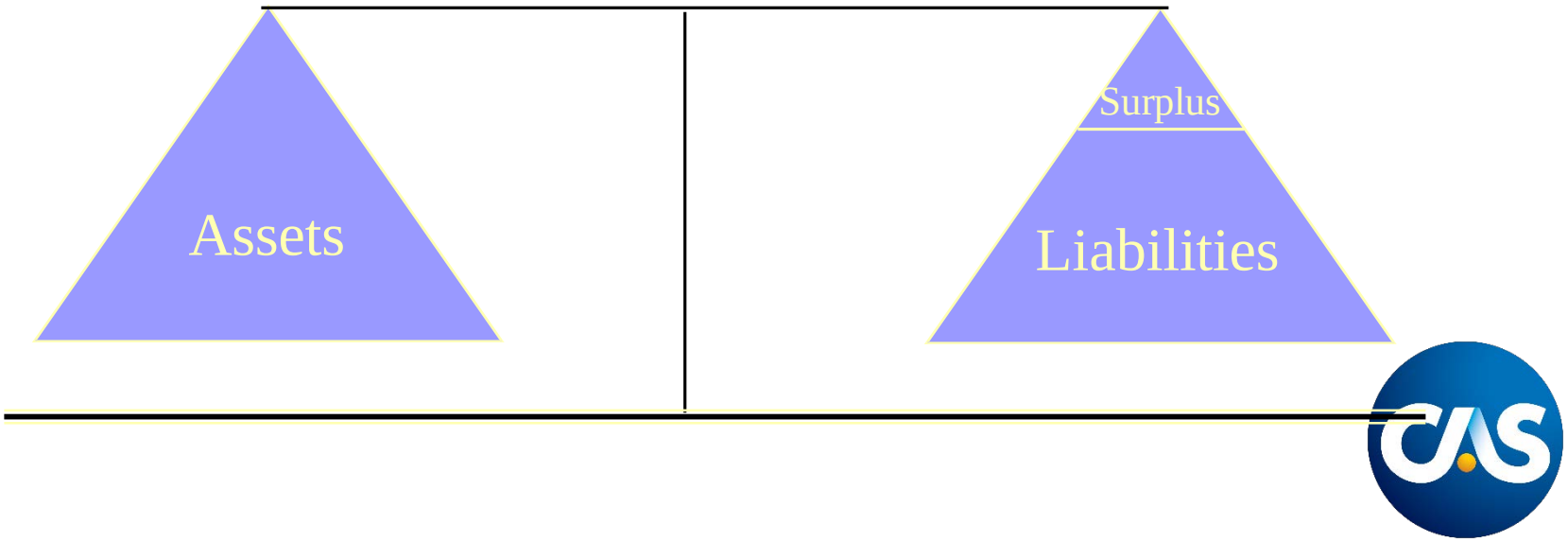
  Unpaid amount required to settle all claims, whether reported or not, for which liability exists on a particular accounting date.

- Why are Loss Reserves Important?

  Needed for accurate evaluation of financial condition & underwriting income

Accounting Aspects of Loss Reserves

Balance Sheet



Definitions

- Carried Loss Reserve

  The amount shown in a published statement or an internal statement of financial condition.

- Indicated Loss Reserve

  The amount that results from the application of a particular loss reserving method.

- Reserve Margin/Deficit

  The difference between an indicated loss reserve and a carried loss reserve.

Definitions

- Elements of a Loss Reserve
  - Incurred But Not Reported (“Pure” IBNR)
  - Claims in Transit (Reported Not Reserved Yet)
  - Formula Reserve/Case Reserve
  - Development on Known Claims
  - Reopened Claims Reserve

Life Cycle of a Claim Reserve

8/7/15
Accident occurs

11/7/15 Accident reported

Claims in Transit

1/8/15
Accident entered into records as $1,000 Formula Reserve

5/10/15
Individual reserve established

$10,000 Case Reserve

1/1/16
Estimate revised

$25,000 Case Reserve

18/8/16
Settlement agreed

$30,000 Case Reserve

25/8/16
Payment sent

$30,000 Case Reserve

2/9/16
Claim draft clears

Claim Closed

$ 0 Case Reserve

Definitions

- Case Reserves
  - For specific claim reported but not yet settled
  - Assigned a value by a claims adjuster or by formula based on information known for that claim
- Bulk + IBNR Reserves
  - Reserves for claims not yet reported (“pure” IBNR)
  - Claims in transit
  - Development on known claims
  - Reserves for reopened claims
- Can also include expenses for settling claims

Other Terminology in Use

- Carried Loss Reserve = Unpaid Losses, Outstanding Reserve, Total Reserve
- Indicated Loss Reserve = Unpaid Claim Estimate, Best Estimate, Point Estimate, Actuarial Central Estimate
- Reserve Margin/Deficit = Redundancy/Deficiency
- Incurred Losses = Ultimate Losses (incl. IBNR) or sometimes Reported Losses (excl. IBNR)
- Losses may mean Losses and LAE (Loss Adjustment Expense)

Principles

- Actuarially sound reserves
  - based on estimates
  - derived from reasonable assumptions
  - using appropriate methods

- Inherent Uncertainty
  - a range of reserves can be actuarially sound
  - true value known only after all claims settled

Principles

- Most appropriate indicated reserve depends on:
  - relative likelihood of estimates in range
  - financial reporting context

Considerations: Data Organization

- Accident Date
  - The date on which the loss occurred.

- Report Date
  - The date on which the loss is first reported to the insurer.
- Recorded Date
  - The date on which the loss is first entered into the statistical records of the insurer.

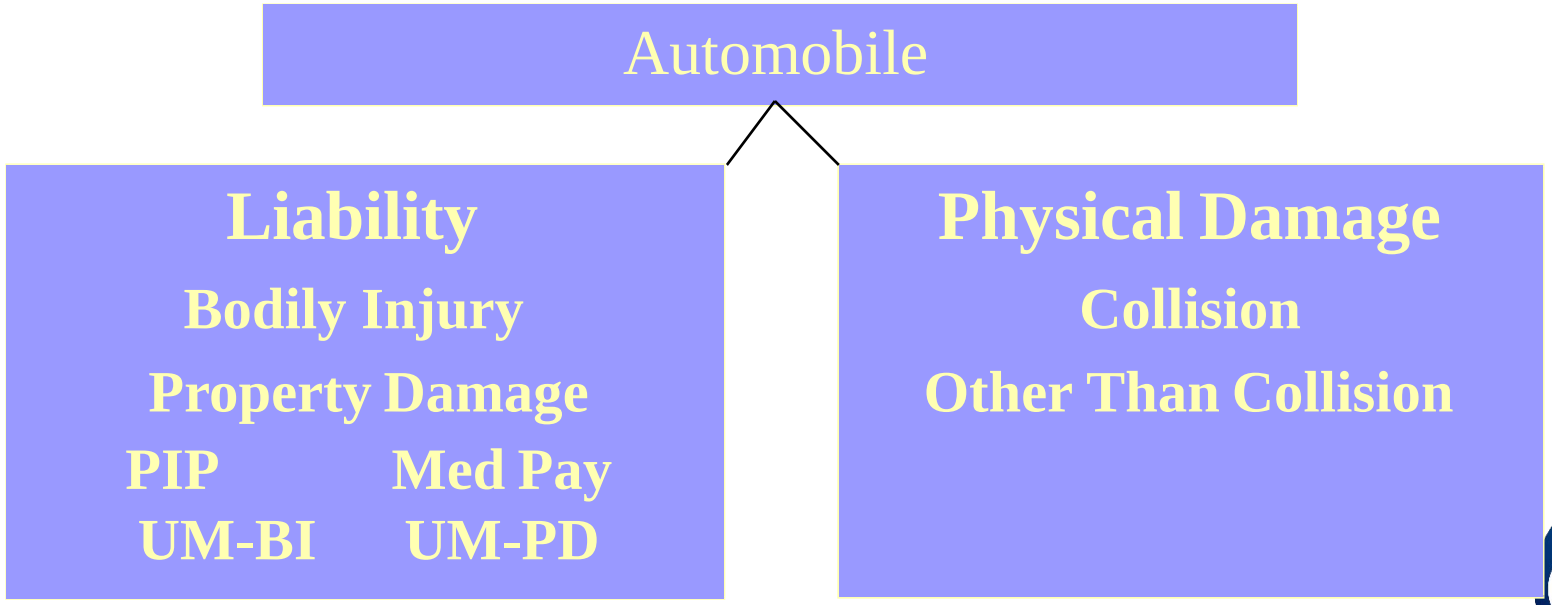
Considerations: Data Organization

- Accounting Date
  - Defines a group of claims for which liability may exist.
  - All claims incurred on or before the accounting date.

- Valuation Date
  - Defines the time period for which transactions are included when evaluating the existing liability.

Considerations: Homogeneity

Accuracy is often improved by subdividing claims into groups exhibiting similar claim experience or settlement patterns.



Considerations: Credibility

- A measure of the predictive value that is attached to a body of data.
- A group of claims should be large enough to be statistically reliable.
  - May be a point at which subdividing claims will form groups that are too small to provide credible development patterns.
- Use of supplementary data sources
  - Examples include industry data, countrywide data.

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 payments from inception are summed at the end of each year.
- Losses paid to date are shown on the most recent column (accounting) or diagonal (actuarial).
- Actuarial triangle shows that more recent accident years are at earlier stages of claim life cycle.
- Future development might be similar to historical.

Basic Reserving Techniques:
Compilation of Paid Loss Triangle

Accounting Format

Goal: Calculate the total paid-to-date

Accident Year	Cumulative Paid Losses ($000 Omitted) Cumulative Accident Year Paid as of Year End					
	2013	2014	2015	2016	2017	2018
2013	3,780	6,671	8,156	9,205	9,990	10,508
2014		4,212	7,541	9,351	10,639	11,536
2015			4,901	8,864	10,987	12,458
2016				5,708	10,268	12,699
2017					6,093	11,172
2018						6,962

Basic Reserving Techniques:
Compilation of Paid Loss Triangle

Actuarial Format

Goal: Estimate the total ultimately paid

Accident Year	Cumulative Paid Losses ($000 Omitted) Development Stage in Months						Final Total Cost
	12	24	36	48	60	72	
2013	3,780	6,671	8,156	9,205	9,990	10,508	???
2014	4,212	7,541	9,351	10,639	11,536		???
2015	4,901	8,864	10,987	12,458			???
2016	5,708	10,268	12,699				???
2017	6,093	11,172					???
2018	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
2013	1.765	1.223	1.129	1.085	1.052	???
2014	1.790	1.240	1.138	1.084		
2015	1.809	1.240	1.134			
2016	1.799	1.237				
2017	1.834					
2018						

Sample Calculation for Accident Year 2014:

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 2008 grew 79%. During the next year (from 24 to 36 months), paid losses experienced an additional 24% growth (or development) and so forth.

