Reserve Variability: A Practical Guide

CLRS, Austin, TX

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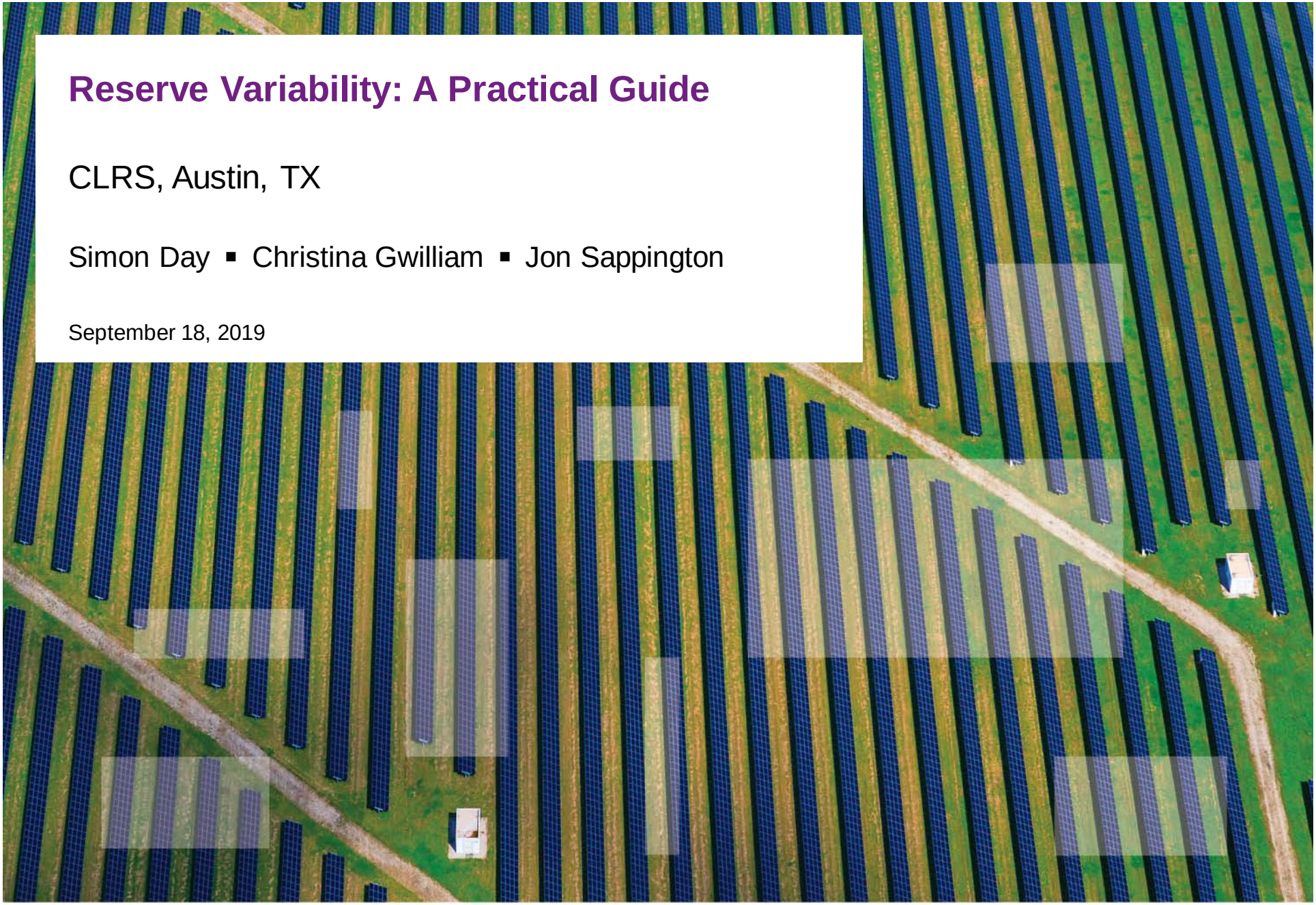

AEGIS | Willis Towers Watson

Today's speakers

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Subject Matter Expert

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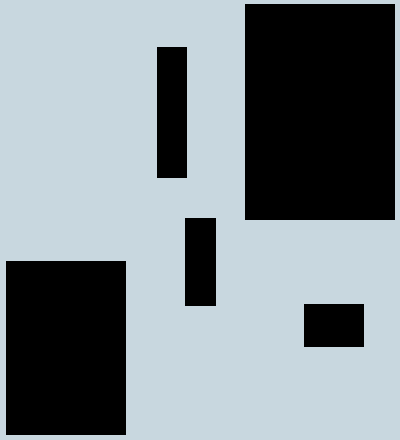
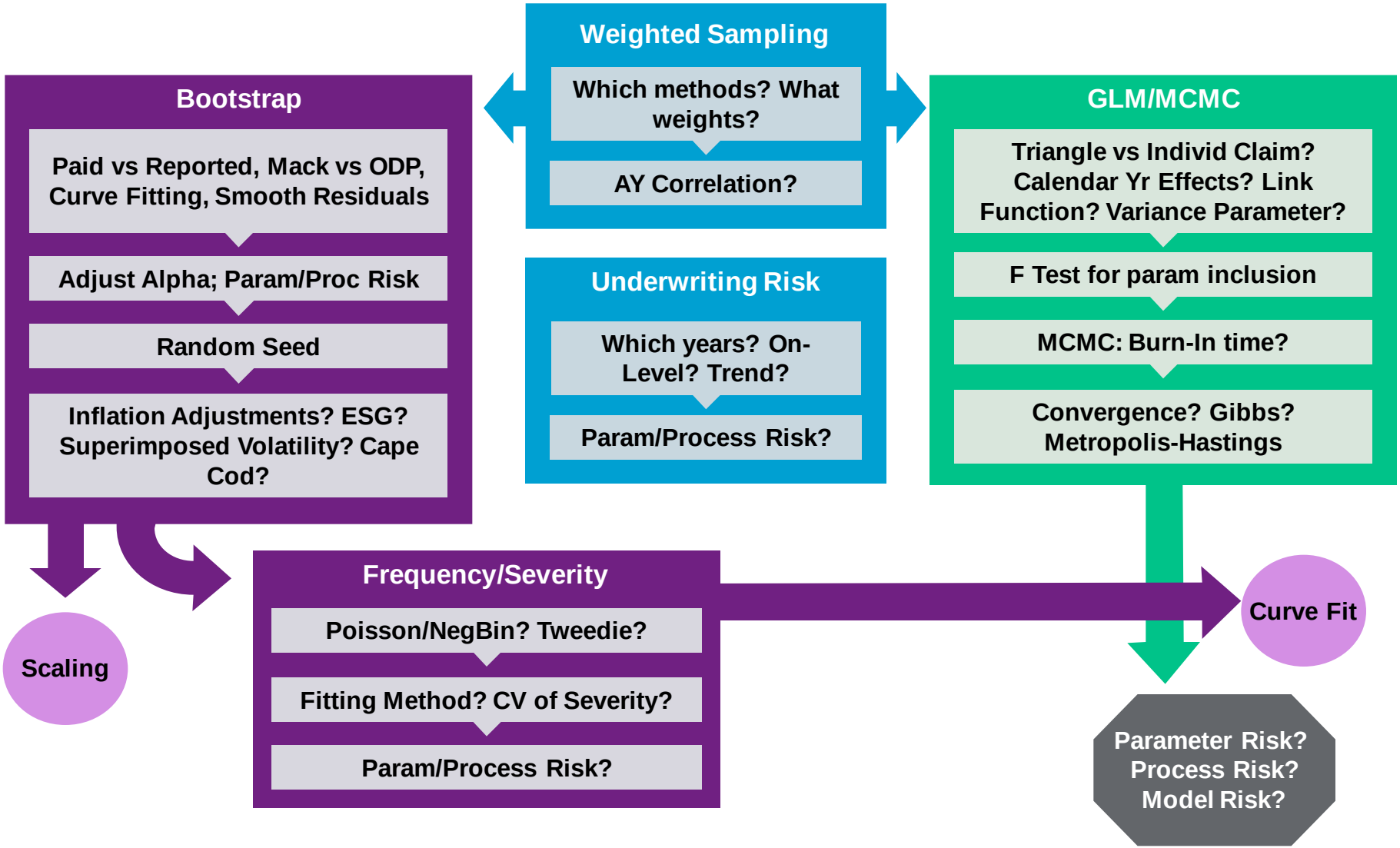
Agenda

