Intermediate Reserving Boot Camp

Casualty Loss Reserve Seminar
Anaheim, California
September 6th, 2018

Welcome

- Introductions
  - Instructors
    - Karin Rhoads
    - Brian Clancy
    - Scott Lamb
    - Andrew Somers

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Agenda

- Session 1
  - Reserving Level-Set
  - Chain Ladder and Mix Changes
  - Tails
- Session 2
  - Recap
  - Berquist-Sherman Adjustments
  - Cape Cod

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Agenda

Session 2

BERQUIST-SHERMAN

Change In Operations

- Change in Case Reserve Adequacy
- Change in Coverages or Policy Terms
- Shifting legal climate or change in laws
- Change in territory, class or size of risks

Strategies for Addressing Change

- Data Selection and Rearrangement
  - Case Reserve Adequacy
    - Paid Losses instead of Incurred
  - Coverage Changes
    - Policy Year instead of Accident Year
  - Law Changes
    - Report Year instead of Accident Year
  - Change in Underlying Mix
    - Divide data into smaller, more homogenous groups

Strategies for Addressing Change

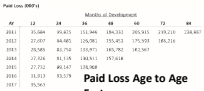
- Quantitative Adjustments to the Data
  - Change in Case Reserve Adequacy
    - Adjust the case outstanding triangle to account for the change
  - Change in Claim Payments/Closure Rates
    - Adjust the paid loss triangle
  - B-S method makes these adjustments to the data before applying traditional development methods

Loss Triangles

Paid Loss (000's)

	Months of Development						
AY	**12**	**24**	**36**	**48**	**60**	**72**	**84**
2011	35,684	99,825	151,946	184,332	205,915	219,210	228,887
2012	27,607	84,481	126,081	155,452	175,593	186,216	
2013	28,585	83,750	133,971	165,782	182,567		
2014	27,326	81,135	130,511	157,618			
2015	27,732	89,147	138,968				
2016	31,913	93,579					
2017	35,563						

Loss Triangles



Paid Loss Age to Age Factors

AY	12-24	24-36	36-48	48-60	60-72	72-84
2011	2.797	1.522	1.213	1.117	1.065	1.044
2012	3.060	1.492	1.233	1.130	1.060	
2013	2.930	1.600	1.237	1.101		
2014	2.969	1.609	1.208			
2015	3.215	1.559				
2016	2.932					
Avg	2.984	1.556	1.223	1.116	1.063	1.044
Cum	8.437	2.827	1.817	1.486	1.331	1.253

Tail 1.200

Loss Triangles

Incurred Loss (000's)

Months of Development

AY	12	24	36	48	60	72	84
2011	101,955	166,375	217,065	230,415	242,254	243,567	252,914
2012	78,877	153,601	180,115	194,315	206,580	206,907	
2013	81,672	152,272	191,387	207,227	214,785		
2014	78,073	147,517	174,015	197,022			
2015	101,008	193,927	213,450				
2016	118,093	203,963					
2017	136,487						

Loss Triangles

Incurred Loss Age to Age Factors

AY	12-24	24-36	36-48	48-60	60-72	72-84
2011	1.632	1.305	1.062	1.051	1.005	1.038
2012	1.947	1.173	1.079	1.063	1.002	
2013	1.864	1.257	1.083	1.036		
2014	1.889	1.180	1.132			
2015	1.920	1.101				
2016	1.727					
Avg	1.830	1.203	1.089	1.050	1.004	1.038
Cum	2.859	1.562	1.299	1.193	1.136	1.132

Tail 1.090

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Loss Triangles

Indemnity Open Claims

AY	12	24	36	48	60	72	84
2011	7,800	4,426	2,569	1,550	1,036	907	648
2012	6,088	3,455	2,006	1,210	808	708	
2013	6,026	3,224	1,986	1,197	800		
2014	6,175	3,304	2,034	1,227			
2015	6,026	3,224	1,986				
2016	6,254	3,346					
2017	6,618						

Loss Triangles

Indemnity Closed Claims (excl CWOP)