Basic Reserving Techniques:
Compilation of Paid Loss Triangle

Accident Year	Cumulative Paid Losses ($000 Omitted) Development Stage in Months		
	12	24	36
2013	3,780	6,671	8,156
2014	4,212	7,541	

Accident Year	Cumulative Paid Losses ($000 Omitted) Evaluation Interval In Months	
	12-24	24 - 36
2013	+6,671 / 3,780	+8,156 / 6,671
2014	+7,541 / 4,212	

Basic Reserving Techniques:
Compilation of Paid Loss Triangle

Accident Year	Cumulative Paid Losses ($000 Omitted) Evaluation Interval In Months	
	12 - 24	24 - 36
2013	+6,671 / 3,780	+8,156 / 6,671
2014	+7,541 / 4,212	

Accident Year	Evaluation Interval in Months	
	12 - 24	24 - 36
2013	1.765	1.223
2014	1.790	

Basic Reserving Techniques:
Paid Loss Development Factors

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
2013	1.765	1.223	1.129	1.085	1.052	
2014	1.790	1.240	1.138	1.084		
2015	1.809	1.240	1.134			
2016	1.799	1.237				
2017	1.834					
2018						
Average - All Years	1.799	1.235	1.134	1.085	1.052	
Average - Latest 3 Years	1.814	1.239	1.134	XXX	XXX	
Average - Excl Hi & Lo	1.799	1.239	1.134	XXX	XXX	
Wt Average - All Years	1.803	1.235	1.134	1.085	1.052	
Selected LDF	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	
2013	3,780	6,671	8,156	9,205	9,990	10,508	11,244
2014	4,212	7,541	9,351	10,639	11,536	12,136	12,985
2015	4,901	8,864	10,987	12,458	13,517	14,220	15,215
2016	5,708	10,268	12,699	14,401	15,625	16,437	17,588
2017	6,093	11,172	13,797	15,646	16,976	17,859	19,109
2018	6,962	12,532	15,477	17,550	19,042	20,032	21,435

Sample Calculations for Accident Year 2018:

At 24 Months: 12,532 = 6,962 x 1.800

At 36 Months: 13,797 = 6,093 x 1.235

15,477 = 6,962 x 1.800 x 1.235

Basic Reserving Techniques:
Paid LDM Projections & Reserves

Loss Reserve Estimate @ 12/31/18 = $32.241 million

Accident Year	Actual Paid Losses 12/31/18	Selected LDFs	Cumulative Development Factors to Ultimate	Estimated Ultimate Losses [(2) x (4)]	Actual Paid Losses 12/31/18	Estimated Loss Reserves [(5) - (6)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2013	10,508	1.070	1.070	11,244	10,508	736
2014	11,536	1.052	1.126	12,985	11,536	1,449
2015	12,458	1.085	1.221	15,215	12,458	2,757
2016	12,699	1.134	1.385	17,588	12,699	4,889
2017	11,172	1.235	1.710	19,109	11,172	7,937
2018	6,962	1.800	3.079	21,435	6,962	14,473
Total	65,335			97,576	65,335	32,241

Basic Reserving Techniques:
Issues to Consider for Paid LDM

Issues to Consider	Example
Have there been any changes which might make the older years irrelevant?	There are more motorcycle losses in the oldest year; Typical P&C no longer insures motorcycles.
Are the more recent years better predictors of the future?	Typical P&C has begun writing more business in state X.
Are there outlier points that need to be ignored or adjusted?	In one year, there were bad ice storms at the end of December. Late reporting caused unusually high development in the next year.

Basic Reserving Techniques:

Incurred Loss Triangle

Accident Year	Case Reserves ($000 Omitted) Development Stage in Months					
	12	24	36	48	60	72
2013	5,557	4,176	2,936	1,987	1,245	742
2014	6,328	4,664	3,200	2,051	1,189	
2015	6,974	4,968	3,251	1,955		
2016	7,635	5,274	3,367			
2017	8,376	5,604				
2018	9,599					

Add Add

Accident Year	Cumulative Paid Losses ($000 Omitted) Development Stage in Months					
	12	24	36	48	60	72
2013	3,780	6,671	8,156	9,205	9,990	10,508
2014	4,212	7,541	9,351	10,639	11,536	
2015	4,901	8,864	10,987	12,458		
2016	5,708	10,268	12,699			
2017	6,093	11,172				
2018	6,962					

Basic Reserving Techniques:
Incurred Loss Triangle

Accident Year	Cumulative Case Reported Losses ($000 Omitted) Development Stage in Months						Final Total Cost
	12	24	36	48	60	72	
2013	9,337	10,847	11,092	11,192	11,235	11,250	???
2014	10,540	12,205	12,551	12,690	12,725		???
2015	11,875	13,832	14,238	14,413			???
2016	13,343	15,542	16,066				???
2017	14,469	16,776					???
2018	16,561						???

Basic Reserving Techniques:
Incurred Loss Triangle

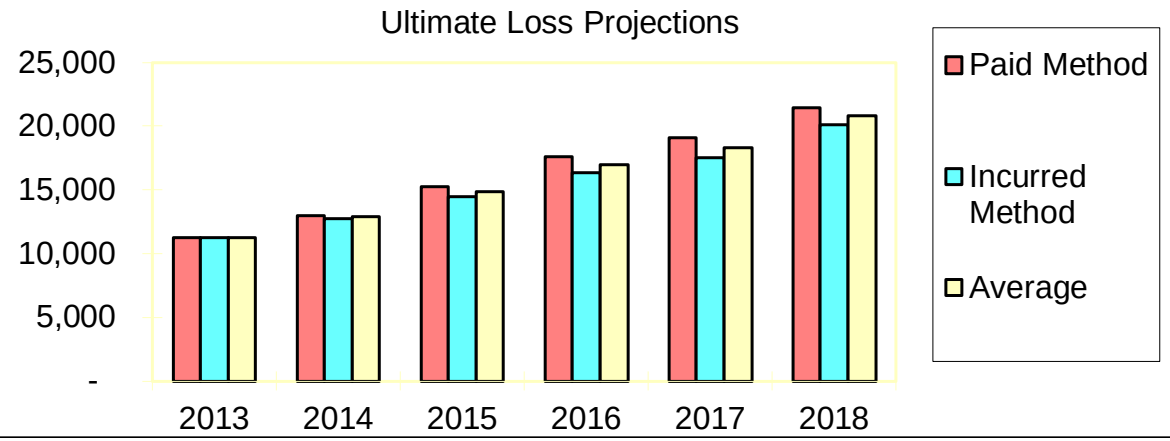
Accident Year	Evaluation Interval in Months					
	12-24	24-36	36-48	48-60	60-72	72 to Ultimate
2013	1.162	1.023	1.009	1.004	1.001	???
2014	1.158	1.028	1.011	1.003		
2015	1.165	1.029	1.012			
2016	1.165	1.034				
2017	1.159					
2018						
Average - All Years	1.162	1.029	1.011	1.004	1.001	
Average - Latest 3 Years	1.163	1.030	1.011	XXX	XXX	
Average - Excl Hi & Lo	1.162	1.029	1.011	XXX	XXX	
Wt Average - All Years	1.162	1.029	1.011	1.003	1.001	
Selected LDF	1.162	1.030	1.011	1.003	1.001	1.000
Cumulative LDF	1.215	1.045	1.015	1.004	1.001	1.000

Basic Reserving Techniques:
Incurred LDM Projections & Reserves

Accident Year	Actual Reported Losses 12/31/18	Development Factors to Ultimate	Estimated Ultimate Losses [(2) x (3)]	Actual Paid Losses 12/31/18	Estimated Loss Reserves {(4) - (5)}
(1)	(2)	(3)	(4)	(5)	(6)
2013	11,250	1.000	11,250	10,508	742
2014	12,725	1.001	12,738	11,536	1,202
2015	14,413	1.004	14,471	12,458	2,013
2016	16,066	1.015	16,308	12,699	3,609
2017	16,776	1.045	17,539	11,172	6,367
2018	16,561	1.215	20,119	6,962	13,157
Total	87,791		92,425	65,335	27,090

Comparison of LDM Projections

Accident Year	Estimated Ultimate Losses Based on: Paid LDM	Incurred LDM	Average = Selected
	Paid Method	Incurred Method	Average
2013	11,244	11,250	11,247
2014	12,985	12,738	12,862
2015	15,215	14,471	14,843
2016	17,588	16,308	16,948
2017	19,109	17,539	18,324
2018	21,435	20,119	20,777
Total	97,576	92,425	95,001



Comparison of Loss Development Methods

Underlying Assumptions

- PLDM: No changes in the payment pattern
- ILDM: No changes in case reserve adequacy

Pro	Con
PLDM: "Hard" data; no estimates involved	PLDM: May generate large, volatile loss development factors & take longer to develop to ultimate
ILDM: Uses all available information	ILDM: Uses case reserves, which are estimates, to develop estimates of ultimate losses

Key Assumptions & Potential Problems

Assumptions	Potential Problems
Claims settlement patterns unchanging	Increasing delays in claim closing rates
Case reserving practices & philosophies unchanging	Conscious effort to improve case reserve adequacy; Introduction of new case reserving procedures
No claim processing changes	Change in data processing; Revised claim payment recording procedures
Policy limits have no impact on loss development	Increasing frequency of full policy limits claims; Changing policy limits

Key Assumptions & Potential Problems

Assumptions	Potential Problems
Loss development unaffected by changing loss cost trends	Surges in inflation; Increased litigation; Diminished policy defenses
No change in mix of business	Changes in reinsurance coverages; Increased long-tail exposures; Introduction of new or revised coverages
No cyclical loss development	Underwriting cycles impact claims settlement or reserving practices