- Challenges in Measuring Variability
- Ranges of Unpaid Liabilities
  - Common Uses
  - Selecting a Range from a Stochastic Distribution
- Calculation of Ceded Liabilities
  - When is a stochastic analysis needed?
  - Areas for special consideration
- Risk Transfer
  - Motivations
  - Two Examples

Challenges in Measuring Variability



Variability – Pandora's Box of Decisions



Overview of Methods: Advantages and Disadvantages

Bootstrap

- Advantage:
  - Easy to describe, uses your own data
  - Automatically supplies appropriate correlation between accident years
  - Generates future cash flows by calendar period
- Disadvantage:
  - Same disadvantages as the loss development method
    - Assumes no change in historical development;
    - Assumes no calendar year effects
  - Breaks down if you have very slow developing data or sparse data
  - Does not work for latent exposures like asbestos or pollution that are not easily assigned to accident year

Overview of Methods: Advantages and Disadvantages

Bootstrap

GLM/MCMC on Triangles

- Advantages:
  - Flexible model specification allows incorporation of calendar year effects
  - Automatically supplies appropriate correlation between accident years
  - Generates future cash flows by calendar period
- Disadvantages:
  - Infinite choice of parameterization makes it difficult to choose one model over another
  - The models can often be unstable
  - Unfamiliar (although that is changing)

Overview of Methods: Advantages and Disadvantages

Bootstrap

GLM/MCMC on Triangles

Individual Claim Modeling

- Advantages:
  - Allows frequency/severity modeling to be tailored to specific claims in a book of business
- Disadvantages:
  - Challenging to select Pure IBNR
  - No obvious choice for accident year correlations
  - Can require numerous judgmental parameter selections (Mean and CV for both frequency and severity, by year)

Overview of Methods: Advantages and Disadvantages

Bootstrap

GLM/MCMC on Triangles

Individual Claim Modeling

Weighted Sampling

- Advantages:
  - Incorporates a provision for model risk
  - Easy to understand, implement
- Disadvantages:
  - Requires a justification for method weights
  - Does not capture all model risk, only the ones given weight
  - Requires origin period correlation if method weights vary by accident year

Overview of Methods: Advantages and Disadvantages

Bootstrap

GLM/MCMC on Triangles

Individual Claim Modeling

Weighted Sampling

Curve Fits

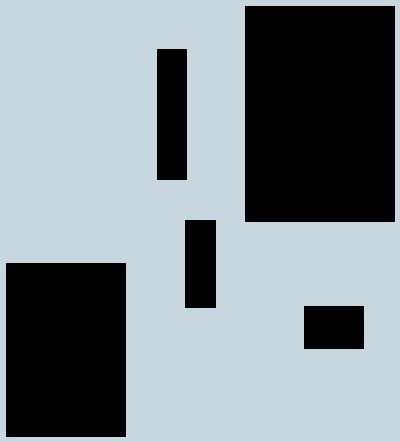
- Advantages:
  - Method of last resort when other statistical methods fail
  - Flexible, easy to explain
- Disadvantages:
  - Does not produce future cash flows without additional modeling assumptions
  - Requires selection of percentiles for fitting
  - Is the tail of the distribution appropriate at the higher percentiles?

Common Issues and Possible Solutions

Situation	Method to Consider
Long-Tail Segment	Curve fits for tail, inflation-adjusted bootstrap
No reliable triangle (A&E, OMT)	Fit a distribution to low and high reasonable estimates
No payments in first 12 months	Add on Cape Cod or B-F to standard bootstrap
Sparse data	Frequency/Severity, Benchmarks
Annuity Claims	Individual claim modeling with simulated mortality
Calendar year distortions	GLM/MCMC

Ranges of Unpaid Liabilities

Uses

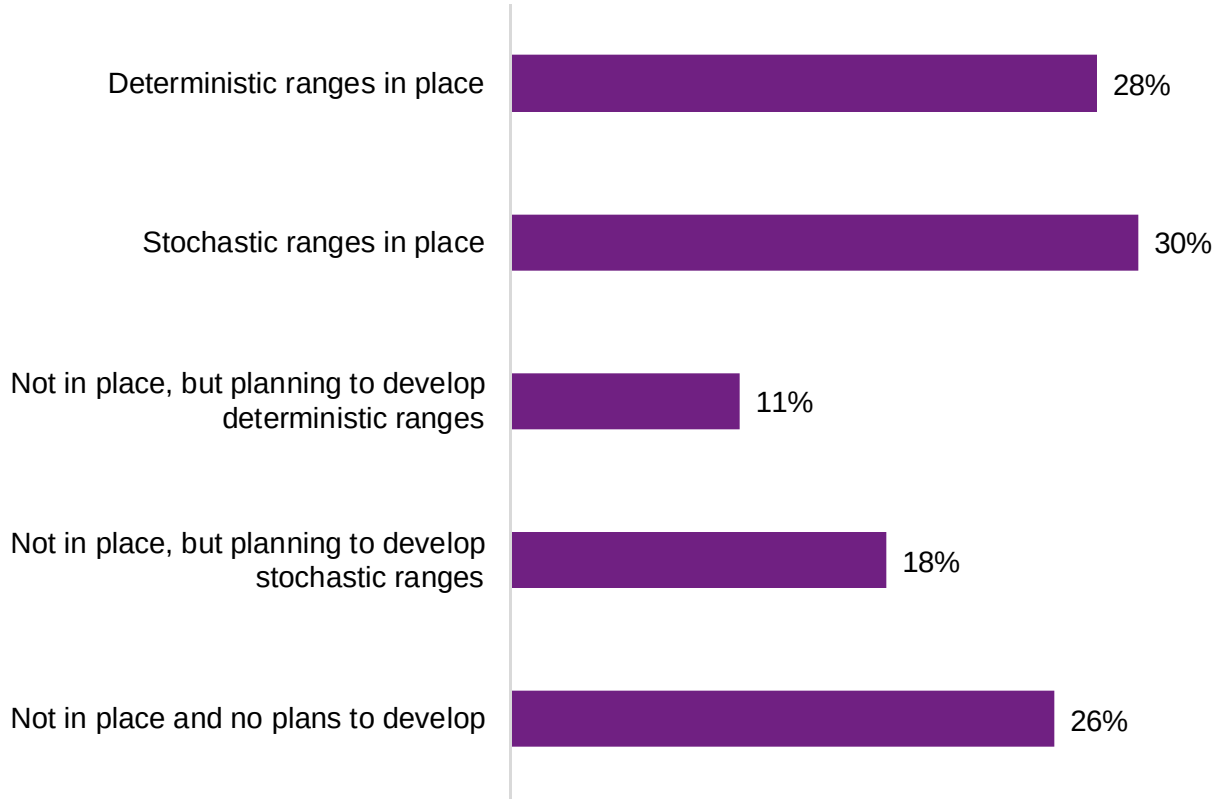


Poll Questions 1 & 2

From 2019 Willis Towers Watson Reserve Survey

Over half of organizations calculate reserve ranges through either deterministic and stochastic models or both

