



BASIC RESERVING WORKSHOP



Caribbean Actuarial Association Annual Conference

Santa Barbara Beach & Golf Resort, Curacao
December 4–6, 2019



Basic Loss Reserving – Part 1

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



Overview

- 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?
 - Need to have enough money to pay claims
 - Need for accurate evaluation of financial condition & underwriting income
 - Meet regulatory requirements
 - Need for business planning
 - Tax purposes



Definitions

- **Carried Loss Reserve**

The amount shown in a published statement or an internal statement of financial condition. May be set by management.

- **Indicated Loss Reserve**

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

- **Reserve Margin/Deficit**

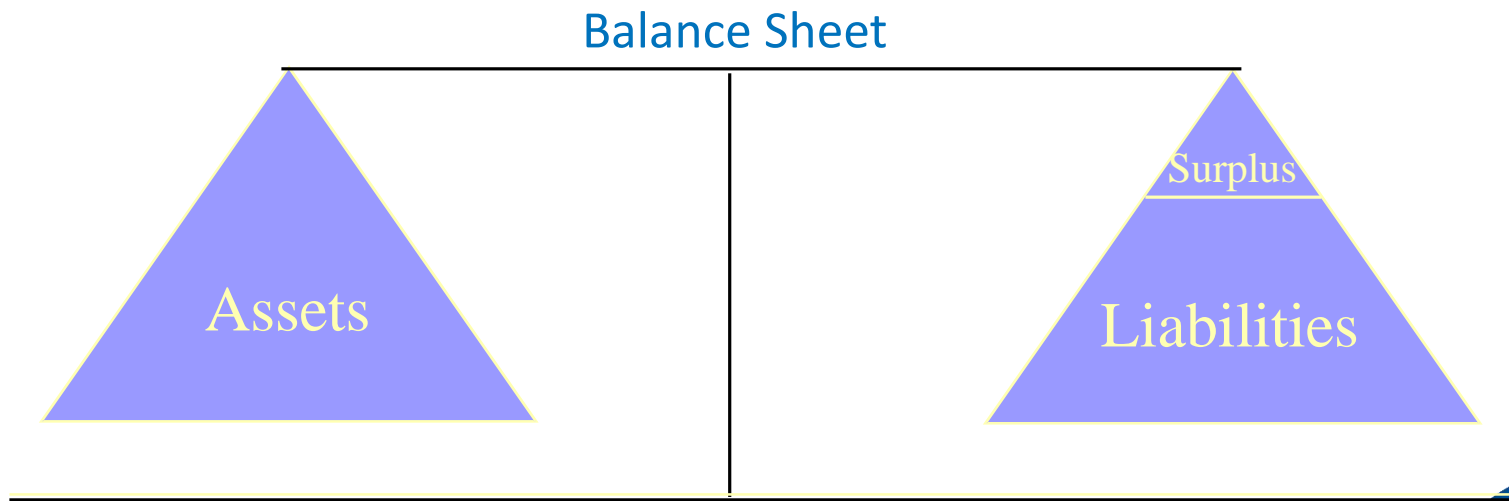
The difference between an indicated loss reserve and a carried loss reserve.

- is a reserve deficiency a positive or negative number?



Financial Condition - Balance Sheet

Accounting Aspects of Loss Reserves



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 Loss(es) = Ultimate Loss(es) (incl. IBNR) or sometimes Reported Loss(es) (excl. IBNR)
- Loss(es) may mean Loss(es) and LAE
 - LAE could be ALAE, ULAE, DCC or A&O



Elements of a Loss Reserve

- 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
- IBNR Reserves (incurred but not reported)



Formulas to Derive IBNR Reserves

- IBNR

= Ultimate Losses - Reported Losses

= Ultimate Losses - Paid Losses - Case Reserves

Its what the actuaries estimate or back into!



Elements of a Loss Reserve

- 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
- IBNR Reserves (incurred but not reported)
 - Development on known claims (IBNER)
 - Reserves for claims not yet reported (“pure” IBNR, aka IBNYR)
 - Claims in transit (Reported But Not Yet Reserved)
 - Reserves for reopened claims
- Considerations: earning of premiums, product liability, construction defects



Elements of a Loss Reserve (cont'd)

- Can also include expenses for settling claims (Loss Adjustment Expense [LAE])
 - ALAE = Allocated Loss Adjustment Expense
 - ULAE = Unallocated Loss Adjustment Expense
- Or
- DCC = Defense and Cost Containment
- A&O = Adjusting and Other
- Loss Reserve Margins
 - e.g., 75th percentile
- Discounted (for the time value of money)



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

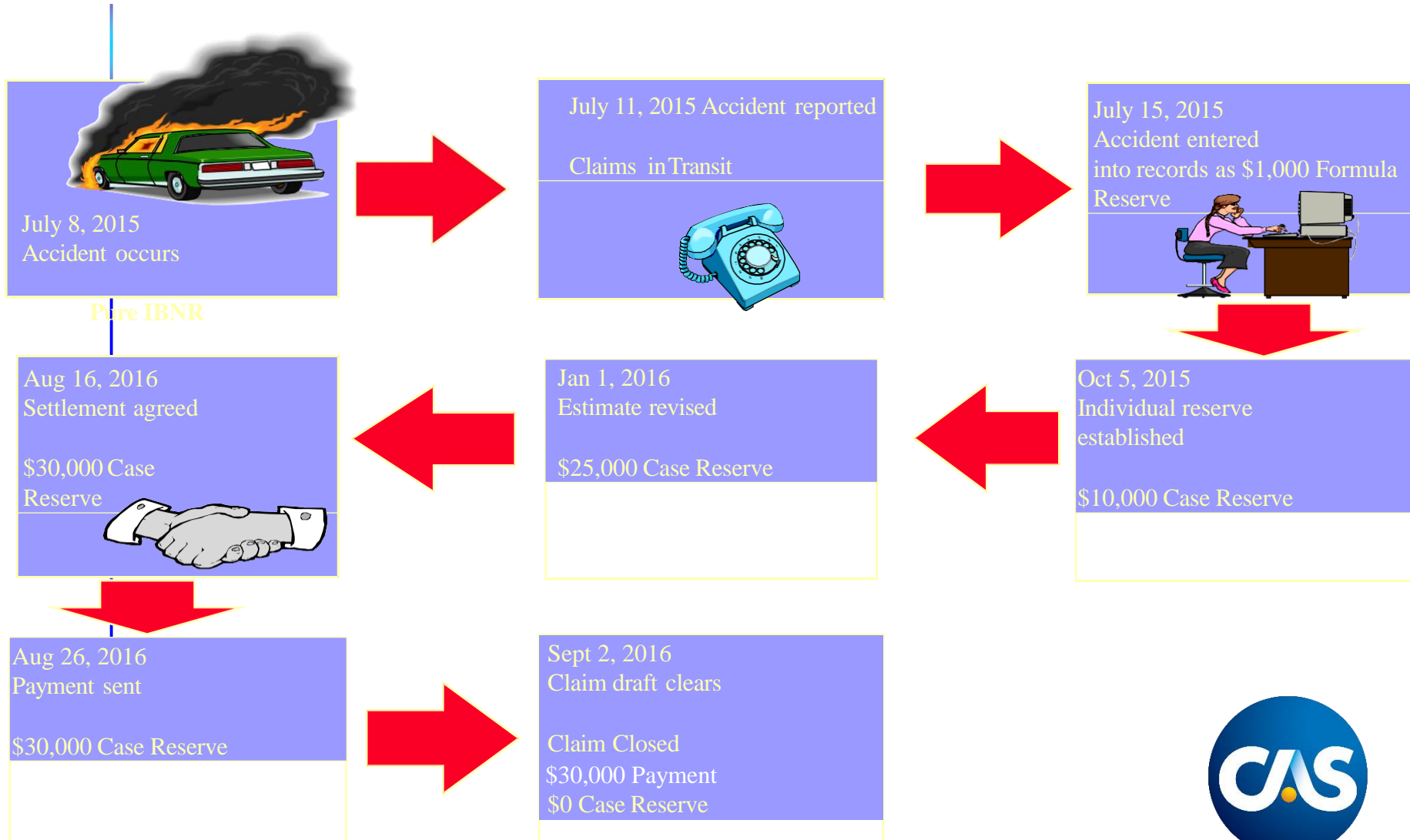


Principles

- Most appropriate indicated reserve depends on:
 - relative likelihood of estimates in range
 - financial reporting context
 - US Statutory
 - US GAAP
 - IFRS 17
 - Swiss Statutory



Life Cycle of a Claim Reserve



Claim Characteristics

- Claim activity usually extends over a period of time
- Claim value is estimated and can change over time. The final value is not known until claim is finally closed
- A claim could have many different types of payment (e.g. A motor claim could have payments to a garage for repairs, a third party for liability, an expense to external adjusters, etc.)



Claim Characteristics

- A claim is associated with many critical dates
 - Policy Effective Date: The date a policy becomes effective
 - 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
 - Closed Date: The date on which the claim is closed
 - Reopened date: The date a closed claim is reopened



Two Relevant Dates

- Accounting Date
 - Defines a group of claims for which liability may exist, i.e. all claims incurred on or before this particular date
- Valuation Date
 - The date through which transactions are included in evaluating the existing liability

e.g., loss reserves as of **December 31, 2017**, using data as of **September 30, 2017**



Valuation Date



Accounting Date



Data Verification

- DO NOT SKIP THIS STEP
- Data Review:
 - Consistency with financial statements
 - Consistency with data used in the prior analysis
 - Reasonableness
 - Data definitions
- Although not requiring a formal data audit, the reserving actuary should ensure the data used in the analysis is reliable and suitable
- Proper documentation of the verification processes and findings



Data Organization

- Calendar Year Data

- Think financial statements
- Aggregation of all transactions (e.g. payments, reserve changes, etc.) occurred in a given calendar year
- $\text{Incurred losses} = \text{payments during the year} + \text{loss reserves at the end of the year} - \text{loss reserves at the beginning of the year}$

Advantage	Disadvantage
<ul style="list-style-type: none">• Readily available• Value remains fixed and doesn't change	<ul style="list-style-type: none">• Values might be influenced by claims from old years and not relevant to recent experience• Distortions in periods with growth or shrinkage



Data Organization

- Policy Year Data

- Aggregation of all claims associated with policies effective in a given year
- Incurred losses = payments accumulated since the effective year up to the valuation date + loss reserves at the valuation date

Advantage	Disadvantage
<ul style="list-style-type: none">• Direct match of exposures (premiums) and claims arising from a block of policies	<ul style="list-style-type: none">• Requires a longer time frame for experience maturity (premiums and losses)



Data Organization

- Accident Year Data

- Aggregation of all claims occurred in a given year
- Incurred losses = payments accumulated since the accident year up to the valuation date + loss reserves at the valuation date

Advantage	Disadvantage
<ul style="list-style-type: none">• Shorter time frame than policy year data• Commonly used for actuarial analyses	<ul style="list-style-type: none">• Potential mismatch between exposures and claims (e.g., could have a really large claim against only one month of premium)



