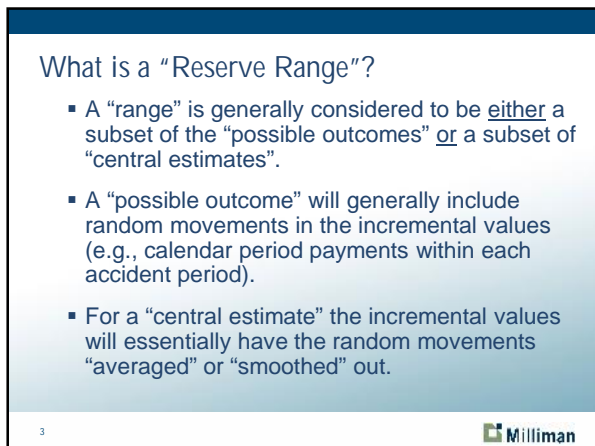


Reserve Variability and the Use of Ranges in Practice







Reserve Variability and the Use of Ranges in Practice

What is a "Reserve Range"?

- A "distribution" generally describes "all" possible outcomes.
- A purely statistical distribution will include all possible outcomes as defined by that distribution.
- The estimation of unpaid claims involves significant uncertainties that cannot be completely estimated, so "all" should be thought of as a reasonable estimate of the distribution to the extent that it can be estimated using historical data.

4



What is a "Reserve Range"?

- If point estimates are used to determine the "range" then the statistical meaning of the points cannot readily be determined – e.g., we do not know if they represent a mean, median or mode estimate.*
- A "distribution" does have statistical meaning – e.g., the mean, median, mode, percentiles, confidence intervals, etc. can be determined.

* See ASOP 43, Appendix 3.

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What is a "Reserve Range"?

- A "range of *reasonable* estimates" of the unpaid claims is:
 - an aid to management in determining management's best estimate.
 - used in determining whether or not the reported reserves make a reasonable provision for the value of the unpaid claims.
 - a statement about the reliability of current earnings, i.e., how much of current earnings are a function of judgments or assumptions.

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Reserve Variability and the Use of Ranges in Practice

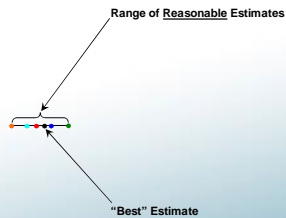
What is a "Reserve Range"?

- A "range of *reasonable* estimates" of the unpaid claims is:
- based on different views or opinions as to what might be considered reasonable assumptions and/or methods.
- intended to represent only those opinions or assumptions that are considered reasonable with respect to a central estimate.
- not readily usable for ERM.

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What is a "Reserve Range"?



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What is a "Reserve Range"?

- A "range of *possible* estimates" of the unpaid claims:
- is intended to provide "high" and "low" estimates in addition to a central estimate.
- can be estimated by scenario testing, in which different assumptions create a range of possibilities using deterministic methods.
- is generally intended to be wider than a "range of *reasonable* estimates," although both are subjective.
- is still not readily usable for ERM.

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Reserve Variability and the Use of Ranges in Practice

What is a "Reserve Range"?

The diagram illustrates the relationship between different types of estimates. A horizontal line represents the 'Range of Possible Estimates', which is the widest range. Within this range, a smaller section is marked as the 'Range of Reasonable Estimates'. A single point within the reasonable range is identified as the '"Best" Estimate'.

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What is a "Reserve Range"?

- An aggregate range:
- can be determined by adding the LOB ranges if the *reasonable* estimates are intended to reflect a "mean" value, as this does not imply any particular correlation assumption.
- is more problematic for *possible* estimates as a correlation assumption would generally be required.

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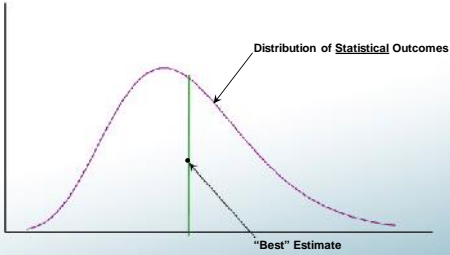
What is a "Reserve Range"?


- A "distribution of *statistical* outcomes" is:
- estimated using statistical distributions to essentially extend a deterministic central estimate.
- generally based on statistical properties estimated from the data, but some properties are simply assumed (e.g., the central estimate is assumed to be the mean).

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Reserve Variability and the Use of Ranges in Practice


What is a "Reserve Range"?



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What is a "Reserve Range"?

- A "distribution of *possible* outcomes" is:
- an expression of the "full" breadth of the possibilities of the future payouts.
- estimated using a probabilistic model which simulates a large number of possible outcomes, with the outcomes providing the ability to measure statistical properties such as the mean, mode, percentiles, etc.
- estimated using either individual claims, semi-aggregated or aggregated claim data

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What is a "Reserve Range"?

- A "distribution of *possible* outcomes" is:
- a statement about the risk to future value and earnings.
- not intended to only be derived from a single probabilistic model – every model has strengths and weaknesses.

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Reserve Variability and the Use of Ranges in Practice

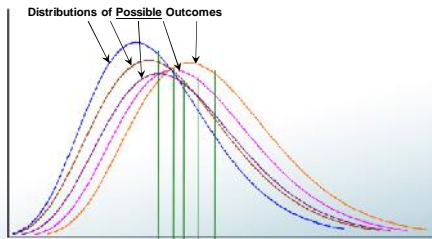
What is a "Reserve Range"?

- A "distribution of *possible* outcomes":
- can become a "best estimate" by weighting multiple distributions.
- can also be used to define subsets or ranges which are analogous to deterministic ranges.

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What is a "Reserve Range"?

