# Stochastic Based BCAR for Reserving Actuaries

**Thomas Mount, ACAS, MAAA, CERA, CEEM**
**Senior Director, PC Ratings**
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Casualty Loss Reserve Seminar - Anaheim, CA

# Agenda

- BCAR Overview
- Development of Stochastic Based Reserve Capital Factors
- Reserving Actuary's Impact on
  - BCAR
  - Company's Rating

# BCAR Overview

## What is BCAR?

# Best's Capital Adequacy Ratio (BCAR)

- A comprehensive quantitative tool that evaluates many of the risks to the balance sheet simultaneously
- Generates an overall estimate of the required level of capital to support those risks and compares it with available capital

# BCAR and the Building Blocks

BCAR is a key tool in the assessment of balance sheet strength

- Not the sole determinant of balance sheet strength
- Not the sole determinant of the rating

BCAR is also being used in ERM assessment

- Identify companies with tail risk
- Promote discussions of how companies identify, monitor, manage, measure, and protect policyholders from that risk

# Overview of Available Capital & Risk Categories

$$\text{BCAR} = \frac{(\text{Available Capital} - \text{Net Required Capital})}{\text{Available Capital}} \times 100$$

## Available Capital (AC)

Reported Capital (PHS)

Equity Adjustments:
- Unearned Premiums (DAC)
- Assets
- Loss Reserves
- Reinsurance

Debt Adjustments:
- Surplus Notes
- Debt Service Requirements

Other Adjustments:
- Future Operating Losses
- Goodwill & Intangible Assets
- Other

## Net Required Capital

Gross Required Capital (GRC):
- (B1) Fixed Income Securities
- (B2) Equity Securities
- (B3) Interest Rate
- (B4) Credit
- (B5) Loss and LAE Reserves
- (B6) Net Premiums Written
- (B7) Business Risk
- (B8) Potential Catastrophe Loss

Covariance Adjustment

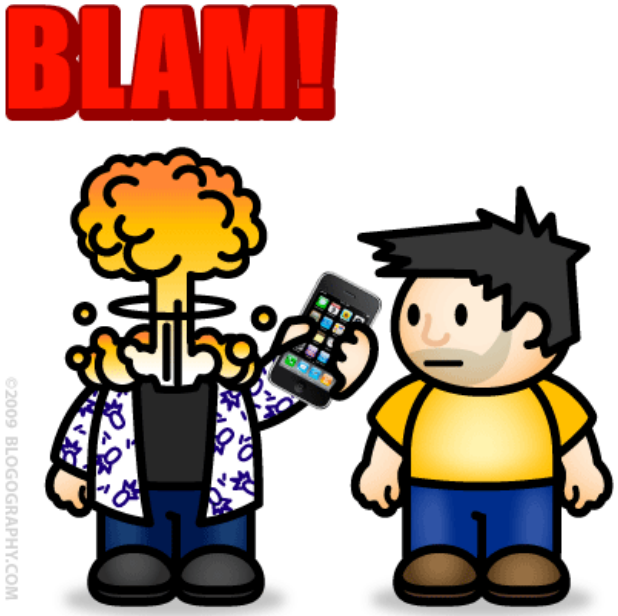
Net Required Capital (NRC)*

$$\text{Net Required Capital} = \sqrt{(B1)^2 + (B2)^2 + (B3)^2 + (.5 * B4)^2 + [(.5 * B4) + (B5)]^2 + (B6)^2 + (B8)^2} + (B7)$$

# Development of Reserve Capital Factors

# Your Mission

To design and build a process to estimate Reserve Risk for every company and Rating Unit in the U.S. P/C industry.



# Project Plan

- Purpose of the Reserve Risk Model
- How do you define Reserve Risk
- How do you measure Reserve Risk
- Vision of end product
- Software/Hardware needed/cost
- Staff/Consultants needed/cost
- Research/cost
- Data Desired vs Data Available/cost
- Target Completion Dates
- Internal Approvals
- Build & Test
- External Feedback/Approvals

# Purpose of the Reserve Risk Model

Generate an estimate of the required level of capital to support reserve risk

- How will it be used?
  - Financial Strength Rating Process
    - Ability to Pay Claims – Policyholder Protection
    - Balance Sheet Strength Assessment
    - ERM Assessment
- Will it be used as input elsewhere
  - BCAR model
- Who will use it?
  - Internally – Financial Analysts
  - Externally – Rated Entities, Consultants, Regulators

# How Do You Define Reserve Risk?

Risk of unanticipated adverse development on net loss & LAE reserves

Subsequent Re-Estimate of that CY End Booked Reserve = $150M

Original CY End Booked Reserve = $100M

Unanticipated adverse development = $50M
Which = 50% of Original CY End Booked Reserve

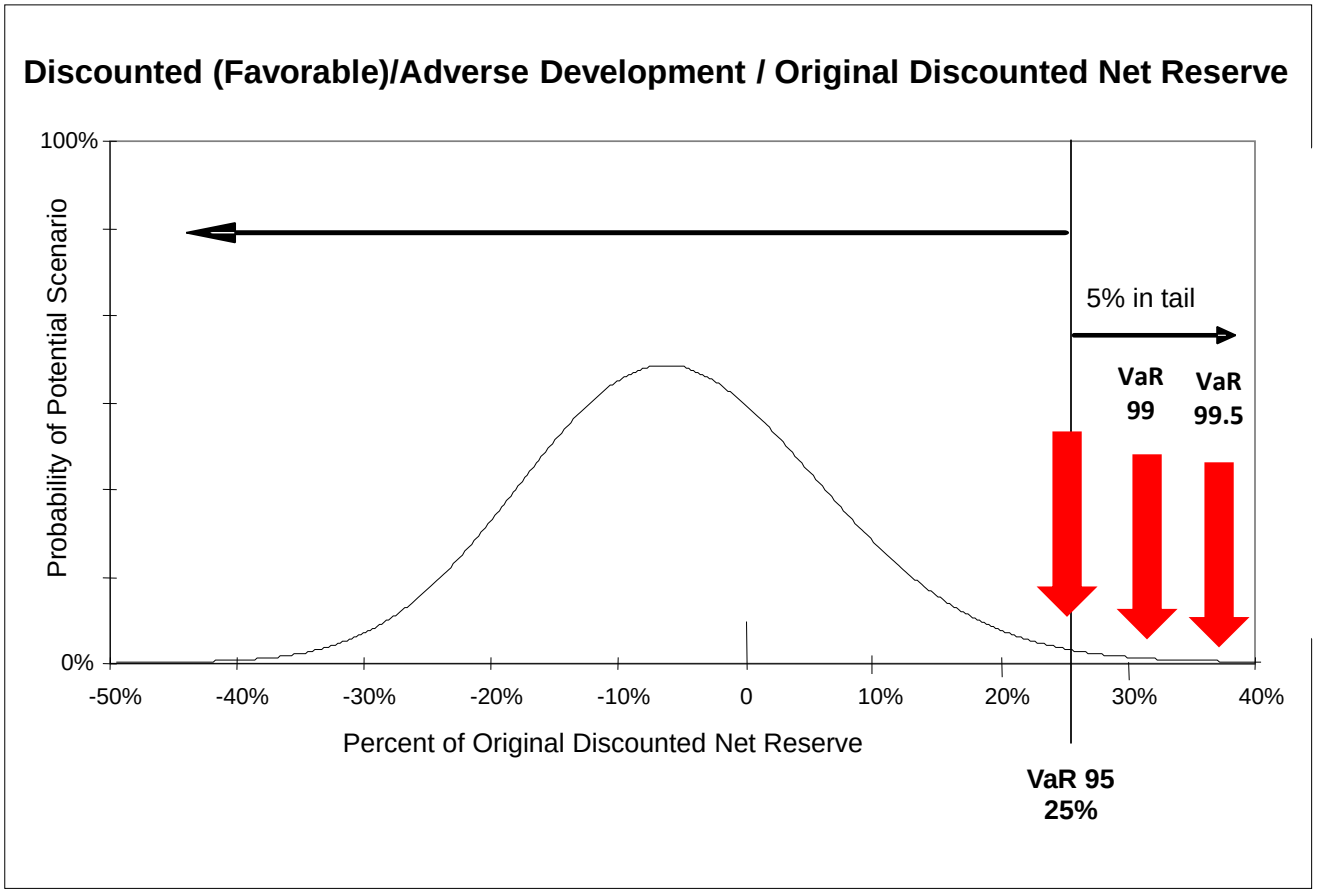
# How Do You Measure Reserve Risk?