Illustration-an example

- A Claim with Policy Effective Date = 2013/12/1, Loss Date = 2014/9/15 and Reported Date =2014/9/20
 1. Opening Reserve @ 2014/9/20 = \$5,000
 2. Payment of \$1,000 and Increase Reserve \$15,000 @ 2015/6/18 (After Increasing, O/S=\$20,000)
 3. Final Payment @ 2016/3/20 = \$12,000
- Calendar Year Incurred Losses
 - 2014 = $0+(5,000-0) =5,000$
 - 2015 = $1,000+(20,000-5,000) =16,000$
 - 2016 = $12,000+(0-20,000) = -8,000$
- Accident Year Incurred Losses: Loss Date = 2014/9/15 => Accident Year is 2014
 - Incurred Loss Amount for AY2014 @ 2014/12/31= \$5,000
 - Incurred Loss Amount for AY2014 @ 2015/12/31= \$21,000
 - Incurred Loss Amount for AY2014 @ 2016/12/31= \$13,000
- Policy Year Incurred Losses: Policy Effective Date = 2013/12/1 => Policy Year is 2013
 - Incurred Loss Amount for PY2013 @ 2014/12/31= \$5,000
 - Incurred Loss Amount for PY2013 @ 2015/12/31= \$21,000
 - Incurred Loss Amount for PY2013 @ 2016/12/31= \$13,000



Data Organization - Exercise

Policy Effective Date	Claim ID	Accident Date Report Date		<u>2005 Transactions</u>		<u>2006 Transactions</u>		<u>2007 Transactions</u>		<u>2008 Transactions</u>	
				Total Payments	Ending Case O/S	Total Payments	Ending Case O/S	Total Payments	Ending Case O/S	Total Payments	Ending Case O/S
20-Apr-04	1	1-Jan-05	1-Feb-05	400	200	220	0	0	0	0	0
15-Aug-04	2	5-Apr-05	15-May-05	200	300	200	0	0	0	0	0
18-Jul-05	3	20-Aug-05	15-Dec-05	0	400	200	200	300	0	0	0
9-May-05	4	28-Oct-05	15-May-06			0	1000	0	1200	300	1200
11-Sep-05	5	3-Mar-06	1-Jul-06			260	190	190	0	0	0
3-Oct-05	6	18-Sep-06	2-Oct-06			200	500	0	500	230	270
28-Feb-06	7	12-Jan-06	15-Feb-07					270	420	0	650
5-Jun-06	8	3-Jan-07	1-Apr-07					200	200	200	0
20-Aug-06	9	15-Jun-07	9-Sep-07					460	390	0	390
16-Feb-07	10	30-Sep-07	20-Oct-07					0	400	400	400
30-Dec-06	11	12-Dec-07	10-Mar-08							60	530
1-May-07	12	12-Apr-08	18-Jun-08							400	200
2-Mar-08	13	28-May-08	23-Jul-08							300	300
25-Dec-07	14	11-Dec-08	5-Dec-08							0	540
26-Sep-08	15	15-Oct-08	2-Feb-09								

Exercise:

- (1) How many calendar years are there? Calculate each calendar year incurred losses?
- (2) How many accident years are there? Calculate each accident year incurred losses at each subsequent year end?
- (3) How many policy years are there? Calculate each policy year incurred losses at each subsequent year end?



Answers:

(1) How many calendar years are there? Calculate each calendar year incurred losses.

4--2005, 2006, 2007 and 2008

Calendar Year	Incurred Losses
2005:	
2006:	
2007:	
2008:	

(2) How many accident years are there? Calculate each accident year incurred losses at each subsequent year end.

4--2005, 2006, 2007 and 2008

Accident Year	@2005	@2006	@2007	@2008
2005:				
2006:				
2007:				
2008:				

(3) How many policy years are there? Calculate each policy year incurred losses at each subsequent year end.

5--2004, 2005, 2006, 2007 and 2008

Policy Year	@2005	@2006	@2007	@2008
2004:				
2005:				
2006:				
2007:				
2008:				



Answers:

(1) How many calendar years are there? Calculate each calendar year incurred losses.

4--2005, 2006, 2007 and 2008

Calendar Year	Incurred Losses
2005:	1500
2006:	2070
2007:	2640
2008:	3260

(2) How many accident years are there? Calculate each accident year incurred losses at each subsequent year end.

4--2005, 2006, 2007 and 2008

Accident Year	@2005	@2006	@2007	@2008
2005:	1500	2420	2720	3020
2006:		1150	1840	2070
2007:			1650	2640
2008:				1740

(3) How many policy years are there? Calculate each policy year incurred losses at each subsequent year end.

5--2004, 2005, 2006, 2007 and 2008

Policy Year	@2005	@2006	@2007	@2008
2004:	1100	1020	1020	1020
2005:	400	2550	2850	3150
2006:		0	1940	2760
2007:			400	1940
2008:				600



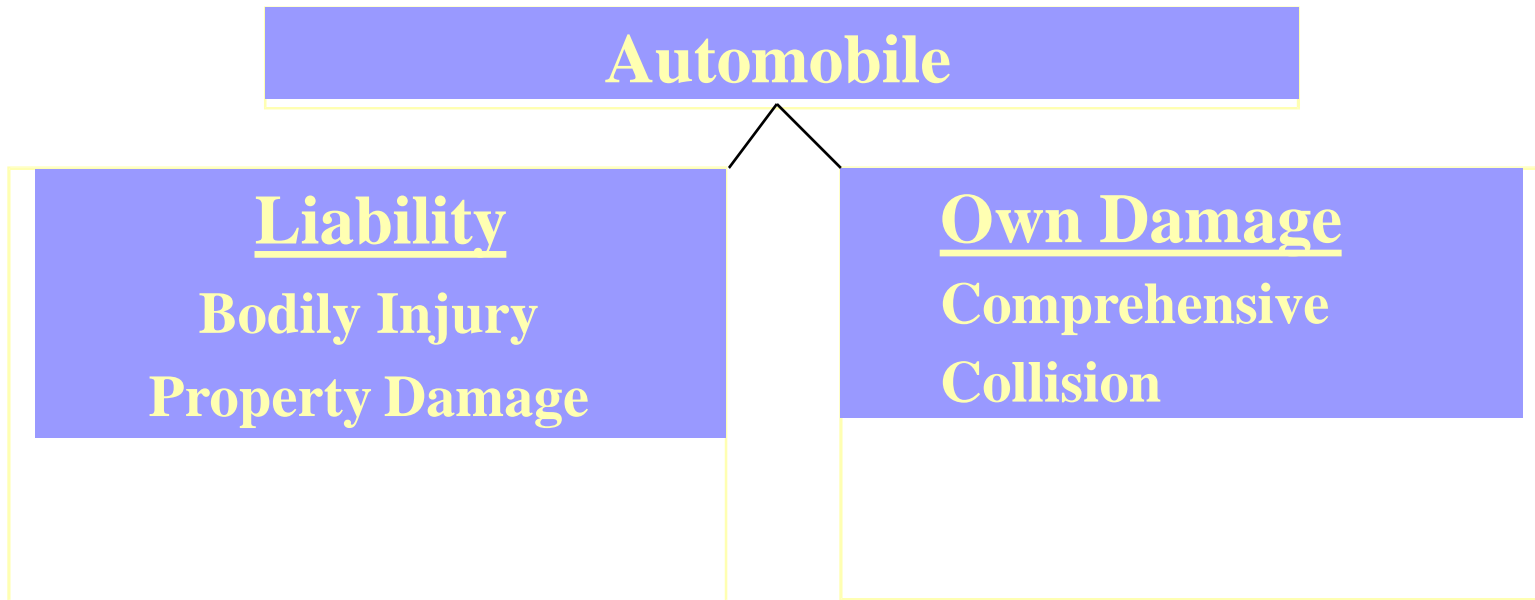
Data Organization (others)

- Underwriting Year
 - Similar to a policy year for a primary insurer
 - But for reinsurer, it consists of all treaties executed in a year
 - If reinsurance is on a policy attaching basis, then an underwriting year for a reinsurer could include primary policies written from 1/1/XX to 12/31/XX+1, so it is not even closed until 12/31/XX+2
- Report Year
 - Includes all claims reported in a year regardless when the policy was written
 - Used to analyze additional development on known claims (i.e., supplemental reserves)



Considerations: Homogeneity

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



Considerations: Credibility

- Refer to the predictability 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



Considerations: Homogeneity and Credibility

- The goal is to divide the data into sufficiently homogeneous groupings without comprising the credibility of each group
- Use of relevant supplementary data sources to complement the lack of data credibility
 - Examples include industry 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
- **Development Triangles**
 - A table compiled to measure the changes in cumulative claim activity of various cohorts (e.g. accident year claims) 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). Also known as Age-to-Age Factors or Link Ratios



Basic Reserving Techniques: Key Assumptions

- Future claims' development is similar to prior years' development; i.e. the past is indicative of the future
- Consistent claim processing
- A stable mix of types of claims, stable policy limits, and stable reinsurance (or excess insurance) retention limits throughout the experience period



Basic Reserving Techniques: Issues to Consider for 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; Company 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 major floods at the end of December. Late reporting caused unusually high development in the next year



Basic Reserving Techniques: Major Mechanical Steps

- Step 1 – Compile claims data in a development triangle
(Details refer to Friedland’s “Estimating Unpaid Claims Using Basic Techniques” p 54-60)
- Step 2 – Calculate loss development factors
- Step 3 – Calculate averages of the loss development factors
- Step 4 – Select loss development factors
- Step 5 – Select tail factor
- Step 6 – Calculate cumulative loss development factors
- Step 7 – Project ultimate claims cost
- Step 8 – Calculate Claim Reserves and IBNR



Basic Reserving Techniques:

Step 1 - Compilation of Accident Year/Quarter Loss Triangle

- The losses are sorted by the year/quarter in which the accident occurred. The payments from inception are summed at the end of each year/quarter
- Losses paid/incurred to date are shown on the most recent column (accounting) or diagonal (actuarial)
- Actuarial triangle shows that more recent accident years/quarters are at earlier stages of claim life cycle
- Future development might be similar to historical
- Options: AY/EY, EQ; AQ/EQ,



Basic Reserving Techniques:

Step 1 - 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					
	2011	2012	2013	2014	2015	2016
2011	3,780	6,671	8,156	9,205	9,990	10,508
2012		4,212	7,541	9,351	10,639	11,536
2013			4,901	8,864	10,987	12,458
2014				5,708	10,268	12,699
2015					6,093	11,172
2016						6,962



Basic Reserving Techniques:

Step 1 - Compilation of Paid Loss Triangle

Actuarial Format

Goal: Estimate the total ultimately paid

Accident Year	Cumulative Paid Losses (\$000 Omitted)						Final Total Cost
	Development Stage in Months						
	12	24	36	48	60	72	
2011	3,780	6,671	8,156	9,205	9,990	10,508	???
2012	4,212	7,541	9,351	10,639	11,536		???
2013	4,901	8,864	10,987	12,458			???
2014	5,708	10,268	12,699				???
2015	6,093	11,172					???
2016	6,962						???