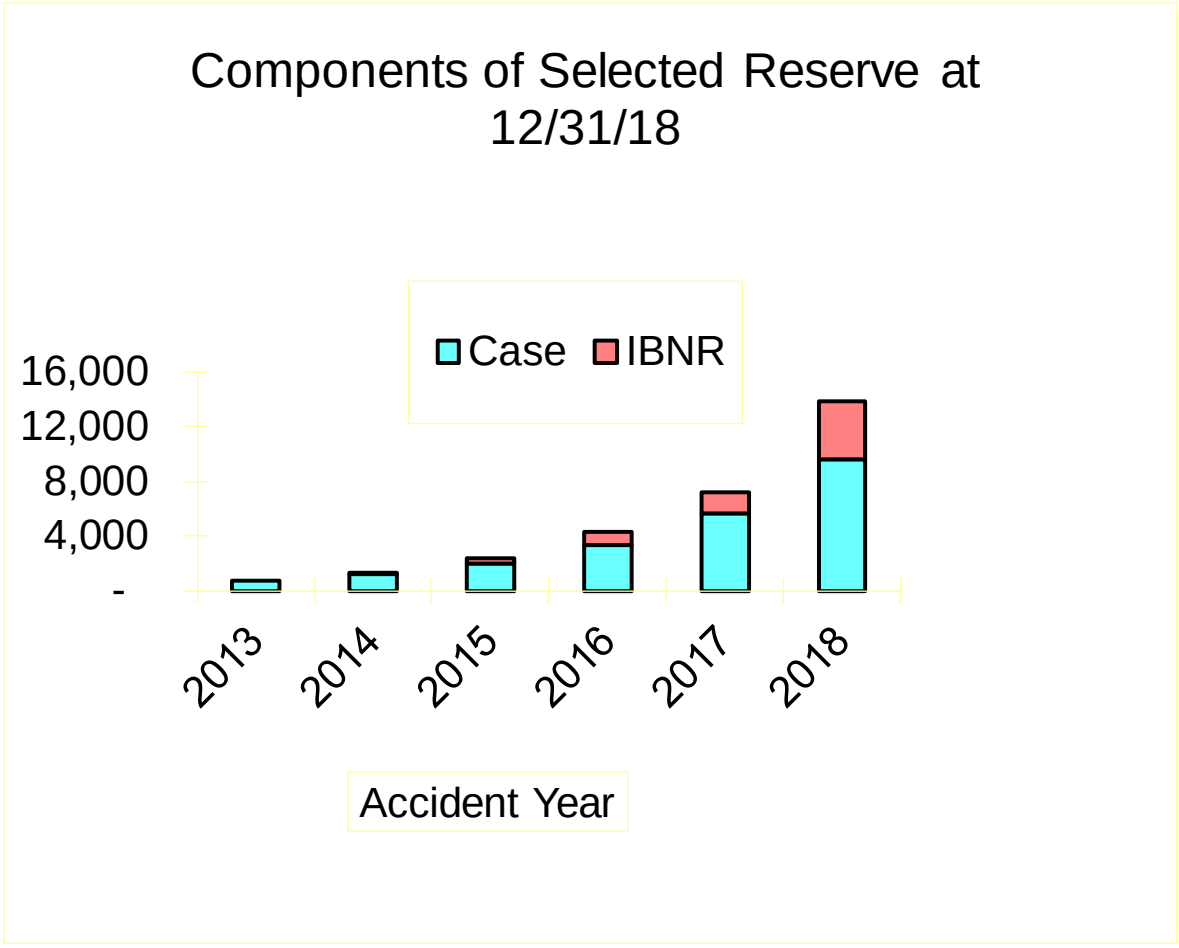
Key Assumptions & Potential Problems

Assumptions	Potential Problems
No data anomalies	Catastrophic or unusual losses reflected in loss experience; Unusual claim settlement/reporting delays

Comparison of Estimated Reserves

Accident Year	Estimated Loss Reserves Based on:		
	Paid LDM	Incurred LDM	Average = Selected
	Paid Method	Incurred Method	Average
2013	736	742	739
2014	1,449	1,202	1,326
2015	2,757	2,013	2,385
2016	4,889	3,609	4,249
2017	7,937	6,367	7,152
2018	14,473	13,157	13,815
Total	32,241	27,090	29,666

Comparison of Estimated Reserves



Comparison of Estimated Reserves

- Which estimate is right?
- Which estimate is best?
- How will you know?
- When will you know?

Formulas to Derive IBNR Reserves

- Once an estimate of ultimate loss has been obtained, the arithmetic of IBNR is straightforward.

Ultimate Losses	**Ultimate Losses**	**Unpaid Losses**
Minus		
Paid Losses	**Minus**	**Minus**
Minus		
Case Reserves	**Reported Losses**	**Case Reserves**

Reasonableness

- Check ultimate losses for reasonableness against relevant indicators:
  - Premium
    - Loss Ratios (LR)
  - Exposures or Number of Policies
    - Frequency
    - Pure Premium (PP)
  - Claim Counts
    - Implied Severity

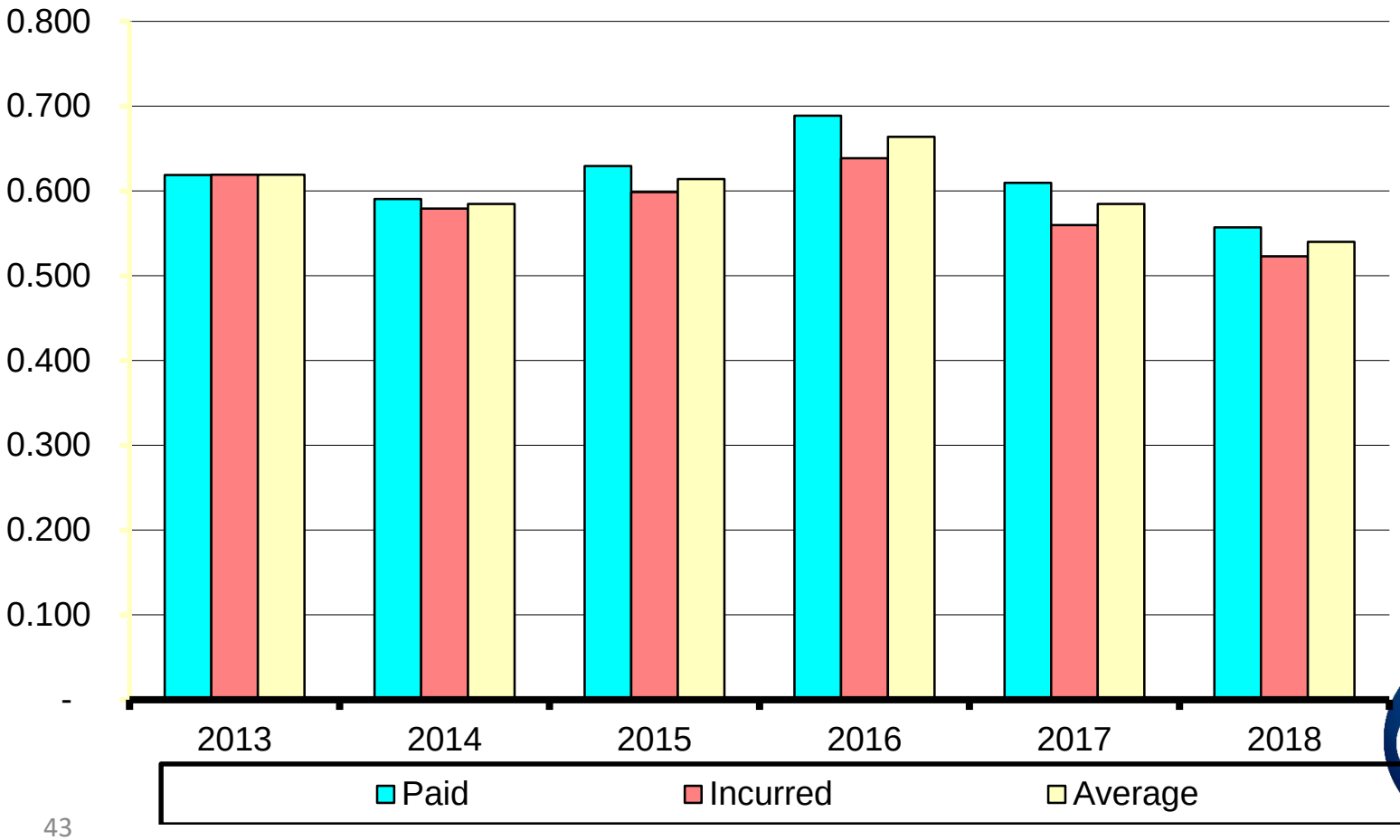
Reasonableness

- Assumptions & Methods
  - Document
    - Notes on spreadsheets
    - Written report detailing assumptions
  - Sensitivity analyses
    - Tests performed
    - Results of tests

Reasonableness Checks:
Ultimate Loss Ratios

Accident Year	Earned Premium	Est. Ultimate Losses ($000) Using:			Indicated Loss Ratio Using:		
		PLDM	ILDM	Selected	PLDM	ILDM	Selected
2013	18,168	11,244	11,250	11,247	0.619	0.619	0.619
2014	21,995	12,985	12,738	12,862	0.590	0.579	0.585
2015	24,173	15,215	14,471	14,843	0.629	0.599	0.614
2016	25,534	17,588	16,308	16,948	0.689	0.639	0.664
2017	31,341	19,109	17,539	18,324	0.610	0.560	0.585
2018	38,469	21,435	20,119	20,777	0.557	0.523	0.540
Total	159,680	97,576	92,425	95,001	0.611	0.579	0.595

Reasonableness Checks:
Ultimate Loss Ratios



Sensitivity Analysis:
Current Year Analysis

- Improvements in results may stem from:
  - Higher rates
  - Lower claim frequency
  - Lower claim severity
- Better results would appear to be present if:
  - Claims were being processed or paid more slowly
  - Case reserves were less adequate
  - Mix of business is different

Sensitivity Analysis:
Ratios

- Review historical relationships
  - Losses
    - Paid losses to reported losses
  - Claim counts
    - Settlement
    - Ratio of claims closed with no payment to total closed claims
  - Losses and Claim Counts
    - Severities or average values

Sensitivity Analysis:
Ratios - Paid to Reported

Cumulative Paid Losses ($000 Omitted)

Accident Year	Development Stage in Months		
	12	24	36
2013	3,780	6,671	8,156
2014	4,212	7,541	
2015	4,901		

Cumulative Case Reported Losses ($000 Omitted)

Accident Year	Development Stage in Months		
	12	24	36
2013	9,337	10,847	11,092
2014	10,540	12,205	
2015	11,875		

Ratio Paid to Case Reported

Accident Year	Development Stage in Months		
	12	24	36
2013	0.405	0.615	0.735
2014	0.400	0.618	
2015	0.413		

Sensitivity Analysis: Ratios - Paid to Reported

Accident Year	Ratio Paid to Case Reported Development Stage in Months					
	12	24	36	48	60	72
2013	0.405	0.615	0.735	0.822	0.889	0.934
2014	0.400	0.618	0.745	0.838	0.907	
2015	0.413	0.641	0.772	0.864		
2016	0.428	0.661	0.790			
2017	0.421	0.666				
2018	0.420					

Sensitivity Analysis:
Ratios - Average Reported

Accident Year	Average Reported Loss Development Stage in Months					
	12	24	36	48	60	72
2013	6,539	3,913	3,892	3,905	3,915	3,895
2014	6,164	4,025	4,067	4,101	4,092	
2015	8,744	4,976	4,762	4,804		
2016	8,836	6,005	6,049			
2017	9,724	6,442				
2018	10,325					

Tail Factors:
Impact of Selection

Accident Year	Reported Losses @ 12/31/18	Selected LDF's		Estimated Ultimate Losses	Earned Premium	Loss Ratio	Unpaid Losses @ 12/31/18
		LDF	Age to Ult.				
2013	11,250	**1.000**	**1.000**	11,250	18,168	61.9%	742
2014	12,725	1.001	1.001	12,738	21,995	57.9%	1,202
2015	14,413	1.003	1.004	14,471	24,173	59.9%	2,013
2016	16,066	1.011	1.015	16,308	25,534	63.9%	3,609
2017	16,776	1.030	1.045	17,539	31,341	56.0%	6,367
2018	16,561	1.162	1.215	20,119	38,469	52.3%	13,157
Total	87,791			92,425	159,680	57.9%	27,090

Tail Factors:
Impact of Selection

Effect on Estimates Given a 2% Increase in Reported Losses Tail Factor

Accident Year	Reported Losses @12/31/18	Selected LDF's LDF	Selected LDF's Age to Ult.	Estimated Ultimate Losses	Earned Premium	Revised Loss Ratio	Unpaid Losses @12/31/18
2013	11,250	**1.020**	**1.020**	11,475	18,168	63.2%	967
2014	12,725	1.001	1.021	12,992	21,995	59.1%	1,456
2015	14,413	1.003	1.024	14,759	24,173	61.1%	2,301
2016	16,066	1.011	1.035	16,628	25,534	65.1%	3,929
2017	16,776	1.030	1.066	17,883	31,341	57.1%	6,711
2018	16,561	1.162	1.239	20,519	38,469	53.3%	13,557
Total	87,791			94,256	159,680	59.0%	28,921

Estimated Unpaid Losses Based on Original ILDM (Without the 2% Tail Factor Increase)	27,090
Increase in Estimated Unpaid Losses Due to Increased Tail Factor	6.8%

Selection of Tail Factors

- Ultimate losses increase by
  - $1.8 million
  - 2.0% increase in ultimate losses
- Loss reserves also increase by
  - $1.8 million
  - 6.8% increase in overall reserve levels!
- IBNR reserves also increase by
  - $1.8 million
  - 40.0% increase in overall IBNR levels!!!!
- Biggest impacts are in the most recent year.