- Metric – ES, EPD, VaR, TVaR, Co-Tvar, Co-XTVaR, etc.
- Time horizon – 1 year, 5 year, Ultimate
- Confidence level – Varies with Time Horizon and Metric
- Method – Bootstrap, Mack, etc.

Selected for Stochastic Based BCAR Reserve Risk:
Metric - VaR
Time Horizon – Ultimate
Confidence Levels – 95%, 99%, 99.5%, 99.6%, and 99.8%
Method – Based on AAA P/C RBC Task Force "Report on Reserve and Underwriting Risk Factors" May 20, 1993

# Metric

## VaR (Value at Risk)




**VaR does not tell us about what's in the tail so we need to look at more than one VaR**

# Vision of the End Product

| Schedule P Line | (1) Carried Net Loss & LAE Reserve | (2) Deficiency Factor | (3) Discount Factor | (4) Adjusted Reserves (1) * (2) * (3) | (5) 1% EPD Reserve Factor | (6) (4) * (5) Required Capital |
|---|---|---|---|---|---|---|
| Homeowners/Farmowners | 6,000 | 1.00 | 0.942 | 5,652 | 0.350 | 1,978 |
| Personal Auto Liability | 20,000 | 1.00 | 0.941 | 18,813 | 0.260 | 4,891 |
| Commercial Auto Liability | 19,000 | 1.00 | 0.930 | 17,673 | 0.270 | 4,772 |
| Workers Compensation | 40,000 | 1.00 | 0.824 | 32,944 | 0.330 | 10,872 |
| Commercial Multiperil | 15,000 | 1.00 | 0.905 | 13,570 | 0.350 | 4,750 |
| Medical Prof Liab - Occurrence | 18,000 | 1.00 | 0.882 | 15,873 | 0.440 | 6,984 |
| Medical Prof Liab - Claims Made | 22,000 | 1.00 | 0.911 | 20,039 | 0.370 | 7,415 |
| Special Liability | 12,000 | 1.00 | 0.914 | 10,969 | 0.280 | 3,071 |
| Other Liability - Occurrence | 33,000 | 1.00 | 0.856 | 28,246 | 0.410 | 11,581 |
| Other Liability - Claims Made | 28,000 | 1.00 | 0.891 | 24,954 | 0.400 | 9,981 |
| Products Liability - Occurrence | 13,000 | 1.00 | 0.832 | 10,818 | 0.530 | 5,734 |
| Products Liability - Claims Made | 16,000 | 1.00 | 0.875 | 14,005 | 0.430 | 6,022 |
| Property | 9,000 | 1.00 | 0.953 | 8,581 | 0.350 | 3,003 |
| Auto Physical Damage | 6,000 | 1.00 | 0.979 | 5,871 | 0.290 | 1,703 |
| Fidelity & Surety / Guaranty | 8,000 | 1.00 | 0.925 | 7,398 | 0.370 | 2,737 |
| Other | 7,000 | 1.00 | 0.952 | 6,663 | 0.300 | 1,999 |
| International | 11,000 | 1.00 | 0.944 | 10,381 | 0.330 | 3,426 |
| Reinsurance A | 12,000 | 1.00 | 0.923 | 11,074 | 0.370 | 4,098 |
| Reinsurance B | 29,000 | 1.00 | 0.843 | 24,438 | 0.490 | 11,975 |
| Reinsurance C | 6,000 | 1.00 | 0.914 | 5,482 | 0.400 | 2,193 |
| Warranty | 7,000 | 1.00 | 0.976 | 6,833 | 0.280 | 1,913 |
| Long Duration Contract UPR | 25,000 | 1.00 | 1.000 | 25,000 | 0.250 | 6,250 |
| **Total** | **362,000** | **1.00** | **0.899** | **325,280** | **0.361** | **117,348** |
| | | | | | **Diversification Factor:** | **x** **0.78** |
| | | | | | **Growth Factor:** | **x** **1.05** |
| | | | | | **(B5) Reserve Risk Required Capital Amount:** | **=** **96,108** |