Basic Reserving Techniques:

Step 2 - Calculate Paid Loss Development Factors

Accident Year	Evaluation Interval in Months					
	12-24	24-36	36-48	48-60	60-72	72 to Ultimate
2011	1.765	1.223	1.129	1.085	1.052	???
2012	1.790	1.240	1.138	1.084		
2013	1.809	1.240	1.134			
2014	1.799	1.237				
2015	1.834					
2016						

Sample Calculation for Accident Year 2012:		
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 2012 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:

Steps 3 – 6 (calculate average LDF, select LDF, select tail factor, calculate cumulative LDF)

Accident Year	Evaluation Interval in Months					
	12-24	24-36	36-48	48-60	60-72	72 to Ultimate
2011	1.765	1.223	1.129	1.085	1.052	
2012	1.790	1.240	1.138	1.084		
2013	1.809	1.240	1.134			
2014	1.799	1.237				
2015	1.834					
2016						
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
Cumulative LDF	3.079	1.710	1.385	1.221	1.126	1.070

Basic Reserving Techniques:

Step 7 - Application of PLDM to Project Ultimate Claims

		Evaluation Interval in Months						72 to Ultimate
		12-24	24-36	36-48	48-60	60-72		
LDFs		1.800	1.235	1.134	1.085	1.052	1.070	
Accident Year	Cumulative Paid Losses (\$000 Omitted)						Final Total Cost	
	Development Stage in Months							
	12	24	36	48	60	72		
2011	3,780	6,671	8,156	9,205	9,990	10,508	11,244	
2012	4,212	7,541	9,351	10,639	11,536	12,136	12,985	
2013	4,901	8,864	10,987	12,458	13,517	14,220	15,215	
2014	5,708	10,268	12,699	14,401	15,625	16,437	17,588	
2015	6,093	11,172	13,797	15,646	16,976	17,859	19,109	
2016	6,962	12,532	15,477	17,550	19,042	20,032	21,435	

Sample Calculations for Accident Year 2016:

At 24 Months: $12,532 = 6,962 \times 1.800$

At 36 Months: $13,797 = 11,172 \times 1.235$

$15,477 = 6,962 \times 1.800 \times 1.235$



Basic Reserving Techniques:

Step 8 - Paid LDM Projections & Reserves

Loss Reserve Estimate @ 12/31/16 = \$32.241 million

Accident Year	Actual Paid Losses 12/31/16	Selected LDFs	Cumulative Development Factors to Ultimate	Estimated Ultimate Losses [(2) x (4)]	Actual Paid Losses 12/31/16	Estimated Loss Reserves [(5) - (6)]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2011	10,508	1.070	1.070	11,244	10,508	736
2012	11,536	1.052	1.126	12,985	11,536	1,449
2013	12,458	1.085	1.221	15,215	12,458	2,757
2014	12,699	1.134	1.385	17,588	12,699	4,889
2015	11,172	1.235	1.710	19,109	11,172	7,937
2016	6,962	1.800	3.079	21,435	6,962	14,473
Total	65,335			97,576	65,335	32,241



Basic Reserving Techniques:

Step 1 - Compilation of Reported Loss Triangle

Accident Year	Case Reserves (\$000 Omitted)					
	Development Stage in Months					
	12	24	36	48	60	72
2011	5,557	4,176	2,936	1,987	1,245	742
2012	6,328	4,664	3,200	2,051	1,189	
2013	6,974	4,968	3,251	1,955		
2014	7,635	5,274	3,367			
2015	8,376	5,604				
2016	9,599					

Accident Year	Cumulative Paid Losses (\$000 Omitted)					
	Development Stage in Months					
	12	24	36	48	60	72
2011	3,780	6,671	8,156	9,205	9,990	10,508
2012	4,212	7,541	9,351	10,639	11,536	
2013	4,901	8,864	10,987	12,458		
2014	5,708	10,268	12,699			
2015	6,093	11,172				
2016	6,962					



Basic Reserving Techniques:

Step 1 - Compilation of Reported Loss Triangle

Accident Year	Cumulative Case Reported Losses (\$000 Omitted)						Final Total Cost
	Development Stage in Months						
	12	24	36	48	60	72	
2011	9,337	10,847	11,092	11,192	11,235	11,250	???
2012	10,540	12,205	12,551	12,690	12,725		???
2013	11,875	13,832	14,238	14,413			???
2014	13,343	15,542	16,066				???
2015	14,469	16,776					???
2016	16,561						???



Basic Reserving Techniques:

Reported Loss Triangle - Steps 2 through 6

Accident Year	Evaluation Interval in Months					
	12-24	24-36	36-48	48-60	60-72	72 to Ultimate
2011	1.162	1.023	1.009	1.004	1.001	???
2012	1.158	1.028	1.011	1.003		
2013	1.165	1.029	1.012			
2014	1.165	1.034				
2015	1.159					
2016						
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:

Reported LDM Projections & Reserves - Step 7 & 8

Accident Year	Actual Reported Losses 12/31/16	Development Factors to Ultimate	Estimated Ultimate Losses [(2) x (3)]	Actual Paid Losses 12/31/16	Estimated Loss Reserves {(4) - (5)}
(1)	(2)	(3)	(4)	(5)	(6)
2011	11,250	1.000	11,250	10,508	742
2012	12,725	1.001	12,738	11,536	1,202
2013	14,413	1.004	14,471	12,458	2,013
2014	16,066	1.015	16,308	12,699	3,609
2015	16,776	1.045	17,539	11,172	6,367
2016	16,561	1.215	20,119	6,962	13,157
Total	87,791		92,425	65,335	27,090



Basic Loss Reserving – Part 2

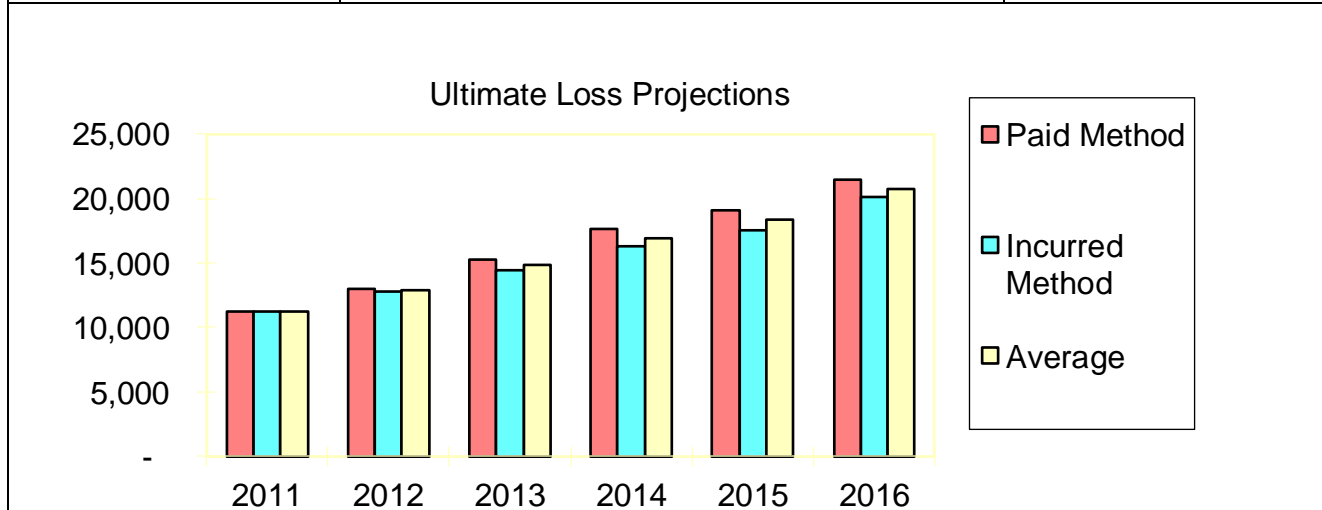
• Topics Covered

- Comparison of Results from Paid and Incurred LDMs
- Reasonableness Checks
 - Ultimate Loss Ratios
 - Frequency/Severity
 - Pure Premium
- Current Year Sensitivity Analysis
 - Paid to Reported Ratios
 - Settlement/Frequency
 - Closed With No Payment Ratios
 - Severities & Avg Values
 - Average Case Reserves
- Importance of Tail Factors



Comparison of LDM Projections

Accident Year	Estimated Ultimate Losses Based on:		
	Paid LDM	Incurred LDM	Average = Selected
	Paid Method	Incurred Method	Average
2011	11,244	11,250	11,247
2012	12,985	12,738	12,862
2013	15,215	14,471	14,843
2014	17,588	16,308	16,948
2015	19,109	17,539	18,324
2016	21,435	20,119	20,777
Total	97,576	92,425	95,001



