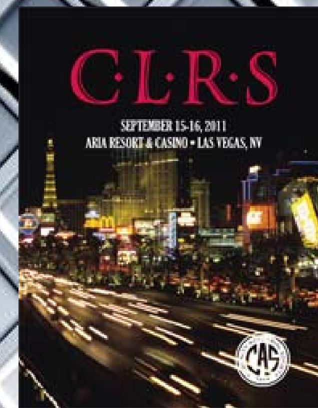

Casualty Loss Reserve Seminar

VR – 8: The very, very basic guide to reserve variability and ranges

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September 15, 2011

TOWERS WATSON

Agenda

- The first portion of the session will answer the question “why care about reserve variability?”
  - We will explore drivers internal and external to insurance companies
- The second portion will provide an introduction to the terminology and basic concepts associated with the development of reserve ranges
- We will conclude our formal presentation with a case study and role play
- We plan to have time at the end for questions

Why Care about Reserve Variability?

There are a number of existing or growing forces driving the increased interest in reserve variability

- Insurance risk management
- Regulatory authorities
- Future accounting concepts
- Rating agencies
- Actuarial best practices

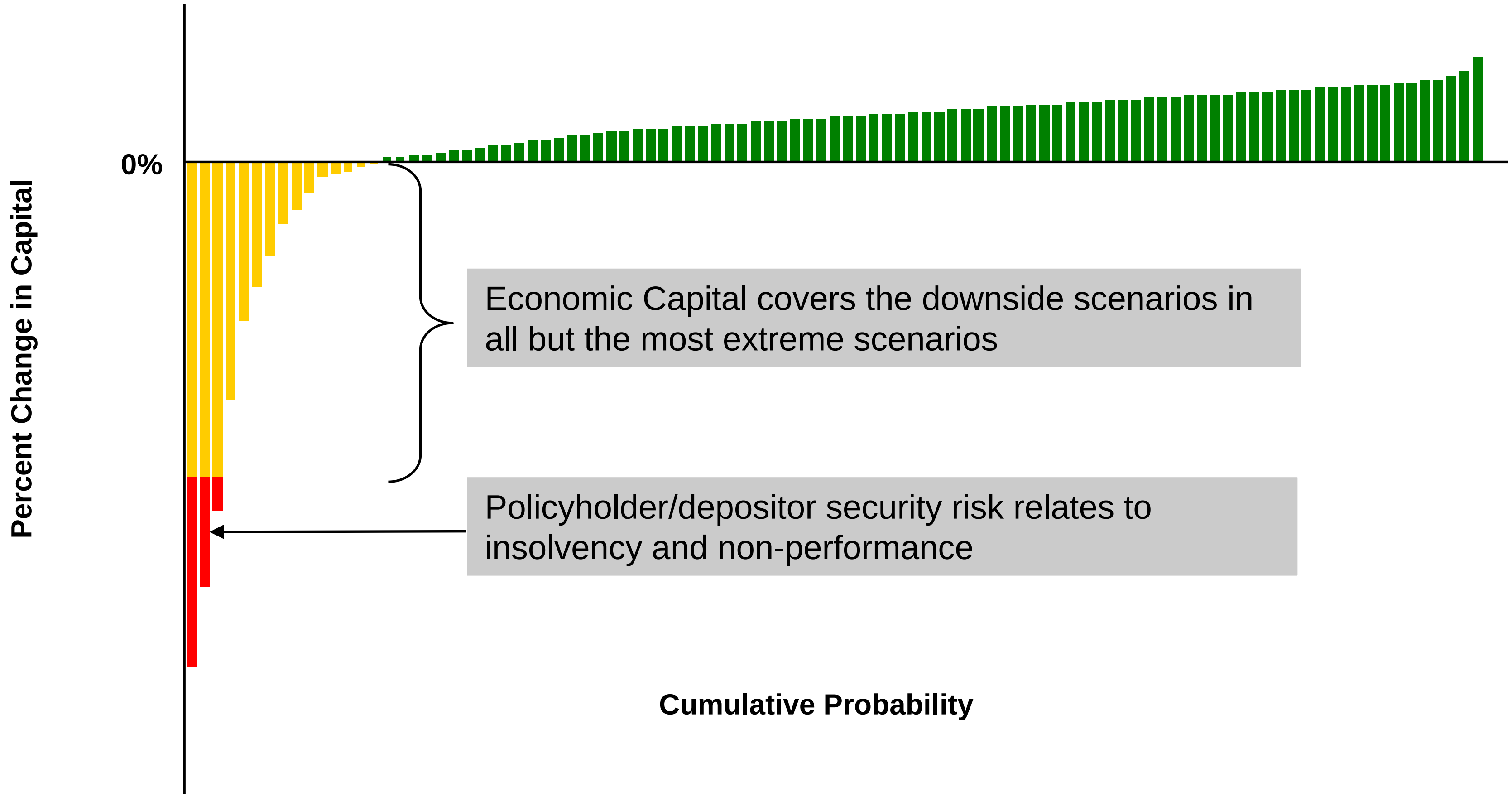
Because the development of relevant and meaningful information about reserve variability takes time, companies should start climbing the learning curve today

A primary reason to do this work is that information about reserve variability is useful in a business context

- Knowing the uncertainty of an estimate can improve operational decision making
  - Anticipating “negative surprises”
  - Rigorous range analysis allows assessment of the probability of “worse than expected” results
  - Allows for risk management interventions
- Effective capital management considers the uncertainty of the largest balance sheet entry
  - How to allocate surplus to line, branch? It should consider the riskiness of each level of the operation
- Asset management may be improved by gaining a better grasp of how shared economic driver variables (e.g., interest rates and inflation) affect both assets and liabilities
- Transparency related to the reporting of financial results is promoted by an understanding of the inherent volatility of the loss estimates
  - Transparency is the “watch word” of Boards of Directors and Wall Street analysts following the recent economic crisis

Economic capital considers the variation in results, much of which comes from the variability of claim liability estimates

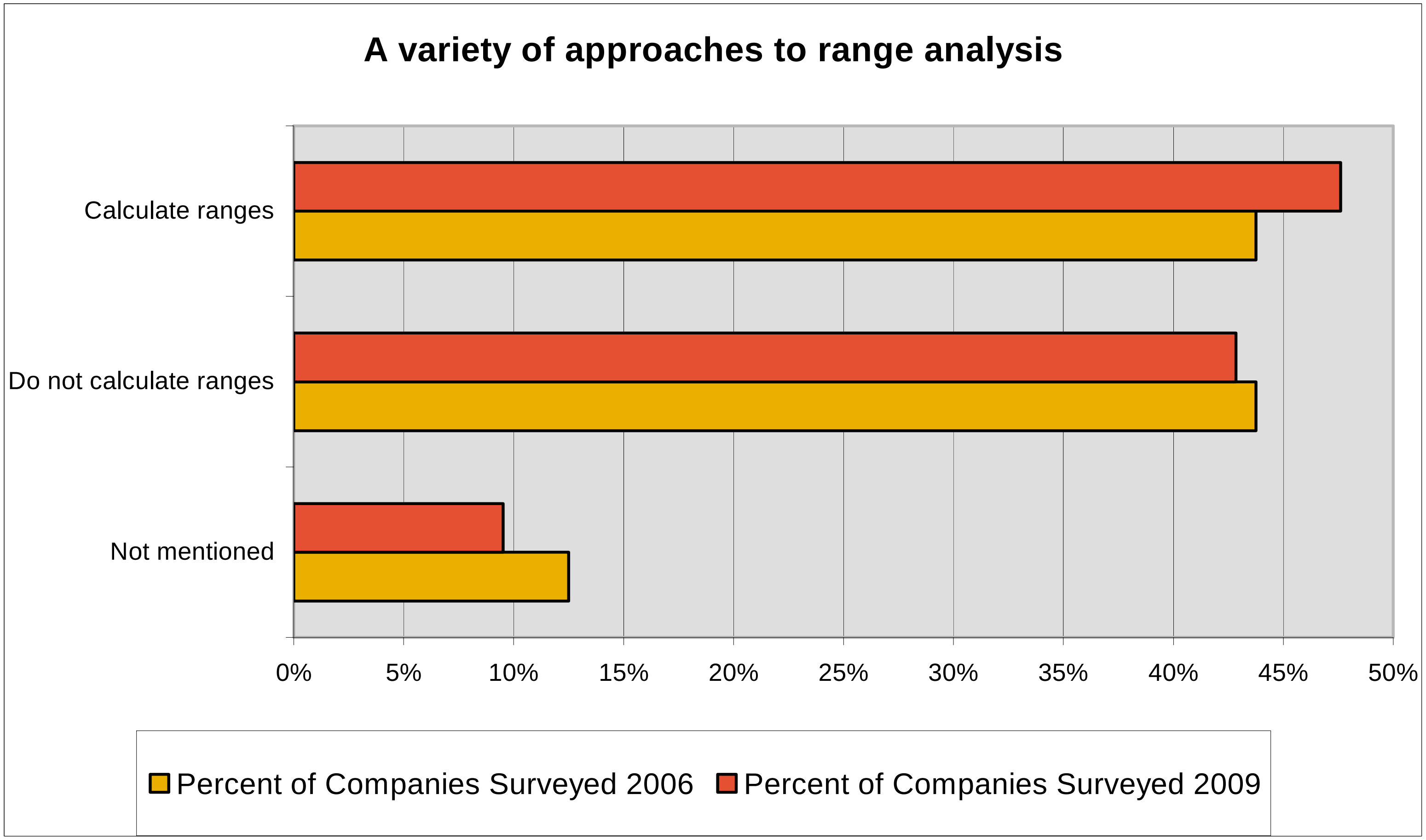
Impact of Hypothetical Scenarios on Company Capital Structure (One-year Time Horizon)