# Vision of the End Product

| | | | | | Capital Factors | | | | | Required Capital Amounts | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| | Carried Net Loss & LAE | Deficiency | Discount | Adjusted Reserves | | | | | | (4) * (5) | (4) * (6) | (4) * (7) | (4) * (8) | (4) * (9) |
| Schedule P Line | Reserve | Factor | Factor | (1) * (2) * (3) | VaR 95 | VaR 99 | VaR 99.5 | VaR 99.6 | VaR 99.8 | VaR 95 | VaR 99 | VaR 99.5 | VaR 99.6 | VaR 99.8 |
| Homeowners/Farmowners | 6,000 | 1.00 | 0.942 | 5,652 | 0.242 | 0.364 | 0.412 | 0.426 | 0.475 | 1,368 | 2,057 | 2,329 | 2,408 | 2,685 |
| Personal Auto Liability | 20,000 | 1.00 | 0.941 | 18,813 | 0.169 | 0.250 | 0.281 | 0.291 | 0.320 | 3,179 | 4,703 | 5,286 | 5,475 | 6,020 |
| Commercial Auto Liability | 19,000 | 1.00 | 0.930 | 17,673 | 0.194 | 0.289 | 0.326 | 0.338 | 0.373 | 3,428 | 5,107 | 5,761 | 5,973 | 6,592 |
| Workers Compensation | 40,000 | 1.00 | 0.824 | 32,944 | 0.223 | 0.334 | 0.377 | 0.390 | 0.430 | 7,347 | 11,003 | 12,420 | 12,848 | 14,166 |
| Commercial Multiperil | 15,000 | 1.00 | 0.905 | 13,570 | 0.239 | 0.360 | 0.406 | 0.422 | 0.467 | 3,243 | 4,885 | 5,510 | 5,727 | 6,337 |
| Medical Prof Liab - Occurrence | 18,000 | 1.00 | 0.882 | 15,873 | 0.299 | 0.456 | 0.520 | 0.540 | 0.599 | 4,746 | 7,238 | 8,254 | 8,571 | 9,508 |
| Medical Prof Liab - Claims Made | 22,000 | 1.00 | 0.911 | 20,039 | 0.251 | 0.381 | 0.432 | 0.448 | 0.497 | 5,030 | 7,635 | 8,657 | 8,978 | 9,960 |
| Special Liability | 12,000 | 1.00 | 0.914 | 10,969 | 0.200 | 0.299 | 0.338 | 0.350 | 0.386 | 2,194 | 3,280 | 3,708 | 3,839 | 4,234 |
| Other Liability - Occurrence | 33,000 | 1.00 | 0.856 | 28,246 | 0.283 | 0.430 | 0.487 | 0.507 | 0.560 | 7,994 | 12,146 | 13,756 | 14,321 | 15,818 |
| Other Liability - Claims Made | 28,000 | 1.00 | 0.891 | 24,954 | 0.288 | 0.438 | 0.497 | 0.516 | 0.573 | 7,187 | 10,930 | 12,402 | 12,876 | 14,298 |
| Products Liability - Occurrence | 13,000 | 1.00 | 0.832 | 10,818 | 0.365 | 0.558 | 0.634 | 0.658 | 0.733 | 3,949 | 6,037 | 6,859 | 7,118 | 7,930 |
| Products Liability - Claims Made | 16,000 | 1.00 | 0.875 | 14,005 | 0.289 | 0.441 | 0.501 | 0.519 | 0.578 | 4,048 | 6,176 | 7,017 | 7,269 | 8,095 |
| Property | 9,000 | 1.00 | 0.953 | 8,581 | 0.243 | 0.366 | 0.415 | 0.430 | 0.475 | 2,085 | 3,141 | 3,561 | 3,690 | 4,076 |
| Auto Physical Damage | 6,000 | 1.00 | 0.979 | 5,871 | 0.188 | 0.279 | 0.314 | 0.325 | 0.357 | 1,104 | 1,638 | 1,844 | 1,908 | 2,096 |
| Fidelity & Surety / Guaranty | 8,000 | 1.00 | 0.925 | 7,398 | 0.252 | 0.381 | 0.433 | 0.448 | 0.496 | 1,864 | 2,819 | 3,204 | 3,315 | 3,670 |
| Other | 7,000 | 1.00 | 0.952 | 6,663 | 0.206 | 0.307 | 0.346 | 0.359 | 0.396 | 1,373 | 2,046 | 2,306 | 2,392 | 2,639 |
| International | 11,000 | 1.00 | 0.944 | 10,381 | 0.239 | 0.359 | 0.406 | 0.422 | 0.465 | 2,481 | 3,727 | 4,215 | 4,381 | 4,827 |
| Reinsurance A | 12,000 | 1.00 | 0.923 | 11,074 | 0.256 | 0.387 | 0.440 | 0.456 | 0.507 | 2,835 | 4,286 | 4,873 | 5,050 | 5,615 |
| Reinsurance B | 29,000 | 1.00 | 0.843 | 24,438 | 0.332 | 0.508 | 0.577 | 0.599 | 0.667 | 8,114 | 12,415 | 14,101 | 14,639 | 16,300 |
| Reinsurance C | 6,000 | 1.00 | 0.914 | 5,482 | 0.274 | 0.417 | 0.474 | 0.491 | 0.545 | 1,502 | 2,286 | 2,599 | 2,692 | 2,988 |
| Warranty | 7,000 | 1.00 | 0.976 | 6,833 | 0.188 | 0.279 | 0.314 | 0.326 | 0.358 | 1,285 | 1,907 | 2,146 | 2,228 | 2,446 |
| Long Duration Contract UPR | 25,000 | 1.00 | 1.000 | 25,000 | 0.170 | 0.250 | 0.290 | 0.300 | 0.330 | 4,250 | 6,250 | 7,250 | 7,500 | 8,250 |
| **Total** | **362,000** | **1.00** | **0.899** | **325,280** | **0.248** | **0.374** | **0.424** | **0.440** | **0.487** | **80,606** | **121,712** | **138,058** | **143,198** | **158,550** |
| | | | | | | | | **Diversification Factor:** | **x** | **0.78** | **0.78** | **0.78** | **0.78** | **0.78** |
| | | | | | | | | **Growth Factor:** | **x** | **1.05** | **1.05** | **1.05** | **1.05** | **1.05** |
| | | | | | | | | **(B5) Reserve Risk Required Capital Amount:** | **=** | **66,016** | **99,682** | **113,070** | **117,279** | **129,852** |

# Software/Hardware Needed

- Software
  - Curve Fitting Software
  - Stochastic Simulation Software
  - ESG?
  - Cost = Expensive
- Hardware
  - Additional Server
  - Faster Laptop
  - Cost = Cheap

# Staffing/Consulting

- Staffing
  - Existing staff reallocated
  - Hire temporary staff
  - Hire more permanent staff
  - Hire consultants


# Research

- Methods
- Models
- Actuarial
- Other Sciences
- New
  - Time
  - Cost

# Data Desired

- Schedule P Parts 1, 2, 3, 4
  - For each 10 year LOB
  - Cumulative Paid Loss&DCC
  - Cumulative Case Incurred Loss&DCC
  - CY end Booked Net Loss&DCC Reserve
  - NEPs
  - For each company
  - For industry
- US Treasury Yield Curves
  - For each accident year working with
- Cost?

# LOB Plan

- For all companies in the Sch P LOB:
  - Download Sch P Parts 1, 2, 3, 4 (2012 Stmnt)
  - Inspect data
  - Remove incomplete or strange data
  - Project AY ultimate Loss&DCC for each AY
    - Paid LDF method
    - Case Incurred LDF method
    - Industry Deficiency by AY applied to Co Unpd
    - Calculate discounted needed reserve
  - For each CY end
    - Calculate CY end booked Loss&DCC reserve
    - Calculate Payout Pattern and PV Loss&DCC reserve
      - Some payments are actual some are projected
  - Discounted Needed Reserve – Discounted booked reserve
  - Divide by discounted booked reserve