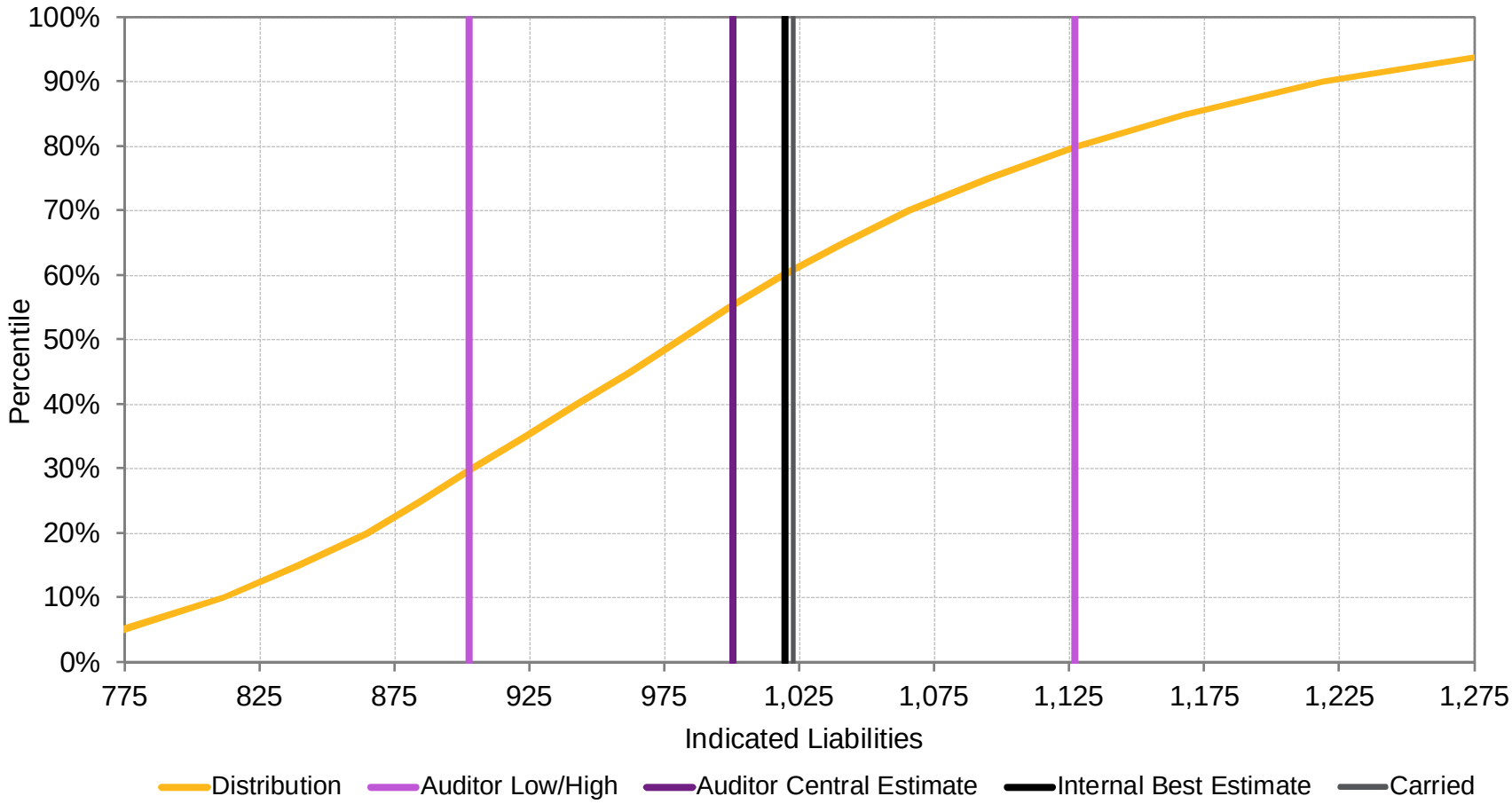
Q.22 Do you calculate reserve ranges?



Base: Total Respondents (2019 n = 57)

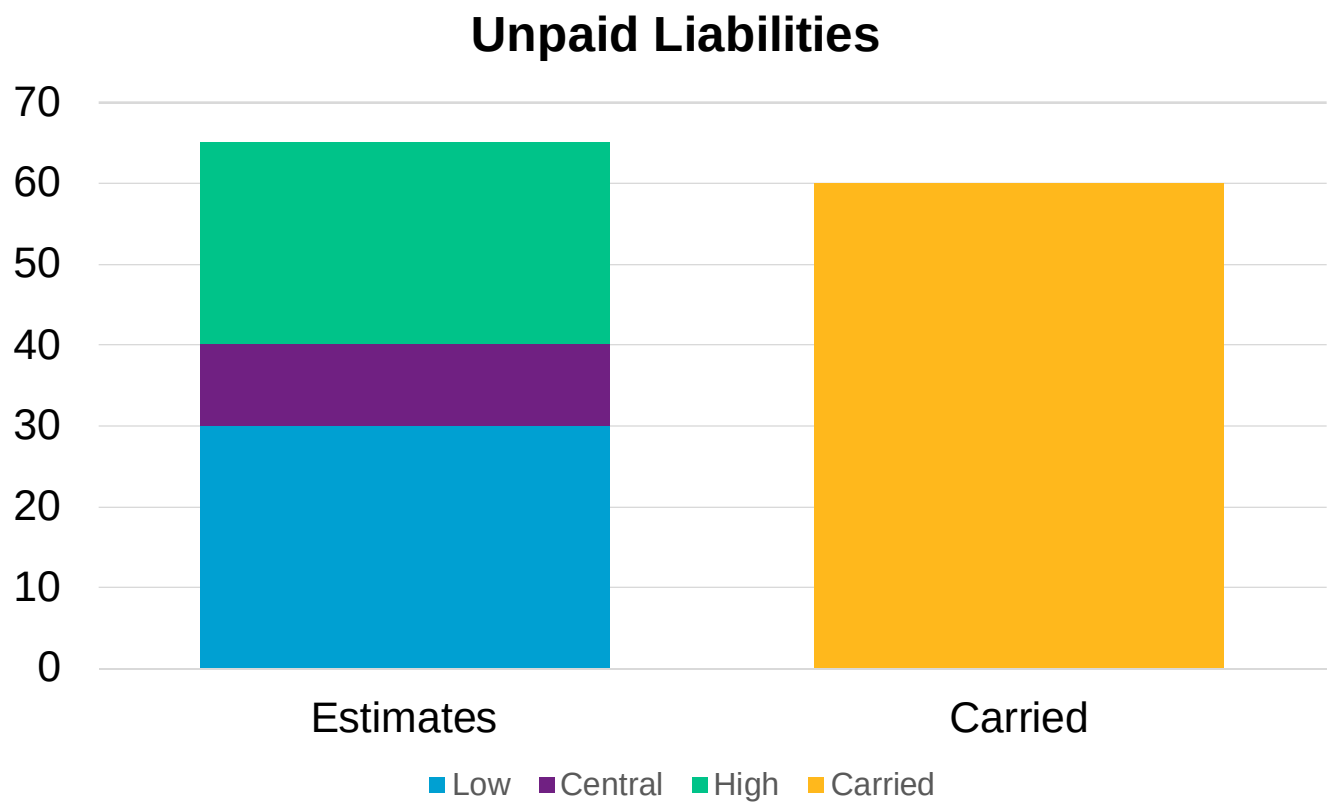
Ranges – Context

Although the carried reserve is a single number, low and high reasonable estimates can help stakeholders understand the context of that estimate