The SEC is pressuring registrants for more robust analysis and disclosure of potential variability of loss reserves

- Although the SEC's 10-K filing does not specifically require a company to disclose ranges of loss liability estimates, questions directed at P/C insurers have required them to begin to disclose their current practices. Similar to the 10-K itself, these additional disclosures are publicly available
  - Companies have responded cautiously
  - Current practices appear to vary widely
- Additional information sought by the SEC includes
  - Key assumptions underlying the methods used to determine reported reserves
  - Effects on reported reserves of reasonably likely changes to these assumptions
  - Description of methods used to calculate ranges of estimates
  - Retrospective tests of the quality of previous estimates and their influence on current selections
  - Rationale for selection of one method over another
- Given the current economic turmoil, it can be expected that the SEC will only intensify its demands for more transparency

Recent SEC inquiries have resulted in disclosure by publicly traded P/C insurers of current practices with respect to reserve variability analysis



Source: Towers Watson analysis based on public SEC filings

Disclosures exhibit a great deal of variation in how companies present the results of the quantifications

- Some disclose ranges of actuarial central estimates derived from different estimation methods
- Some provide ranges that attempt to capture the actual variability inherent in the estimate of the liabilities
- Some disclose the results of stochastic simulations of the unpaid claim liabilities at specified percentiles
- Some provide judgmental “high” and “low” estimates derived from the simulated distributions
- Others do not publish an overall range, but instead provide scenario-specific outcomes based on deterministic changes in assumptions
- Ranges tend to be expressed without a time frame, although some companies do provide a risk horizon. In the absence of a specified time frame, readers should assume that risk horizon is on a run-off basis (i.e., ultimate value)

The NAIC is ramping up its ERM requirements which will have far-reaching implications for US-based insurers

Risk-Focused Exams

- Regulatory assessments of insurer's ERM practices became effective with **tri-annual** exams in 2010
  - Evaluation of key risks are driven by management's assessment and prioritization of current risks
  - Exam focus is shifting from "rear-view" to "prospective-view" on risks
  - Companies need to communicate mitigation strategies for the most significant prospective risks
- Companies exhibiting "weak" ERM may incur increased oversight and regulatory compliance costs

NAIC Own Risk and Solvency Assessment Requirement (ORSA)

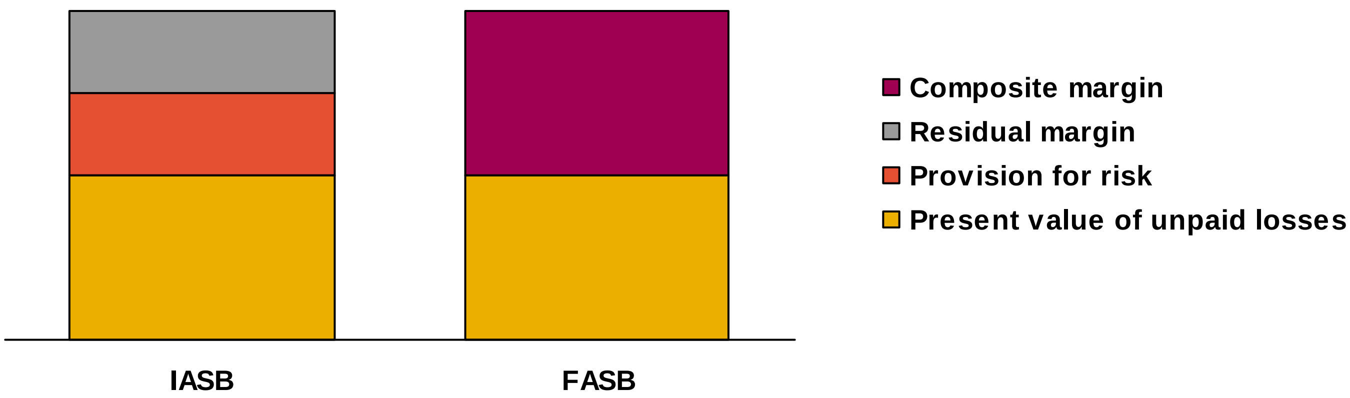
- The NAIC has issued an exposure draft to the insurance industry proposing an ORSA requirement
  - Will likely require insurers with >$500M of premium to conduct an ORSA on a periodic or defined basis
  - Insurers must demonstrate that processes are in place to identify key risks to the business strategy
  - ORSA requires quantification i.e., demonstrating that economic and regulatory capital is fully supportive of key risks
  - NAIC will likely align ORSA with existing requirements e.g., Risk-focused exam; is leaning toward allowing companies to use existing reports prepared for BOD or rating agencies
- May require insurers to develop a risk policy document that address three key items:
  - — Description of Risk Management Policy
  - — Quantitative Measurements of Risk Exposure in Normal/Stressed Environments
  - — Prospective Solvency Assessment

The accounting boards are individually working toward new insurance accounting standards, though the aim is a single global standard

- The International Accounting Standards Board (IASB) has been working on a standard for insurance accounting
  - One standard for life and p/c companies, including captives
  - Not applicable to self-insured liabilities
- FASB has its own view
- Aim is to converge to one global standard. Some objectives of the new standard include
  - Provide users of financial statements more useful information for economic decision-making
  - Eliminate inconsistencies and weaknesses in current practices
  - Provide comparability across entities, jurisdictions and capital markets
  - Be more principles-based than prescribed in approach

Differences in the approach to the determination of claim liabilities illustrates the separation that still exists

Liabilities for unpaid losses under the two approaches are as follows:



Definitions

Provision for risk – "Maximum amount the insurer would pay to be relieved of the risk…"

Residual margin – PV premiums less PV costs less risk margin; earned over policy period.

Composite margin – PV of premiums less PV costs; earned over policy period.

All of this is measured on a portfolio basis, but does not recognize diversification benefits across portfolios.

Despite its appearance, IASB specifically states that their method is not equal to fair value.

Variability of claim liabilities is accounted for by a risk margin under the IASB scheme

Three methods to calculate risk margins are permitted:

1. Confidence level – Margin can be based on specific confidence level. However, this method is not permitted if distribution is not statistically close to normal.
2. Conditional tail expectancy (CTE) – Based on probability weighted amounts beyond a certain confidence level (e.g., all amounts above 95%); also known as Tail Value at Risk.
3. Cost of capital – Based on cost of additional capital needed such that assets equal liabilities at a certain confidence level. Target confidence level in this approach is expected to be very high (e.g., 99.5%).

Calculations are done on a gross basis, with separate calculations/ margins for ceded losses.