AY	12	24	36	48	60	72	84
2011	3,343	8,221	10,280	11,364	11,904	12,050	12,313
2012	2,609	6,416	8,023	8,869	9,291	9,404	
2013	2,582	6,546	7,941	8,779	9,196		
2014	2,646	6,708	8,138	8,996			
2015	2,583	6,547	7,942				
2016	2,680	6,794					
2017	2,837						

Estimated Ultimate Losses

(000's)

AY	Earned Premium	Paid Loss	Incurred Loss	Paid LDF	Incurred LDF	Paid Estimate Ultimate	Incurred Estimate Ultimate
2011	830,775	228,887	252,914	1.200	1.090	274,664	275,676
2012	800,295	186,216	206,907	1.253	1.132	233,324	234,183
2013	904,278	182,567	214,785	1.331	1.136	243,056	243,951
2014	1,031,438	157,618	197,022	1.486	1.193	234,175	235,037
2015	1,209,428	138,968	213,450	1.817	1.299	252,469	277,254
2016	1,367,756	93,579	203,963	2.827	1.562	264,588	318,683
2017	1,569,261	35,563	136,487	8.437	2.859	300,039	390,264
Total	7,713,232	1,023,397	1,425,529			1,802,315	1,975,049

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Estimates Diverging?

(000's)

AY	Earned Premium	Paid Loss	Incurred Loss	Paid LDF	Incurred LDF	Paid Estimate Ultimate	Incurred Estimate Ultimate
2011	830,775	228,887	252,914	1.200	1.090	274,664	275,676
2012	800,295	186,216	206,907	1.253	1.132	233,324	234,183
2013	904,278	182,567	214,785	1.331	1.136	243,056	243,951
2014	1,031,438	157,618	197,022	1.486	1.193	234,175	235,037
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2017	1,569,261	35,563	136,487	8.437	2.859	300,039	390,264
Total	7,713,232	1,023,397	1,425,529			1,802,315	1,975,049

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Berquist Sherman – Change in Reserve Adequacy

- Check for change
  - Paid to Incurred Ratios
- Select a Severity Trend
  - Average Paid Claim
- Restate Average Case Reserves
  - Detrend from current averages

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Berquist Sherman – Change in Reserve Adequacy

- Restate Incurred Loss Triangle
  - Open Counts x Restated Average Case
  - Add to Paid Losses
- Chain Ladder Analysis
  - Using Restated Incurred

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Paid to Incurred Ratios

Paid Loss (000's)

AY	Months of Development 12	24
2011	35,684	99,825
2012	27,607	84,481

Incurred Loss (000's)

AY	Months of Development 12	24
2011	101,955	166,375
2012	78,877	153,601

35,684 ÷ 101,955 = 0.350

Ratio of Paid Loss to Incurred Loss

AY	12	24
2011	0.350	0.600
2012	0.350	0.550

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Look for changes in case reserves

Ratio of Paid Loss to Incurred Loss

AY	12	24	36	48	60	72	84
2011	0.350	0.600	0.700	0.800	0.850	0.900	0.905
2012	0.350	0.550	0.700	0.800	0.850	0.900	
2013	0.350	0.550	0.700	0.800	0.850		
2014	0.350	0.550	0.750	0.800			
2015	0.275	0.460	0.651				
2016	0.270	0.459					
2017	0.261						

Look for changes in case reserves

Ratio of Paid Loss to Incurred Loss

AY	12	24	36	48	60	72	84
2011	0.350	0.600	0.700	0.800	0.850	0.900	0.905
2012	0.350	0.550	0.700	0.800	0.850	0.900	
2013	0.350	0.550	0.700	0.800	0.850		
2014	0.350	0.550	0.750	0.800			
2015	0.275	0.460	0.651				
2016	0.270	0.459					
2017	0.261						

Case Reserve Triangle

Outstanding Case Reserves (000's)

AY	12	24	36	48	60	72	84
2011	66,271	66,550	65,120	46,083	36,338	24,357	24,027
2012	51,270	69,121	54,035	38,863	30,987	20,691	
2013	53,087	68,523	57,416	41,445	32,218		
2014	50,748	66,383	43,504	39,404			
2015	73,276	104,780	74,483				
2016	86,180	110,385					
2017	100,925						

Calculate Average Case

Outstanding Case Reserves (000's)