Other Basic Methods

- Expected Loss
  - Estimating the ultimate
- Bornhuetter-Ferguson
  - Estimating the reserve

⋮

- Many, many others available

Expected Loss Ratio Method

- **EXPECTED LOSS RATIO (ELR)**

  The anticipated ratio of projected ultimate losses to earned premiums.

- Sources:
  - Pricing assumptions
  - Historical data such as Schedule P
  - Industry data

Expected Loss Ratio Method

	Percent of Premium
Commissions	20.0%
Taxes	5.0%
General Expenses	15.0%
Profit	-2.0%
Total	38.0%
Expected Loss Ratio (Available for Loss and Loss Adjustment Expense)	62.0%

Expected Loss Ratio Method

Schedule P - Part 1B
Private Passenger Auto Liability/Medical

Years Premiums Earned and Losses Incurred		Loss and Loss Expense Percentage (Incurred/Premiums Earned)		
		Direct and Assumed	Ceded	Net
1.	Prior	XXXX	XXXX	XXXX
2.	2009	73.1%	73.8%	72.4%
3.	2010	66.6%	65.9%	67.3%
4.	2011	70.3%	68.9%	71.7%
5.	2012	69.0%	70.6%	67.4%
6.	2013	74.1%	75.0%	73.2%
7.	2014	80.2%	83.3%	77.1%
8.	2015	60.5%	59.1%	61.9%
9.	2016	62.6%	61.3%	63.9%
10.	2017	66.7%	68.0%	65.4%
11.	2018	67.0%	68.3%	65.7%
	3 year average			65.0%
	5 year average			66.8%

Expected Loss Ratio Method

- Estimating Reserves Based on ELR

Earned Premium x ELR	=	Expected Ultimate Losses
Ultimate Losses - Paid Losses	=	Total Reserve
Total Reserve - Case Reserve	=	IBNR Reserve

Expected Loss Ratio Method

Earned Premium	=	$100,000
Expected Loss Ratio	=	0.65
Paid Losses	=	$10,000
Case Reserves	=	$13,000
Total Reserve	=	($100,000 x 0.65) - $10,000
	=	$65,000 - $10,000
	=	$55,000
IBNR Reserve	=	$55,000 - $13,000
	=	$42,000

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 or negative IBNR if Ultimate Losses < Incurred Losses; wrong unless recoveries such as salvage/subrogation are typical after payment made

Bornhüetter-Ferguson Method

- Reserves Based on ELR and Actual Loss

(EP x ELR) x (IBNR Factor)	=	(IBNR Reserves)
Where IBNR Factor	=	(1.000 - 1.000/CDF)
Actual + IBNR Reserve	=	Ultimate Losses

- Case Reserve + IBNR Reserve = Total Reserve
- The IBNR Factor is the percent of expected losses unreported.

Bornhüetter-Ferguson Method

Accident Year	Evaluation Interval in Months		
	12-24	24-36	36-48
2013	1.162	1.023	1.009
2014	1.158	1.028	1.011
2015	1.165	1.029	1.012
2016	1.165	1.034	
2017	1.159		
2018			
Selected LDF	1.162	1.162	1.162
Cumulative LDF	1.215	1.045	1.015

IBNR Factor = 1.000 - 1.000/Cumulative Loss Development Factor

+1.000 - 1.000/1.215 +1.000 - 1.000/1.015

IBNR Factor	**0.177**	**0.044**	**0.015**

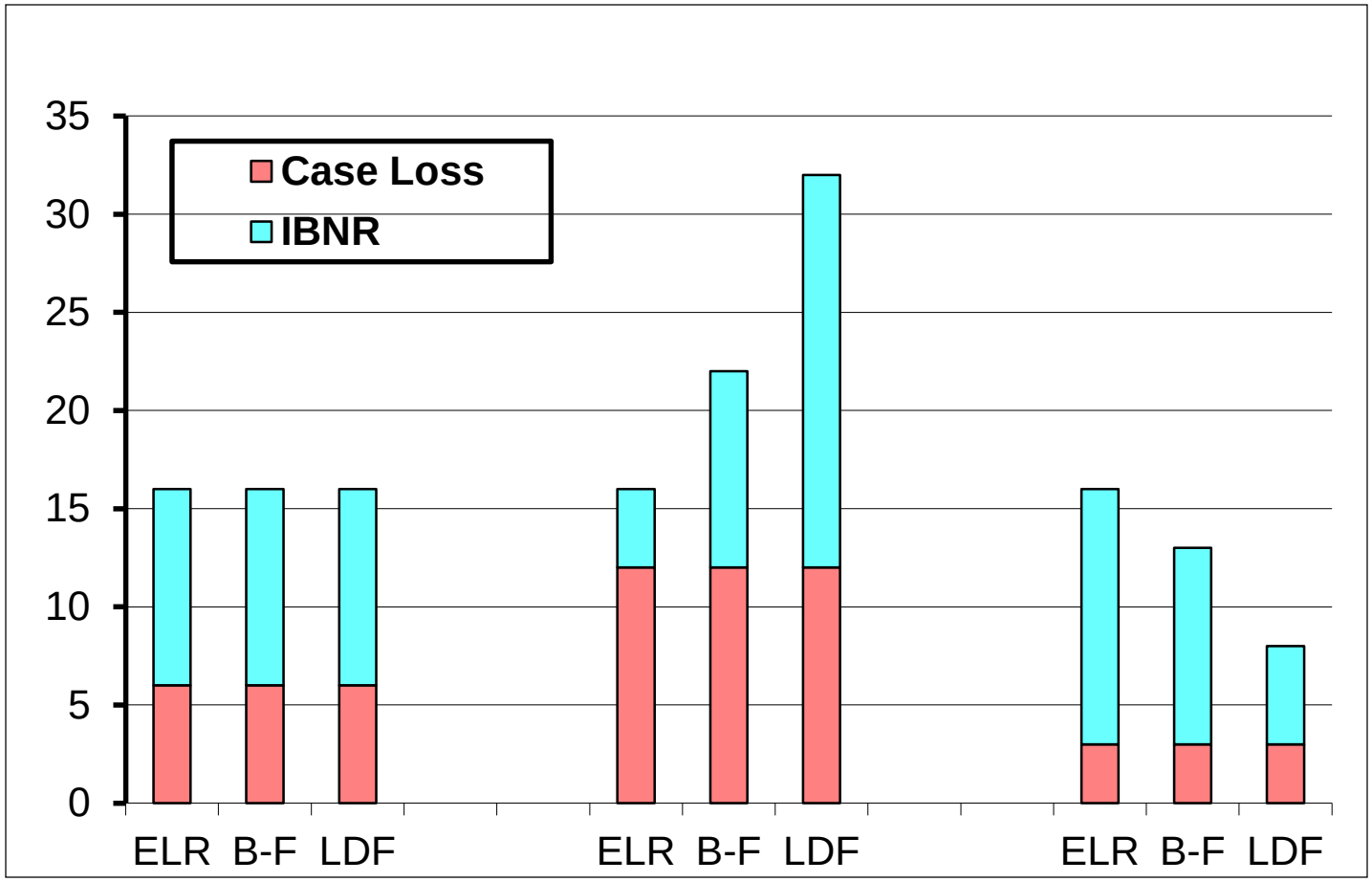
Bornhüetter-Ferguson Method

Accident Year	Evaluation Interval in Months					
	12-24	24-36	36-48	48-60	60-72	72 to Ultimate
2013	1.162	1.023	1.009	1.004	1.001	???
2014	1.158	1.028	1.011	1.003		
2015	1.165	1.029	1.012			
2016	1.165	1.034				
2017	1.159					
2018						
Average - All Years	1.162	1.029	1.011	1.004	1.001	
Average - Latest 3 Years	1.163	1.030	1.011	XXX	XXX	
Average - Excl Hi & Lo	1.162	1.029	1.011	XXX	XXX	
Wt Average - All Years	1.162	1.029	1.011	1.003	1.001	
Selected LDF	1.162	1.030	1.011	1.003	1.001	1.000
Cumulative LDF	1.215	1.045	1.015	1.004	1.001	1.000
IBNR Factor = 1.000 - 1.000/Cumulative Loss Development Factor						
IBNR Factor	0.177	0.044	0.015	0.004	0.001	-

Bornhüetter-Ferguson Method

Accident Year (1)	Earned Premium (2)	Assumed Expected Loss Ratio (3)	Assumed Expected Losses (4) (2) x (3)	IBNR Factor (5)	Estimated IBNR (6) (4) x (5)	Cumulative Incurred Losses (7)	Estimated Ultimate Losses (8) (6) + (7)
2013	18,168	62.0%	11,264.16	-	-	11,250	11,250
2014	21,995	62.0%	13,636.90	0.001	14	12,725	12,739
2015	24,173	62.0%	14,987.26	0.004	60	14,413	14,473
2016	25,534	62.0%	15,831.08	0.015	235	16,066	16,301
2017	31,341	62.0%	19,431.42	0.044	846	16,776	17,622
2018	38,469	62.0%	23,850.78	0.177	4,218	16,561	20,779
Total	159,680		99,001.60		5,372	87,791	93,163

Comparison of Methods



Expected Twice Expected Half Expected

B-F Football Forecasting

Given the following, how many goals will Lionel Messi score this year?

He has scored 25 goals through 10 games. He will play 50 games this year

Information is needed to perform a Bornhüetter-Ferguson (B-F) projection:

- Expected Ultimate Value
- Factor to Project to Actual Data to Ultimate Actual Data To Date

B-F Football Forecasting

Information for our example : Career average

Before the year started, how many goals would we expect Lionel Messi to score?

Expected Ultimate Value = 50

To project season total from current statistics, multiply the current statistics by 5 since the season is 1/5 completed.

Projection Factor = 5.000

He has already scored 25 goals.

Actual Goals To Date = 25

B-F Football Forecasting

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

- IBNR Factor = 1.000 - (1.000/LDF) = 1.000 - (1.000/5.000) = .80

(In Other Words, 80% of the year is left to be played

- Ultimate Value = (50 * .80) + 25 = 65

The B-F Method projects that Lionel Messi will score 65 goals this year.