# Getting the Data for Curve Fitting

part 2 ultimate loss & DCC

| AY | YE 03 | YE 04 | YE 05 | YE 06 | YE 07 | YE 08 | YE 09 | YE 10 | YE 11 | YE 12 |
|---|---|---|---|---|---|---|---|---|---|---|
| Prior | 147 | 174 | 214 | 219 | 227 | 229 | 240 | 247 | 248 | 250 |
| 2003 | 144 | 140 | 153 | 161 | 161 | 165 | 169 | 169 | 171 | 172 |
| 2004 | 0 | 190 | 138 | 143 | 143 | 145 | 154 | 155 | 158 | 163 |
| 2005 | 0 | 0 | 181 | 169 | 170 | 170 | 181 | 184 | 187 | 183 |
| 2006 | 0 | 0 | 0 | 196 | 186 | 182 | 188 | 193 | 198 | 205 |
| 2007 | 0 | 0 | 0 | 0 | 209 | 203 | 231 | 250 | 251 | 263 |
| 2008 | 0 | 0 | 0 | 0 | 0 | 213 | 218 | 246 | 248 | 265 |
| 2009 | 0 | 0 | 0 | 0 | 0 | 0 | 159 | 170 | 178 | 187 |
| 2010 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 149 | 151 | 181 |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 173 | 168 |
| 2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 141 |

# Getting the Data for Curve Fitting

part 3 cumulative paid loss & DCC

| AY | YE 03 | YE 04 | YE 05 | YE 06 | YE 07 | YE 08 | YE 09 | YE 10 | YE 11 | YE 12 |
|---|---|---|---|---|---|---|---|---|---|---|
| Prior | 0 | 70 | 135 | 166 | 191 | 211 | 220 | 237 | 243 | 245 |
| 2003 | 29 | 67 | 102 | 126 | 142 | 156 | 164 | 169 | 170 | 172 |
| 2004 | 0 | 47 | 66 | 81 | 107 | 123 | 141 | 156 | 158 | 160 |
| 2005 | 0 | 0 | 39 | 79 | 109 | 142 | 167 | 183 | 186 | 181 |
| 2006 | 0 | 0 | 0 | 59 | 93 | 131 | 158 | 187 | 192 | 200 |
| 2007 | 0 | 0 | 0 | 0 | 61 | 110 | 165 | 218 | 242 | 260 |
| 2008 | 0 | 0 | 0 | 0 | 0 | 61 | 120 | 182 | 220 | 249 |
| 2009 | 0 | 0 | 0 | 0 | 0 | 0 | 34 | 82 | 120 | 153 |
| 2010 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32 | 77 | 121 |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 | 78 |
| 2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 |

# Getting the Data for Curve Fitting

unpaid loss & DCC at

| AY | YE 03 | YE 04 | YE 05 | YE 06 | YE 07 | YE 08 | YE 09 | YE 10 | YE 11 | YE 12 |
|---|---|---|---|---|---|---|---|---|---|---|
| Prior | 147 | 104 | 79 | 53 | 36 | 18 | 20 | 10 | 5 | 5 |
| 2003 | 115 | 73 | 51 | 35 | 19 | 9 | 5 | 0 | 1 | 0 |
| 2004 | 0 | 143 | 72 | 62 | 36 | 22 | 13 | -1 | 0 | 3 |
| 2005 | 0 | 0 | 142 | 90 | 61 | 28 | 14 | 1 | 1 | 2 |
| 2006 | 0 | 0 | 0 | 137 | 93 | 51 | 30 | 6 | 6 | 5 |
| 2007 | 0 | 0 | 0 | 0 | 148 | 93 | 66 | 32 | 9 | 3 |
| 2008 | 0 | 0 | 0 | 0 | 0 | 152 | 98 | 64 | 28 | 16 |
| 2009 | 0 | 0 | 0 | 0 | 0 | 0 | 125 | 88 | 58 | 34 |
| 2010 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 117 | 74 | 60 |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 133 | 90 |
| 2012 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 123 |

# Getting the Data for Curve Fitting

adjusted unpd

| AY | YE 03 | YE 04 | YE 05 | YE 06 | YE 07 | YE 08 | YE 09 | YE 10 | YE 11 | YE 12 | defic |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Prior | | | | | | | | | | 6 | 10% |
| 2003 | | | | | | | | | | 0 | 10% |
| 2004 | | | | | | | | | | 3 | 10% |
| 2005 | | | | | | | | | | 2 | 10% |
| 2006 | | | | | | | | | | 6 | 10% |
| 2007 | | | | | | | | | | | |
| 2008 | | | | | | | | | | | |
| 2009 | | | | | | | | | | | |
| 2010 | | | | | | | | | | | |
| 2011 | | | | | | | | | | | |
| 2012 | | | | | | | | | | | |

# Getting the Data for Curve Fitting

part 3 incrementals

| | | | | | Actual | | | | | | Projected | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AY | YE 03 | YE 04 | YE 05 | YE 06 | YE 07 | YE 08 | YE 09 | YE 10 | YE 11 | YE 12 | YE 13 | YE 14 | YE 15 | YE 16 | YE 17 | YE 18 | YE 19 | YE 20 | YE 21 | YE 22 |
| Prior | 0 | 70 | 65 | 31 | 25 | 20 | 9 | 17 | 6 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | | | | |
| 2003 | 29 | 38 | 35 | 24 | 16 | 14 | 8 | 5 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2004 | 0 | 47 | 19 | 15 | 26 | 16 | 18 | 15 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | | |
| 2005 | 0 | 0 | 39 | 40 | 30 | 33 | 25 | 16 | 3 | -5 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2006 | 0 | 0 | 0 | 59 | 34 | 38 | 27 | 29 | 5 | 8 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 2007 | | | | | | | | | | | | | | | | | | | | |
| 2008 | | | | | | | | | | | | | | | | | | | | |
| 2009 | | | | | | | | | | | | | | | | | | | | |
| 2010 | | | | | | | | | | | | | | | | | | | | |
| 2011 | | | | | | | | | | | | | | | | | | | | |
| 2012 | | | | | | | | | | | | | | | | | | | | |

**YE 06** 464 undisc needed reserve

discounted part 3 incrementals

| | | | | | Actual | | | | | | Projected | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AY | YE 03 | YE 04 | YE 05 | YE 06 | YE 07 | YE 08 | YE 09 | YE 10 | YE 11 | YE 12 | YE 13 | YE 14 | YE 15 | YE 16 | YE 17 | YE 18 | YE 19 | YE 20 | YE 21 | YE 22 |
| Prior | | | | | 24.5 | 18.9 | 8.2 | 14.8 | 5.0 | 1.6 | 0.8 | 0.7 | 0.7 | 0.7 | 0.7 | 0.6 | | | | |
| 2003 | | | | | 15.7 | 13.2 | 7.3 | 4.4 | 0.8 | 1.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | |
| 2004 | | | | | 25.5 | 15.1 | 16.3 | 13.1 | 1.7 | 1.6 | 0.8 | 0.7 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | |
| 2005 | | | | | 29.4 | 31.1 | 22.7 | 13.9 | 2.5 | -4.0 | 0.8 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | |
| 2006 | | | | | 33.3 | 35.8 | 24.5 | 25.3 | 4.2 | 6.4 | 1.5 | 0.7 | 0.7 | 0.7 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0 |
| 2007 | | | | | | | | | | | | | | | | | | | | |
| 2008 | | | | | | | | | | | | | | | | | | | | |
| 2009 | | | | | | | | | | | | | | | | | | | | |
| 2010 | | | | | | | | | | | | | | | | | | | | |
| 2011 | | | | | | | | | | | | | | | | | | | | |
| 2012 | | | | | | | | | | | | | | | | | | | | |