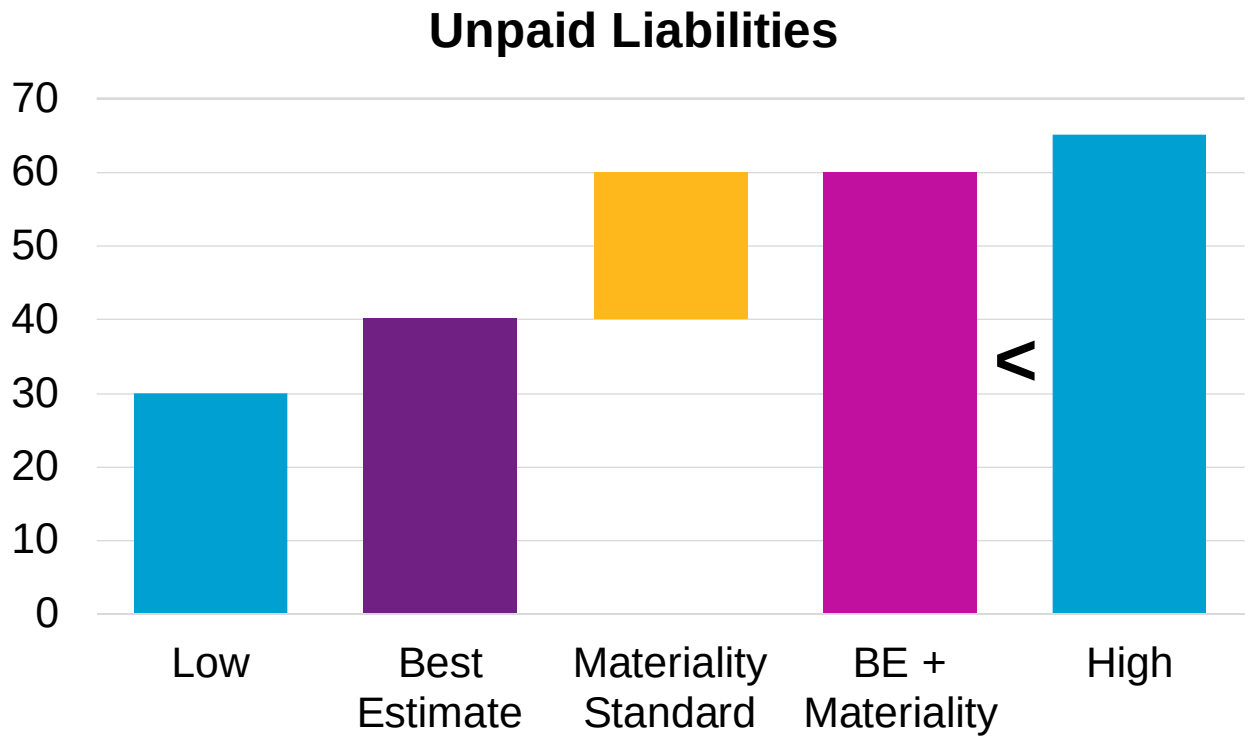
Ranges – Statutory Opinions

- U.S. Statutory Opinion requires that the carried reserves "...make a reasonable provision for all unpaid loss and loss adjustment expense obligations of the Company..."
- Other geographies have different requirements



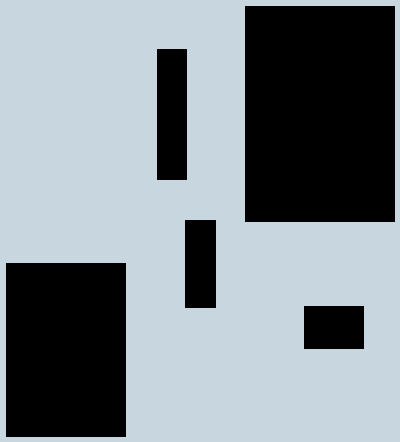
Ranges – Risk of Material Adverse Deviation

One signal that warns of a risk of material adverse deviation is when the best estimate plus the standard of materiality lies below the high reasonable estimate



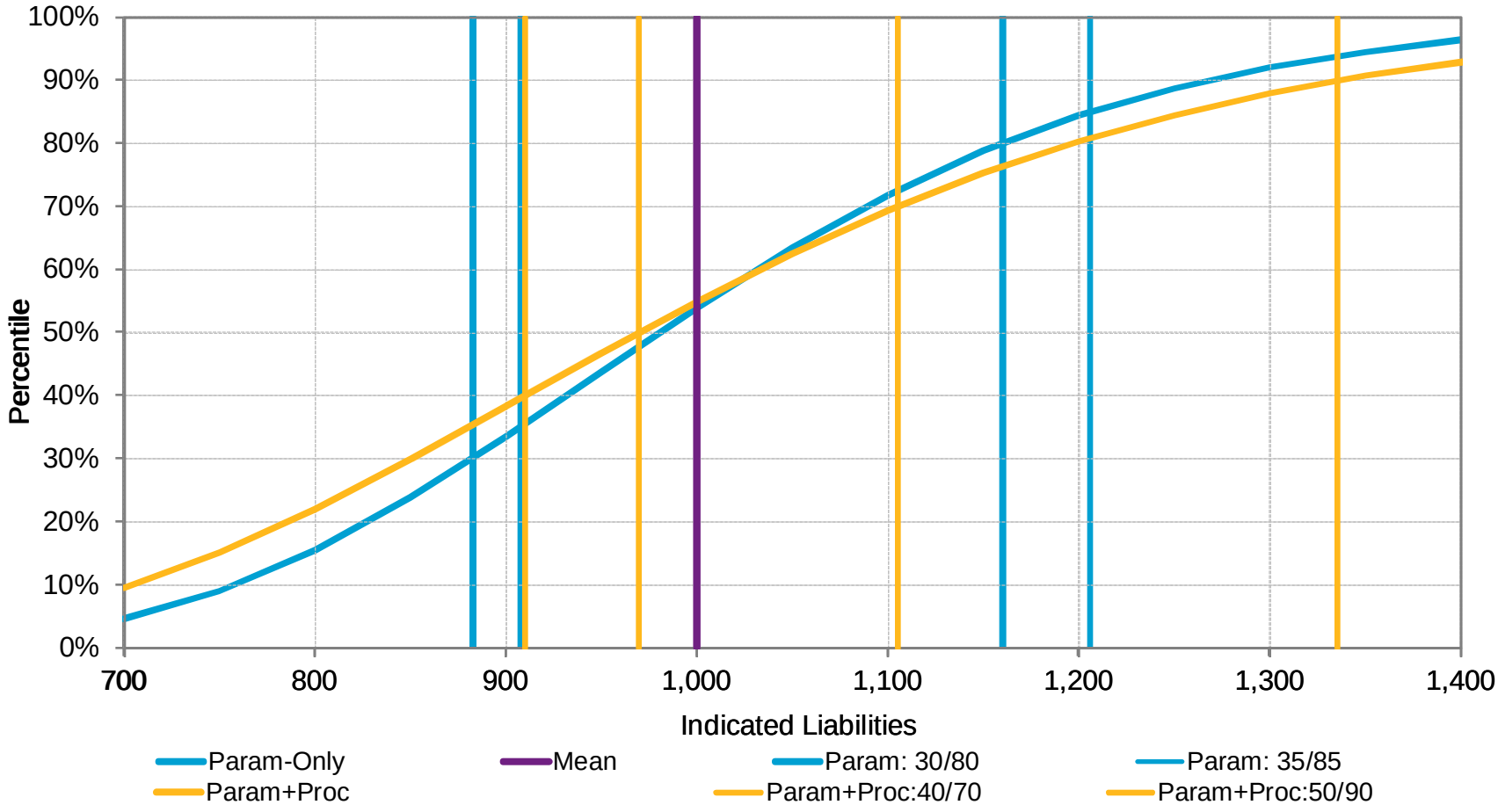
Ranges of Unpaid Liabilities

Selecting from Stochastic Distribution



Ranges – Selected Percentiles – Common Approaches

- Middle 50 percentiles of Parameter-only distribution e.g., 30th/80th or 35th/85th
- Narrower percentiles of Param+Process distribution, e.g., 40th/70th or 50th/90th