Games 1-10	Games 11-20	Games 21-30	Games 31-40	Games 41-50
25 Goal	10 Goals	10 Goals	10 Goals	10 Goals

B-F Football Forecasting

Comparison of B-F with Two Other Methods

Incurred Loss Development Method

Ultimate Value = Incurred To Date * Cumulative LDF

= 25 * 5.000 = 125 Goals

Games 1-10	Games 11-20	Games 21-30	Games 31-40	Games 41-50
25	25	25	25	25

Expected Loss Ratio Method

Ultimate Value = Expected Value = 50 Goals

Games 1-10	Games 11-20	Games 21-30	Games 31-40	Games 41-50
10	10	10	10	10

Note: goals previously expected – 25 so far early in the season. Unless Lionel Messi is expected to slump, this method seems inappropriate.

Bornhüetter-Ferguson Method

ASSUMPTIONS	PROBLEMS
Premium is an accurate measure of exposure	Pricing Inconsistency
Expected loss ratio is predictable	Instability in accident year loss ratios
Constant reporting, case reserving and settling	Introduction of new claim systems
	Backlog in processing

Bornhüetter-Ferguson Method

Advantages	Disadvantages
Compromise between loss development and expected loss ratio methods	Assumes that case development is unrelated to reported losses
Avoids overreaction to unexpected incurred losses to date	Relies on accuracy of expected loss ratio
Suitable for new or volatile line of business	Less responsive to losses incurred to date
Can be used with no internal loss history	Relies on accuracy of earned premium
Easy to use	

A Complete Example
Incurred Losses

Accident	Incurred Losses ($000) at Accident Period Maturity in Months									
Year	12	24	36	48	60	72	84	96	108	120
2009	13,138	18,109	19,132	21,253	21,830	23,146	23,784	25,247	25,433	25,808
2010	13,541	16,432	19,053	20,121	21,705	22,897	24,375	24,746	25,148	
2011	15,043	19,371	22,468	24,084	25,215	27,376	28,560	29,202		
2012	15,259	22,208	23,521	24,541	26,526	27,372	28,013			
2013	18,192	28,347	31,148	36,610	38,742	40,011				
2014	23,442	35,375	42,659	46,365	48,858					
2015	32,176	51,426	58,334	63,018						
2016	43,431	60,795	68,770							
2017	40,152	56,263								
2018	39,888									

A Complete Example

Incurred Loss Development

Accident Year	Incurred Loss Development Factors (LDF's)									
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - ULT
2009	1.378	1.056	1.111	1.027	1.060	1.028	1.062	1.007	1.015	
2010	1.214	1.159	1.056	1.079	1.055	1.065	1.015	1.016		
2011	1.288	1.160	1.072	1.047	1.086	1.043	1.022			
2012	1.455	1.059	1.043	1.081	1.032	1.023				
2013	1.558	1.099	1.175	1.058	1.033					
2014	1.509	1.206	1.087	1.054						
2015	1.598	1.134	1.080							
2016	1.400	1.131								
2017	1.401									
All Yr. Avg	1.422	1.126	1.089	1.058	1.053	1.040	1.033	1.012	1.015	
Latest 3 Yr Avg	1.466	1.157	1.114	1.064	1.050	1.044	1.033			
X High/Low	1.427	1.124	1.081	1.059	1.049	1.035				
Selected	1.466	1.157	1.114	1.064	1.050	1.044	1.033	1.012	1.015	1.015
Age to Ult.	2.374	1.619	1.399	1.255	1.180	1.123	1.076	1.042	1.030	1.015
IBNR Factor	0.579	0.382	0.285	0.204	0.152	0.110	0.071	0.040	0.029	0.015

A Complete Example
Paid Losses

Accident	Paid Losses ($000) at Accident Period Maturity in Months									
Year	12	24	36	48	60	72	84	96	108	120
2009	4,992	10,830	14,855	17,230	19,135	19,925	20,989	22,101	23,598	24,636
2010	4,399	10,534	13,911	15,993	18,009	19,343	20,149	21,377	22,865	
2011	6,533	12,677	16,341	19,353	21,489	22,667	23,961	25,807		
2012	6,974	16,342	20,009	21,058	21,950	23,042	24,090			
2013	8,370	18,062	24,484	28,437	30,900	32,989				
2014	11,037	23,881	31,056	36,153	38,508					
2015	14,046	31,164	41,864	47,770						
2016	16,299	36,500	46,119							
2017	15,470	33,837								
2018	14,962									

A Complete Example

Paid Loss Development

Accident Year	Paid Loss Development Factors (LDF's)									
	12 - 24	24 - 36	36 - 48	48 - 60	60 - 72	72 - 84	84 - 96	96 - 108	108 - 120	120 - ULT
2009	2.169	1.372	1.160	1.111	1.041	1.053	1.053	1.068	1.044	
2010	2.394	1.321	1.150	1.126	1.074	1.042	1.061	1.070		
2011	1.941	1.289	1.184	1.110	1.055	1.057	1.077			
2012	2.343	1.224	1.052	1.042	1.050	1.046				
2013	2.158	1.356	1.161	1.087	1.068					
2014	2.164	1.300	1.164	1.065						
2015	2.219	1.343	1.141							
2016	2.239	1.264								
2017	2.187									
All Yr. Avg	2.202	1.309	1.145	1.090	1.058	1.049	1.064	1.069	1.044	
Latest 3 Yr Avg	2.215	1.302	1.156	1.065	1.057	1.048	1.064			
X High/Low	2.211	1.312	1.155	1.093	1.057	1.049				
Selected	2.215	1.302	1.156	1.065	1.057	1.048	1.064	1.069	1.044	1.044
Age to Ult.	4.873	2.200	1.689	1.462	1.373	1.298	1.239	1.165	1.090	1.044
Reserve Factor	0.795	0.545	0.408	0.316	0.272	0.230	0.193	0.141	0.083	0.042

A Complete Example
Development Forecasts

Incurred LDF Method			
Accident Year	Incurred Loss (000) at 12/31/18	Age to Ult LDF	Indicated Ultimate Loss (000)
2009	25,808	1.015	26,188
2010	25,148	1.030	25,894
2011	29,202	1.042	30,423
2012	28,013	1.076	30,149
2013	40,011	1.123	44,946
2014	48,858	1.180	57,635
2015	63,018	1.255	79,119
2016	68,770	1.399	96,199
2017	56,263	1.619	91,071
2018	39,888	2.374	94,682
Total	424,979		576,306

Paid LDF Method			
Accident Year	Paid Loss (000) at 12/31/18	Age to Ult LDF	Indicated Ultimate Loss (000)
2009	24,636	1.044	25,720
2010	22,865	1.090	24,921
2011	25,807	1.165	30,060
2012	24,090	1.239	29,846
2013	32,989	1.298	42,835
2014	38,508	1.373	52,870
2015	47,770	1.462	69,830
2016	46,119	1.689	77,904
2017	33,837	2.200	74,443
2018	14,962	4.873	72,914
Total	311,582		501,342

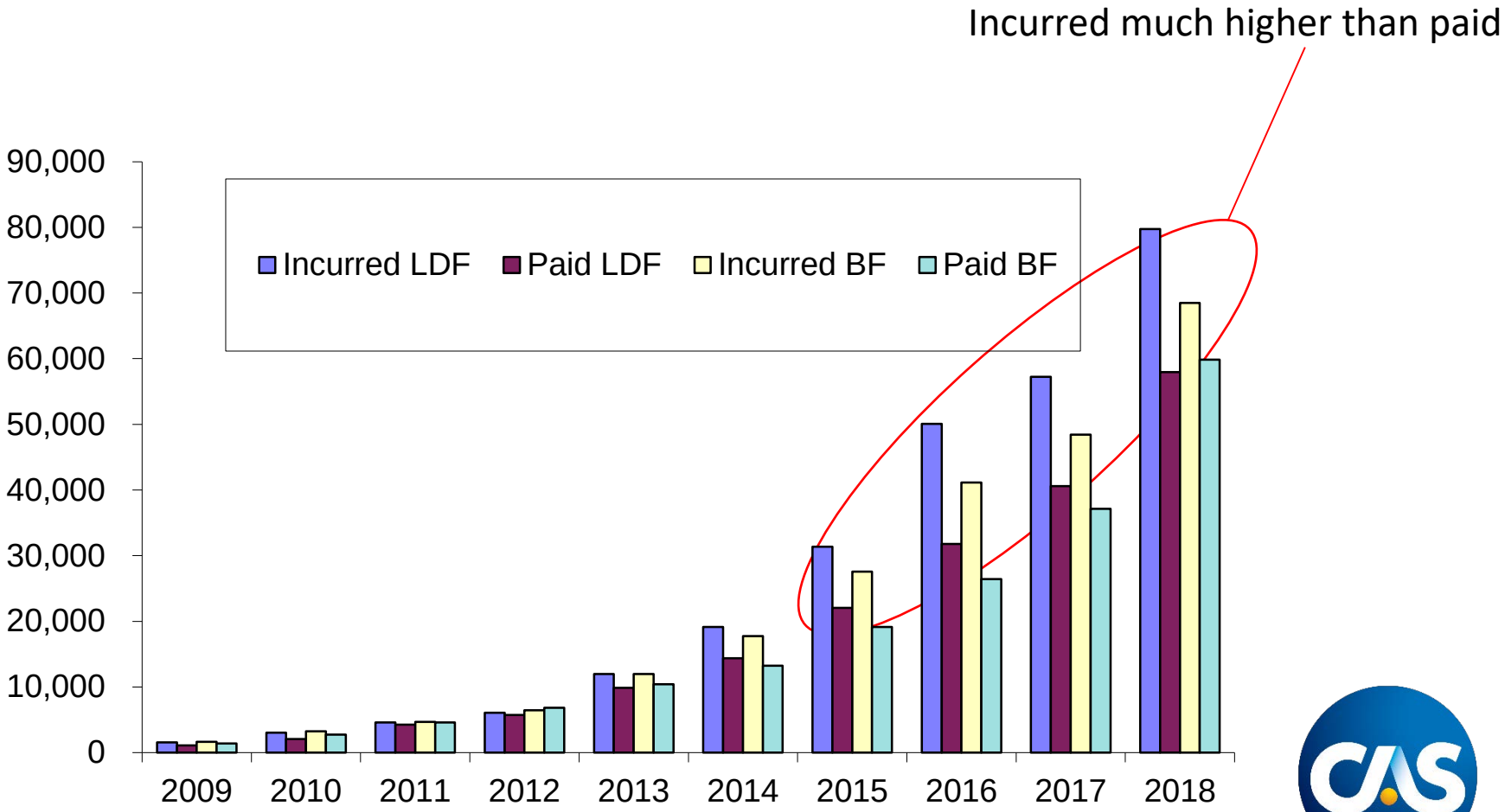
A Complete Example
Bornhüetter-Ferguson Forecasts

