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**Credibility Procedures:**  
*VM-20 (Life Insurance Mortality) and  
Proposed VM-22 (Annuity)*

Session 156 PD, Application of  
Credibility Theory

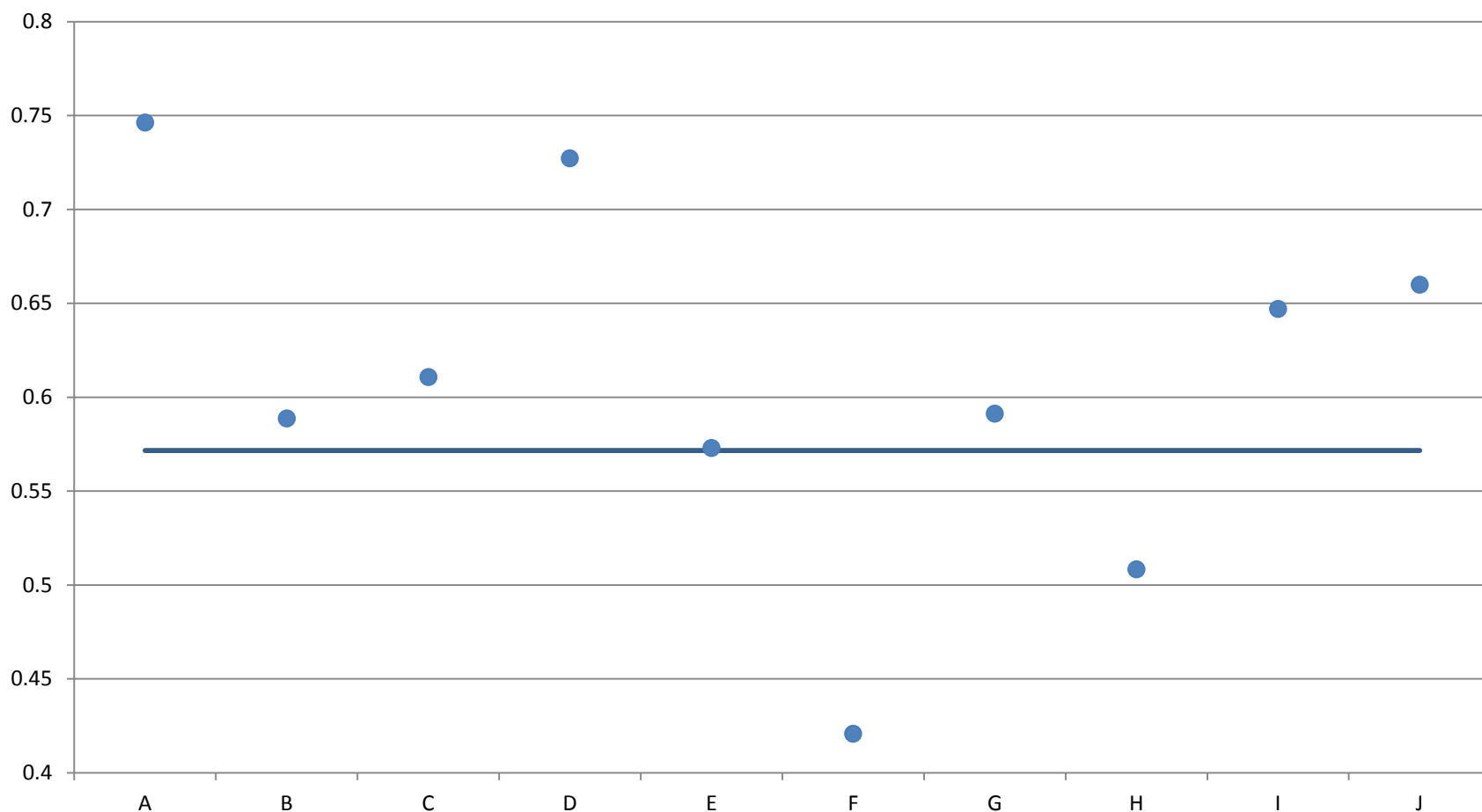
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# Introduction