Months of Development

AY	12	24
2011	66,271	66,550
2012	51,270	69,121

Open Claims

Months of Development

AY	12	24
2011	7,800	4,426
2012	6,088	3,455

Average Case Reserve

Months of Development

AY	12	24
2011	8,496	15,036
2012	8,422	20,006

66,270,622 ÷ 7,800 = 8,496

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Average Case Reserve Triangle

Months of Development

AY	12	24	36	48	60	72	84
2011	8,496	15,036	25,348	29,731	35,075	26,854	37,078
2012	8,422	20,006	26,936	32,118	38,350	29,224	
2013	8,810	21,254	28,910	34,624	40,272		
2014	8,218	20,092	21,388	32,114			
2015	12,160	32,500	37,504				
2016	13,780	32,990					
2017	15,250						

Average Paid Claim

AY	12	24	36	48	60	72	84
2011	10,674	12,143	14,781	16,221	17,298	18,192	18,589
2012	10,581	13,167	15,715	17,528	18,899	19,802	
2013	11,071	12,794	16,871	18,884	19,853		
2014	10,327	12,095	16,037	17,521			
2015	10,736	13,617	17,498				
2016	11,908	13,774					
2017	12,535						

Average Annual Change Based on Regression Analysis

2.5%	1.9%	3.6%	3.1%

R-Squared of Exponential Regression

56.5%	41.9%	75.4%	40.5%

Average Paid Claim

AY	12	24	36	48	60	72	84
2011	10,674	12,143	14,781	16,221	17,298	18,192	18,589
2012	10,581	13,167	15,715	17,528	18,899	19,802	
2013	11,071	12,794	16,871	18,884	19,853		
2014	10,327	12,095	16,037	17,521			
2015	10,736	13,617	17,498				
2016	11,908	13,774					
2017	12,535						

Selected Severity Trend: +3.0%

Average Annual Change Based on Regression Analysis

2.5%	1.9%	3.6%	3.1%

R-Squared of Exponential Regression

56.5%	41.9%	75.4%	40.5%

Average Case Reserve Triangle

Months of Development

AY	12	24	36	48	60	72	84
2011	8,496	15,036	25,348	29,731	35,075	26,854	37,078
2012	8,422	20,006	26,936	32,118	38,350	29,224	
2013	8,810	21,254	28,910	34,624	40,272		
2014	8,218	20,092	21,388	32,114			
2015	12,160	32,500	37,504				
2016	13,780	32,990					
2017	15,250						

Average Case Reserve Triangle

Months of Development

AY	12	24	36	48	60	72	84
2011							37,078
2012						29,224	
2013					40,272		
2014				32,114			
2015			37,504				
2016		32,990					
2017	15,250						

- Keep the most recent values

Restate Average Case Reserve

Months of Development

AY	12	24	36	48	60	72	84
2011	12,772	28,457	33,322	29,389	37,960	28,373	37,078
2012	13,155	29,311	34,321	30,271	39,099	29,224	
2013	13,549	30,191	35,351	31,179	40,272		
2014	13,956	31,096	36,412	32,114			
2015	14,375	32,029	37,504				
2016	14,806	32,990					
2017	15,250						
Selected Severity Trend			3.0%				

- Detrend from latest value back to earlier valuations

Detrend Average Case Reserve

Months of Development

AY	12	24	36	48	60	72	84
2011	12,772	28,457	33,322	29,389	37,960	28,373	37,078
2012	13,155	29,311	34,321	30,271	39,099	29,224	
2013	13,549	30,191	35,351	31,179	40,272		
2014	13,956	31,096	36,412	32,114			
2015	14,375	32,029	37,504				
2016	14,806	32,990					
2017	15,250						
Selected Severity Trend			3.0%				

$$32{,}990 \div (1.000 + 0.030) = 32{,}029$$

Detrend Average Case Reserve

	Months of Development						
AY	12	24	36	48	60	72	84
2011	12,772	28,457	33,322	29,389	37,960	28,373	37,078
2012	13,155	29,311	34,321	30,271	39,099	29,224	
2013	13,549	30,191	35,351	31,179	40,272		
2014	13,956	31,096	36,412	32,114			
2015	14,375	32,029	37,504				
2016	14,806	32,990					
2017	15,250						