				Incurred BF Method				Paid BF Method			
Accident Year	Earned Premium	ELR	Expected Losses	IBNR Factor	Indicated IBNR	Incurred Loss (000) at 12/31/18	Indicated Ultimate Loss (000)	Reserve Factor	Indicated Reserve	Paid Loss (000) at 12/31/18	Indicated Ultimate Loss (000)
2009	47,975	70.0%	33,582	0.015	487	25,808	26,295	0.042	1,415	24,636	26,051
2010	47,397	70.0%	33,178	0.029	956	25,148	26,104	0.083	2,737	22,865	25,603
2011	46,609	70.0%	32,626	0.040	1,309	29,202	30,511	0.141	4,615	25,807	30,423
2012	50,599	70.0%	35,419	0.071	2,510	28,013	30,523	0.193	6,831	24,090	30,921
2013	64,637	70.0%	45,246	0.110	4,968	40,011	44,979	0.230	10,400	32,989	43,389
2014	69,510	70.0%	48,657	0.152	7,410	48,858	56,268	0.272	13,218	38,508	51,726
2015	86,505	70.0%	60,554	0.204	12,323	63,018	75,341	0.316	19,130	47,770	66,899
2016	92,564	70.0%	64,795	0.285	18,475	68,770	87,245	0.408	26,436	46,119	72,555
2017	97,248	70.0%	68,073	0.382	26,018	56,263	82,281	0.545	37,132	33,837	70,969
2018	107,538	70.0%	75,276	0.579	43,563	39,888	83,452	0.795	59,830	14,962	74,792
Total	710,581		497,407		118,019	424,979	542,998		181,744	311,582	493,326

A Complete Example
Comparison of Estimates

Accident Year	Indicated Ultimates: Incurred LDF	Paid LDF	Incurred BF	Paid BF	Selected Ultimate	Selected Reserve	Selected IBNR	Selected Loss Ratio
2009	26,188	25,720	26,295	26,051	26,063	1,427	256	54.3%
2010	25,894	24,921	26,104	25,603	25,630	2,765	482	54.1%
2011	30,423	30,060	30,511	30,423	30,354	4,547	1,152	65.1%
2012	30,149	29,846	30,523	30,921	30,360	6,270	2,347	60.0%
2013	44,946	42,835	44,979	43,389	44,037	11,049	4,026	68.1%
2014	57,635	52,870	56,268	51,726	54,625	16,117	5,767	78.6%
2015	79,119	69,830	75,341	66,899	72,797	25,027	9,779	84.2%
2016	96,199	77,904	87,245	72,555	83,475	37,356	14,706	90.2%
2017	91,071	74,443	82,281	70,969	79,691	45,854	23,428	81.9%
2018	94,682	72,914	83,452	74,792	81,460	66,499	41,572	75.8%
Total	576,306	501,342	542,998	493,326	528,493	216,911	103,514	74.4%

A Complete Example
Reserves Compared



A Complete Example
Ratio of Paid to Incurred

Accident	Ratio of Paid to Incurred at Accident Period Maturity in Months									
Year	12	24	36	48	60	72	84	96	108	120
2009	0.380	0.598	0.776	0.811	0.877	0.861	0.882	0.875	0.928	0.955
2010	0.325	0.641	0.730	0.795	0.830	0.845	0.827	0.864	0.909	
2011	0.434	0.654	0.727	0.804	0.852	0.828	0.839	0.884		
2012	0.457	0.736	0.851	0.858	0.827	0.842	0.860			
2013	0.460	0.637	0.786	0.777	0.798	0.824				
2014	0.471	0.675	0.728	0.780	0.788					
2015	0.437	0.606	0.718	0.758						
2016	0.375	0.600	0.671							
2017	0.385	0.601								
2018	0.375									

Changing Conditions

- Must go beyond rote application of basic techniques to produce a meaningful reserve estimates.
- Additional considerations and diagnostic tools offer perspective in the effort to understanding risks and uncertainties.
- Communication among operating units is essential.
- Subsequent Intermediate Tracks will provide additional insights and techniques useful in addressing several of these issues.

Considerations

- Aging of Claims
- Loss Adjustment Expenses
- Operations
- Limits and Deductibles
- Interpolation/Extrapolation
- Changing Indications

Considerations

- Aging of Claims
  1. Average Closed Value is not the same as Average Open Value
  2. Early Reported Claims are not the same as Late Reported Claims
- Loss Adjustment Expenses
- Operations
- Limits and Deductibles
- Interpolation/Extrapolation
- Changing Indications

Consideration #1

The average value of claims closed is often a poor estimator of the ultimate average settlement value of claims still open.

Consideration #1

Accident Year 2010

Calendar Date	Cumulative Paid on Closed Claims		Number of Closed Claims		Average Settlement Value
	$	% of Ultimate	No.	% of Ultimate	$
12-10	$50,000,000	25%	1,000	50%	$50,000
12-11	100,000,000	50%	1,500	75%	66,667
12-12	150,000,000	75%	1,800	90%	83,333
*	*	*	*	*	*
*	*	*	*	*	*
*	*	*	*	*	*
12/18 (Ult)	200,000,000	100%	2,000	100%	100,000

Why might this frequently be true?

Consideration #1

- Claims that close early are smaller
- For example in Workers Compensation:
  - The cases that close quickly are usually for minor injuries, and may involve just medical-only costs.
  - The cases open for a long period represent severe injuries and may include:
    - Major Medical Expenses
    - Lifetime Pension Benefits

Consideration #2

The average costs for late reported claims may differ materially from those reported earlier.

Consideration #2

- Reason: Often, late reported claims have a very different nature than those reported early.

(1) General Liability: Product Liability vs "Slip & Fall"

- Product Liability cases are often reported later
- Product cases are often complex, requiring expert testimony and lengthy litigation
- Product cases reported very late may involve latent injury or cumulative exposure, cases which are difficult to define in terms of date of loss, party at fault, number of occurrences, and type or extent of injuries

Consideration #2

(2) Workers Compensation:

Most Workers Compensation cases are reported within the first 18 months. However, when there are late reported claims they often involve occupational diseases (e.g. carpal tunnel), rather than trauma that is quickly identified and assignable to a single accident date and/or policy.

Considerations

- Aging of Claims
- Loss Adjustment Expenses
    3. The ratio of Paid Expenses to Settle Individual Claims to Paid Loss increases over time
    4. Segregate into Components
- Operations
- Limits and Deductibles
- Interpolation/Extrapolation
- Changing Indications

Consideration #3

For an accident year, the ultimate ratio of DCC to loss may be materially higher than has been true for payments to date.

Reasons:

1) Cases open for lengthy periods often involve costly litigation.
2) Legal payments are occasionally disbursed later than loss payments.

Consideration #3

Example Net Payments
Other Liability and Products Liability
Net Payments Through 12/31/16
(millions)

Accident Year	Age (months)	Cumulative Paid Losses (1)	Cumulative Paid DCC (2)	Ratio (3)=(2)/(1)
2014	60	$10,258	$2,272	22.1%
2015	48	9,549	1,979	20.7%
2016	36	7,673	1,612	21.0%
2017	24	5,183	765	14.8%
2018	12	2,600	209	8.0%

DCC Represents Defense and Cost Containment and includes costs to settle individual claims.

Consideration #3

- This pattern by company can be influenced by many factors, such as the mode of payment of legal bills, which may vary by company between:
  - Interim Case Billing
  - End of Case Billing
- Other influences can include:
  - Geographical Differences
  - Use of Staff Counsel vs. Outside Counsel
  - Classes of Business
  - Primary vs. Excess Contracts

Consideration #4

- Where claim defense costs are volatile, it may be useful to split it into components such as:
  - Attorney Fees (External or Internal)
  - Other Legal
  - Expert Witnesses
  - Medical Audits/Reviews

Consideration #4

Reasons:

1. Legal expense are typically the fastest growing component of DCC, with a growth rate exceeding trends in loss costs.
2. Many companies have attempted cost savings steps such as:
   - Use of staff counsel, rather than independent attorneys, in some situations
   - Use of companies which audit legal bills
   - More vigorous defense (which may slow payment patterns on loss side)
   - Initiating contact with the claimant sooner

Considerations

- Aging of Claims
- Loss Adjustment Expenses
- Operations
    5. Rate adequacy can impact reserving
    6. Positive Development does not mean a Claim Department problem
    7. Operational changes affect reserving
- Limits and Deductibles
- Interpolation/Extrapolation
- Changing Indications

Consideration #5

Expected Loss Ratios based on prior years' experience, used in reserving, must be adjusted for any material changes in rate adequacy.

Consideration #5

If adjustments are not made, severe distortions can result:

Accident Year (1)	Earned Premium (2)	Paid Losses (3)	2015 Loss Ratio (4)	Reserves Using 2015 Loss Ratio (5)=(2)x(4)-(3)	Ratio of Actual Rates to Adequate Rates (6)	Actual Loss Ratio (7)=(4) / (6)	Reserves Using Actual Loss Ratio (8)=(2)x(7)-(3)
2016	10,000	5,000	50%	0	1.0	50%	0
2017	9,000	2,700	50%	1,800	0.9	56%	2,300
2018	8,000	800	50%	3,200	0.8	63%	4,200
Total		8,500		**5,000**			**6,500**
						Error = $1,500	

Consideration #5

Think about it! From another angle.

Accident Year	Earned Premium	Paid Losses	2015 Loss Ratio	Ultimates Using 2015 Loss Ratio	Ratio of Actual Rates to Adequate Rates	Adjusted Loss Ratio	Ultimates Using Actual Loss Ratio
(1)	(2)	(3)	(4)	(5)=(2)x(4)	(6)	(7)=(4) / (6)	(8)=(2)x(7)-(3)
2016	10,000	5,000	50%	5,000	1.0	50%	5,000
2017	9,000	2,700	50%	4,500	0.9	56%	5,000
2018	8,000	800	50%	4,000	0.8	63%	5,000
Total		8,500		**13,500**			**15,000**

If rates are changing, but exposure is not …,

What do you expect to happen with ultimate losses?

Consideration #5

- Premium can be affected by increased competition and efforts to retain market share
  - filed rate decreases
  - increased use of flexible discounts
  - accounts moved to “preferred” status

- Need to talk to your colleagues to understand what is happening in the marketplace
  - underwriters
  - marketing
  - field office staff
  - pricing actuaries

Consideration #6

Upward case development does not necessarily demonstrate something “needs fixing” in the Claims Department.

Consideration #6

Resulting Development (Illustration):

ESTIMATE AT 12 MONTHS			STATUS 3 YEARS LATER	
Claims	Average $	Total	Average $	Total
1-97	$10,000	$970,000	$10,000	$970,000
98-100	10,000	30,000	500,000	1,500,000
TOTAL		$1,000,000		$2,470,000

LDF = 2.47

The Point: Loss development can arise from the natural emergence of facts within the context of a company's reserving philosophy

Consideration #7

Internal company changes can dramatically affect patterns in reserving data, and distort the result of basic reserving methodologies.

Consideration #7

Paid Losses

Acc Yr.	12 Mos.	24 Mos.	36 Mos.	48 Mos.	60 Mos.
2014	100	150	180	198	208
2015	100	150	180	198	
2016	100	150	180		
2017	100	150			
2018	100				

Reported Losses

Acc Yr.	12 Mos.	24 Mos.	36 Mos.	48 Mos.	60 Mos.
2014	125	167	189	202	208
2015	125	167	189	206	
2016	125	167	194		
2017	125	177			
2018	133				

Consideration #7

Paid to Reported Ratios

Acc Yr.	12 Mos.	24 Mos.	36 Mos.	48 Mos.	60 Mos.
2014	0.80	0.90	0.95	0.98	1.00
2015	0.80	0.90	0.95	0.96	
2016	0.80	0.90	0.93		
2017	0.80	0.85			
2018	0.75				

- Paid to Reported Ratios are an example of a diagnostic tool which can be used to check for:
  - Case reserve strengthening (this example)
  - Case reserve weakening
  - Change in rate of payment
- There are methods, such as the Berquist & Sherman approach, to correct for these kinds of changes.