**YE 06**

| | |
|---|---|
| 427 | disctd needed reserve |
| 0.9197 | disct factor |
| 346.7 | disctd booked reserve |
| 80 | disctd deviation |
| to database = 0.231 | disctd deviation / disctd reserve |

# Getting the Data for Curve Fitting

| | NPE Growth Rate% | Carried Disctd Reserve | Deviation as ratio to disc original w/reverse sign (Fav)/Adverse |
|---|---|---|---|
| 2003 | 52.0% | 240,300 | 0.495 |
| 2004 | 61.0% | 280,100 | 0.253 |
| 2005 | 21.0% | 305,600 | 0.185 |
| 2006 | -2.0% | 346,700 | 0.231 |
| 2007 | 4.5% | 385,400 | 0.155 |
| 2008 | 7.0% | 435,200 | 0.110 |
| 2009 | -19.0% | 410,800 | 0.095 |
| 2010 | -12.0% | 285,200 | 0.240 |

Inspect

| | NPE Growth Rate% | Carried Disctd Reserve | Deviation as ratio to disc original w/reverse sign (Fav)/Adverse |
|---|---|---|---|
| 2003 | **52.0%** | 240,300 | 0.495 |
| 2004 | **61.0%** | 280,100 | 0.253 |
| 2005 | 21.0% | 305,600 | 0.185 |
| 2006 | -2.0% | 346,700 | 0.231 |
| 2007 | 4.5% | 385,400 | 0.155 |
| 2008 | 7.0% | 435,200 | 0.110 |
| 2009 | -19.0% | 410,800 | 0.095 |
| 2010 | -12.0% | 285,200 | 0.240 |

Remove

# Getting the Data for Curve Fitting

Once Company #1 is done,

Repeat process for Company #2

and Repeat for Company #3

And so on……

| | | NPE Growth Rate% | Carried Disctd Reserve | Deviation as ratio to disc original w/reverse sign (Fav)/Adverse |
|---|---|---|---|---|
| co #1 | 2005 | 21.0% | 305,600 | 0.185 |
| co #1 | 2006 | -2.0% | 346,700 | 0.231 |
| co #1 | 2007 | 4.5% | 385,400 | 0.155 |
| co #1 | 2008 | 7.0% | 435,200 | 0.110 |
| co #1 | 2009 | -19.0% | 410,800 | 0.095 |
| co #1 | 2010 | -12.0% | 285,200 | 0.240 |
| co #2 | 2003 | 5.1% | 85,000 | 0.103 |
| co #2 | 2004 | 3.2% | 89,500 | 0.052 |
| co #2 | 2005 | 4.0% | 95,200 | 0.040 |
| co #2 | 2006 | 6.2% | 100,300 | 0.010 |
| co #2 | 2007 | 1.5% | 102,000 | 0.015 |
| co #2 | 2008 | -2.0% | 99,500 | -0.025 |
| co #2 | 2009 | -1.0% | 99,000 | -0.100 |
| co #2 | 2010 | 3.0% | 95,000 | -0.050 |
| co #3 | 2003 | 10.0% | 5,100 | 0.166 |
| co #3 | 2004 | 12.0% | 6,500 | 0.142 |
| co #3 | 2005 | 8.0% | 7,500 | 0.101 |
| co #3 | 2006 | 6.0% | 8,000 | 0.050 |
| co #3 | 2007 | 16.0% | 9,300 | 0.090 |
| co #3 | 2008 | -5.0% | 9,100 | 0.040 |
| co #3 | 2009 | -3.0% | 9,000 | 0.020 |
| co #3 | 2010 | 8.0% | 9,200 | -0.030 |
| | | etc.... | | |
| | | etc.... | | |
| | | etc.... | | |

# Getting the Data for Curve Fitting

Now sort from smallest reserve to largest.

| | | NPE Growth Rate% | Carried Disctd Reserve | Deviation as ratio to disc original w/reverse sign (Fav)/Adverse |
|---|---|---|---|---|
| co #3 | 2003 | 10.0% | 5,100 | 0.166 |
| co #3 | 2004 | 12.0% | 6,500 | 0.142 |
| co #3 | 2005 | 8.0% | 7,500 | 0.101 |
| co #3 | 2006 | 6.0% | 8,000 | 0.050 |
| co #3 | 2009 | -3.0% | 9,000 | 0.020 |
| co #3 | 2008 | -5.0% | 9,100 | 0.040 |
| co #3 | 2010 | 8.0% | 9,200 | -0.030 |
| co #3 | 2007 | 16.0% | 9,300 | 0.090 |
| co #2 | 2003 | 5.1% | 85,000 | 0.103 |
| co #2 | 2004 | 3.2% | 89,500 | 0.052 |
| co #2 | 2010 | 3.0% | 95,000 | -0.050 |
| co #2 | 2005 | 4.0% | 95,200 | 0.040 |
| co #2 | 2009 | -1.0% | 99,000 | -0.100 |
| co #2 | 2008 | -2.0% | 99,500 | -0.025 |
| co #2 | 2006 | 6.2% | 100,300 | 0.010 |
| co #2 | 2007 | 1.5% | 102,000 | 0.015 |
| co #1 | 2010 | -12.0% | 285,200 | 0.240 |
| co #1 | 2005 | 21.0% | 305,600 | 0.185 |
| co #1 | 2006 | -2.0% | 346,700 | 0.231 |
| co #1 | 2007 | 4.5% | 385,400 | 0.155 |
| co #1 | 2009 | -19.0% | 410,800 | 0.095 |
| co #1 | 2008 | 7.0% | 435,200 | 0.110 |
| | | etc.... | | |
| | | etc.... | | |
| | | etc.... | | |

# Getting the Data for Curve Fitting

And split into quartiles:

Very small

Small

Medium

Large

| | | NPE Growth Rate% | Carried Discted Reserve | Deviation as ratio to disc original w/reverse sign (Fav)/Adverse |
|---|---|---|---|---|
| co #3 | 2003 | 10.0% | 5,100 | 0.166 |
| co #3 | 2004 | 12.0% | 6,500 | 0.142 |
| co #3 | 2005 | 8.0% | 7,500 | 0.101 |
| co #3 | 2006 | 6.0% | 8,000 | 0.050 |
| co #3 | 2009 | -3.0% | 9,000 | 0.020 |
| co #3 | 2008 | -5.0% | 9,100 | 0.040 |
| co #3 | 2010 | 8.0% | 9,200 | -0.030 |
| co #3 | 2007 | 16.0% | 9,300 | 0.090 |
| etc… | etc… | etc… | etc… | etc… |
| co #2 | 2003 | 5.1% | 85,000 | 0.103 |
| co #2 | 2004 | 3.2% | 89,500 | 0.052 |
| co #2 | 2010 | 3.0% | 95,000 | -0.050 |
| co #2 | 2005 | 4.0% | 95,200 | 0.040 |
| co #2 | 2009 | -1.0% | 99,000 | -0.100 |
| co #2 | 2008 | -2.0% | 99,500 | -0.025 |
| etc… | etc… | etc… | etc… | etc… |
| co #2 | 2006 | 6.2% | 100,300 | 0.010 |
| co #2 | 2007 | 1.5% | 102,000 | 0.015 |
| co #1 | 2010 | -12.0% | 285,200 | 0.240 |
| etc… | etc… | etc… | etc… | etc… |
| co #1 | 2005 | 21.0% | 305,600 | 0.185 |
| co #1 | 2006 | -2.0% | 346,700 | 0.231 |
| co #1 | 2007 | 4.5% | 385,400 | 0.155 |
| co #1 | 2009 | -19.0% | 410,800 | 0.095 |
| co #1 | 2008 | 7.0% | 435,200 | 0.110 |
| etc… | etc… | etc… | etc… | etc… |