Comparison of Loss Development Methods

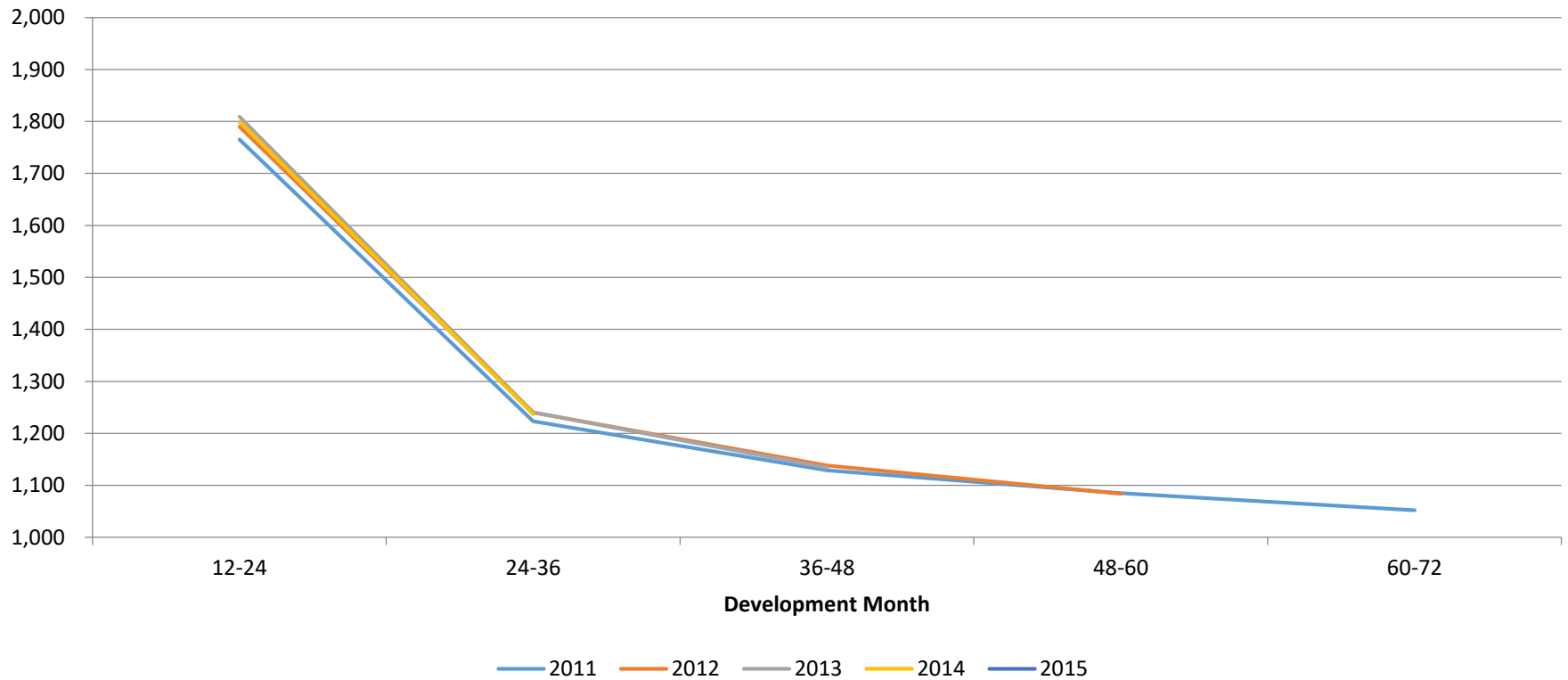
Underlying Assumptions

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

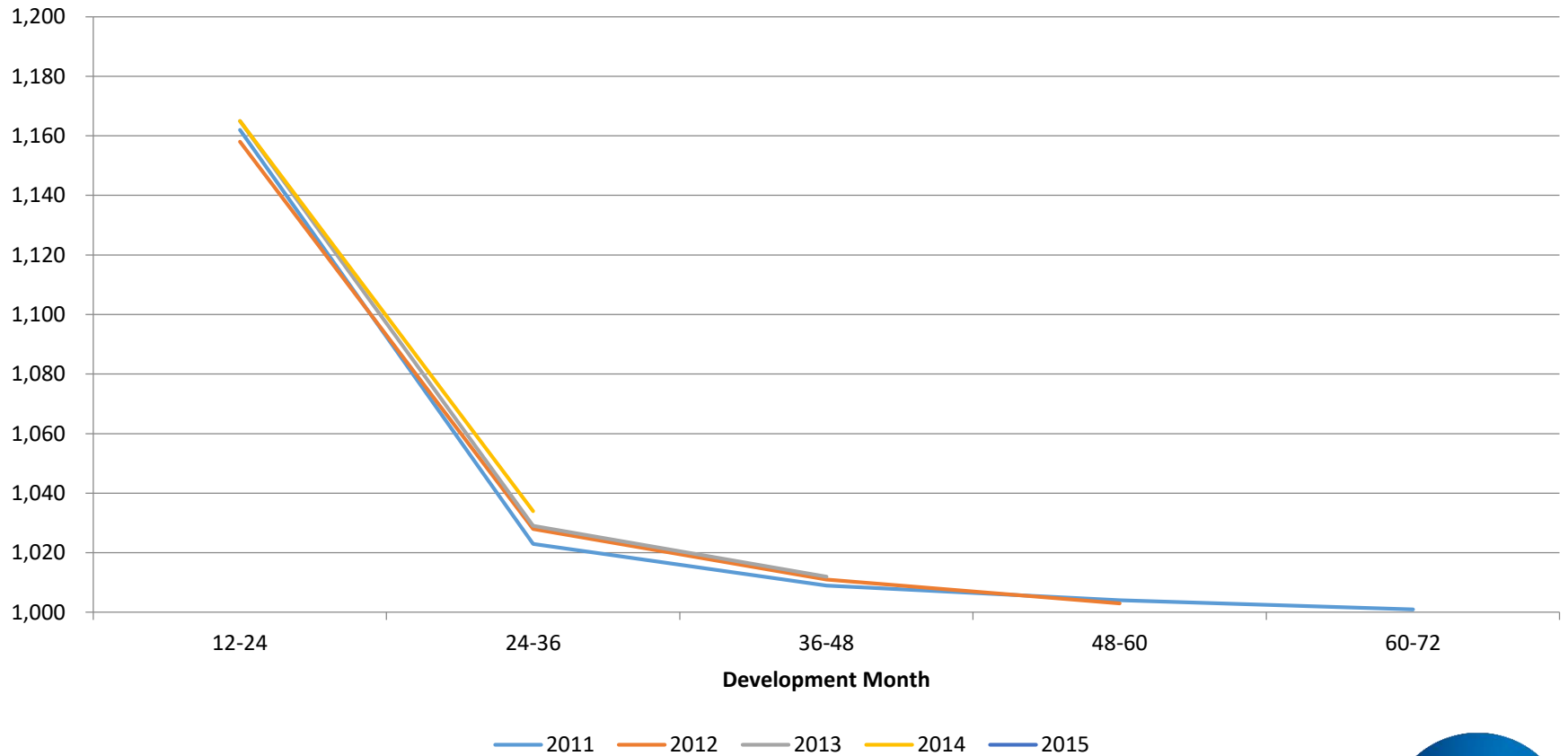
Pro	Con
PLDM: “Hard” data; no estimates involved	PLDM: May generate large, volatile loss development factors especially at early ages & take longer to develop to ultimate
ILDM: Uses all available information	ILDM: Uses case reserves, which are estimates, to develop estimates of ultimate losses



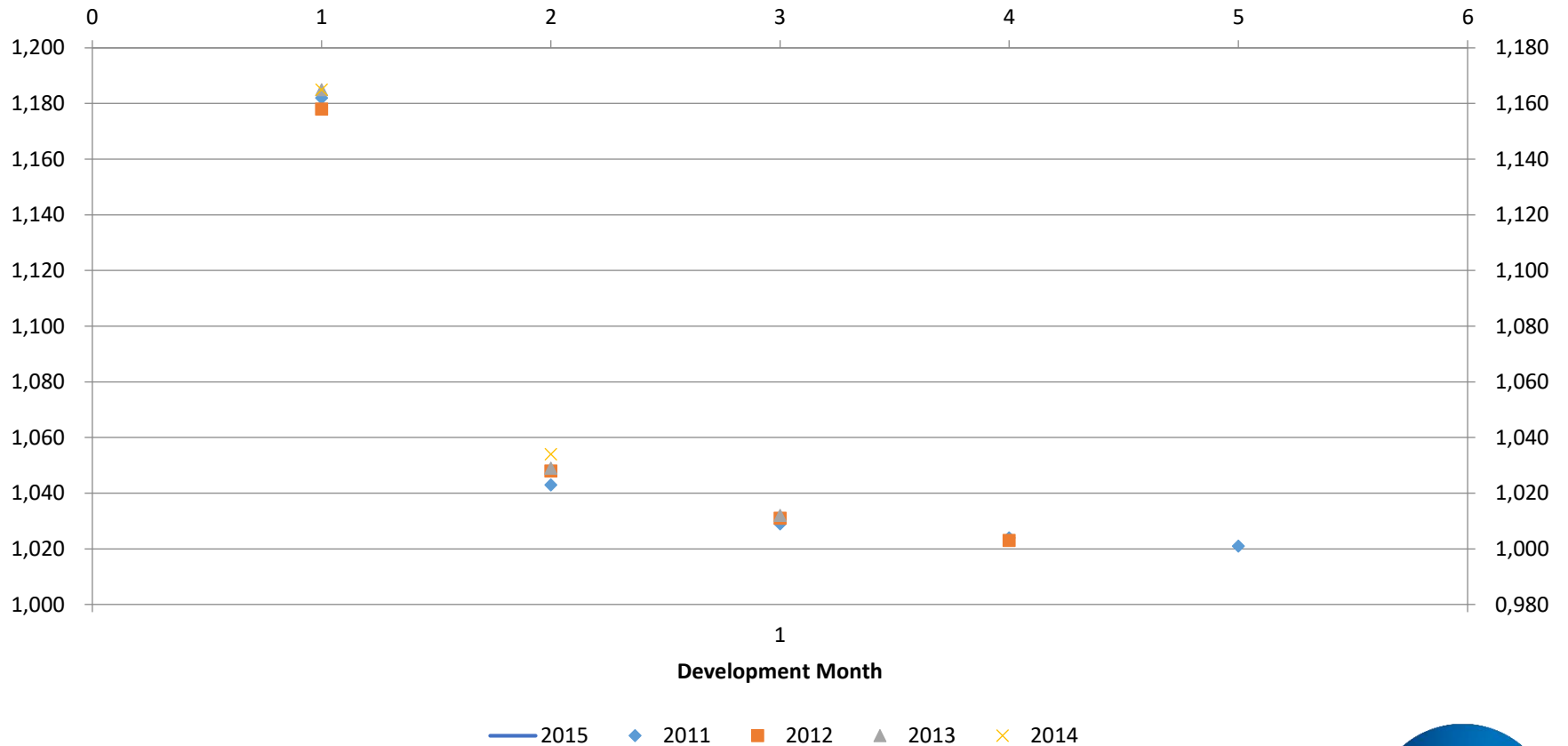
PLDF in graph (slide 36)



ILDF in graph (slide 42)



ILDF in graph (slide 42)



Key Assumptions & Potential Problems

Assumptions	Potential Problems
Claims settlement patterns unchanging	Speed-up or 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