Considerations

- Aging of Claims
- Loss Adjustment Expenses
- Operations
- Limits and Deductibles
    8. Higher limits mean more future development
    9. Higher deductibles (attachment points) mean more future development
- Interpolation/Extrapolation
- Changing Indications

Consideration #8

When reinsurance retentions and/or policy limits are higher, the portion of ultimate losses that are reported at each given maturity tends to be lower.

Consideration #8

ILLUSTRATION:

One Claim	Dollars Reported as of: 12 Months	24 Months	36 Months (Ult.)
Loss Limited to $100,000	$50,000	$100,000	$100,000
Loss Limited to $500,000	50,000	300,000	500,000
Unlimited Loss	50,000	300,000	1,000,000

	% of Ultimate Losses Reported as of: 12 Months	24 Months	36 Months (Ult.)
Loss Limited to $100,000	50%	100%	100%
Loss Limited to $500,000	10%	60%	100%
Unlimited Loss	5%	30%	100%

Consideration #9

When attachment points are higher for reinsurance, excess, umbrella or self-insured coverages, then the percentage of ultimate dollars that is reported at each given maturity tends to be lower.

Consideration #9

ILLUSTRATION:

	Dollars Reported as of:		
One Claim	12 Months	24 Months	36 Months (Ult.)
1st Dollar Coverage	$50,000	$300,000	$1,000,000
Losses in excess of $100,000	0	200,000	900,000
Losses in excess of $500,000	0	0	500,000

	% of Ultimate Losses Reported as of:		
	12 Months	24 Months	36 Months (Ult.)
1st Dollar Coverage	5%	30%	100%
Losses in excess of $100,000	0%	22%	100%
Losses in excess of $500,000	0%	0%	100%

Considerations

- Aging of Claims
- Loss Adjustment Expenses
- Operations
- Limits and Deductibles
- Interpolation/Extrapolation
    10. Incomplete accident years can be deceiving
    11. Tail development is important
- Changing Indications

Consideration #10

Estimating ultimate losses for an incomplete accident year requires special adjustments.

Consideration #10

Reported losses through Q3 2018

Accident Year	9 mos.	21 mos.	33 mos.	45 mos.	57 mos. (ult.)
2014	100,000	250,000	300,000	315,000	315,000
2015	100,000	250,000	300,000	315,000	
2016	120,000	300,000	360,000		
2017	110,000	275,000			
2018	130,000				

Age to Age Factors

Accident Year	9-21	21-33	33-45	45-57
2014	2.50	1.20	1.05	1.00
2015	2.50	1.20	1.05	
2016	2.50	1.20		
2017	2.50			
Cumulative Factor to Ultimate	3.15	1.26	1.05	1.00

Consideration #10

Required IBNR as of Q3 2018

Accident Year	(1) Reported as of Q3 2018	(2) Factor to Ultimate	(3)=(1)*(2) Estimated Ultimate Losses	(4)=(3)-(1) Required IBNR as of Q3 2018
2014	315,000	1.00	315,000	0
2015	315,000	1.00	315,000	0
2016	360,000	1.05	378,000	18,000
2017	275,000	1.26	346,500	71,500
2018	130,000	3.15	409,500	279,500

IS THIS CORRECT?

Consideration #10

Estimating ultimate losses for an incomplete accident year requires special adjustments.

The latest year needs to be reduced by .75 for the incomplete policy period. Future claims for the final quarter need to be excluded.

Consideration #11

"Tail Development" can have a dramatic effect on reserve needs.

Consideration #11

- Some examples of when development occurs beyond 10 years

Product	Complex issues (Who's liable? How to prove injury was caused by product? Date of loss?)
Workers Compensation	Occupational Disease Life pension cases, with escalation clauses in some states' benefit structures Medical costs on life pension cases
Medical Malpractice	Child injured at delivery reaches legal age Delayed manifestation, with subsequent complex issues

Consideration #11

Techniques To Derive Tail Factors

1. Examine broader data sources
   – e.g. ISO, NCCI, RAA, AM Best
   – (Caution: Learn the limitations of such data)
2. Curve Fitting
3. Generalized Bondy Method

Consideration #11
Broader Data Sources

How Much Tail Can There Be?

Development in Reinsured Layers

Selected Cumulative Age to Ultimate Factors

Source: RAA data

Line of Business	15 Years to Ultimate	25 Years to Ultimate
WC Treaty	1.582	1.149
GL Treaty	1.234	1.030
AL Treaty	1.021	1.000

Considerations

- Aging of Claims
- Loss Adjustment Expenses
- Operations
- Limits and Deductibles
- Interpolation/Extrapolation
- Changing Indications
    12. Indications can change for a variety of reasons - ask why!

Consideration #12

- Why do indications change?
  - Actual losses emergence differs from expected.
  - Assumptions and/or methods change.

Consideration #12

Last Year's Review
Reported Losses at 12/2017

AY	12 Mos.	24 Mos.	36 Mos.	48 Mos.
2014	125	167	189	202
2015	125	167	189	
2016	125	167		
2017	125			

Age to Age Factors

AY	12-24	24-36	36-48	
2014	1.34	1.13	1.07	
2015	1.34	1.13		
2016	1.34			
				Tail
Selected	1.34	1.13	1.07	1.00
Factor to Ultimate	1.62	1.21	1.07	1.00

Consideration #12

AY	Reported Losses at 12/2017	Factor to Ultimate	Estimated Ultimate
2014	202	1.00	202
2015	189	1.07	202
2016	167	1.21	202
2017	125	1.62	202

Easy, Right?

Consideration #12

12 months later the actuary returns:

“Bad news, boss...

We have to take a big hit to cover deterioration in the prior years.”

Will this be a pleasant discussion?

What happened????

Consideration #12

This Year's Review
Reported Losses at 12/2018

AY	12 Mos.	24 Mos.	36 Mos.	48 Mos.	60 Mos.
2014	125	167	189	202	208
2015	125	167	189	206	
2016	125	167	194		
2017	125	177			
2018	133				

Age to Age Factors

AY	12-24	24-36	36-48	48-60
2014	1.34	1.13	1.07	1.03
2015	1.34	1.13	1.09	
2016	1.34	1.16		
2017	1.42			

					Tail
Prior selected	1.34	1.13	1.07	1.00	1.00
Selected	1.40	1.15	1.08	1.03	1.00
Factor to Ultimate	1.79	1.28	1.11	1.03	1.00

Consideration #12

AY	Reported Losses at 12/2018	Factor to Ultimate	Estimated Ultimate	Estimate Last Year	Impact
2014	208	1.00	208	202	6
2015	206	1.03	212	202	10
2016	194	1.11	216	202	14
2017	177	1.28	226	202	24

Total Prior Year impact:	54
Increase in 4-year ultimate	6.7%

What happened?

Consideration #12

- Did the actuary miss the boat last year?
- Did the actuary overreact this year?
- What if factors (development assumptions) remained unchanged?

Consideration #12

AY	Reported Losses at 12/2018	Retain Prior Factor	Estimated Ultimate	Estimate Last Year	Impact
2014	208	1.00	208	202	6
2015	206	1.00	206	202	4
2016	194	1.07	207	202	5
2017	177	1.21	214	202	12

Total Prior Year impact:	27
Increase in 4-year ultimate	3.4%

Consideration #12

- Part of the impact is due to actual losses emerging different from what was expected.

- Should development assumptions change?
  - If so, that accounts for the remaining impact.

Conclusions

It is seldom sufficient to simply manipulate the numbers. The actuary must actively seek a thorough understanding of...

- ...the loss and claims process
- ...the business and the exposures involved
  - underwriting
  - pricing
  - reinsurance
- …techniques and models to deal with the available data

Conclusions

If professional colleagues are to rely on actuarial advice, they will expect meaningful interpretation of the indications, and the risks and uncertainties in changing estimates.

Investigating and Detecting Change

The Ideal Situation

Loss reserve data should contain a long, stable history of homogeneous claim experience, where no significant operations changes materially affect either the mix of business or the handling of claims, and there should be a sufficient number of claims to produce credible loss patterns.

The Reality

- Virtually all elements of “The Ideal” are periodically violated:

1. The Mix Changes
2. Claim Handling Changes
3. Case Reserves are Strengthened/Weakened
4. Other Factors
   - Changes in Deductibles, Limits, SIRs
   - Changes in Reinsurance
   - Tort Reform, other law changes
   - New Sources of Loss
   - Changes in the Economy

We Will Discuss

- The potential impact of mix changes
- Changes in claim closing patterns
- Changes in case reserve adequacy
- What Else?

Change in Mix

Cumulative Paid Losses

Accident Year	Months of Development 12	24	36+	Ultimate
2015	$2,000	$4,000	$5,100	$5,100
2016	2,000	4,000	5,100	5,100
2017	2,000	4,000		5,100
2018	2,000			5,100

Change in Mix

Cumulative Paid Losses (Category A)

Accident Year	Months of Development 12	24	36+	Ultimate
2015	$1,500	$1,800	$2,100	$2,100
2016	1,500	1,800	2,100	2,100
2017	1,500	1,800		2,100
2018	500			700

Develops quickly
Most of $ paid within 12 months

Change in Mix

Cumulative Paid Losses (Category B)

Accident	Months of Development			
Year	12	24	36+	Ultimate
2015	$500	$2,200	$3,000	$3,000
2016	500	2,200	3,000	3,000
2017	500	2,200		3,000
2018	1,500			9,000

Develops slower than Category A
Most of $ paid between 12-24 months

Change in Mix

Paid Loss Ultimate Comparison

- Accident Year 2018 ultimate loss if change in mix is ignored: $5,100 (i.e. unchanged from 2017)

- Accident Year 2018 ultimate if data is separately analyzed: $9,700 (i.e. sum of two category ultimates)

Change in Mix

Key Principle

Always search for subdivisions of data related to possible causes of variable loss development

Change in Mix

Suggested Subdivisions of Data Include

Primary:

1. Geographic
2. New Products vs. Old
3. Subline or Coverage
4. Deductibles or Policy Limits
5. Type of Loss Payment (e.g., Medical vs. Indemnity)

Reinsurance:

1. Attachment Point
2. Production Source
3. Line or Subline

Change in Mix

What Should be Done if Mix Change Includes New Business for Which You Have Insufficient Data?

Seek Alternative Sources of Data

Perhaps general liability book formerly was comprised solely of "OL&T" exposures, but in recent years began adding "M&C" risks.

Possible Solution: Relate ISO development patterns for M&C to OL&T and modify development factors for your analysis.