Ranges – Stochastic

Selected Percentiles

Measuring deviation of the ranges from the Actuarial Central Estimate can help assess the reasonability of the percentiles

- For example, a highly skewed distribution might have an unreasonably low 30th percentile, which might require sliding upward on the distribution
- Generally, select percentiles where the upward deviation is greater than the downward deviation

Ranges – Stochastic

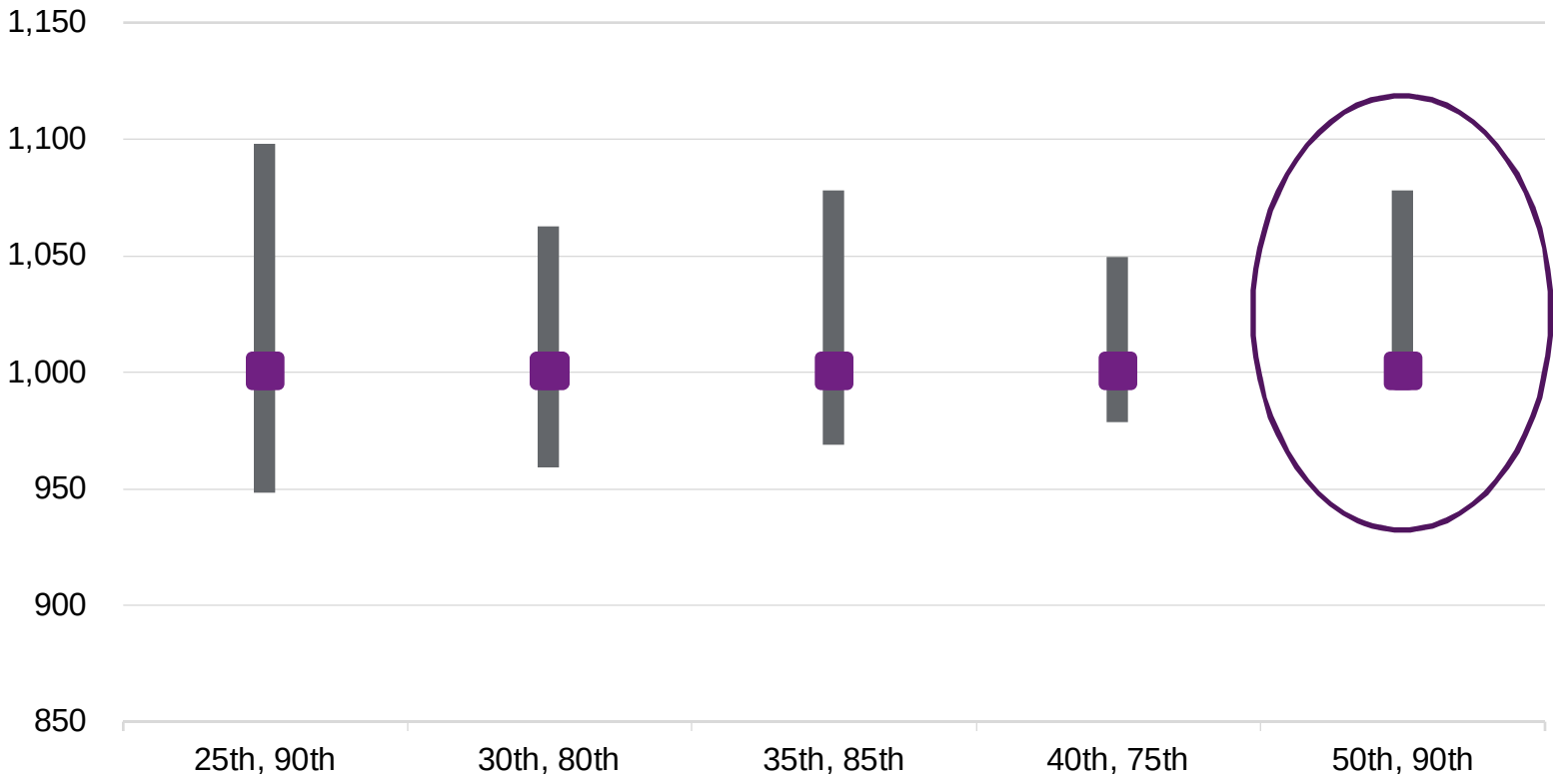
Possible Percentiles – Lognormal Distribution, low variability

- **The below lognormal distribution has a CoV of approximately 7.5%.**
  - Most of the choices produce narrow ranges, some of which have upward skew

Percentile Range	low$	mean$	high$	% low	% high
25th, 90th	948	1,000	1,098	-5.2%	9.8%
30th, 80th	959	1,000	1,062	-4.1%	6.2%
35th, 85th	969	1,000	1,078	-3.1%	7.8%
40th, 75th	978	1,000	1,049	-2.2%	4.9%
50th, 90th	997	1,000	1,078	-0.3%	7.8%