The rating criteria used by the S&P and A.M. Best cite reserve variability as a consideration

- Standard & Poor's (S&P)
  - "P/C Criteria for Assessing Insurers/Reinsurers' Loss Reserve Adequacy"
    - States S&P "may calculate a range into which the level of adequacy will likely fall and quantify the possible effect on capital. The point estimate and the endpoints for the range of estimates are compared with existing capital to approximate the effect any potential reserve deficiency might have on the company's ability to meet its obligations"
    - Published May 18, 2009
  - It is anticipated that in the near term S&P will expect higher rated companies to stochastically model loss reserve distributions to gain more confidence in the loss reserve variability
  - Consideration of the variability inherent in the loss reserve is also consistent with their stated desire for insurers/reinsurers to develop robust enterprise risk management programs, including the quantification of economic capital

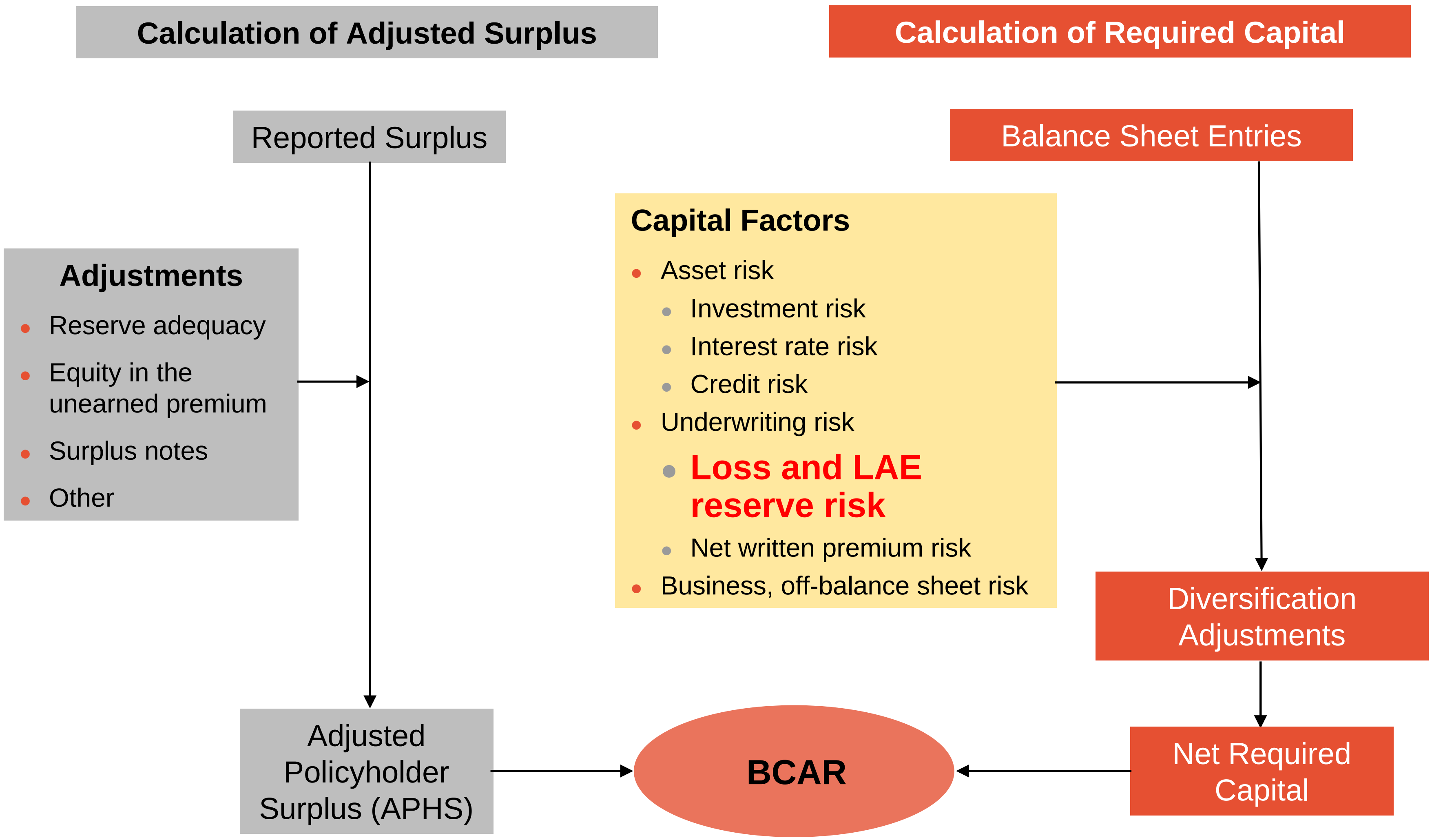
Continued…

The rating criteria used by the S&P and A.M. Best cite reserve variability as a consideration

- A.M. Best
  - "An Explanation of Best's Rating System and Procedures"
    - States Best's evaluates "the degree of uncertainty in loss reserves. If the level of uncertainty exceeds any equity in the reserves, or is considered large in relation to net income and surplus, we will require a company to maintain a more conservative capital position…"
    - 2008 Edition
  - It is anticipated that A.M. Best will be slower to implement probabilistic reserve distributions.
    - Moreover, more robust reserve modeling will be a positive rating factor only if range estimates are reasonable relative to industry trends and historical experience
    - A.M. Best seems to value consistently favorable reserve trends without stochastic modeling over robust stochastic modeling while reporting adverse reserve development

For both S&P and A.M. Best, transparency, especially related to volatility of reserves and adverse reserve development, is a key to avoiding an increase in required capital

A.M. Best's Capital Adequacy Ratio (BCAR) currently uses a factor-based approach to risk, but have announced their intention to build a stochastic capital adequacy model



Actuarial organizations reflect the increasing sophistication of the discussion of the uncertainty surrounding loss liability estimates through published papers and continuing educational opportunities

- Examples of recent papers and articles
  - "P/C Actuarial Communication on Reserves Ranges and Variability of Unpaid Claim Estimates"
    - Issue Brief of the American Academy of Actuaries, published in September 2008
    - Written by the Committee on Property and Liability Financial Reporting (COPLFR)
    - Stated goal is to improve "casualty actuaries' communications with regard to ranges of unpaid claim estimates"
  - "Measurement of Liabilities for Insurance Contracts: Current Estimates and Risk Margins"
    - A Research Paper of the International Actuarial Association, published April 15, 2009
    - Written by the Ad Hoc Risk Margin Working Group
    - Stated purpose is to address those issues "that will help determine future practice for measuring liabilities for insurance contracts for both regulatory and general purpose financial reporting"
  - *Variance,* the peer-reviewed journal of the Casualty Actuarial Society, has in the last four years published 13 articles on topics related to reserve variability. Each of the eight issues contained at least one article directly related to the topic
- There are numerous continuing educational opportunities related to reserve variability offered each year through the various actuarial organizations in the U.S. and elsewhere

Actuarial Standards of Practice (ASOP) cite the importance of considering the variability inherent in the loss estimates

Source	Topic	Considerations
ASOP 43: P/C Unpaid Claim Estimates	Uncertainty	• Consider uncertainty associated with unpaid claim estimate analysis; does not require or prohibit the measurement of this uncertainty; consider the purpose and use of the estimate in deciding whether to measure the uncertainty • Consider the types, sources (model, parameter and process risks), and correlation of uncertainty; choosing appropriate methods, models and assumptions
ASOP 36: SAO Regarding P/C Loss & LAE Reserves	Risk	• SAO should identify whether the reserve includes an explicit risk margin and state the basis for the risk margin, if any • SAO should disclose if there are significant risks and uncertainties which could result in actual future payments being materially different than the stated reserves

CAS Statement of Principles Regarding P&C Insurance Ratemaking	Risk	• Charges to be reflected in the profit and contingency provision
		  • Rate should include charge for risk of random variation from expected costs
		  • Rate should include a charge for any systematic variation of the estimated costs from the expected costs

CAS Statement of Principles Regarding P&C L&LAE Reserves	Uncertainty	• Due to uncertainty inherent in the estimation of the required reserve provision a range of reserves may be actuarially sound • The most appropriate reserve from within a range depends on both the relative likelihood of estimates within the range and the financial reporting context
CAS Statement of Principles Regarding P&C Valuations	Sensitivity testing	• Address the sensitivities of the appraisal value to changes in key assumptions • Consider whether the results reflect a reasonable range of variation in the key assumptions