Discuss Potential Impacts with Claims, Underwriting, Other Actuaries

- Length of Tail
- Frequency
- Severity
- Loss Ratios

Claim Closing Patterns

Unadjusted Paid Loss Development Method

Accident	Months of Development			
Year	12	24	36+	Ultimate
2007	$1,000	$4,000	$6,000	$6,000
2008	1,000	3,500		5,250
2009	750			4,219

Incurred Loss Development Method

Accident	Months of Development			
Year	12	24	36+	Ultimate
2007	$2,000	$5,000	$6,000	$6,000
2008	1,967	4,917		5,900
2009	1,867			5,600

Claim Closing Patterns

1. Review Closing Rates to Determine Whether There Has Been a Change
2. Seek Independent Confirmation That a Change Has Occurred
3. Restate Historical Closed Claims Using Current
4. Closing Rates
5. Restate Historical Paid Losses Using Restated Closed Claims
6. Apply Standard Loss Development Method To Restated Paid Losses

Claim Closing Patterns

Data Needed

- Paid Loss Development Triangle (slide 142)
- Reported Claims Development Triangle (slide 146)
- Projected Ultimate Claims (slide 146)
- Closed Claims Development Triangle (slide 146)
- Calendar period data offers alternative perspective and added insight (slide 149)

Claim Closing Patterns

Step 1: Review Closing Rates to Determine Whether There Has Been a Change

Claim Closing Patterns

Reported Claims

Accident Year	Months of Development 12	24	36	Ultimate
2016	500	900	1,000	1,000
2017	480	880		980
2018	450			900

Closed Claims

Accident Year	Months of Development 12	24	36+
2016	250	810	1,000
2017	240	704	
2018	180		

Claim Closing Patterns

Closed / Reported

Accident Year	Months of Development 12	24	36
2016	50.0%	90.0%	100.0%
2017	50.0%	80.0%	
2018	40.0%		

Closed / Ultimate

Accident Year	Months of Development 12	24	36
2016	25.0%	81.0%	100.0%
2017	24.5%	71.8%	
2018	20.0%		

Claim Closing Patterns

Calendar period data from the Claim Department may also offer a useful tool for monitoring change.

- New Reported Claims
- Open Claims
- Closed Claims

Claim Closing Patterns

Calendar Year-end	(1) New Reported Claims	(2) Open Claims @ year-end	(3) In-Force Claims = (1) + prior year (2)	(4) Closed Claims	(5) Closure Rate = (4) / (3)
2014	1,000	340	1,340	1,000	74.6%
2015	1,000	340	1,340	1,000	74.6%
2016	1,000	340	1,340	1,000	74.6%
2017	980	330	1,320	990	75.0%
2018	950	446	1,280	834	65.2%

1,280 = 950 + 330

columns (1), (2) and (4) derived from slide 145

Claim Closing Patterns

Note that the slowdown in claims closing produces LOWER estimated reserves with the paid development method (will you look a gift horse in the mouth?)

Applies to incurred losses as well

Claim Closing Patterns

Step 2: Seek Independent Confirmation that a Change Has Occurred

Ask the Claims Department About Changes in:

- Opening and Closing Practices
- The Claims Handling Environment
- Levels of Staffing, Reorganizations
- Definition of a Claim (e.g., Multiple Claimants)

Claim Closing Patterns

Step 3: Restate Historical Closed Claims Using Current Closing Rates

Claim Closing Patterns

Adjusted Closing Percent (see slide 146)

Accident Year	Months of Development 12	24	36
2016	20.0%	71.8%	100.0%
2017	20.0%	71.8%	
2018	20.0%		

Adjusted Closed Claims

Accident Year	Months of Development 12	24	36+
2016	200	718	1,000
2017	196	704	
2018	180		

Ultimate Claims (slide 145) * Adjusted Closing %

200 = 1,000 * 20.0%

718 = 1,000 * 71.8%

196 = 980 * 20.0%

Claim Closing Patterns

Step 4: Restate Historical Paid Losses Using Restated Closed Claim

Claim Closing Patterns

Linear Interpolation of Adjusted Paid Losses

Accident Year 2016 @ 12 Months	Age 0	Age 12
Actual Closed Claims (slide 145)	0	250
Actual Paid Loss (slide 141)	0	1,000

Therefore, 200 Claims would expect to have $800 paid loss

AY 2016 @ 12 Months: $\frac{200 - 0}{250 - 0} \times (1{,}000 - 0) + 0 = 800$

Accident Year 2016 @ 24 Months	Age 12	Age 24
Actual Closed Claims (slide 145)	250	810
Actual Paid Loss (slide 15)	1,000	4,000

Therefore, 718 Claims would expect to have $3,507 paid loss

AY 2016 @ 24 Months: $\frac{718 - 250}{810 - 250} \times (4{,}000 - 1{,}000) + 1{,}000 = 3{,}507$

Accident Year 2017 @ 12 Months	Age 0	Age 12
Actual Closed Claims (slide 145)	0	240
Actual Paid Loss (slide 141)	0	1,000

Therefore, 196 Claims would expect to have $817 paid loss

AY 2017 @ 12 Months: $\frac{196 - 0}{240 - 0} \times (1{,}000 - 0) + 0 = 817$

Claim Closing Patterns

Step 5: Apply Standard Loss Development Method to Restated Paid Losses

Claim Closing Patterns

Adjusted Paid Loss Development Method

Accident Year	Months of Development 12	24	36+
2016	$800	$3,507	$6,000
2017	817	3,500	
2018	750		

Accident Year	Months of Development 12-24	24-36	36-Ult
2016	4.38	1.71	
2017	4.28		
Selected	4.33	1.71	1.00
CDF	7.41	1.71	1.00
Ultimate	**5,561**	**5,988**	**6,000**

From slide 154

Claim Closing Patterns

Impact of Adjustment

Acc Yr	Revised Forecast Slide 156	Original Forecast Slide 141	Difference
2016	$6,000	$6,000	$0
2017	5,988	5,250	738
2018	5,561	4,219	1,342
Total	$17,549	$15,469	$2,080

Case Reserve Adequacy

Incurred Losses ($000)

Accident Year	Months of Development 12	24	36+	Projected Ultimate
2016	10,000	40,000	50,000	50,000
2017	10,000	45,000		56,250
2018	10,417			55,340

Paid Losses ($000)

Accident Year	Months of Development 12	24	36+	Projected Ultimate
2016	2,000	24,000	50,000	50,000
2017	2,500	30,000		62,500
2018	3,125			78,125

Case Reserve Adequacy

What if claim closing patterns are not changing?

Reported Claims

Accident Year	Months of Development 12	24	36	Ultimate
2016	5,000	8,000	10,000	10,000
2017	5,000	8,000		10,000
2018	5,000			10,000

Closed Claims

Accident Year	Months of Development 12	24	36+
2016	1,000	6,000	10,000
2017	1,000	6,000	
2018	1,000		

Case Reserve Adequacy

1. Review Paid-To-Incurred Triangles
2. Review Trends in Average Paid Claims Versus Trends in Average Case Reserves
3. Review Potential Reasons for Observed Trends
4. Adjust Historical Case Reserves to Current Adequacy Levels
5. Calculate Adjusted Incurred Losses

Project Ultimate Losses Using Adjusted Incurred Losses and Standard Loss Development

Case Reserve Adequacy

Step 1: Review Paid - To - Incurred Triangles

Case Reserve Adequacy

Accident Year	Months of Development 12	24	36
2016	20%	60%	100%
2017	25%	67%	
2018	30%		

[paid loss / incurred loss from slide 158]

Ratios are increasing. Since settlement rates appear consistent, may be due to a decrease in case reserve adequacy.

Case Reserve Adequacy

Step 2: Review Trends in Average Paid Claims Versus Trends in Average Case Reserves

Case Reserve Adequacy

Accident	Average Paid Loss		Average Case Reserves	
Year	12	24	12	24
2016	2,000	4,000	2,000	8,000
2017	2,500	5,000	1,875	7,500
2018	3,125		1,823	
Trend	25%	25%	-4.5%	-6.3%

Average Paid Loss =
  Paid Loss Triangle (Slide 158)
  Closed Claim Triangle (Slide 159)
Average Case Reserves =
  (Incurred Loss Triangle - Paid Loss Triangle (Slide 158))
  (Reported Claim Triangle - Closed Claim Triangle (Slide 159))

Case Reserve Adequacy

Step 3: Review Potential Reasons for Observed Trends

- Is the book shifting to a lower severity mix?
- Have policy limits and/or reinsurance retentions kept pace with claims inflation?
- Has anything material changed in the handling of claims?
- Turnover in claim department staff
- Changes in philosophy
- If you conclude there has been case reserve weakening (or strengthening), adjust the data. Here's one approach.

Case Reserve Adequacy

Step 4: Adjust Historical Case Reserves to Current Adequacy Levels

Case Reserve Adequacy

- Assumption:
  - 25% is the Actual Rate of Claim Inflation (slide 164)

Accident Year	Adjusted Average Case Reserves 12	24	36
2016	1,167	6,000	0
2017	1,458	7,500	
2018	1,823		

6,000 = 7,500 / 1.25

1,167 = 1,823 / (1.25^2)

1,458 = 1,823 / 1.25

Case Reserve Adequacy

Step 5: Calculate Adjusted Incurred Losses

Case Reserve Adequacy

	Paid to Date Losses (slide 158)	+	# of Open Claims (slide 159)	x	Adjusted Average Case Reserves (slide 167)/1000	=	Adjusted Incurred Losses
AY 2016 @ 12 Months	2,000	+	4,000	x	1.167	=	6,667
AY 2016 @ 24 Months	24,000	+	2,000	x	6.000	=	36,000
AY 2017 @ 12 Months	2,500	+	4,000	x	1.458	=	8,334

Case Reserve Adequacy

Step 6: Project Ultimate Losses Using Adjusted Incurred Losses and Standard Loss Development

Case Reserve Adequacy

Adjusted Incurred Losses

Accident Year	Months of Development 12	24	36+
2016	$6,667	$36,000	$50,000
2017	8,334	45,000	
2018	10,417		

From slide 169

Accident Year	Months of Development 12-24	24-36	36-Ult
2016	5.40	1.39	
2017	5.40		
Selected	5.40	1.39	1.00
CDF	7.50	1.39	1.00
Ultimate	78,125	62,500	50,000

Case Reserve Adequacy

Impact of Adjustment

Accident Year	Original Incurred Estimate (Slide 158)	Original Paid Estimate (Slide 158)	Revised Incurred Estimate (Slide 169)
2016	$50,000	$50,000	$50,000
2017	56,250	62,500	62,500
2018	55,340	78,125	78,125
Total	$161,590	$190,625	$190,625

What Else?

- Deductibles/Limits/SIRs change
- Reinsurance Arrangements Change
- Tort Reform
- New Sources of Loss
- Changes in the Economy

Deductibles/Limits/SIRs change

- Deductibles may change the number of claims
- May change loss $ as well
- Need to review profile of deductibles and limits – inherent assumption is no change
- Treat like change in mix

Reinsurance Arrangements Change

- Effect on total net liability
- Might also affect claims handling
- e.g., if retention is limited to $100,000 by reinsurance, is there an incentive to settle a
- $500,000 case more quickly than if you were on the hook for the whole thing?

Tort Reform

- Change in benefits which would affect severity and payout (e.g. cost containment)
- Change in statute of limitations (frequency change, less “tail” development)
- New patterns – e.g., ability to do lump-sum settlements of permanent workers’ comp claims

New Sources of Loss

- Mold
- Terrorism
- Asbestos – just keeps on running
- Stacking of auto limits

Summary

Assumption of long, stable history is often violated.

- The mix of business can change
- Claim closing patterns can change
- Case reserve adequacy can change
- Other factors can change as well