- Principles Based Reserves (PBR) allows companies to use company experience in setting life and annuity reserves
- ASOP 25 Credibility Procedures updated
- Implement PBR: Valuation Law and Valuation Manual (VM)
  - VM-20 for Life Insurance has been adopted by NAIC
  - Proposed VM-22 for Annuities is under development
- Credibility procedures are involved in setting margins
  - VM-20 sets margins for each individual risk
  - Proposed VM-22 uses an aggregate margin approach from Representative Scenario Method
  - Needed because company mortality varies from average

# Company A/E Ratios (Blue Dots) vary above and below Average A/E Ratio (Straight Line)



# VM-20 Life Insurance Mortality Margin

- VM-20 Mortality is in Section 9C
- Terminology
  - Anticipated experience assumption + Margin = Prudent estimate assumption
  - Mortality Segment are policies selected that have similar mortality experience
  - Underwriting Criteria Scoring (UCS) used to point to an applicable industry table
  - Sufficient data period is last duration of own company experience with at least 50 deaths

# Mortality Segment Selection

## First Approach

- Mortality Segment: own company nonsmoker policies
  - Credibility factor based on the nonsmoker experience
  - Subsets of nonsmoker mortality can be created using Conservation of Deaths:
    - Preferred nonsmoker
    - Residual nonsmoker

# Mortality Segment Selection

## Second Approach

- One Mortality Segment: own company preferred nonsmoker policies
  - Credibility factor based on the preferred nonsmoker experience
  - Credibility factor generally less than for the nonsmoker mortality segment
- Second Mortality Segment: own company residual non-smoker policies
  - Credibility factor based on the residual nonsmoker experience
  - Credibility factor generally less than for the nonsmoker mortality segment