Ranges – Stochastic – Graphical View

Possible Percentiles – Lognormal Distribution, Low Volatility



Ranges – Stochastic

Possible Percentiles – Skewed Distribution

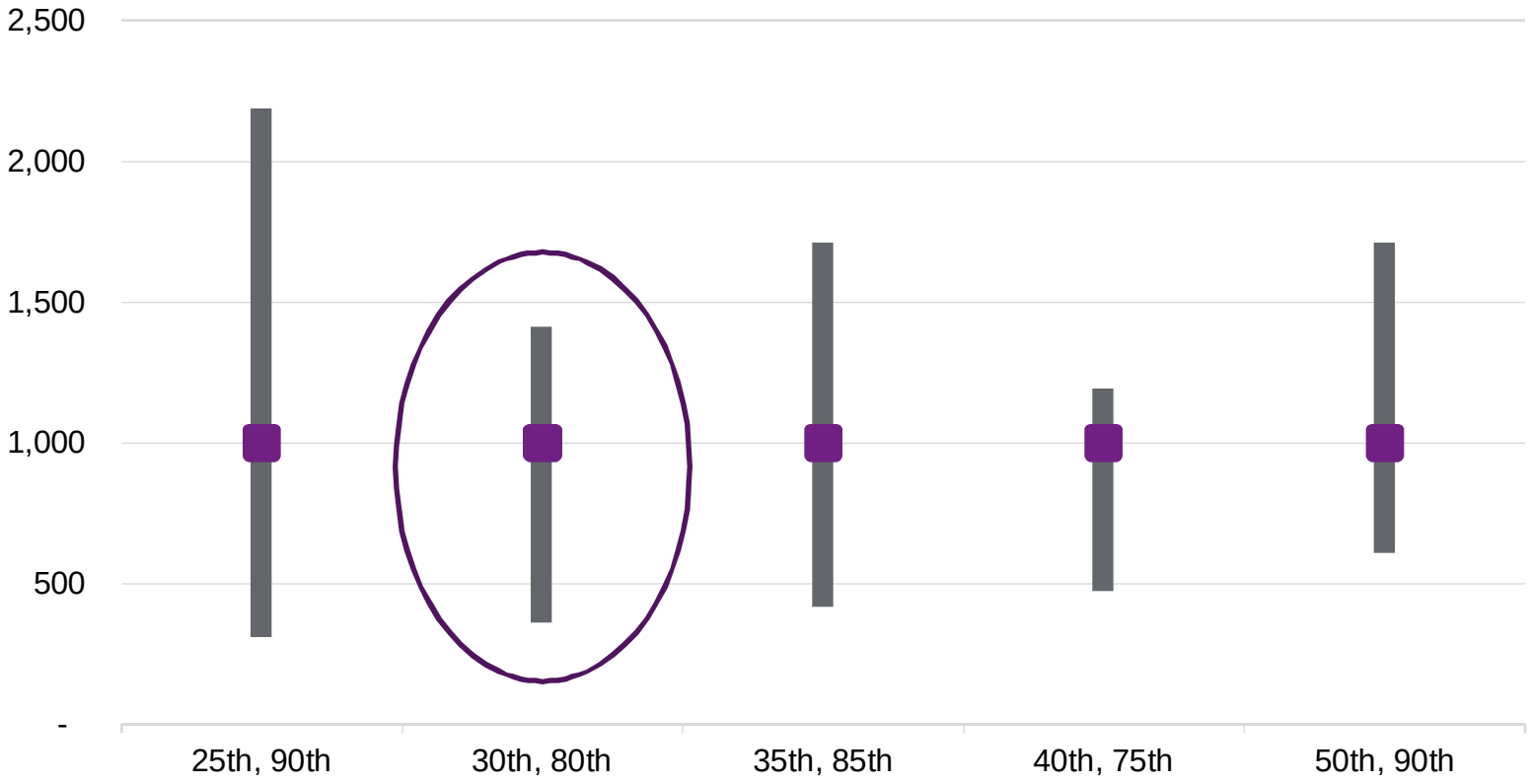
- When the CoV gets above 80%, it's possible to have highly asymmetric ranges depending on the selected percentiles
- Many of the choices below have far too much deviation on the low estimate

Percentile Range	low$	mean$	high$	% low	% high
25th, 90th	309	1,000	2,185	-69.1%	118.5%
30th, 80th	359	1,000	1,408	-64.1%	40.7%
35th, 85th	413	1,000	1,710	-58.7%	71.0%
40th, 75th	471	1,000	1,191	-52.9%	19.1%
50th, 90th	607	1,000	1,710	-39.3%	71.0%

Ranges – Stochastic – Graphical View

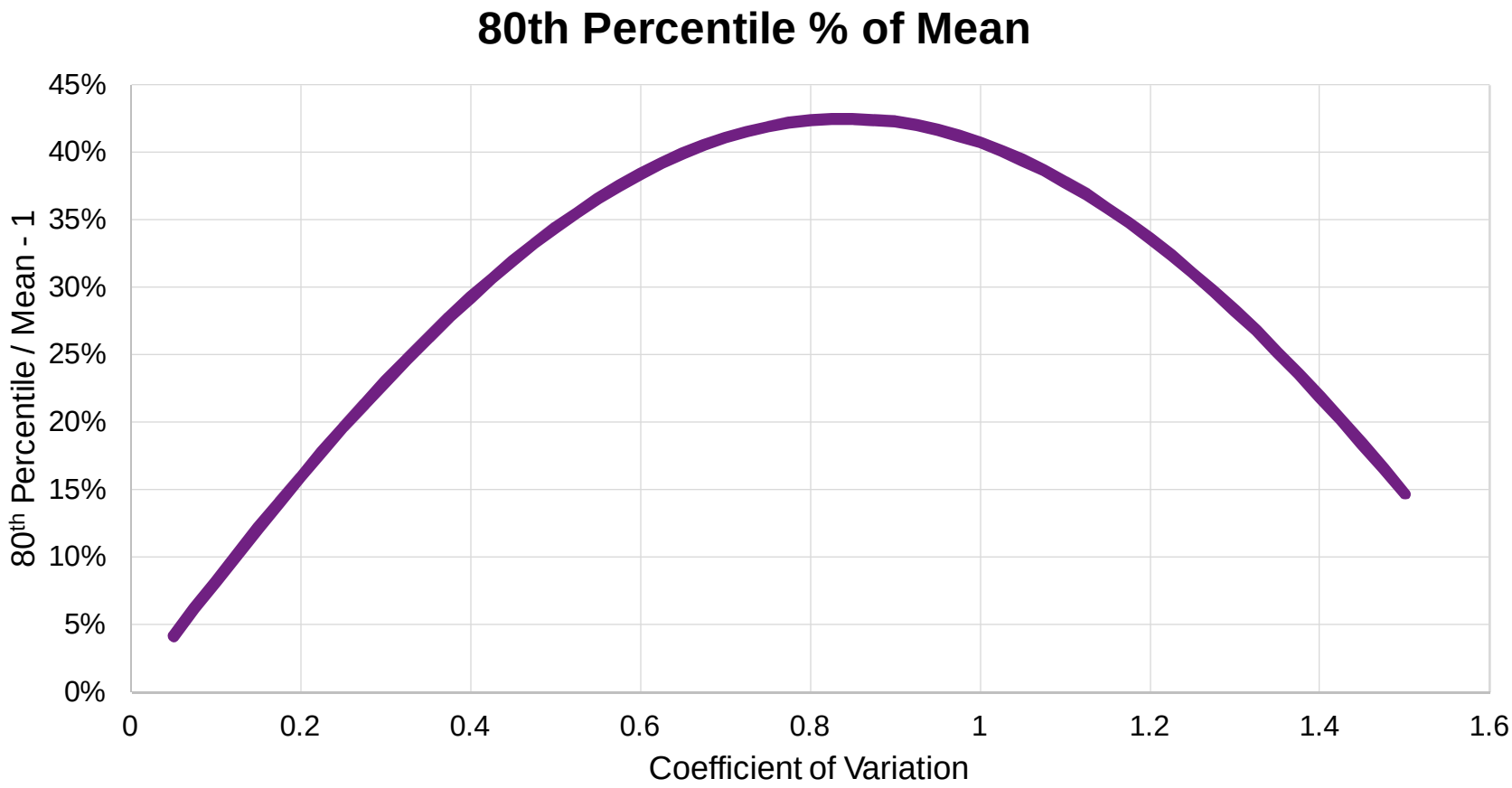
Possible Percentiles – Lognormal Distribution, High Volatility

- When the CoV gets above 80%, it's possible to have highly asymmetric ranges depending on the selected percentiles
- Many of the choices below have far too much deviation on the low estimate



Ranges – Stochastic

The 80th percentile has an inflection point as the CoV increases. At higher CoVs, the lower percentiles are compressed to allow for the massive tail



Poll Question 2

Percentiles – From 2019 Willis Towers Watson Reserve Survey

What percentiles of the distribution do you select for your low and high reasonable estimates?