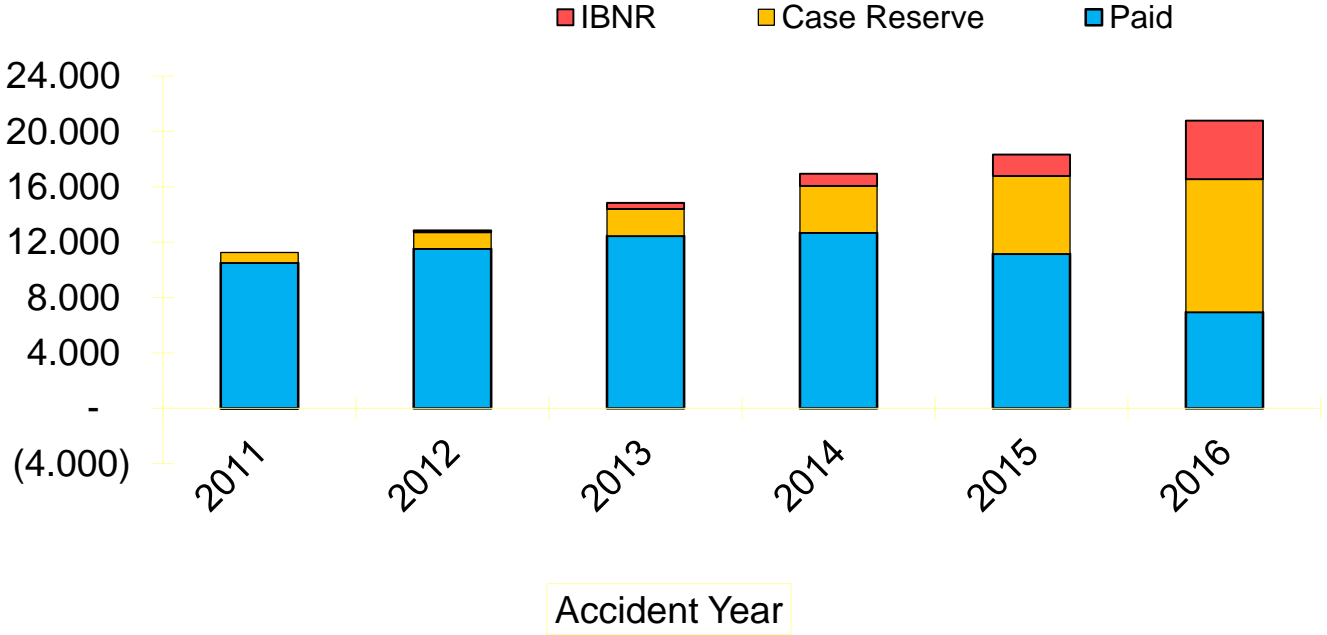
Comparison of Estimated Reserves

Accident Year	Estimated Loss Reserves Based on:		
	Paid LDM	Incurred LDM	Average = Selected
	Paid Method	Incurred Method	Average
2011	736	742	739
2012	1,449	1,202	1,326
2013	2,757	2,013	2,385
2014	4,889	3,609	4,249
2015	7,937	6,367	7,152
2016	14,473	13,157	13,815
Total	32,241	27,090	29,666



Comparison of Estimated Reserves

Components of Selected Ultimate Projected Losses at 12/31/16



Comparison of Estimated Reserves

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



Reasonableness

- Check ultimate losses for reasonableness against relevant indicators to observe historical trends:
 - 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

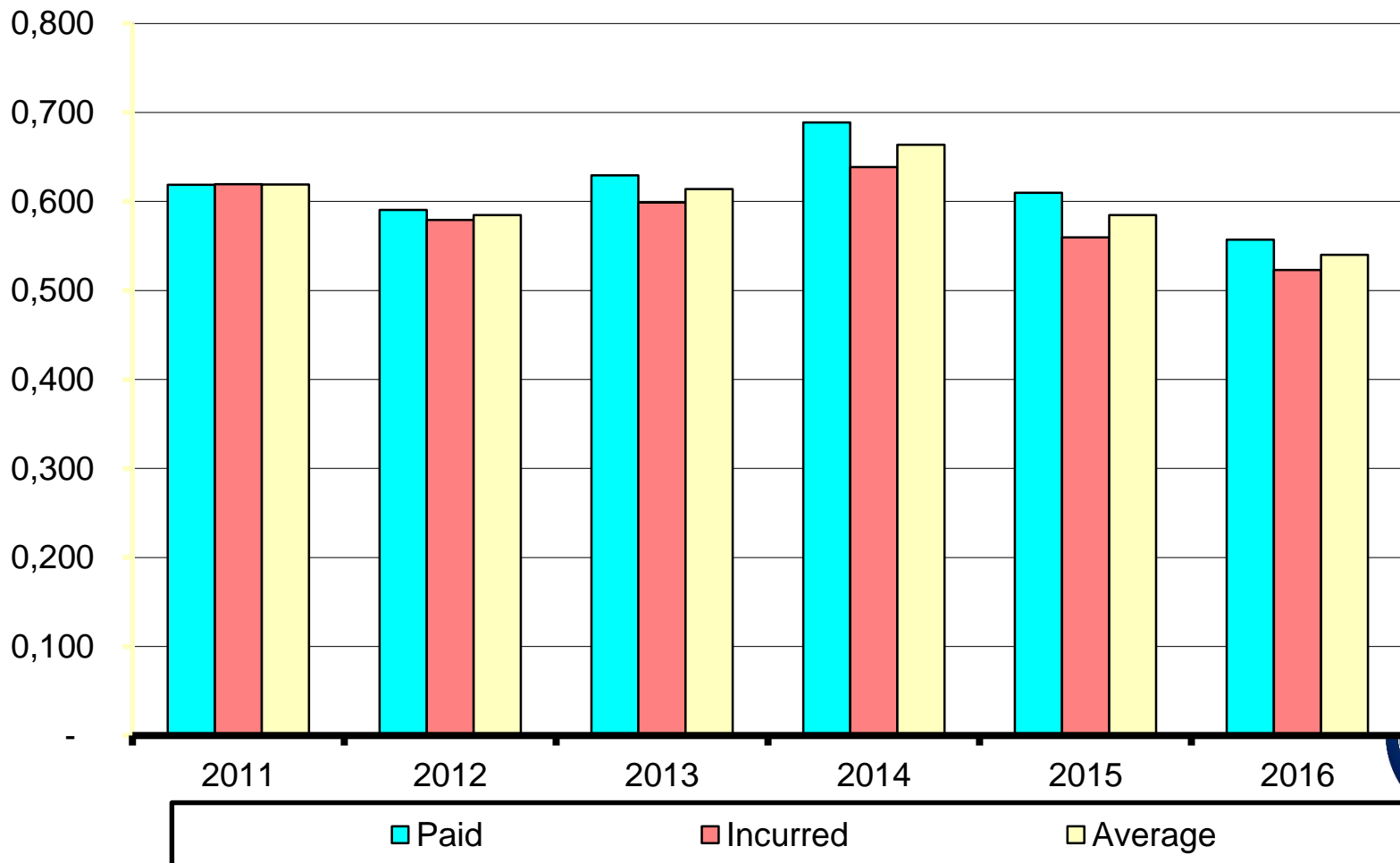


Reasonableness Checks: Ultimate Loss Ratios

Accident Year	Earned Premium	Est. Ultimate Losses (\$000)			Indicated Loss Ratio		
		Using:			Using:		
		PLDM	ILDm	Selected	PLDM	ILDm	Selected
2011	18,168	11,244	11,250	11,247	0.619	0.619	0.619
2012	21,995	12,985	12,738	12,862	0.590	0.579	0.585
2013	24,173	15,215	14,471	14,843	0.629	0.599	0.614
2014	25,534	17,588	16,308	16,948	0.689	0.639	0.664
2015	31,341	19,109	17,539	18,324	0.610	0.560	0.585
2016	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

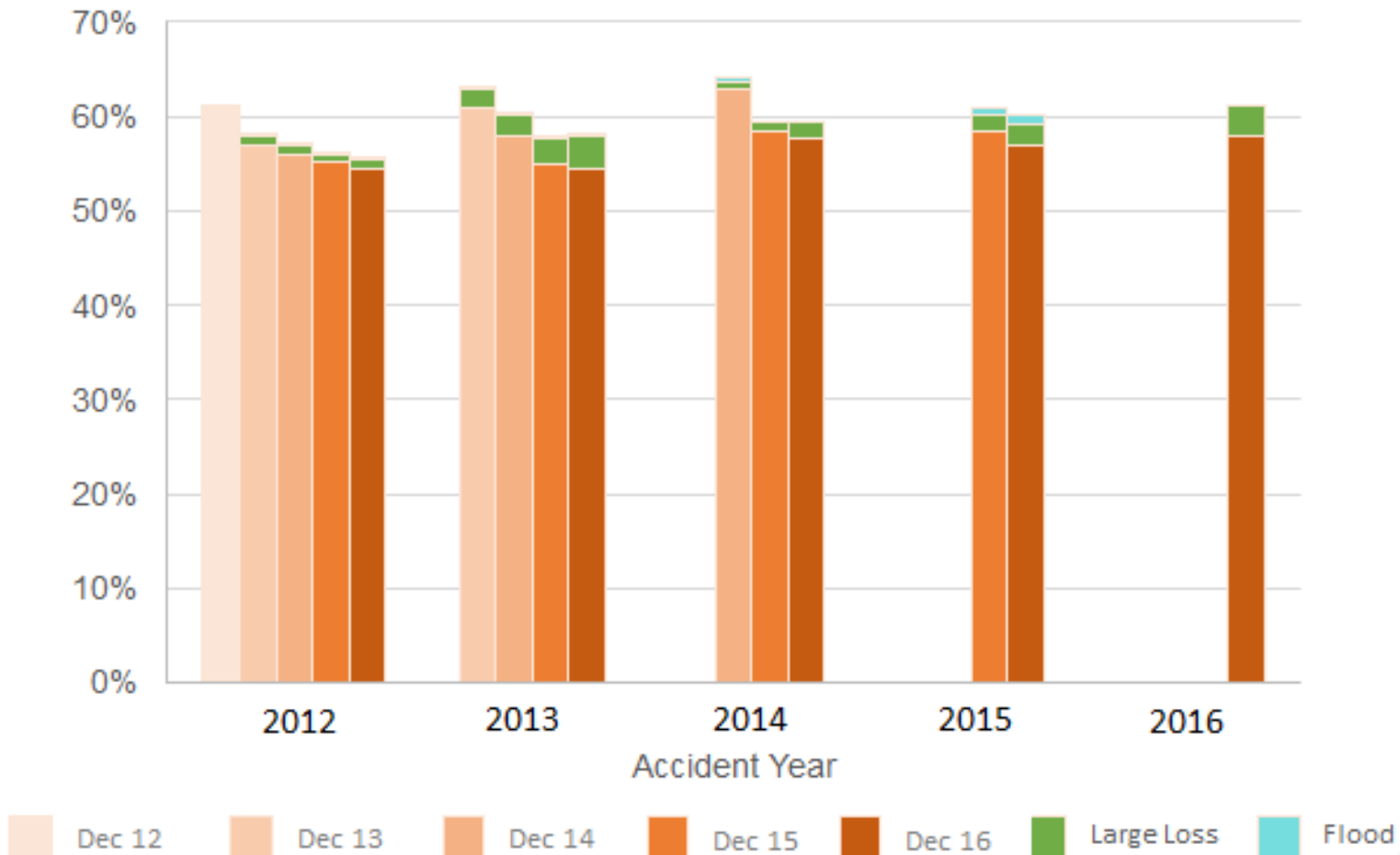


Reasonableness Checks: Ultimate Loss Ratios by Accident Year



Reasonableness Checks:

Ultimate Loss Ratio Movements at various valuation dates



Sensitivity Analysis:

Current Year Analysis - better results

- 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:

Current Year Analysis - worse results

- Deteriorations in results may stem from:
 - _____ rates
 - _____ claim frequency
 - _____ claim severity
- Worse results would appear to be present if:
 - Claims were being processed or paid more _____
 - Case reserves were _____
 - Mix of business is _____



Sensitivity Analysis:

Current Year Analysis—worse results

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



Sensitivity Analysis: Ratios

- Review historical relationships
 - Losses
 - Paid losses to reported losses
 - Case reserves to paid losses
 - Case reserves to reported losses
 - Claim counts
 - Settlement, frequency
 - Ratio of claims closed with no payment to total closed claims
 - Losses and Claim Counts
 - Severities or average values
 - Average case reserves (lesser used but worthwhile)