# Credibility Procedure

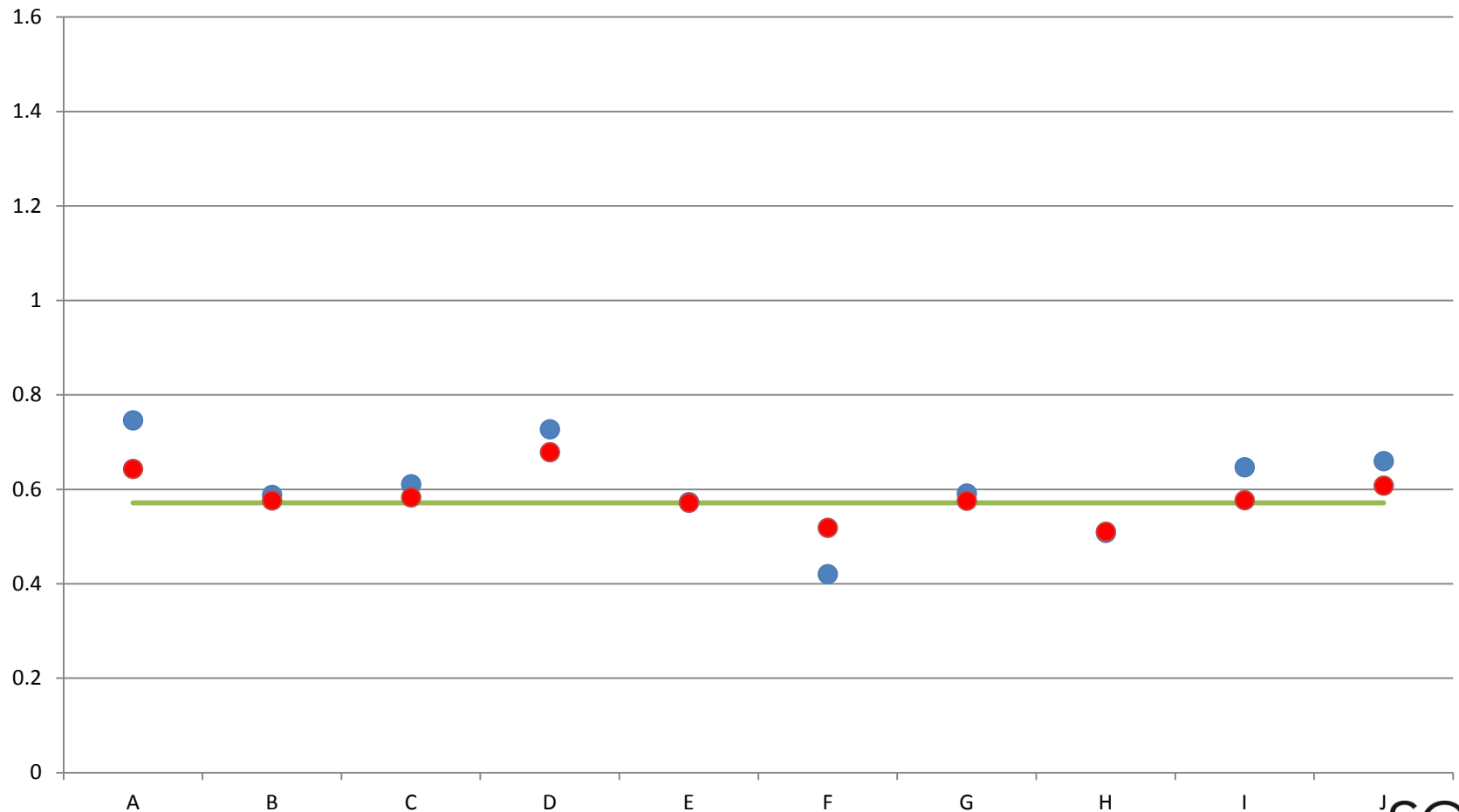
## VM-20 Individual Life Mortality

Step 1: Mortality Segment, credibility, margin and resulting own company mortality

Step 2: Determine Applicable Industry Table, margin and resulting mortality

Step 3: Grade the mortality results of Step 1 into the mortality results of Step 2

# Limited Fluctuation Method Results (Red Dots), Company A/E Ratios (Blue Dots), and Average A/E Ratio (Line)





# Step 1

- Mortality segment – Select the mortality segment from your own company experience
- Determine the credibility factor using Limited Fluctuation Method or other technique
- Using charts in VM-20 Section 9 C
  - Use credibility factor to select column (with range of credibility levels) that contain margin percentages
- Apply margin percentages to obtain own company mortality

# Step 2

- Determine Applicable Industry Table
  - Use UCS to point to preliminary RR table
  - From preliminary RR table move up or down two tables to determine applicable industry table
- Using chart in VM-20 Section 9 C to determine column containing margin percentages for applicable industry table
- Apply margin percentages to obtain applicable industry table mortality

# Step 3

- Grade the mortality results of Step 1 into the mortality results of Step 2
- Determine sufficient data period (last duration of own company experience with at least 50 deaths)
- Using charts in VM-20 Section 9 C and the credibility factor from step 1 to determine the grading period from own company mortality to applicable industry table mortality
- Combined own company and applicable industry table mortality is the prudent estimate mortality

# Proposed VM-22 for Annuities using Aggregate Margin

Different approach for annuities than for life

- Improve auditability of PBR reserve calculations and conserve both company and regulatory resources
- Avoid redundancy stemming from separate margins for each assumption
- Address all key risk factors in complex products

Simplification for this presentation:

- Assume the anticipated experience reserve is equal to the reserve from the Representative Scenarios Method

# Key Risk Factors

- Key Risk Factors Vary based on Complexity of Annuity Product
- Example of Key Risk Factors:
  - Mortality
  - Lapse
  - Expense
  - Interest
  - Guaranteed Living Income Benefits (GLIB)