Low/High Estimate	2019 Study
10/90	2
18/83	1
20/80	1
25/75	0
25/90 after correlation	0
30/80	1
33/67	1
40/60	0
40/85	1

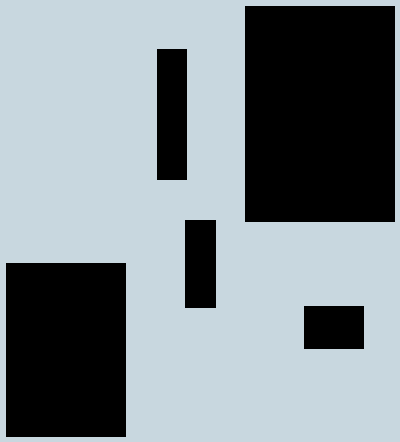
Base: Those that have implemented or are in the process of implementing their stochastic reserving n = 7

Ranges – Recap

- Although ranges are useful tools in a reserving process, there remains no standard of practice or prescribed method
- Care must be taken when communicating the range
- With stochastic distributions, the percentile choices will vary depending on the context, intended use, and underlying risks present in the distribution

Ceded Liabilities

When is Stochastic Analysis needed?

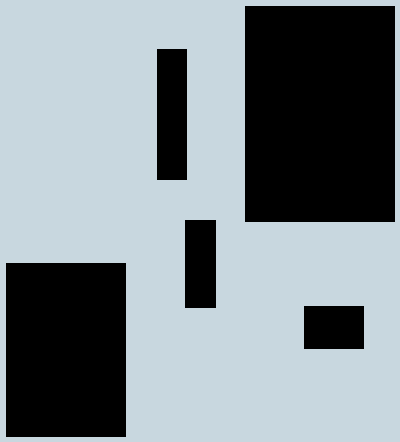


Ceded Liabilities – Deterministic vs Stochastic

- For simple proportional treaties, the ceded best estimate is generally easy to calculate accurately based on the gross Actuarial Central Estimate
- However, there are many other features that require more thought when calculating the ceded liabilities
  - Aggregate attachments or limits
  - Corridors
  - Loss ratio caps
  - Sliding scale commissions
  - Swing rating