Selected Severity Trend 3.0%

$$32{,}990 \div (1.000 + 0.030)^2 = 31{,}096$$

Calculate Restated Case Reserves

Restated Average Case Reserves

	Months of Development	
AY	12	24
2011	12,772	28,457
2012	13,155	29,311

Open Claims

	Months of Development	
AY	12	24
2011	7,800	4,426
2012	6,088	3,455

Restated Case Reserves (000's)

	Months of Development	
AY	12	24
2011	99,619	125,953
2012	80,086	101,270

$$13{,}155 \times 6{,}088 = 80{,}086{,}325$$

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Restate Total Case Reserves

	Months of Development						
AY	12	24	36	48	60	72	84
2011	99,619	125,953	85,604	45,553	39,327	25,734	24,027
2012	80,086	101,270	68,849	36,628	31,592	20,691	
2013	81,649	97,334	70,207	37,321	32,218		
2014	86,178	102,742	74,061	39,404			
2015	86,621	103,262	74,483				
2016	92,596	110,385					
2017	100,925						

Restate Incurred Loss

Months of Development

AY	12	24	36	48	60	72	84
2011	135,303	225,778	237,549	229,886	245,242	244,944	252,914
2012	107,693	185,751	194,930	192,080	207,185	206,907	
2013	110,234	181,084	204,178	203,103	214,785		
2014	113,503	183,877	204,573	197,022			
2015	114,353	192,409	213,450				
2016	124,508	203,963					
2017	136,487						

Restate Incurred LDF's

Restate Incurred Loss Age to Age Factors

AY	12-24	24-36	36-48	48-60	60-72	72-84	
2011	1.669	1.052	0.968	1.067	0.999	1.033	
2012	1.725	1.049	0.985	1.079	0.999		
2013	1.643	1.128	0.995	1.058			
2014	1.620	1.113	0.963				
2015	1.683	1.109					
2016	1.638						
Avg	1.663	1.090	0.978	1.068	0.999	1.033	
Cum	2.127	1.279	1.173	1.200	1.124	1.125	Tail 1.090

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Use Restated Incurreds

(000's)

AY	Earned Premium	Paid Loss	Restated Incurred Loss	Paid LDF	Restated Incurred LDF	Paid Estimate Ultimate	Restated Incurred Estimate Ultimate
2011	830,775	228,887	252,914	1.200	1.090	274,664	275,676
2012	800,295	186,216	206,907	1.253	1.125	233,324	232,866
2013	904,278	182,567	214,785	1.331	1.124	243,056	241,423
2014	1,031,438	157,618	197,022	1.486	1.200	234,175	236,440
2015	1,209,428	138,968	213,450	1.817	1.173	252,469	250,452
2016	1,367,756	93,579	203,963	2.827	1.279	264,588	260,906
2017	1,569,261	35,563	136,487	8.437	2.127	300,039	290,317
Total	7,713,232	1,023,397	1,425,529			1,802,315	1,788,081

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Compare Original & Restated

(000's) AY	Incurred Estimate Ultimate	Restated Incurred Estimate Ultimate	Paid Estimate Ultimate	Selected Ultimate
2011	275,676	275,676	274,664	275,170
2012	234,183	232,866	233,324	233,754
2013	243,951	241,423	243,056	243,503
2014	235,037	236,440	234,175	234,606
2015	277,254	250,452	252,469	251,460
2016	318,683	260,906	264,588	262,747
2017	390,264	290,317	300,039	295,178
Total	1,975,049	1,788,081	1,802,315	1,796,419

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Berquist-Sherman Considerations

- Changing Claim Severity
  - Change in average case reserve might be due to a change in the mix of claim sizes
- Change in definition of claim
  - "Marker" claims
- It is important to validate what you observe in the data with the real world

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Berquist-Sherman Considerations

- Severity Trend
  - Method is highly sensitive to selection
  - Often requires considerable judgement
- Changing Claim Settlement Rates
  - B-S also present method to adjust paid loss development method for changes in claim settlement rates.