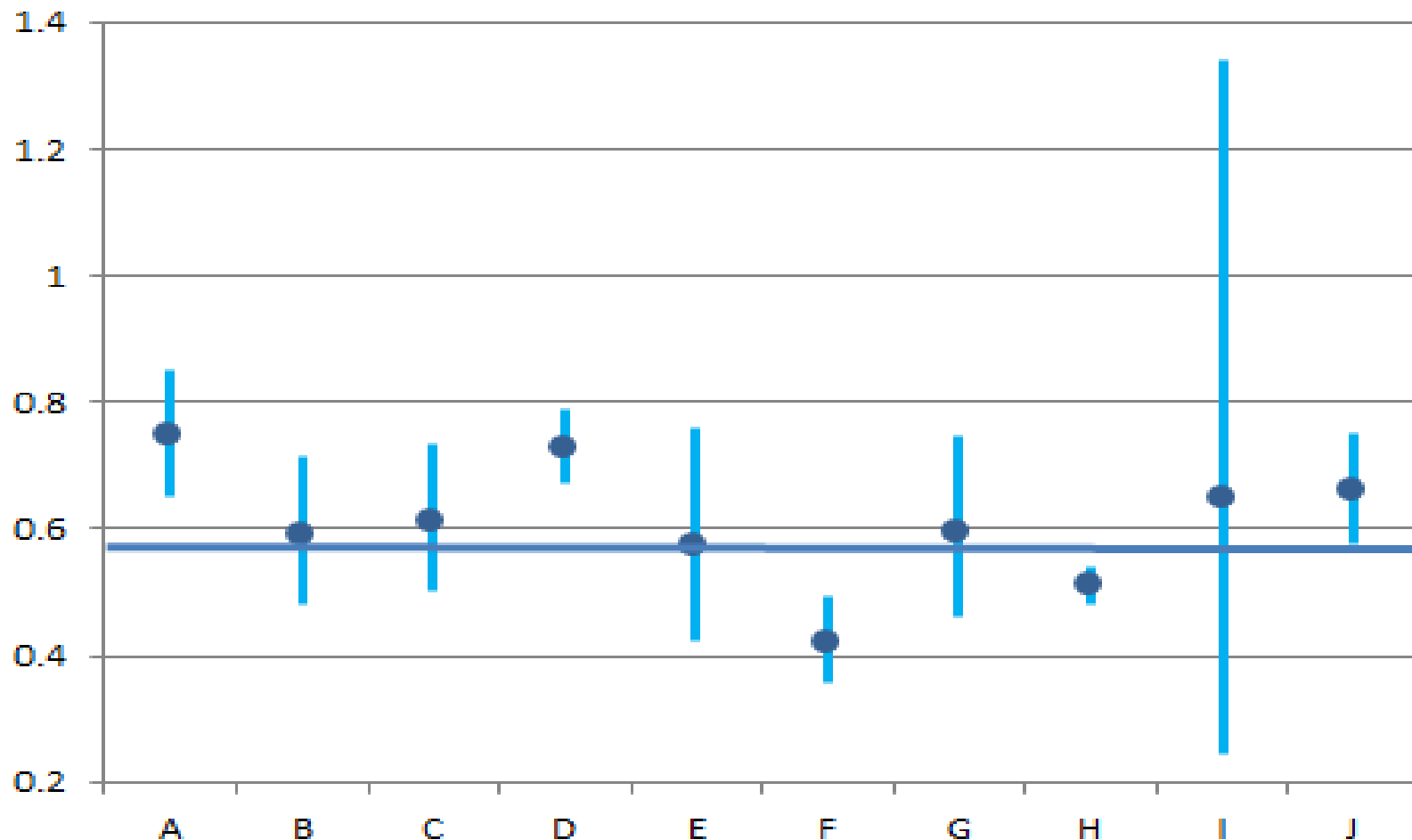
# Credibility Procedure for Proposed VM-22

- Anticipated Reserve
- Vary Key Risk Factors
- Maximum Difference in reserve due to each Key Risk Factor's variation
- A Worst Case Scenario
- Aggregate Margin based on the Cost of Capital Method