To curve fitting software

To curve fitting software

To curve fitting software

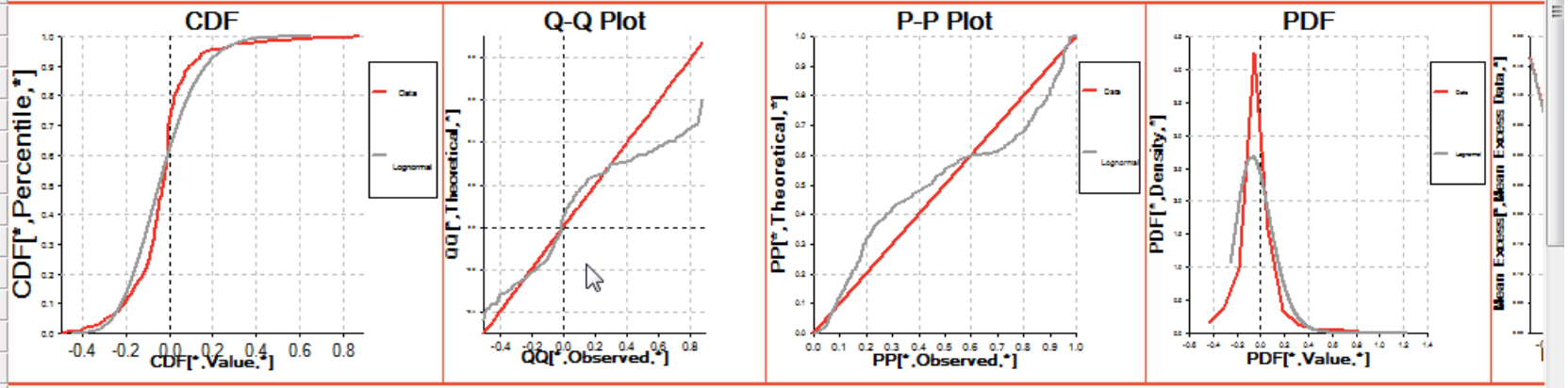
To curve fitting software

A.M. BEST

# Curve Fitting

| Fitted Parameters | | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| Lognormal | -0.04750339 | 0.15802098 | -1.00000000 |

| Chi-Squared Test Results | | | | Parameters before override | |
|---|---|---|---|---|---|
| PValue | Statistic | DF | NumBins | 1 | 2 |
| 0.000 | 339.509 | 5.000 | 8.000 | -0.05 | 0.16 |




**Double-click graphs to enlarge

| Log Likelihood | Lognormal |
|---|---|
| | 466.01 |

| Statistics | | |
|---|---|---|
| | Data | Lognormal |
| Mean | -0.0344 | -0.0344 |
| Standard | 0.1569 | 0.1535 |