Statutory actuarial opinions require consideration of the variability of the reserve estimate

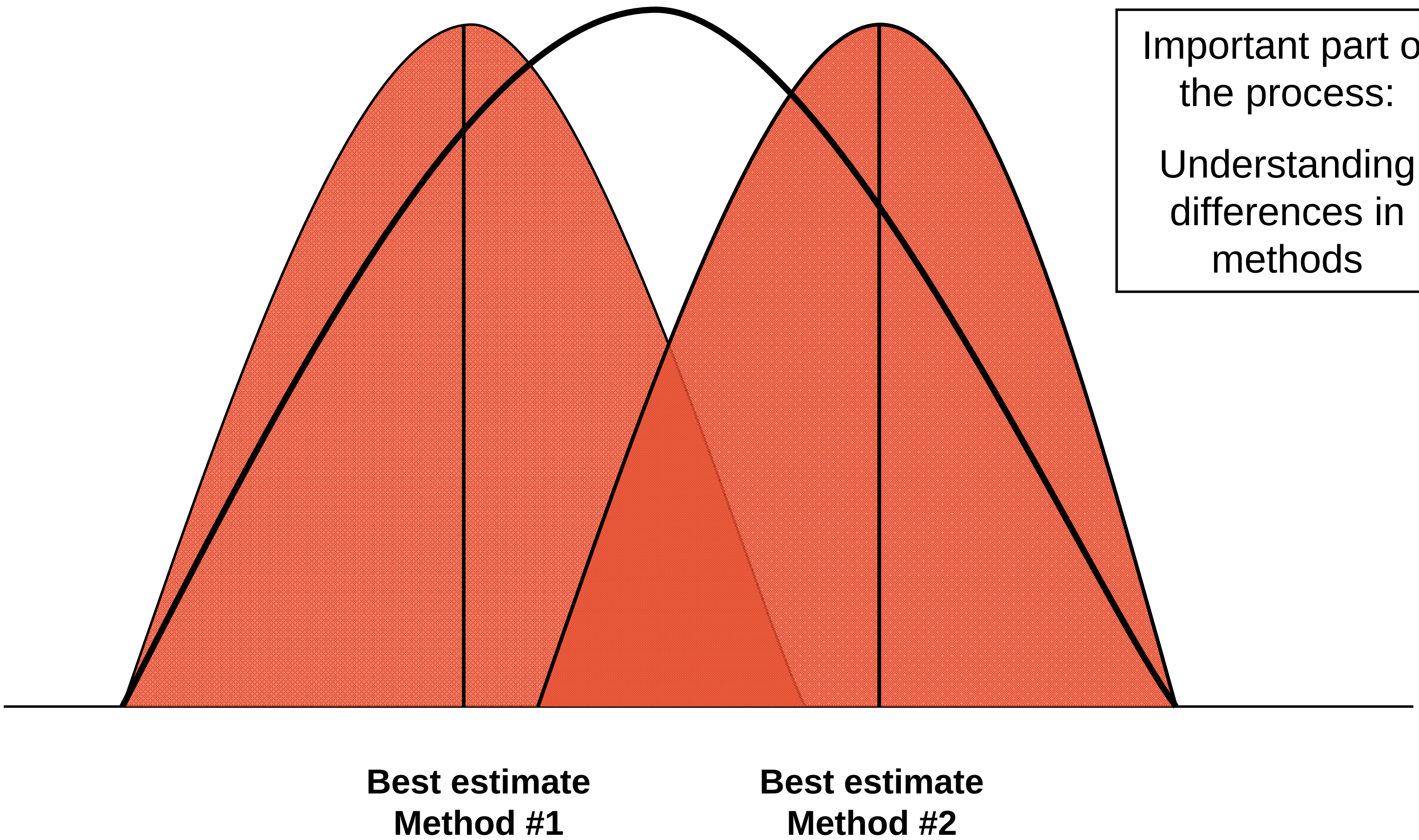
- The Property and Casualty Practice Note, prepared by the American Academy of Actuaries, related to Statements of Actuarial Opinion on P&C Loss Reserves as of December 31, 2010, provides information on current and emerging practices related to reserve variability, among other topics
- Statutory Actuarial Opinion (SAO)
  - ASOP 36 is cited as the source for the statement that a reserve makes a reasonable provision if it is within the range of reasonable estimates *[Note that the recently published revision of ASOP 36 changes the definition of reasonable provision]*
  - It is suggested that, if a reserve estimate is subject to an unusually high degree of variability, the actuary may choose to provide comment on this within the Opinion. If the risk is significant and the amounts material, then the actuary must comment. Reference to ASOP 36 is made in this section
- Actuarial Opinion Summary (AOS)
  - The AOS makes provision for the actuary to compare the carried reserves to the range directly, instead of a point estimate
  - ASOP 36 is again cited as the source for various key definitions

Now is the time to stop being the proverbial ostrich and to start looking forward to the benefits of understanding the range of results

Background of Stochastic Techniques

Stochastic techniques consider the entire range of outcomes

The range of best estimates is likely to understate the range of actual outcomes



Important part of the process:

Understanding differences in methods

Stochastic techniques quantify the claim liability uncertainty

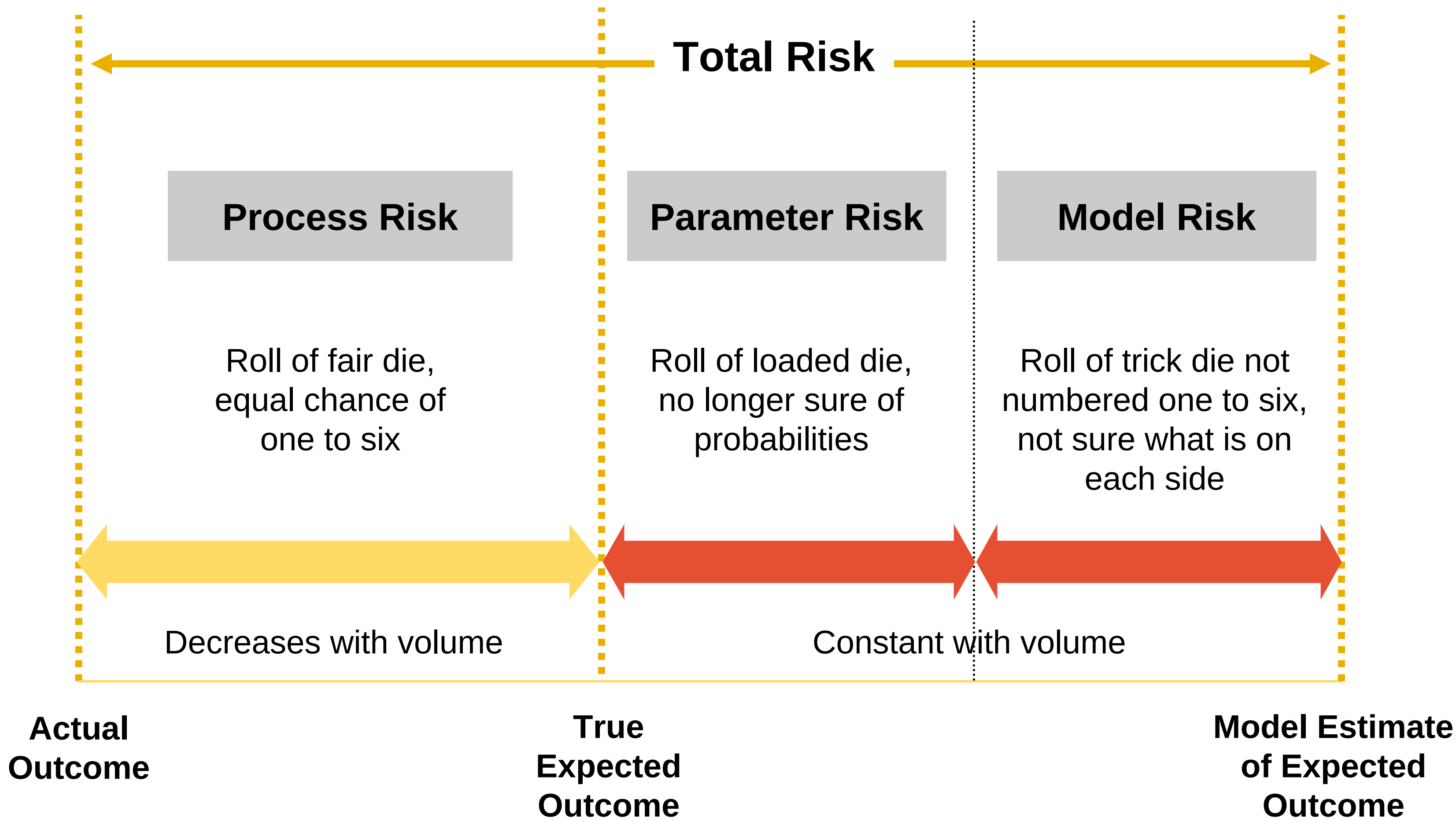
- Loss development is a stochastic process; the historical data is a specific realization
- Deterministic methods provide a point estimate of claim liabilities
  - Multiple methods can give a range of estimates
  - Best estimate usually chosen judgmentally
- Stochastic methods are more informative than deterministic methods
  - Produce a full distribution of possible outcomes
    - — Confidence levels of held reserves