# Anticipated Reserve

- Develop anticipated experience assumption for each key risk factor
  - Mortality could vary by gender, health status, attained age, product, ...
  - Similar development for Lapse, Expense, Interest, GLIB
- Calculate **Anticipated Reserve** using the anticipated experience assumptions developed for the key risk factors

# Poisson 95% Upper and Lower Limits ( $\pm 2$ Std Dev; Vertical Line). Company A/E Ratios (Blue Dots), and Average A/E Ratio (Horizontal Line)





# Vary Mortality Key Risk Factor

Create varying reserves by varying the Mortality Key Risk Factor by:

- + 3 Standard Deviations
- + 1 Standard Deviation
- - 1 Standard Deviation
- - 3 Standard Deviations

(For mortality, you could assume the Poisson distribution in performing calculations.)

# For Mortality Key Risk Factor Maximum Reserve Difference

- Hold the non-mortality Key Risk Factors at their anticipated experience assumptions
- Use the variations in the Mortality Key Risk Factor to calculate MKR reserves.
- Calculate difference between each MKR reserve and Anticipated Reserve
  - $\text{MKR Reserve} + 3 \text{ SD} - \text{Anticipated Reserve} = \text{Mdiff1}$
  - $\text{MKR Reserve} + 1 \text{ SD} - \text{Anticipated Reserve} = \text{Mdiff2}$
  - $\text{MKR Reserve} - 1 \text{ SD} - \text{Anticipated Reserve} = \text{Mdiff3}$
  - $\text{MKR Reserve} - 3 \text{ SD} - \text{Anticipated Reserve} = \text{Mdiff4}$
- For mortality the maximum reserve difference is the largest of Mdiff1, Mdiff2, Mdiff3 and Mdiff4

# Vary Lapse Key Risk Factor

Create varying reserves by varying the Lapse Key Risk Factor by:

- + 3 Standard Deviations
- + 1 Standard Deviation
- - 1 Standard Deviation
- - 3 Standard Deviations

(For lapse, you could assume the Binomial distribution in performing calculations.)

# For Lapse Key Risk Factor Maximum Reserve Difference

- Hold the non-lapse Key Risk Factors at their anticipated experience assumptions
- Use the variations in the Lapse Key Risk Factor to calculate LKR reserves.
- Calculate difference between each LKR reserve and Anticipated Reserve
  - $\text{LKR Reserve} + 3 \text{ SD} - \text{Anticipated Reserve} = \text{Ldiff1}$
  - $\text{LKR Reserve} + 1 \text{ SD} - \text{Anticipated Reserve} = \text{Ldiff2}$
  - $\text{LKR Reserve} - 1 \text{ SD} - \text{Anticipated Reserve} = \text{Ldiff3}$
  - $\text{LKR Reserve} - 3 \text{ SD} - \text{Anticipated Reserve} = \text{Ldiff4}$
- For lapse, the maximum reserve difference is the largest of Ldiff1, Ldiff2, Ldiff3 and Ldiff4

# For Expense, Interest and GLIB Key Risk Factors

- Use the same process to develop the maximum reserve difference for expense
- Use the same process to develop the maximum reserve difference for interest
- Use the same process to develop the maximum reserve difference for GLIB

# A Worst Case Scenario

A worst case scenario is based on:

M = maximum reserve difference for mortality

L = maximum reserve difference for lapse

E = maximum reserve difference for expense

I = maximum reserve difference for interest

G = maximum reserve difference for GLIB

# Aggregate Margin using the Cost of Capital Approach

- Capital Requirement using formula from RBC

$$\sqrt{M^2 + (L + E + I + G)^2}$$

- Aggregate Margin = Capital Requirement \* Cost of Capital Rate\* Present Value Factor
- The Aggregate Margin is added to the anticipated reserve

# PBR and Credibility Approaches

- VM-20 for mortality
  - Prescriptive with actuarial judgment
  - Use credibility of own company data
  - Individual Margin
- Proposed VM-22
  - Still under development
  - Vary Key Risk Factors using mean and std dev
  - Aggregate margin approach from Representative Scenarios Method



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