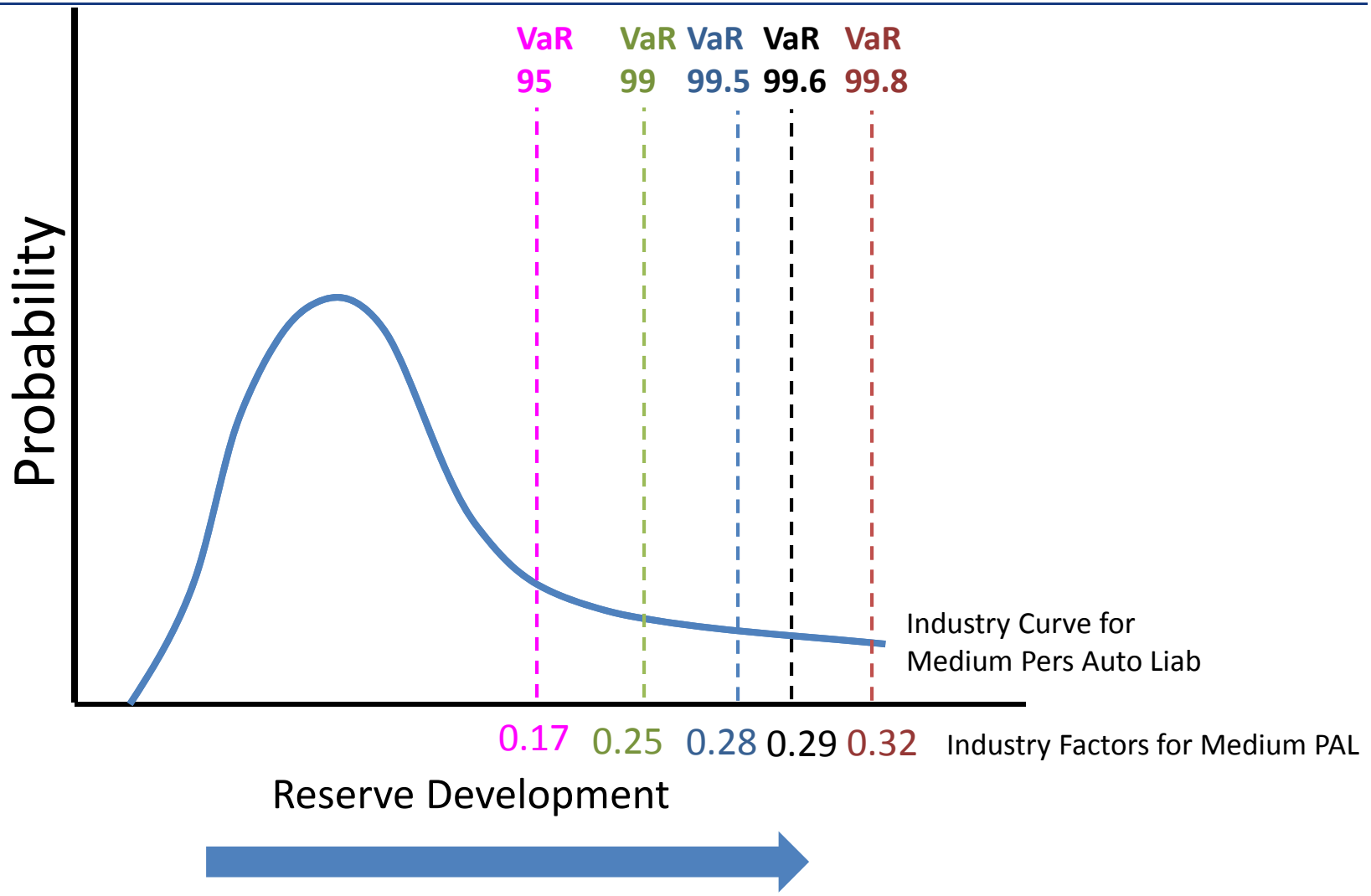
# Curve Fitting

from igloo Continuous Positive Fitting Lognormal

| | | threshold | capped at -50 and +200 fitted parameters lmu | lstd | shift | capped at -30 and +100 fitted parameters lmu | lstd | shift |
|---|---|---|---|---|---|---|---|---|
| indicated | Vsmall | 3000 | -0.0475034 | 0.1580210 | -1 | -0.0284 | 0.131911 | -1 |
| | Small | 7000 | -0.0478761 | 0.1451615 | -1 | -0.02594 | 0.107651 | -1 |
| | Medium | 20000 | -0.0500453 | 0.1232571 | -1 | -0.03909 | 0.103673 | -1 |
| | Large | 999999999 | -0.0354570 | 0.1160355 | -1 | -0.02762 | 0.101693 | -1 |

| | | selected lmu | selected lstd | shift |
|---|---|---|---|---|
| Vsmall | 3000 | ? | ? | -1 |
| Small | 7000 | ? | ? | -1 |
| Medium | 20000 | ? | ? | -1 |
| Large | 999999999 | ? | ? | -1 |

# Industry Reserve Risk Factors



# Industry Reserve Risk Factors

| | Medium Reserves | | Average Stability | | |
|---|---|---|---|---|---|
| | VaR 95 | VaR 99 | VaR 99.5 | VaR 99.6 | VaR 99.8 |
| HO | 0.242 | 0.364 | 0.412 | 0.426 | 0.475 |
| PAL | 0.169 | 0.250 | 0.281 | 0.291 | 0.320 |
| CAL | 0.194 | 0.289 | 0.326 | 0.338 | 0.373 |
| WC | 0.223 | 0.334 | 0.377 | 0.390 | 0.430 |
| CMP | 0.239 | 0.360 | 0.406 | 0.422 | 0.467 |
| MPL OCC | 0.299 | 0.456 | 0.520 | 0.540 | 0.599 |
| MPL CM | 0.251 | 0.381 | 0.432 | 0.448 | 0.497 |
| SP Liab | 0.200 | 0.299 | 0.338 | 0.350 | 0.386 |
| OL OCC | 0.283 | 0.430 | 0.487 | 0.507 | 0.560 |
| OL CM | 0.288 | 0.438 | 0.497 | 0.516 | 0.573 |
| PROD OC | 0.365 | 0.558 | 0.634 | 0.658 | 0.733 |
| PROD CM | 0.289 | 0.441 | 0.501 | 0.519 | 0.578 |
| Prop | 0.243 | 0.366 | 0.415 | 0.430 | 0.475 |
| PHYS | 0.188 | 0.279 | 0.314 | 0.325 | 0.357 |
| F&S | 0.252 | 0.381 | 0.433 | 0.448 | 0.496 |
| OTHER | 0.206 | 0.307 | 0.346 | 0.359 | 0.396 |
| INTL | 0.239 | 0.359 | 0.406 | 0.422 | 0.465 |
| REIN A | 0.256 | 0.387 | 0.440 | 0.456 | 0.507 |
| REIN B | 0.332 | 0.508 | 0.577 | 0.599 | 0.667 |
| REIN C | 0.274 | 0.417 | 0.474 | 0.491 | 0.545 |
| WTY | 0.188 | 0.279 | 0.314 | 0.326 | 0.358 |

# Industry Reserve Risk Factors

- More research
  - Compare to other industry studies/results
    - Reasonable?
  - Adjust for
    - different time horizons
    - Confidence levels
    - Line of business groupings
    - Etc…

# Whew!

# Company Adjustment to Factors

## Reserve stability/volatility

| Stable | Cumulative Case Incurred Link Ratios | | | | | |
|---|---|---|---|---|---|---|
| | 12-24 | 24-36 | 36-48 | 48-60 | 60-72 | 72-84 |
| 2004 | 1.162 | 1.057 | 1.028 | 1.010 | 1.005 | 1.002 |
| 2005 | 1.158 | 1.055 | 1.026 | 1.010 | 1.004 | 1.002 |
| 2006 | 1.160 | 1.056 | 1.027 | 1.010 | 1.004 | 1.002 |
| 2007 | 1.172 | 1.059 | 1.025 | 1.009 | 1.003 | 1.002 |
| 2008 | 1.181 | 1.055 | 1.026 | 1.009 | 1.004 | |
| 2009 | 1.178 | 1.055 | 1.023 | 1.010 | | |
| 2010 | 1.165 | 1.051 | 1.024 | | | |
| 2011 | 1.158 | 1.052 | | | | |
| 2012 | 1.171 | | | | | |
| **All Yr Avg** | **1.167** | **1.055** | **1.025** | **1.010** | **1.004** | **1.002** |
| **Std Dev** | **0.0082** | **0.0023** | **0.0017** | **0.0005** | **0.0007** | **0.0001** |
| **CoV** | **0.0070** | **0.0022** | **0.0017** | **0.0005** | **0.0007** | **0.0001** |

| Volatile | Cumulative Case Incurred Link Ratios | | | | | |
|---|---|---|---|---|---|---|
| | 12-24 | 24-36 | 36-48 | 48-60 | 60-72 | 72-84 |
| 2004 | 1.345 | 1.040 | 1.100 | 1.109 | 1.038 | 1.009 |
| 2005 | 1.580 | 1.010 | 1.307 | 1.012 | 1.036 | 0.995 |
| 2006 | 1.598 | 1.043 | 1.023 | 1.021 | 1.015 | 0.998 |
| 2007 | 1.238 | 1.042 | 1.267 | 0.974 | 1.073 | 0.998 |
| 2008 | 1.014 | 1.365 | 0.998 | 1.003 | 1.094 | |
| 2009 | 1.452 | 1.027 | 1.013 | 1.006 | | |
| 2010 | 1.165 | 1.097 | 1.010 | | | |
| 2011 | 1.147 | 1.011 | | | | |
| 2012 | 1.112 | | | | | |
| **All Yr Avg** | **1.295** | **1.079** | **1.102** | **1.021** | **1.051** | **1.000** |
| **Std Dev** | **0.1986** | **0.1110** | **0.1211** | **0.0422** | **0.0283** | **0.0052** |
| **CoV** | **0.1534** | **0.1029** | **0.1099** | **0.0413** | **0.0269** | **0.0052** |

Coefficient of Variation (COV) = Std Dev / All Yr Avg

Company Adjustment Factor based on:

Company COV / Industry COV

0.70 <= Company Adjustment Factor <= 1.30

# Company Adjustment to Factors

Reserve Capital Factors: Represent potential ultimate UNANTICIPATED adverse loss and LAE reserve development (discounted) using VaR metric

| | | |
|---|---|---|
| Industry Baseline Reserve Capital Factors | | Ex. Medium PAL: 16.9%, 25.0%, 28.1%, 29.1%, 32.0% |
| **X** | Company Stability Factor | 0.80 (based on company's case incurred LDFs) |

Notes:
Reserves represent business exposed to in the past.
Deficiency factor represents expected deficiency.
Reserves are discounted and net of reinsurance.