Terminology

Method vs. Model

Method	Model
• Mathematical algorithm for estimating unpaid amounts • Parameters are selected • Selections assumed appropriate based on judgment • Chain Ladder algorithm	• Mathematical description of the world • “Best-Fitted” Parameters • Selections can be tested • Mack, Bootstrapping models

Several distinct types of risks are inherent in the measurement of claim liabilities — the actuary and the audience need to be clear about which are relevant to a particular application



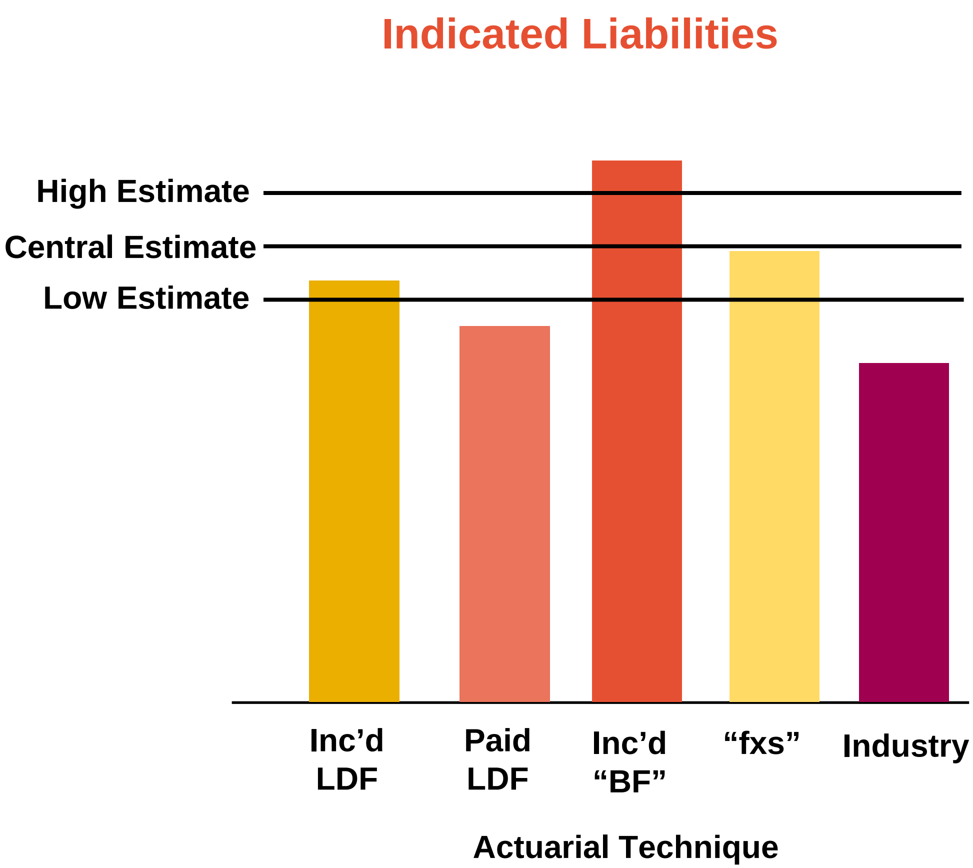
Types of stochastic reserving assignments

- Relevant sources of variability depend on the exercise on hand
- Financial Solvency/Capital adequacy context
  - “Stress testing” the balance sheet
  - Variation of actual outcome around the true expected outcome
  - All types of risk are relevant here
- Reserve variability context
  - Comparing two actuarial estimates
    - Variation around the true expected outcome
    - Parameter and model risk are relevant here

What "risk" do stochastic methods measure?

- Risk could mean different things to different audiences
- Actuaries usually think of risk in terms of "variance" and "standard deviation"
  - "coefficient of variation" (CV) is "scaled" by the mean and measures "relative" risk
- Other definitions
  - (VAR) - Value at Risk: a percentile (i.e., losses at the 75th)
  - (TVar) – Tail value at Risk: expected losses in excess of a given percentile

Deterministic: What range of estimates is implied by the actuarial techniques used?



General Approach — Deterministic

- Estimate range of claim liabilities based on the results of several projections
- Applied to current data evaluation

Advantages

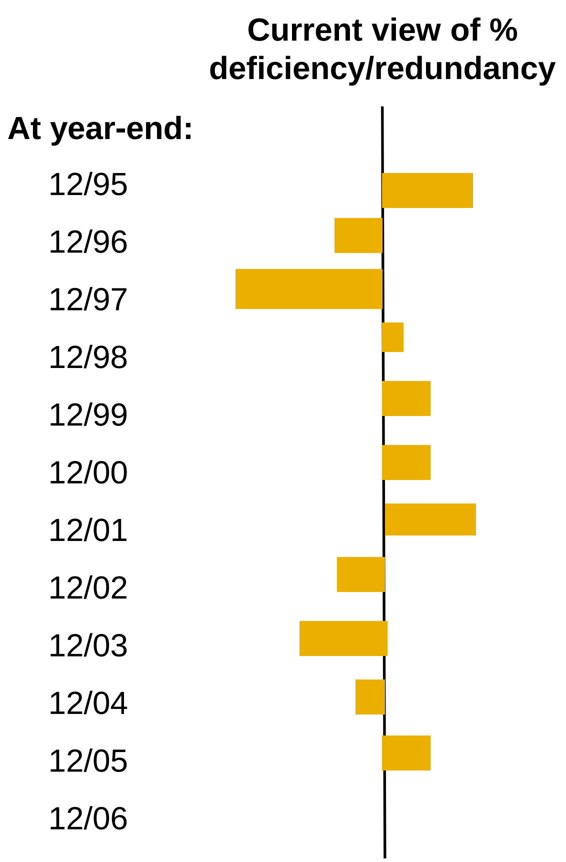
- Easy to understand and apply
- Based on liability estimates of traditional actuarial methods
- No extra work needed

Disadvantages

- Does not include process risk
- Does not separate model and parameter risk
- Does not produce confidence interval estimates
- Highly judgmental
- Simplistic

Performance Test: How accurate have the past estimates proven to be?