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CAPE COD

Review of Bornhuetter-Ferguson

- Splits Ultimate Losses into two components
  - Actual Reported
  - Expected Unreported
- Assumption:
  - Unreported Losses will emerge in accordance with Expected Losses

Review of Bornhuetter-Ferguson

- Expected Loss Ratio
  - Used to estimate Expected Losses
  - Predetermined
  - May be judgmental
- Less susceptible to distortion from random early fluctuations in loss experience than Chain-Ladder

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Cape Cod is similar

- Similar concept to Bornhuetter-Ferguson
- Cape Cod splits Ultimate Losses into two components
  - Actual Reported
  - Expected Unreported
  - Same splits as B-F

Difference from B-F

- The difference is in the derivation of the Expected Loss Ratio
  - Based on Reported Losses
  - Not usually judgmental
  - Introduces “Used Up” concept to better match earned premiums to reported losses

Derivation of Expected Loss Ratio

- “Used Up” Premium
  - Portion of the premium that corresponds to losses reported through the valuation date
  - Inverse of Cumulative Development Factor is % of Ultimate Reported
  - This % is applied to Earned Premium
  - Denominator in Cape Cod ELR

Ultimate Reported Example

- % of Ultimate Expected Reported = 1 ÷ Cumulative Incurred LDF

AY Age	Cumulative Incurred Development Factors	Percent of Ultimate Expected Reported	Unreported
48	1.000	100.0%	0.0%
36	2.000	50.0%	50.0%
24	3.000	33.3%	66.7%
12	4.000	25.0%	75.0%

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Development of Expected Loss Ratio

(000's)

Accident Year	Earned Premium	AY Age	Reported Incurred Loss	LDF to Ultimate	% Ult Reported	Used Up Premium	Estimated Expected Loss Ratio
2011	830,775	84	252,914	1.112	89.9%	747,100	33.9%
2012	800,295	72	206,907	1.153	86.7%	694,098	29.8%
2013	904,278	60	214,785	1.162	86.1%	778,208	27.6%
2014	1,031,438	48	197,022	1.213	82.4%	850,320	23.2%
2015	1,209,428	36	185,290	1.309	76.4%	923,933	20.1%
2016	1,367,756	24	155,964	1.611	62.1%	849,010	18.4%
2017	1,569,261	12	101,608	2.833	35.3%	553,922	18.3%
Total	7,713,232		1,314,490			5,396,592	24.4%

Projection of Ultimate Loss

(000's)

Accident Year	Earned Premium	Expected Loss Ratio	Expected Ultimate Losses	LDF to Ultimate	% Ult Unreported	Expected Unreported Losses	Reported Incurred Loss	Projected Ultimate Loss
2011	830,775	24.4%	202,359	1.112	10.1%	20,381	252,914	273,295
2012	800,295	24.4%	194,934	1.153	13.3%	25,867	206,907	232,774
2013	904,278	24.4%	220,262	1.162	13.9%	30,708	214,785	245,493
2014	1,031,438	24.4%	251,236	1.213	17.6%	44,116	197,022	241,139
2015	1,209,428	24.4%	294,590	1.309	23.6%	69,540	185,290	254,830
2016	1,367,756	24.4%	333,155	1.611	37.9%	126,355	155,964	282,319
2017	1,569,261	24.4%	382,237	2.833	64.7%	247,314	101,608	348,922
Total	7,713,232		1,878,772			564,282	1,314,490	1,878,772

Cape Cod Uses

- Prior selection of ELR not available
  - Reinsurance
- Changing Claim Emergence
  - More responsive than B-F

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Cape Cod Uses

- Trended On-level Expected Loss Ratio
  - Adjusts for changing rate/cost environments
  - Applicable to pricing studies
  - Useful in reserving also
    - After selecting ELR, have to back out trends and on-level adjustments to determine individual year ultimate losses

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When doesn't Cape Cod work?

- Sparse experience
  - Need enough data to develop the ELR
- Volatile lines
  - Overly influence the ELR
- Widely Variable or Uncertain LDF's
  - Affects the calculation of Used Up Premium
- Changing Reserve Adequacy or Product Mix

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Conclusions

- In the first session
  - Workers Compensation basics
  - Change in mix in the data
  - Tail Factors
- In this session
  - Handling Change in case reserve adequacy using Berquist Sherman
  - Using Cape Cod method

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Questions and Discussion