Sensitivity Analysis: Ratios - Paid to Reported

Cumulative Paid Losses (\$000 Omitted)

Accident Year	Development Stage in Months		
	12	24	36
2011	3,780	6,671	8,156
2012	4,212	7,541	
2013	4,901		

Cumulative Case Reported Losses (\$000 Omitted)

Accident Year	Development Stage in Months		
	12	24	36
2011	9,337	10,847	11,092
2012	10,540	12,205	
2013	11,875		

Accident Year	Ratio Paid to Case Reported Development Stage in Months		
	12	24	36
2011	0.405	0.615	0.735
2012	0.400	0.618	
2013	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
2011	0.405	0.615	0.735	0.822	0.889	0.934
2012	0.400	0.618	0.745	0.838	0.907	
2013	0.413	0.641	0.772	0.864		
2014	0.428	0.661	0.790			
2015	0.421	0.666				
2016	0.420					



Sensitivity Analysis: Ratios - Average Reported

Accident Year	Average Reported Loss					
	Development Stage in Months					
	12	24	36	48	60	72
2011	6,539	3,913	3,892	3,905	3,915	3,895
2012	6,164	4,025	4,067	4,101	4,092	
2013	8,744	4,976	4,762	4,804		
2014	8,836	6,005	6,049			
2015	9,724	6,442				
2016	10,325					

- Try with average case reserves



Tail Factors:

Impact of Selection (ILDM)

Accident Year	Reported Losses @ 12/31/16	Selected LDF's		Estimated Ultimate Losses	Earned Premium	Ultimate Loss Ratio	Unpaid Losses @ 12/31/16
		LDF	Age to Ult.				
2011	11,250	1.000	1.000	11,250	18,168	61.9%	742
2012	12,725	1.001	1.001	12,738	21,995	57.9%	1,202
2013	14,413	1.003	1.004	14,471	24,173	59.9%	2,013
2014	16,066	1.011	1.015	16,308	25,534	63.9%	3,609
2015	16,776	1.030	1.045	17,539	31,341	56.0%	6,367
2016	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 @12/31/16	Selected LDF's		Revised Ultimate Losses	Earned Premium	Revised Loss Ratio	Revised Unpaid Losses @12/31/16
		LDF	Age to Ult.				
2011	11,250	1.020	1.020	11,475	18,168	63.2%	967
2012	12,725	1.001	1.021	12,992	21,995	59.1%	1,456
2013	14,413	1.003	1.024	14,759	24,173	61.1%	2,301
2014	16,066	1.011	1.035	16,628	25,534	65.1%	3,929
2015	16,776	1.030	1.066	17,883	31,341	57.1%	6,711
2016	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!!!!
- Which year experiences the biggest impact (in terms of % of ultimate losses or in terms of % of reserves) due to the selection of a tail factor?
- Which has a bigger impact on the result, individual age LDF or tail factor?



Other Basic Loss Reserving 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
- Internal relevant historical data
- Industry data



Expected Loss Ratio Method Pricing Assumption

Commissions	20.0%
General Expenses	15.0%
Profit	5.0%
Total	40.0%
Expected Loss Ratio (Available for Loss and Loss Adjustment Expense)	60.0%



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.	2007	73.1%	73.8%	72.4%
3.	2008	66.6%	65.9%	67.3%
4.	2009	70.3%	68.9%	71.7%
5.	2010	69.0%	70.6%	67.4%
6.	2011	74.1%	75.0%	73.2%
7.	2012	80.2%	83.3%	77.1%
8.	2013	60.5%	59.1%	61.9%
9.	2014	62.6%	61.3%	63.9%
10.	2015	66.7%	68.0%	65.4%
11.	2016	67.0%	68.3%	65.7%
3 year average			▼	65.0%
5 year average			▼	66.8%



Expected Loss Ratio Method

Earned Premium	=	\$100,000
Expected Loss Ratio	=	0.65
<u>Expected Ult. Losses</u>	=	<u>\$65,000</u>
Paid Losses	=	\$10,000
Case Reserves	=	\$13,000
Total Reserve	=	\$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
 $\text{Ultimate Losses} < \text{Incurred Losses}$



Bornhütter-Ferguson Method

- Reserves Based on ELR and Actual Losses

$$(EP \times ELR) \times (IBNR \text{ Factor}) = (IBNR \text{ Reserves})$$

$$\text{Where IBNR Factor} = (1.000 - 1.000/CDF^*)$$

$$\text{Actual} + \text{IBNR Reserve} = \text{Ultimate Losses}$$

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

(*CDF is based on ILDM and it is called Reserve factor if CDF is based on PLDM)



Bornhütter-Ferguson Method

Accident Year	Evaluation Interval in Months		
	12-24	24-36	36-48
2011	1.162	1.023	1.009
2012	1.158	1.028	1.011
2013	1.165	1.029	1.012
2014	1.165	1.034	
2015	1.159		
2016			
Selected LDF	1.162	1.030	1.011
Cumulative LDF	1.215	1.045	1.015

IBNR Factor = $1.000 - 1.000/\text{Cumulative Loss Development Factor}$

$+1.000 - 1.000/1.215$

$+1.000 - 1.000/1.015$

IBNR Factor	0.177	0.044	0.015
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Bornhütter-Ferguson Method

Accident Year	Evaluation Interval in Months					
	12-24	24-36	36-48	48-60	60-72	72 to Ultimate
2011	1.162	1.023	1.009	1.004	1.001	???
2012	1.158	1.028	1.011	1.003		
2013	1.165	1.029	1.012			
2014	1.165	1.034				
2015	1.159					
2016						
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	

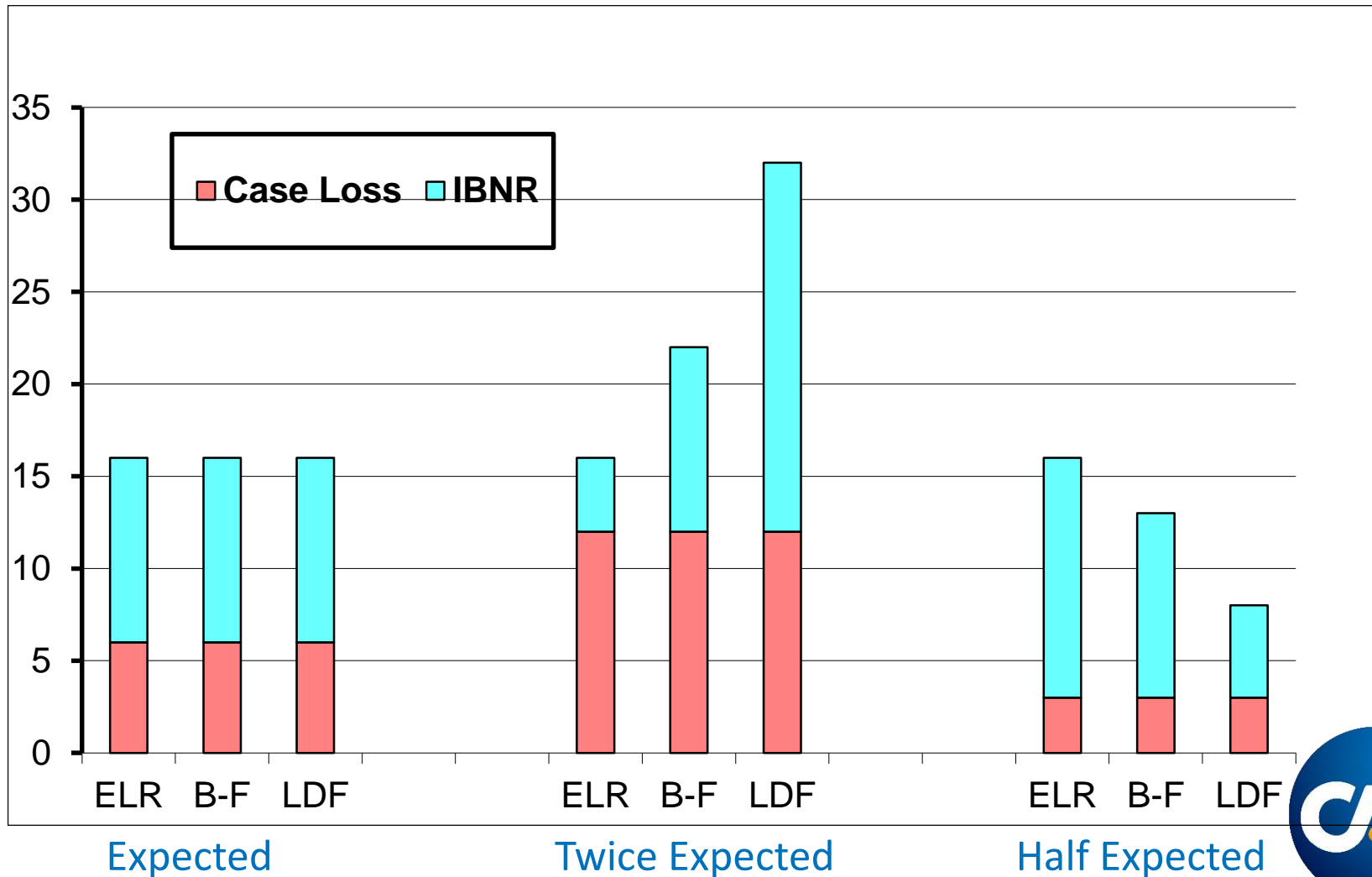


Bornhütter-Ferguson Method

Accident Year	Earned Premium	Assumed Expected Loss Ratio	Assumed Expected Losses	IBNR Factor	Estimated IBNR	Cumulative Incurred Losses	Estimated Ultimate Losses
(1)	(2)	(3)	(4) (2) x (3)	(5)	(6) (4) x (5)	(7)	(8) (6) + (7)
2011	18,168	62.0%	11,264.16	-	-	11,250	11,250
2012	21,995	62.0%	13,636.90	0.001	14	12,725	12,739
2013	24,173	62.0%	14,987.26	0.004	60	14,413	14,473
2014	25,534	62.0%	15,831.08	0.015	235	16,066	16,301
2015	31,341	62.0%	19,431.42	0.044	846	16,776	17,622
2016	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 (with various expected case reserves)



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 Bornhütter-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

$$= 25 * 5.000 = 125 \text{ Goals}$$



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.