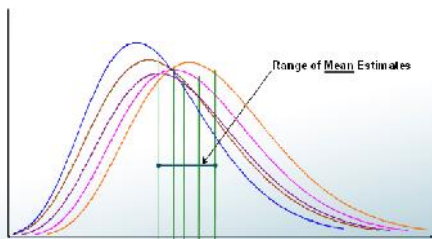


Estimated Unpaid Claims
With multiple models:
You need to evaluate the relative strengths of each model

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What is a "Reserve Range"?



Estimated Unpaid Claims
With multiple models:
You then have a "reasonable" range

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Reserve Variability and the Use of Ranges in Practice

What is a "Reserve Range"?

"Best Estimate" of a Distribution of Possible Outcomes

"Best Estimate" of the Mean

Estimated Unpaid Claims

With multiple models:
You can use credibility weights to get your "best estimate"

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What is a "Reserve Range"?

"Best Estimate" of a Distribution of Possible Outcomes

Confidence Interval

"Best Estimate" of the Mean

25% 75%

Estimated Unpaid Claims

With multiple models:
You can calculate confidence intervals

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What is a "Reserve Range"?

Fictional Insurance Company
General Liability
Evaluated as of December 31, 2013
ODP Bootstrap Summary of Results by Model

Accident Year	Mean Est Unpaid CL-Paid	Mean Est Unpaid CL-Incurred	Mean Est Unpaid BF-Paid	Mean Est Unpaid BF-Incurred	Mean Est Unpaid CC-Paid	Mean Est Unpaid CC-Incurred	Best Est (Weighted) Unpaid
12-2004	7,343	6,769	6,840	6,120	9,520	8,478	7,078
12-2005	7,417	7,081	7,196	6,377	8,581	8,088	7,240
12-2006	8,812	8,202	8,259	7,484	9,530	8,826	8,521
12-2007	12,452	13,520	12,109	12,831	10,115	11,098	13,015
12-2008	13,866	13,857	13,528	13,463	13,340	13,428	13,893
12-2009	22,021	21,407	20,723	20,264	21,690	21,329	21,651
12-2010	48,624	50,338	48,221	49,597	45,253	47,393	49,465
12-2011	78,676	81,577	76,349	79,379	75,048	78,490	80,010
12-2012	117,896	142,279	127,552	144,030	115,802	134,902	130,777
12-2013	187,266	208,835	205,345	212,244	193,043	204,724	204,058
Total	504,373	553,865	526,123	551,790	501,921	536,556	535,708

Range of Mean Estimates

Initial Best Estimate of the Mean

You can use credibility weights to get your "mean estimate"

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Reserve Variability and the Use of Ranges in Practice

What is a "Reserve Range"?

How does your best estimate compare to the individual models?

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What is a "Reserve Range"?

- An aggregate distribution:
 - can be determined by correlating the variances of the *statistical* LOB distributions.
 - can be determined by correlating the outcomes of the *probabilistic* LOB distributions.
 - can be used for Enterprise Risk Management.

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Summary of Distribution Uses:

- Technical Provisions / Unpaid Claim Estimates
 - IFRS: Discounted Best Estimate + CoC Risk Margin
 - GAAP / Statutory: Undiscounted Best Estimate
- Economic / Risk-Based Capital / Solvency II
 - Reserve Risk
 - Pricing Risk
 - Duration Risk
- Pricing / ROE
- Reinsurance Analysis
 - Quota Share
 - Aggregate Excess
 - Stop Loss
 - Loss Portfolio Transfer
- Dynamic Risk Modeling (DFA) → Parameterize ANY Model
- Strategic Planning / Performance Management / ERM
- Regulatory & Rating Agency Support
- Compare Expected vs. Actual Variability / Back Testing
- Mergers & Acquisitions

Stochastic M&A

Allocated Capital

Risk Transfer

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Reserve Variability and the Use of Ranges in Practice

Summary of Distribution Uses:
Adding the distributions to get the aggregate is not enough

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Summary of Distribution Uses:
Correlation is critical for aggregate risk

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Summary of Distribution Uses:
How much capital you need depends on correlation

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Reserve Variability and the Use of Ranges in Practice

Summary of Distribution Uses:

Fictional Insurance Company Evaluated as of December 31, 2013 Rank Correlation of Residuals			
	BI	APD	GL
BI	1.000	(0.026)	0.382
APD	(0.026)	1.000	0.147
GL	0.382	0.147	1.000
T-Dist DoF:	8		

Fictional Insurance Company Evaluated as of December 31, 2013 P-Values of Rank Correlation of Residuals			
	BI	APD	GL
BI	1.000	0.721	0.023
APD	0.721	1.000	0.297
GL	0.023	0.297	1.000

You need to both measure and evaluate correlation!

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Summary of Distribution Uses:

Fictional Insurance Company
Risk Based Capital Reserve Risk Analysis Summary
(No Discounting, Model Correlations)

Line	Mean Unpaid	Coefficient of Variation	Reserve Risk (Simulated Values)				
			99.50% Unpaid	Value at Risk (VaR)	Capital / Unpaid	Allocated Capital *	
BI	978,085	7.00%	1,150,089	172,004	17.6%	159,545	16.3%
APD	128,325	15.57%	189,347	61,022	47.6%	12,139	9.5%
GL	539,300	9.03%	873,661	136,361	24.9%	105,433	19.5%
Sum	1,645,710		2,013,097	367,387	22.3%	277,116	16.8%
Aggregate Results	1,645,710	6.16%	1,922,826	277,116	16.8%		
Correlation Effect				(90,271)	-5.5%		

* Capital is Allocated using a methodology that adjusts for both Co.V and correlation.

Capital management requires consideration of correlation!

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