Actuarial Scorecard for Method X



General Approach — Hindcast Test

- Retrospective test of a consistently applied methodology
- Uses current view of claim liabilities versus historical estimates
- Quantifies the degree of departure that has occurred around the results that would have been indicated by that methodology

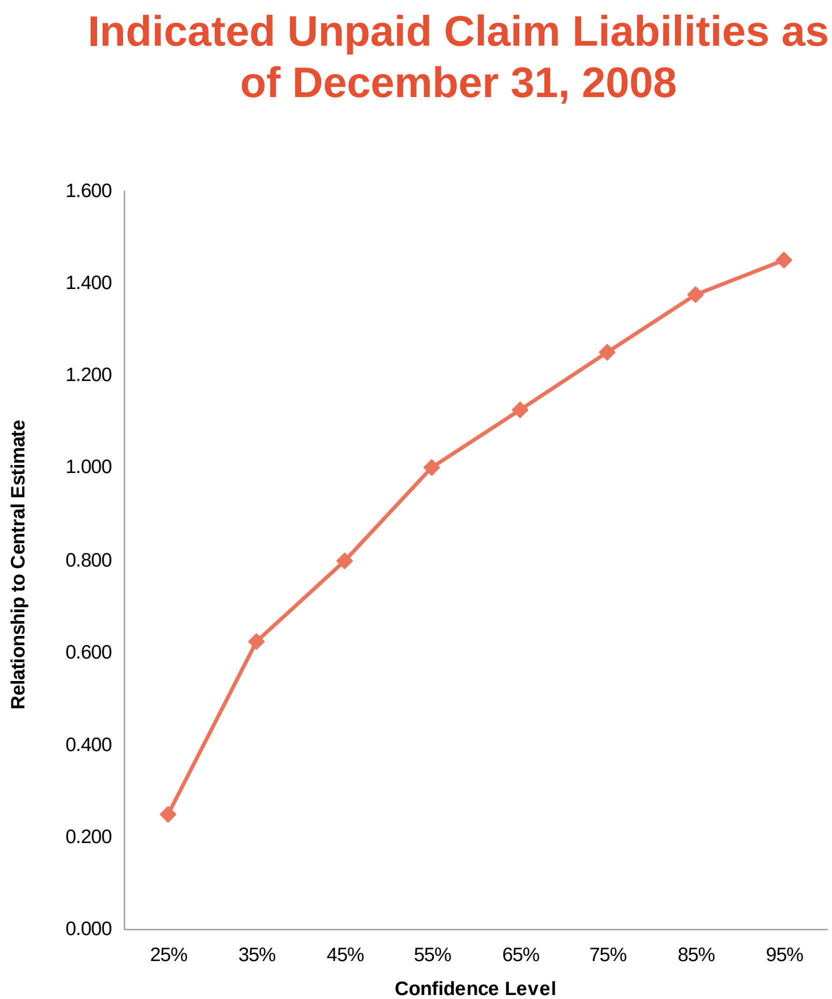
Advantages

- Easy to understand and apply
- Few assumptions needed for each model being tested
- Should do this test anyway in arriving at central estimate

Disadvantages

- Does not separate model, parameter and process risk
- Does not produce confidence interval estimates
- The actual “model” used is likely a combination of methods

Stochastic: What claim liability outcomes are reasonably likely?



General Approach — Stochastic Methods

- Estimate probability distribution
- Based on statistical methods
- Applied to historical development data

Advantages

- Produces estimates of confidence intervals
- Can approximately separate parameter and process risk
- More complete description of loss generating process
- Feeds other analyses (ERM)

Disadvantages

- Involves relatively complex statistical analysis
- An emerging practice within P/C actuarial field
- Lack of general agreement among actuaries on the best approach
- Some exposures not amenable to this approach (A&E)

Popular Stochastic Methods

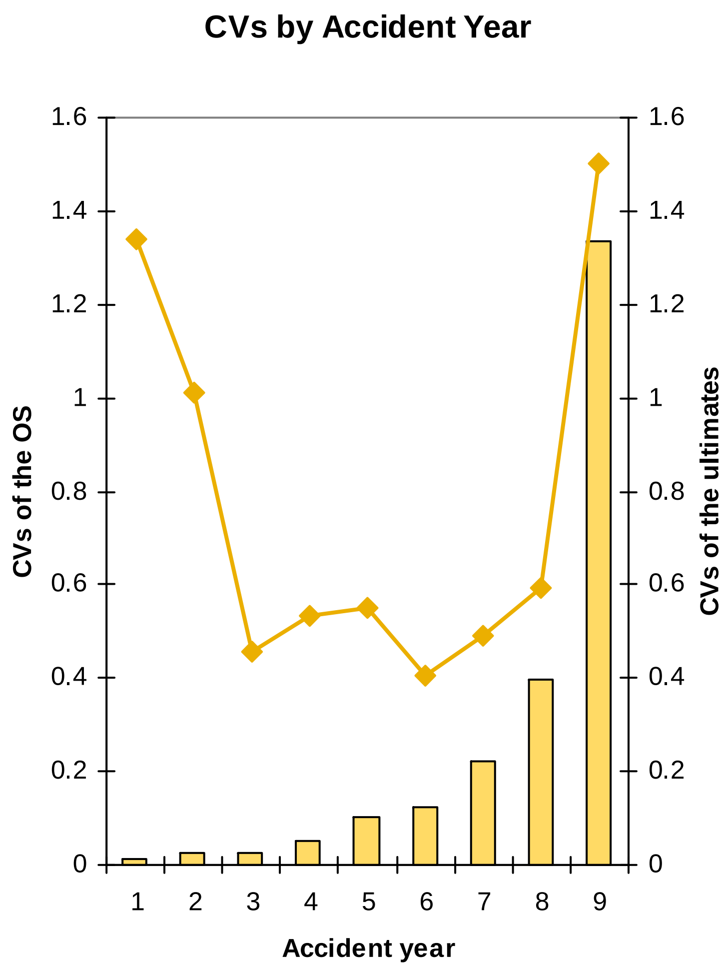
Analytical methods — Mack

- The Mack model measures the standard error of the chain ladder unpaid claim estimate
  - Based on the following simple regression model:

$$C_{ik+1} = f_k C_{i,k} + \sigma_k \varepsilon_{i,k} C_{i,k}^{1/2}$$

- This model is consistent with selected volume weighted RTRs
- Given the mean and standard error of claim liabilities percentiles are calculated
  - Recommended distributional formats are normal and log-normal
- Analytical calculation is based on
  - A "closed form" solution formula
  - A "recursive" calculation

Coefficients of Variation (CVs) by Accident Year



- The CVs of OS are higher for:
  - Older years where the remaining OS amounts are very low
  - Recent years where the uncertainty of the liabilities increases
- The CVs of Ultimate amounts increases in recent years
  - The uncertainty of the liabilities increases

Mack method: Pros and Cons

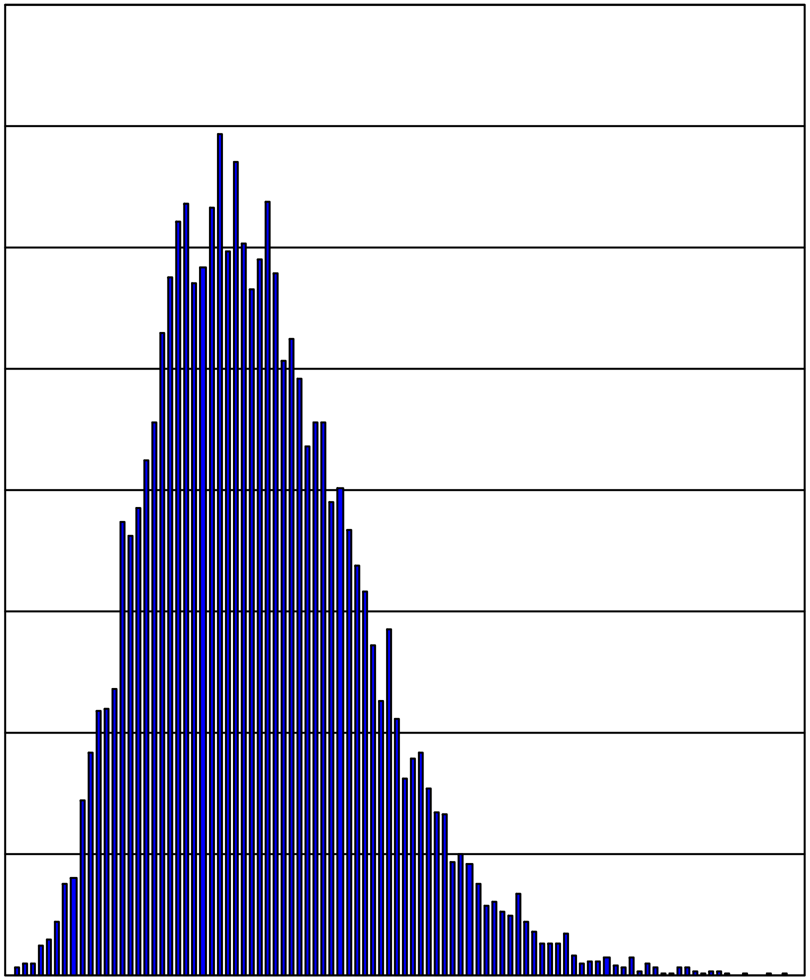
- Pros
  - Intuitive, based on chain-ladder assumptions
  - Widely accepted among actuaries
- Usually provides stable results
  - Very fast
  - Measures parameter, process and total risk