Bornhütter-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



Bornhütter-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 Year	Incurred Losses (\$000) at Accident Period Maturity in Months									
	12	24	36	48	60	72	84	96	108	120
2001	13,138	18,109	19,132	21,253	21,830	23,146	23,784	25,247	25,433	25,808
2002	13,541	16,432	19,053	20,121	21,705	22,897	24,375	24,746	25,148	
2003	15,043	19,371	22,468	24,084	25,215	27,376	28,560	29,202		
2004	15,259	22,208	23,521	24,541	26,526	27,372	28,013			
2005	18,192	28,347	31,148	36,610	38,742	40,011				
2006	23,442	35,375	42,659	46,365	48,858					
2007	32,176	51,426	58,334	63,018						
2008	43,431	60,795	68,770							
2009	40,152	56,263								
2010	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
2001										
2002										
2003										
2004										
2005										
2006										
2007										
2008										
2009										
All Yr. Avg										
Latest 3 Yr Avg										
X High/Low										
Selected										
Age to Ult.										
IBNR Factor										



A Complete Example

Paid Losses

Accident Year	Paid Losses (\$000) at Accident Period Maturity in Months									
	12	24	36	48	60	72	84	96	108	120
2001	4,992	10,830	14,855	17,230	19,135	19,925	20,989	22,101	23,598	24,636
2002	4,399	10,534	13,911	15,993	18,009	19,343	20,149	21,377	22,865	
2003	6,533	12,677	16,341	19,353	21,489	22,667	23,961	25,807		
2004	6,974	16,342	20,009	21,058	21,950	23,042	24,090			
2005	8,370	18,062	24,484	28,437	30,900	32,989				
2006	11,037	23,881	31,056	36,153	38,508					
2007	14,046	31,164	41,864	47,770						
2008	16,299	36,500	46,119							
2009	15,470	33,837								
2010	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
2001										
2002										
2003										
2004										
2005										
2006										
2007										
2008										
2009										
All Yr. Avg										
Latest 3 Yr Avg										
X High/Low										
Selected										
Age to Ult.										
Reserve Factor										



A Complete Example

Development Forecasts

Incurred LDF Method				Paid LDF Method			
Accident Year	Incurred Loss (000) at 12/31/16	Age to Ult LDF	Indicated Ultimate Loss (000)	Accident Year	Paid Loss (000) at 12/31/16	Age to Ult LDF	Indicated Ultimate Loss (000)
2007				2007			
2008				2008			
2009				2009			
2010				2010			
2011				2011			
2012				2012			
2013				2013			
2014				2014			
2015				2015			
2016				2016			
Total				Total	0		0



A Complete Example

Bornhütter-Ferguson Forecasts

Accident Year	Earned Premium	ELR	Expected Losses	Incurred BF Method			Paid BF Method		
				IBNR Factor	Indicated Loss (000) at 12/31/16	Ultimate Loss (000)	Reserve Factor	Indicated Loss (000) Reserve at 12/31/16	Ultimate Loss (000)
2007	47,975	70.0%							
2008	47,397	70.0%							
2009	46,609	70.0%							
2010	50,599	70.0%							
2011	64,637	70.0%							
2012	69,510	70.0%							
2013	86,505	70.0%							
2014	92,564	70.0%							
2015	97,248	70.0%							
2016	107,538	70.0%							
Total	710,581								



A Complete Example

Comparison of Estimates

Accident Year	Indicated Ultimates				Selected Ultimate	Selected Reserve	Selected IBNR	Selected Loss Ratio
	Incurred LDF	Paid LDF	Incurred BF	Paid BF				
2007								
2008								
2009								
2010								
2011								
2012								
2013								
2014								
2015								
2016								
Total								



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
2001	1.378	1.056	1.111	1.027	1.060	1.028	1.062	1.007	1.015	
2002	1.214	1.159	1.056	1.079	1.055	1.065	1.015	1.016		
2003	1.288	1.160	1.072	1.047	1.086	1.043	1.022			
2004	1.455	1.059	1.043	1.081	1.032	1.023				
2005	1.558	1.099	1.175	1.058	1.033					
2006	1.509	1.206	1.087	1.054						
2007	1.598	1.134	1.080							
2008	1.400	1.131								
2009	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 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
2001	2.169	1.372	1.160	1.111	1.041	1.053	1.053	1.068	1.044
2002	2.394	1.321	1.150	1.126	1.074	1.042	1.061	1.070	
2003	1.941	1.289	1.184	1.110	1.055	1.057	1.077		
2004	2.343	1.224	1.052	1.042	1.050	1.046			
2005	2.158	1.356	1.161	1.087	1.068				
2006	2.164	1.300	1.164	1.065					
2007	2.219	1.343	1.141						
2008	2.239	1.264							
2009	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
Age to Ult.	4.873	2.200	1.689	1.462	1.373	1.298	1.239	1.165	1.090
Reserve Factor	0.795	0.545	0.408	0.316	0.272	0.230	0.193	0.141	0.083



A Complete Example

Development Forecasts

Incurred LDF Method

Accident Year	Incurred Loss (000) at 12/31/16	Age to Ult LDF	Indicated Ultimate Loss (000)
2007	25,808	1.015	26,188
2008	25,148	1.030	25,894
2009	29,202	1.042	30,423
2010	28,013	1.076	30,149
2011	40,011	1.123	44,946
2012	48,858	1.180	57,635
2013	63,018	1.255	79,119
2014	68,770	1.399	96,199
2015	56,263	1.619	91,071
2016	39,888	2.374	94,682
Total	424,979		576,306

Paid LDF Method

Accident Year	Paid Loss (000) at 12/31/16	Age to Ult LDF	Indicated Ultimate Loss (000)
2007	24,636	1.044	25,720
2008	22,865	1.090	24,921
2009	25,807	1.165	30,060
2010	24,090	1.239	29,846
2011	32,989	1.298	42,835
2012	38,508	1.373	52,870
2013	47,770	1.462	69,830
2014	46,119	1.689	77,904
2015	33,837	2.200	74,443
2016	14,962	4.873	72,914
Total	311,582		501,342



A Complete Example

Bornhütter-Ferguson Forecasts

Accident Year	Earned Premium	ELR	Expected Losses	Incurred BF Method				Paid BF Method			
				IBNR Factor	Indicated IBNR	Incurred Loss (000) at 12/31/16	Indicated Ultimate Loss (000)	Reserve Factor	Indicated Reserve	Paid Loss (000) at 12/31/16	Indicated Ultimate Loss (000)
2007	47,975	70.0%	33,582	0.015	487	25,808	26,295	0.042	1,415	24,636	26,051
2008	47,397	70.0%	33,178	0.029	956	25,148	26,104	0.083	2,737	22,865	25,603
2009	46,609	70.0%	32,626	0.040	1,309	29,202	30,511	0.141	4,615	25,807	30,423
2010	50,599	70.0%	35,419	0.071	2,510	28,013	30,523	0.193	6,831	24,090	30,921
2011	64,637	70.0%	45,246	0.110	4,968	40,011	44,979	0.230	10,400	32,989	43,389
2012	69,510	70.0%	48,657	0.152	7,410	48,858	56,268	0.272	13,218	38,508	51,726
2013	86,505	70.0%	60,554	0.204	12,323	63,018	75,341	0.316	19,130	47,770	66,899
2014	92,564	70.0%	64,795	0.285	18,475	68,770	87,245	0.408	26,436	46,119	72,555
2015	97,248	70.0%	68,073	0.382	26,018	56,263	82,281	0.545	37,132	33,837	70,969
2016	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