Ceded Liabilities

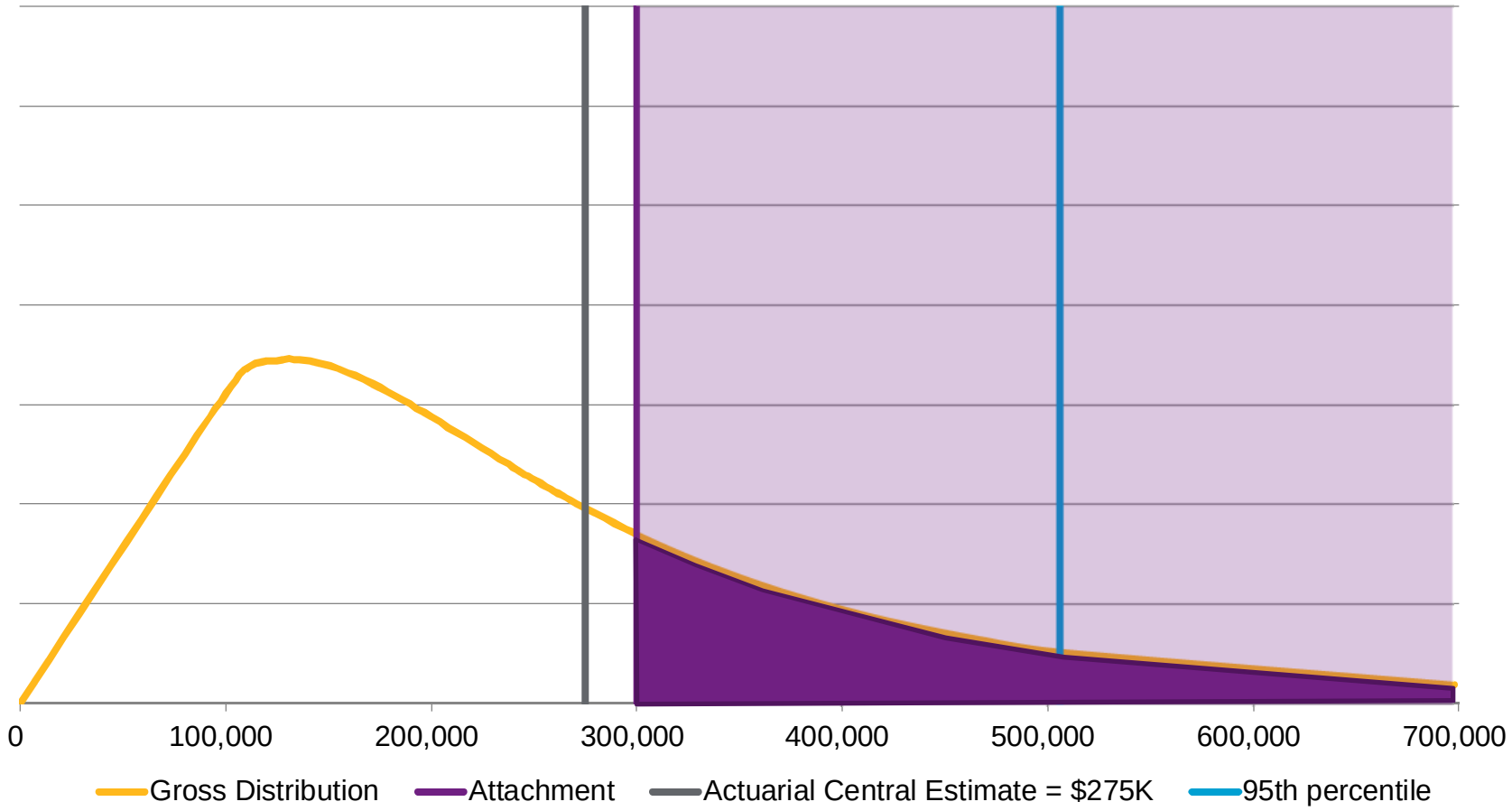
Specific Situations



Ceded Liabilities - Treaty Attaching Slightly Above ACE

For the deterministic estimate, the ceded liability = $0

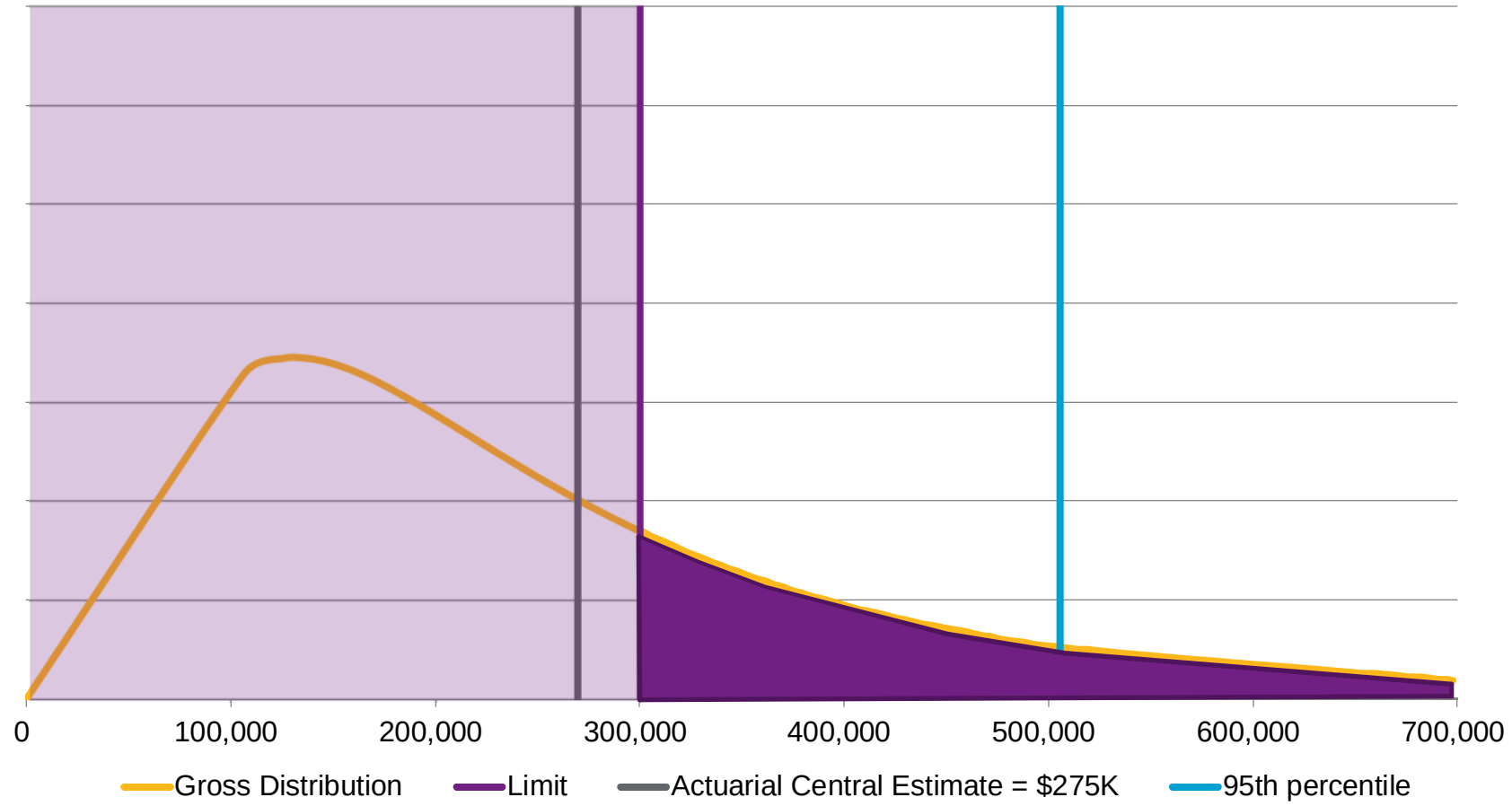
But the stochastic mean ceded liability is greater than $0 (see dark purple shaded area below)



Ceded Liabilities – ACE approaching Limit

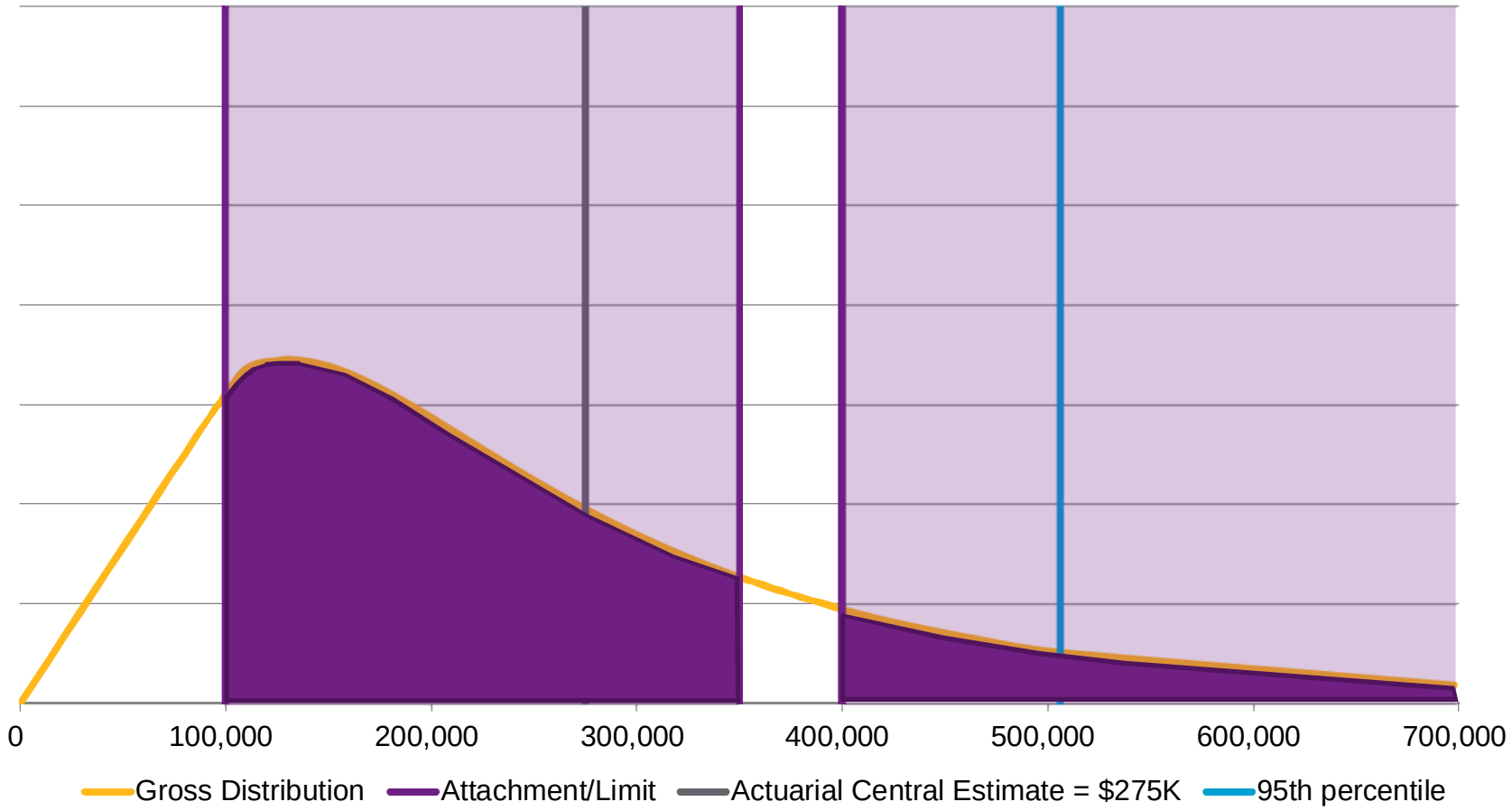
For the deterministic estimate, the ceded liability equals the gross liability

But the stochastic mean ceded liability is less than the gross liability by the area of the shaded region below. No additional ceded coverage exists for higher percentiles



Ceded Liabilities - Multiple Layers/Corridors

Ceded liability estimates can be calculated for more complex treaties, where there might be multiple layers or corridors, simply by applying the reinsurance terms to the individual gross simulations



Ceded Liabilities – Recap

- In some situations, the simple application of treaty terms to a central estimate can be misleading
- There are numerous examples where a variability analysis can assist in calculating ceded liabilities

Recap

- The stochastic process to use depends on the situation, including intended use, the type of data available, and the claims process itself
- When selecting percentiles for low and high reasonable estimates, many considerations come into play
  - There is no standard of practice
- Uses of Variability analysis
  - Range of Reasonable Estimates
  - Ceded Liabilities
  - Risk Transfer

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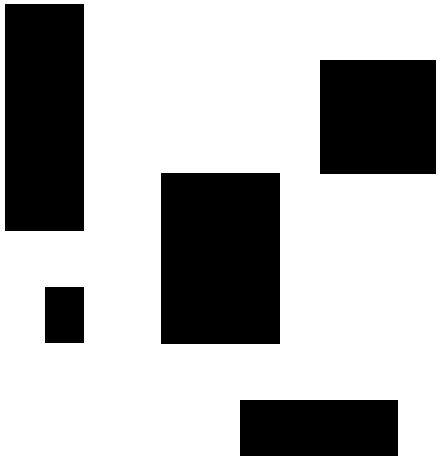

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