- Cons
  - Model provides, only, the mean and standard error of the claim distribution
  - Does not explicitly measure tail variability
  - Does not model well the situation when actuary selects factors other than weighted or simple average

Simulation approach: Monte-Carlo

- Simulation techniques help model the complex loss generating process
- Simulation methods assume that the simulated data has the same statistical characteristics as the actual data
- Simulation works as follows:
  - Start with a deterministic method that generates ultimate loss outcomes (i.e., chain ladder)
  - Makes assumptions about the method parameters
    - i.e. the mean and variance of the link ratios
      - Parameter risk needs to handled separately
    - Randomly generate input values
    - Calculate and save ultimate outcomes
    - Repeat many times

Output simulated distribution



- Simulated "empirical" distribution estimates "theoretical" claim liabilities distribution
- A "wealth" of statistical information is produced (i.e. mean, variance, skewness, etc.)
- Simulated distribution "smooths" with a larger number of simulations

Monte Carlo simulations: Pros and Cons

- Pros
  - Popular method in many sciences
  - Produces an empirical distribution of the reserves
  - Method can be applied to incomplete data triangles (i.e. trapezoids)
  - It explicitly calculates tail volatility
- Cons
  - Data outliers can have a leveraged effect on the results
  - Slow to run
  - Needs additional complexity to measure parameter risk

Bootstrapping is a "second generation" simulation technique

- Monte Carlo techniques simulate the parameter inputs of a method
- Bootstrapping simulates the actual data employed by these methods
  - If the distribution of the data is known then we sample from that distribution
    - Parameters are estimated
    - This is called Parametric Bootstrapping
  - If we do not know the distribution of the data then we simulate from the actual data
    - This is called Nonparametric Bootstrapping
    - The process "resample" the residuals with "replacement"

Bootstrapping: Pros and Cons

- Pros
  - Actual data "guides" the simulation
  - No assumption needed for simulation of parameters
  - It is a "modern" simulation technique
- Cons
  - Data outliers can have a leveraged effect on the results
  - Needs additional complexity to measure process risk
  - Residuals might needed to be divided into similar resampling groups

Aggregation of Liabilities

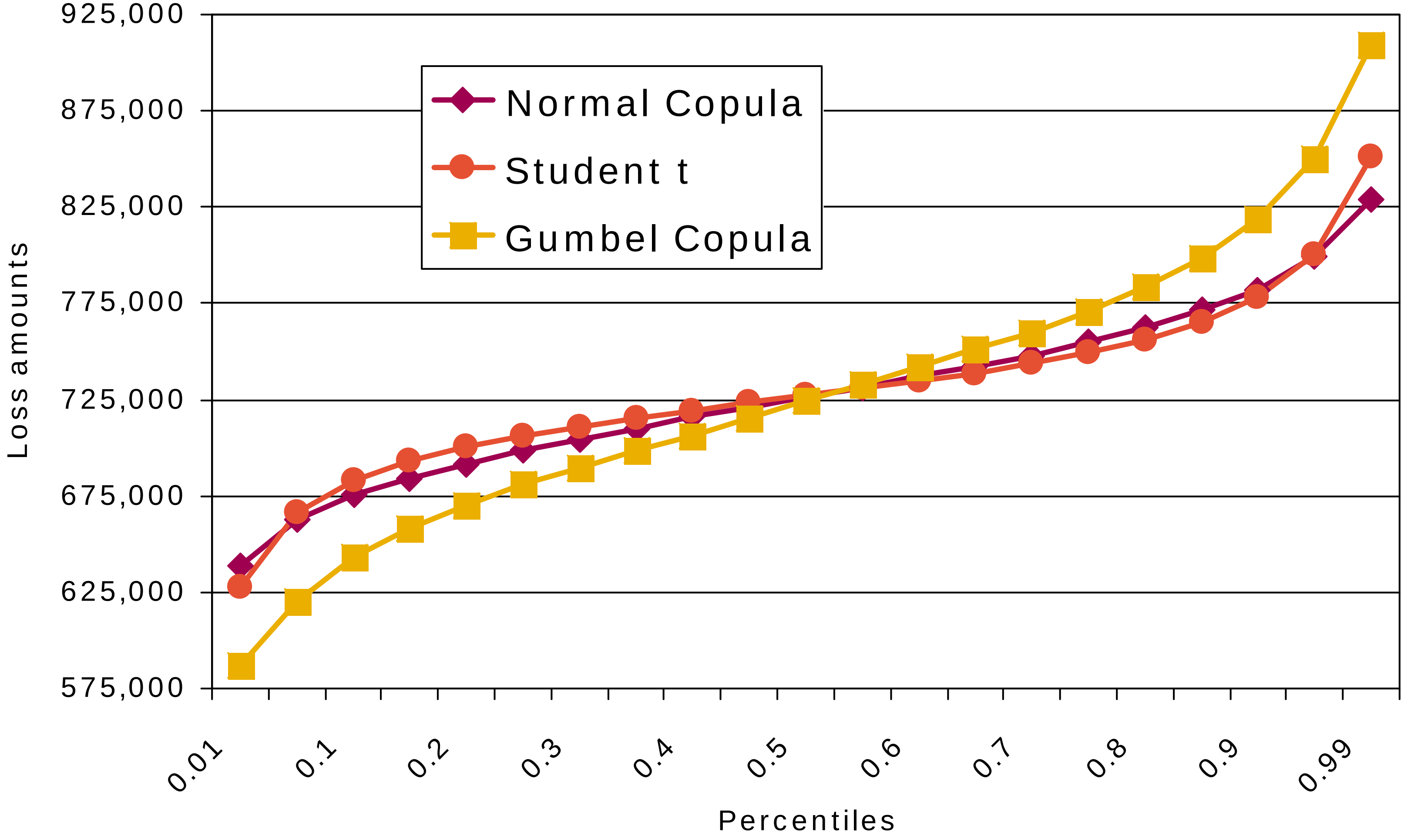
Aggregation: Correlation between Lines of Business

- Strength of the correlation is irrelevant if we only care about the mean reserve indication for two lines A and B:
  - mean(A + B) = mean(A) + mean(B)
- Strength of correlation matters when we look towards the ends of the aggregate distribution of (A+B)!
- Generally, the aggregate distribution is less risky than the distribution of the individual lines:
  - 75thpercentile(A + B) < 75thpercentile(A) + 75thpercentile(B)
  - Equality only occurs in the case of perfect correlation across lines (this is very unlikely!)
- The volatility of the aggregate distribution increases:
  - By the volatility of the individual lines
  - By the correlation between the lines

Theory of Copulas

- Copulas provide a convenient way to express the aggregate distributions of several random variables
- Copula components:
  - The distributions of individual random variables
  - Correlations of these variables
- Correlation coefficients measure the overall strength of association across various distributions
- Copulas can vary that degree of association over the various parts of the aggregate distribution
  - Example: for workers comp and property losses the correlation is higher in the tail of the distribution