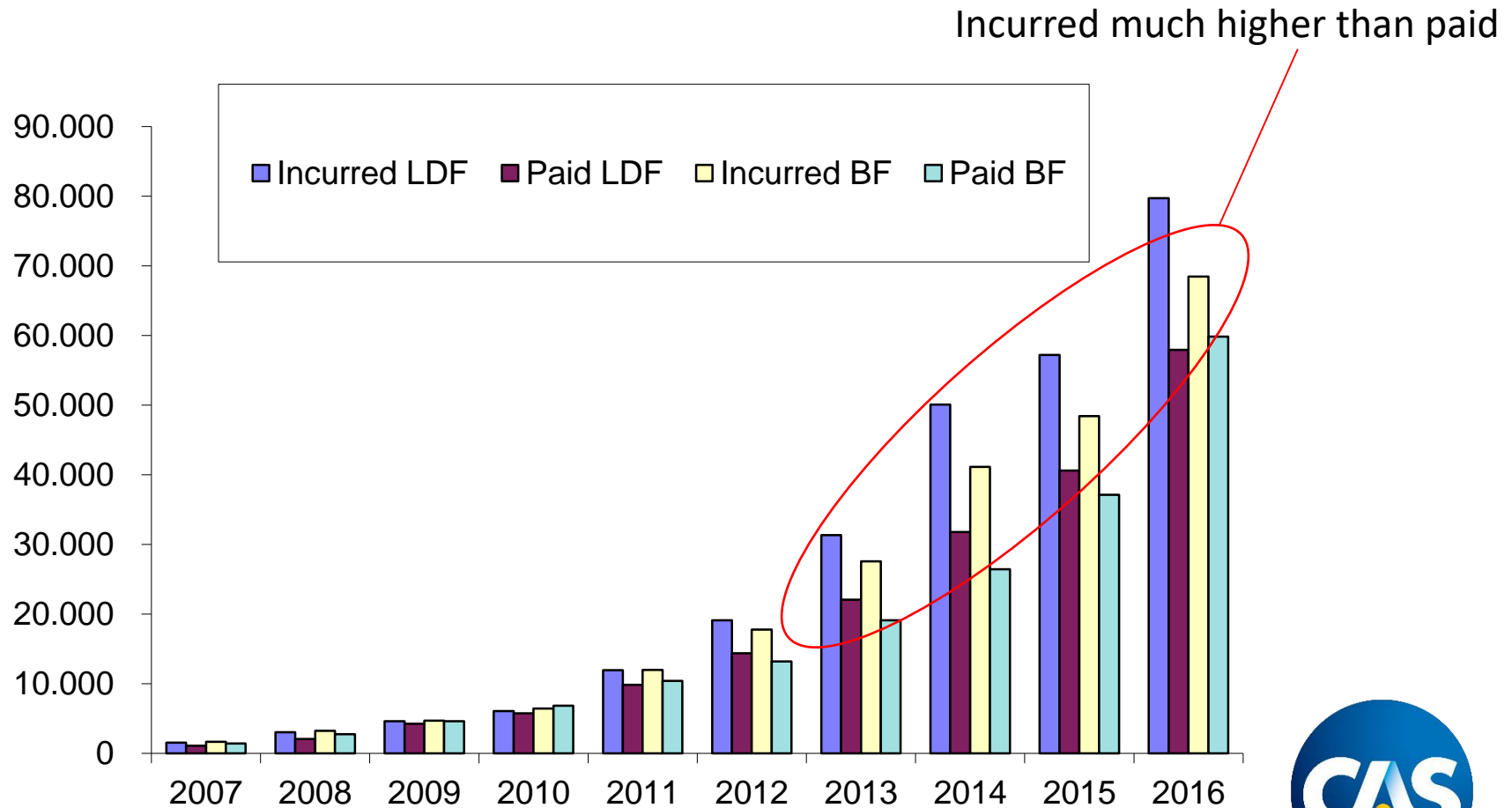
Comparison of Estimates

Accident Year	Indicated Ultimates				Selected Ultimate	Selected Reserve	Selected IBNR	Selected Loss Ratio
	Incurred LDF	Paid LDF	Incurred BF	Paid BF				
2007	26,188	25,720	26,295	26,051	26,063	1,427	256	54.3%
2008	25,894	24,921	26,104	25,603	25,630	2,765	482	54.1%
2009	30,423	30,060	30,511	30,423	30,354	4,547	1,152	65.1%
2010	30,149	29,846	30,523	30,921	30,360	6,270	2,347	60.0%
2011	44,946	42,835	44,979	43,389	44,037	11,049	4,026	68.1%
2012	57,635	52,870	56,268	51,726	54,625	16,117	5,767	78.6%
2013	79,119	69,830	75,341	66,899	72,797	25,027	9,779	84.2%
2014	96,199	77,904	87,245	72,555	83,475	37,356	14,706	90.2%
2015	91,071	74,443	82,281	70,969	79,691	45,854	23,428	81.9%
2016	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 Year	Ratio of Paid to Incurred at Accident Period Maturity in Months									
	12	24	36	48	60	72	84	96	108	120
2007	0.380	0.598	0.776	0.811	0.877	0.861	0.882	0.875	0.928	0.955
2008	0.325	0.641	0.730	0.795	0.830	0.845	0.827	0.864	0.909	
2009	0.434	0.654	0.727	0.804	0.852	0.828	0.839	0.884		
2010	0.457	0.736	0.851	0.858	0.827	0.842	0.860			
2011	0.460	0.637	0.786	0.777	0.798	0.824				
2012	0.471	0.675	0.728	0.780	0.788					
2013	0.437	0.606	0.718	0.758						
2014	0.375	0.600	0.671							
2015	0.385	0.601								
2016	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 2008

Calendar Date	Cumulative Paid on Closed Claims		Number of Closed Claims		Average Settlement Value
	\$	% of Ultimate	No.	% of Ultimate	\$
12-08	\$50,000,000	25%	1,000	50%	\$50,000
12-09	100,000,000	50%	1,500	75%	66,667
12-10	150,000,000	75%	1,800	90%	83,333
*	*	*	*	*	*
*	*	*	*	*	*
*	*	*	*	*	*
12/16 (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 Travel Insurance:
 - The cases that closed quickly are usually for minor injuries, loss of luggage, travel delay, etc.
 - The cases open for a long period represent severe injuries and may include:
 - Major Medical Expenses
 - Hospitalization abroad
 - Personal Liability



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.

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



Considerations

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



Consideration #3

Loss Adjustment Expenses are the costs of administering, determining coverage, defending and settling claims. Loss Adjustment Expenses are usually categorized into:

- **Allocated Loss Adjustment Expenses (ALAE):** costs can be directly assigned to a particular claim, e.g. adjuster fees, legal costs, etc.
 - Be aware of any change in workload assignments between internal and external adjusters
 - May be appropriate to segregate ALAE from claim losses and analyze ALAE separately
- **Unallocated Loss Adjustment Expenses (ULAE):** costs can not be easily assigned to a particular claim, e.g. claims staff payroll, rent, claims department operation costs, etc.
 - Some companies treats ULAE as a part of general operating expenses



Considerations

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



Consideration #4

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



Consideration #4

If adjustments are not made, severe distortions can result:

Accident Year	Earned Premium	Paid Losses	2013 Loss Ratio	Reserves Using 2013 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)
(1)	(2)	(3)	(4)	(5)=(2)x(4)-(3)	(6)	(7)=(4) / (6)	(8)=(2)x(7)-(3)
2014	10,000	5,000	50%	0	1.0	50%	0
2015	9,000	2,700	50%	1,800	0.9	56%	2,300
2016	8,000	800	50%	3,200	0.8	63%	4,200
Total		8,500		5,000			6,500
					Error = \$1,500		



Consideration #4

Think about it!

From another angle.

Accident Year	Earned Premium	Paid Losses	2013 Loss Ratio	Ultimates Using 2013 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)
2014	10,000	5,000	50%	5,000	1.0	50%	5,000
2015	9,000	2,700	50%	4,500	0.9	56%	5,000
2016	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 #4

- Premium can be affected by increased competition and efforts to retain market share
 - filed rate decreases
 - increased use of flexible discounts
- Need to talk to your colleagues to understand what is happening in the marketplace
 - underwriters
 - marketing
 - field office staff
 - pricing actuaries



Consideration #5

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



Consideration #5

Resulting Development (Illustration):

ESTIMATE AT 12 MONTHS			STATUS 3 YEARS LATER	
<u>Claims</u>	<u>Average \$</u>	<u>Total</u>	<u>Average \$</u>	<u>Total</u>
1-97	\$10,000	\$970,000	\$10,000	\$970,000
<u>98-100</u>	<u>10,000</u>	<u>30,000</u>	<u>500,000</u>	<u>1,500,000</u>
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 #6

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



Consideration #6

Paid Losses

<u>Acc Yr.</u>	<u>12 Mos.</u>	<u>24 Mos.</u>	<u>36 Mos.</u>	<u>48 Mos.</u>	<u>60 Mos.</u>
2012	100	150	180	198	208
2013	100	150	180	198	
2014	100	150	180		
2015	100	150			
2016	100				

Reported Losses

<u>Acc Yr.</u>	<u>12 Mos.</u>	<u>24 Mos.</u>	<u>36 Mos.</u>	<u>48 Mos.</u>	<u>60 Mos.</u>
2012	125	167	189	202	208
2013	125	167	189	206	
2014	125	167	194		
2015	125	177			
2016	133				



Consideration #6

Paid to Reported Ratios					
Acc Yr.	12 Mos.	24 Mos.	36 Mos.	48 Mos.	60 Mos.
2012	0.80	0.90	0.95	0.98	1.00
2013	0.80	0.90	0.95	0.96	
2014	0.80	0.90	0.93		
2015	0.80	0.85			
2016	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
 7. Higher limits mean more future development
 8. Higher deductibles (attachment points) mean more future development
- Interpolation/Extrapolation
- Changing Indications



Consideration #7

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 #7

ILLUSTRATION:

<u>One Claim</u>	<u>Dollars Reported as of:</u>		
	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months (Ult.)</u>
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

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



Consideration #8

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 #8

ILLUSTRATION:

One Claim

Dollars Reported as of:

	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months (Ult.)</u>
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:

	<u>12 Months</u>	<u>24 Months</u>	<u>36 Months (Ult.)</u>
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
 - 9. Incomplete accident years can be deceiving
 - 10. Tail development is important
- Changing Indications



Consideration #9

Estimating ultimate losses using incomplete accident year data requires special adjustments (e.g. using 3Q data to estimate ultimate losses at year end)



Consideration #9

Reported losses through Q3 2017

Accident

<u>Year</u>	<u>9 mos.</u>	<u>21 mos.</u>	<u>33 mos.</u>	<u>45 mos.</u>	<u>57 mos. (ult.)</u>
2013	100,000	250,000	300,000	315,000	315,000
2014	100,000	250,000	300,000	315,000	
2015	120,000	300,000	360,000		
2016	110,000	275,000			
2017	130,000				

Age to Age Factors

Accident

<u>Year</u>	<u>9-21</u>	<u>21-33</u>	<u>33-45</u>	<u>45-57</u>
2013	2.50	1.20	1.05	1.00
2014	2.50	1.20	1.05	
2015	2.50	1.20		
2016	2.50			
Cumulative Factor to Ultimate	3.15	1.26	1.05	1.00



Consideration #9

<u>Required IBNR as of Q3 2017</u>				
Accident	(1) Reported as of <u>Q3 2017</u>	(2) Factor to <u>Ultimate</u>	(3)=(1)*(2) Estimated Ultimate <u>Losses</u>	(4)=(3)-(1) Required IBNR as of <u>Q3 2017</u>
Year				
2013	315,000	1.00	315,000	0
2014	315,000	1.00	315,000	0
2015	360,000	1.05	378,000	18,000
2016	275,000	1.26	346,500	71,500
2017	130,000	3.15	409,500	279,500

IS THIS CORRECT?



Consideration #9

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

The latest year needs to be adjusted to reflect the loss emergence in 4Q (one option is to reduce by .25 for the incomplete policy period assuming loss emergence pattern is uniform.)



Consideration #10

“Tail Development” could have a marked effect on reserve needs.

Techniques To Derive Tail Factors:

1. Utilize longer history of internal data, if available
2. Examine broader data sources
 - Industry data (Caution: Understand the limitations of such data)
3. Curve Fitting
4. Generalized Bondy Method



Considerations

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

11. Indications can change for a variety of reasons - ask why!



Consideration #11

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



Consideration #11

Last Year's Review Reported Losses at 12/2015

<u>AY</u>	<u>12 Mos.</u>	<u>24 Mos.</u>	<u>36 Mos.</u>	<u>48 Mos.</u>
2012	125	167	189	202
2013	125	167	189	
2014	125	167		
2015	125			

Age to Age Factors

<u>AY</u>	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	
2012	1.34	1.13	1.07	
2013	1.34	1.13		
2014	1.34			
Selected	1.34	1.13	1.07	Tail 1.00
Factor to Ultimate	1.62	1.21	1.07	1.00



Consideration #11

<u>AY</u>	<u>Reported Losses at 12/2015</u>	<u>Factor to Ultimate</u>	<u>Estimated Ultimate</u>
2012	202	1.00	202
2013	189	1.07	202
2014	167	1.21	202
2015	125	1.62	202

Easy, Right?



Consideration #11

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 #11

This Year's Review Reported Losses at 12/2016

<u>AY</u>	<u>12 Mos.</u>	<u>24 Mos.</u>	<u>36 Mos.</u>	<u>48 Mos.</u>	<u>60 Mos.</u>
2012	125	167	189	202	208
2013	125	167	189	206	
2014	125	167	194		
2015	125	177			
2016	133				

Age to Age Factors

<u>AY</u>	<u>12-24</u>	<u>24-36</u>	<u>36-48</u>	<u>48-60</u>	
2012	1.34	1.13	1.07	1.03	
2013	1.34	1.13	1.09		
2014	1.34	1.16			
2015	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 #11

<u>AY</u>	<u>Reported Losses at 12/2016</u>	<u>Factor to Ultimate</u>	<u>Estimated Ultimate</u>	<u>Estimate Last Year</u>	<u>Impact</u>
2012	208	1.00	208	202	6
2013	206	1.03	212	202	10
2014	194	1.11	216	202	14
2015	177	1.28	226	202	24

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

What happened?



Consideration #11

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



Consideration #11

<u>AY</u>	<u>Reported Losses at 12/2016</u>	<u>Retain Prior Factor</u>	<u>Estimated Ultimate</u>	<u>Estimate Last Year</u>	<u>Impact</u>
2012	208	1.00	208	202	6
2013	206	1.00	206	202	4
2014	194	1.07	207	202	5
2015	177	1.21	214	202	12

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



Consideration #11

- 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