**=** Company Reserve Capital Factors: 13.5%,20%,22.5%,23.3%,25.6%

# Reserve Risk Summary

- Risk of unanticipated adverse development on net loss & loss-adjustment expense (LAE) reserves
- Reserve Risk Factors
  - Created 4 probability curves of potential reserve development for each line of business – based on size of reserve
  - Industry baseline factors correspond to the confidence levels on the curves
  - Company size of reserve determines industry baseline factors for that line of business
  - Adjust industry factors for company volatility/stability to get company specific factors
- Adjustment to required capital for Excessive Growth remains

# Reserve Risk Diversification

***New calculation for line of business diversification uses correlation matrices***

$$Diversification\ Factor = SQRT\{\ [w_1\sigma_1 \ldots w_n\sigma_n] \times \begin{bmatrix} 1 & \cdots & \rho_{1n} \\ \vdots & \ddots & \vdots \\ \rho_{n1} & \cdots & 1 \end{bmatrix} \times \begin{bmatrix} w_1\sigma_1 \\ \vdots \\ w_n\sigma_n \end{bmatrix} \}$$

$$Divided\ by$$

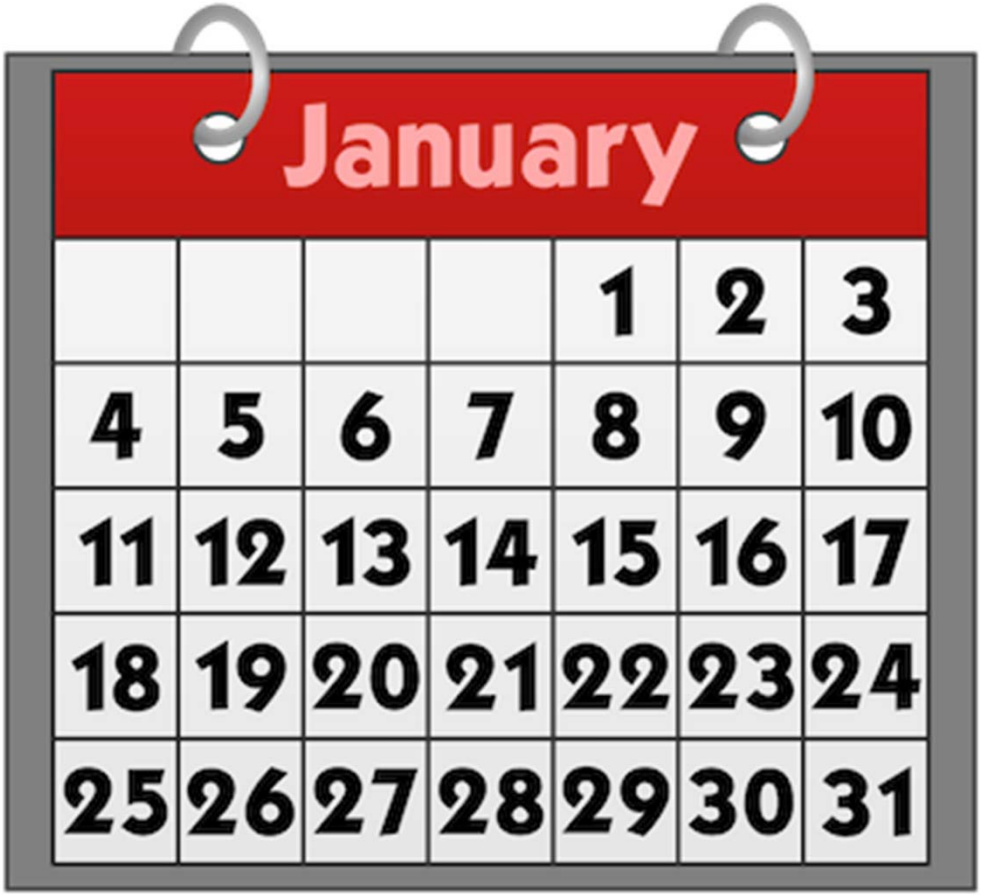
$$\text{SUM}[w_1\sigma_1 \ldots w_n\sigma_n]$$

Where weights (w) are % of total business in that line and the $\sigma$ are the company risk factors by line

Correlation matrices vary by size of company's total NPW or total Reserves

# Target Completion Dates

- Be realistic
- Plan for delays
- Started 2011
- Completed 2017



# Reserve Actuary's Impact on BCAR

- Reserve Risk
  - Schedule P
    - Used to generate A.M. Best's indicated ultimates
    - Used to generate reserve deficiencies
    - Used to generate credibility
    - Used to calculate reserve discount factors
    - Used to generate volatility adjustment
- Credit Risk

# Reserve Actuary's Impact on Rating Process

- BCAR
- Quality of Reserves
  - Reserve opinion
  - Reserve review
  - Reserve range
  - Company history (schedule P)
  - Company philosophy
  - Explanation of
    - Distortions in data
    - Changes – methods, reins, claims dept, management, etc
    - Treatment of retroactive reins, commutations, etc

# Reserve Actuary's Impact on Rating Process

- Reserve Opinion
  - Relevant comments used, including discounting, retroactive reinsurance, salvage/subro treatment, major risk factors, change in methods/assumptions, potential for material adverse deviation
- Actuarial Report
  - Commentary may provide reasons why Sched P not appropriate
  - Case reserve strengthening
  - Change in settlement rates
  - Review Analysis for
    - LDF selections
    - Ultimate selections
    - Pd/Pd selections
    - ELRs used
    - Freq/Severity Trend and other Assumptions
    - Methods used
- Quarterly Statement – Part 3
  - Watch prior year development

# Summary

- Reserving is a corporate philosophy
  - Rating analyst wants to know what that philosophy is
  - Rating analyst wants to see that in historical results
  - Rating analyst likes to see consistency
- Reserve deficiencies are material to rating process
  - You may see 5% deficiency as small
  - Rating analyst sees 10% of PHS (with 2:1 leverage)
  - Rating analyst likes to see conservative reserving
- Reserve Strengthening
  - Rating analysts do not like surprises
  - Rating analysts appreciate quickly identified problems and
  - Rating analysts appreciate quickly fully explained resolutions
- Reserving Risk
  - ERM – company's view/measurement
- Our interactive rating process does value the actuary's expertise and is considered in the rating process.

# Thank You

# Q & A