Comparison of Copulas

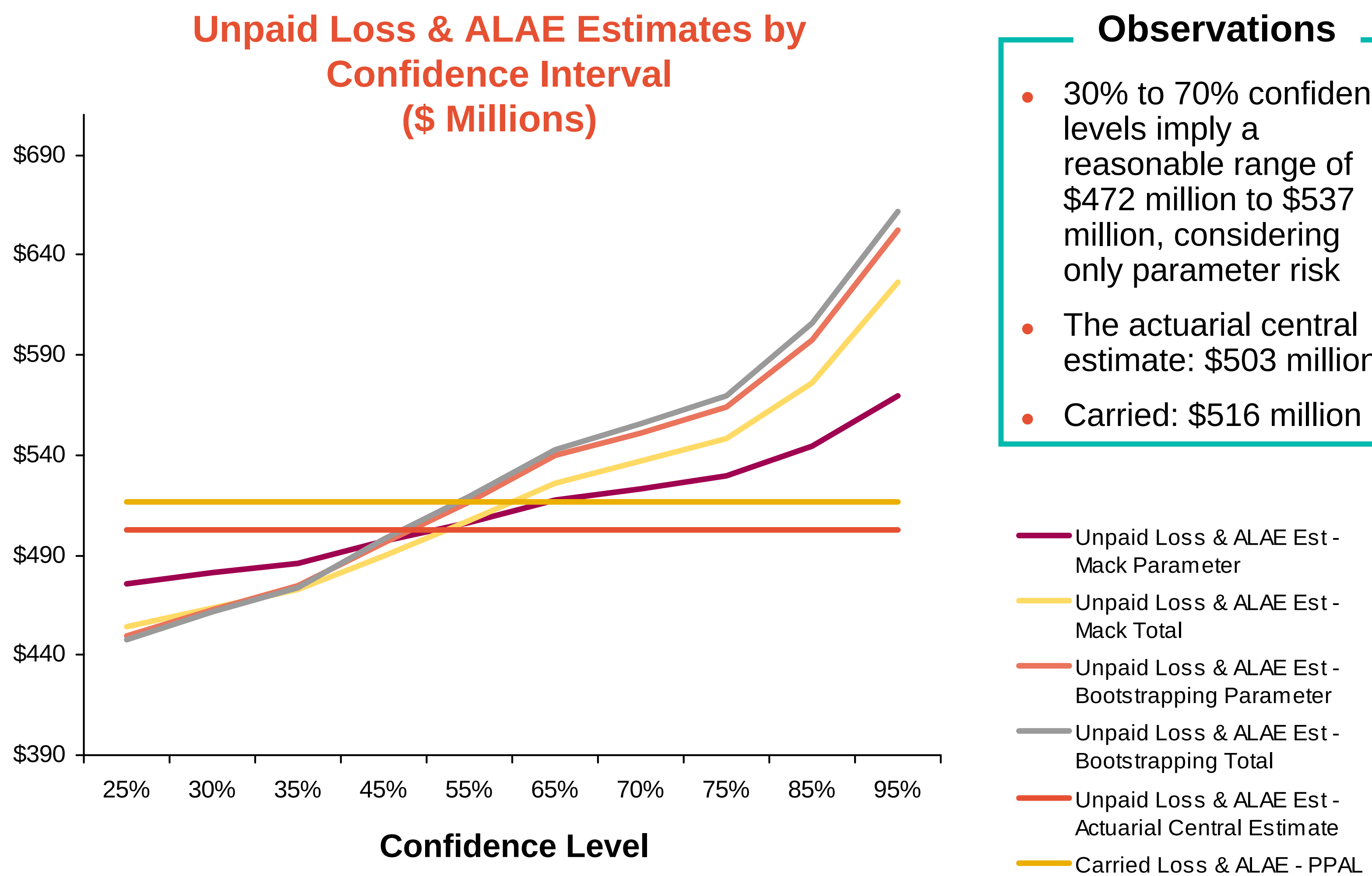


Case Study

A personal auto writer takes reserve variability to heart

- Hypothetical company background
  - Multi lines writer, 60% of NWP is personal lines
  - Personal lines focused on auto to avoid the catastrophe exposure of Homeowners
  - New SVP of claims appointed in 2005, resulting in both case reserving practice changes as well as operational changes. No substantial changes made in last 12 to 15 months
- Impact on loss liability estimates
  - Changes in the claim organization were substantial enough to impact the traditional loss and claim development triangles
  - The results of the various loss estimation methods became unstable
  - Chief actuary (Manolis) took two actions
    - — Started using adjusted as well as unadjusted methods, e.g. Bergquist-Sherman
    - — Started to develop reserve distributions on a periodic basis
- New CFO (Martha) is appointed and the chief actuary presents the results of his most recent quarterly analysis

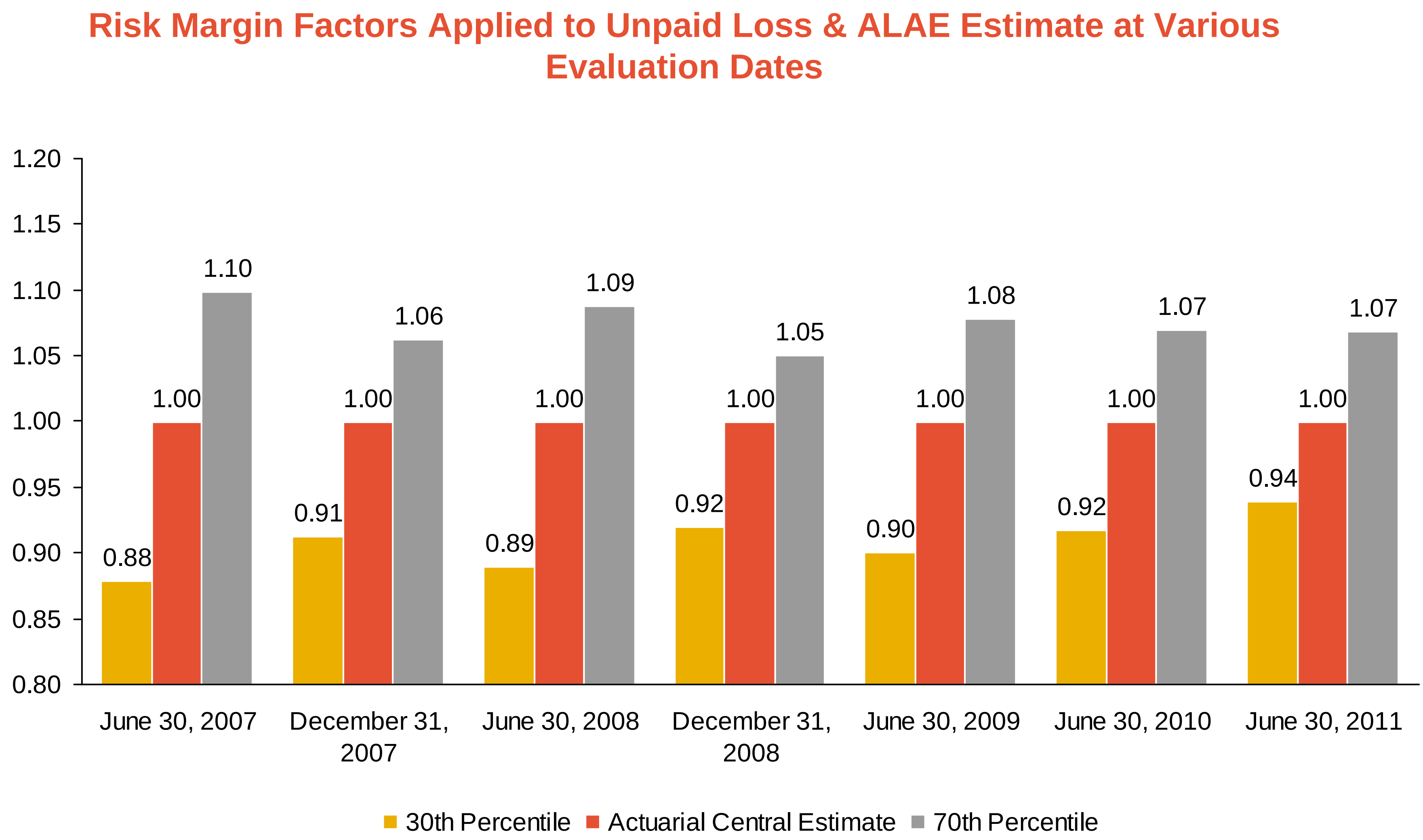
The Company's carried loss and ALAE reserve for the PPAL line of business is well into the tail of the distribution of reasonable estimates



Observations

- 30% to 70% confidence levels imply a reasonable range of $472 million to $537 million, considering only parameter risk
- The actuarial central estimate: $503 million.
- Carried: $516 million

Translating the stochastic ranges to risk margin factors illustrates the change in the uncertainty at various evaluation dates



*Results based on the average of Bootstrapping and Mack methods, considering parameter risk only

Questions?