# Challenges in Building an Advanced Measurement Approach (AMA) Operational Risk Model

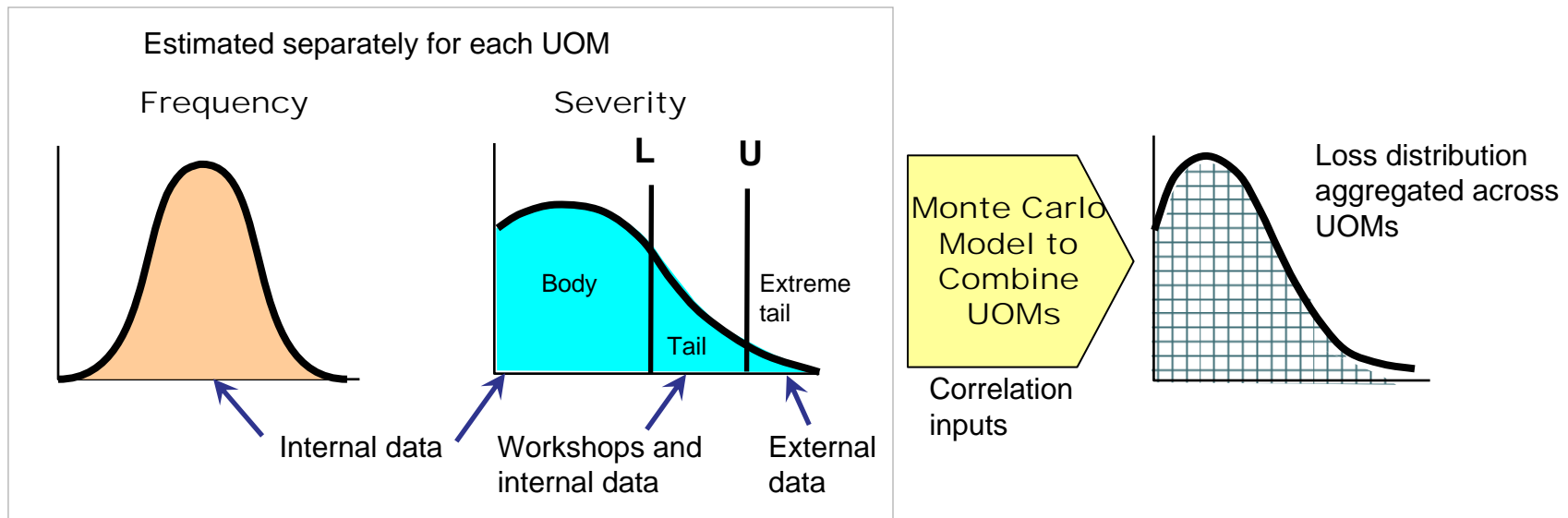**Donald Rosenthal**

**dhrosenthal@statestreet.com**

# Topics

> **Overview of State Street's operational risk modeling**

> **Designing and executing scenario workshops**

> **Modeling dependence and justifying assumptions**

> **Gaining acceptance from senior management and business areas**

# Overview of State Street's operational risk modeling

> **State Street currently has an operational risk model**
> - 20+ customized "units of measure" (UOM)
> - Heavy reliance on scenario workshops for quantifying economic capital
> - Internal data, external data, and business environment and internal control factors (BEIC) influence the model results, although they are not as critical as the scenario data
> - Straightforward parametric value-at-risk (VaR) is used for computing diversified capital across all UOMs

> **A new advanced measurement approach (AMA) model is under development**
> - UOMs are aligned with Level I definitions in Basel and, for most measures, are further broken down by line of business
> - Four sources of input — scenario workshops, internal data, external data, and BEIC — have a more balanced role in the model
> - The methodology for modeling dependence is more complex and uses copulas

# Overview of planned structure of new AMA model

> **Estimates frequency based on internal loss data**
> **Estimates severity of an event from three input sources**
>    – Internal losses
>    – Workshop data
>    – External data

Repeat for each UOM covered by model

> **Combines losses across events using a Monte Carlo simulation with copulas**

Estimated separately for each UOM

**Frequency**

**Severity**

L   U

Body

Tail

Extreme tail

Internal data

Workshops and internal data

External data

**Monte Carlo Model to Combine UOMs**

Correlation inputs

Loss distribution aggregated across UOMs

# Designing and executing workshops

> **Participants are asked to judge the frequency of low-probability events—a difficult task under the best of circumstances**

> **For new AMA model, State Street re-designed its workshop process**

  – Reviewed potential biases identified in the fields of survey research and behavioral economics, e.g., anchoring, recency, herding

  – Designed workshops to minimize identified biases and employed common sense to design intelligent workshop response formats, for example:

    – Educated participants on biases as a key part of our workshops

    – Ran educational sessions on probability and statistics

    – Hired expert in field of "behavioral economics" to review and critique workshop design

    – Held scales fixed on graphs when comparing internal and external data

    – Asked questions about the likelihood and severity of rare events in a three-step process: initial answer, discuss, and final answer

> **End result is a sound workshop process**

  – Workshop responses are used directly in new AMA model

  – Improvements are still possible

# Workshop education: Practice estimates

## Red Sox example

A game in which the Red Sox score _____ runs or more occurs once every *5* years, on average.

A game in which they score _____ runs or more occurs once every *10* years, on average.

A game in which they score _____ runs or more occurs once every *25* years, on average.

A game in which they score _____ runs or more occurs once every *50* years, on average.

# Workshop education: Practice estimate answers

## Red Sox example

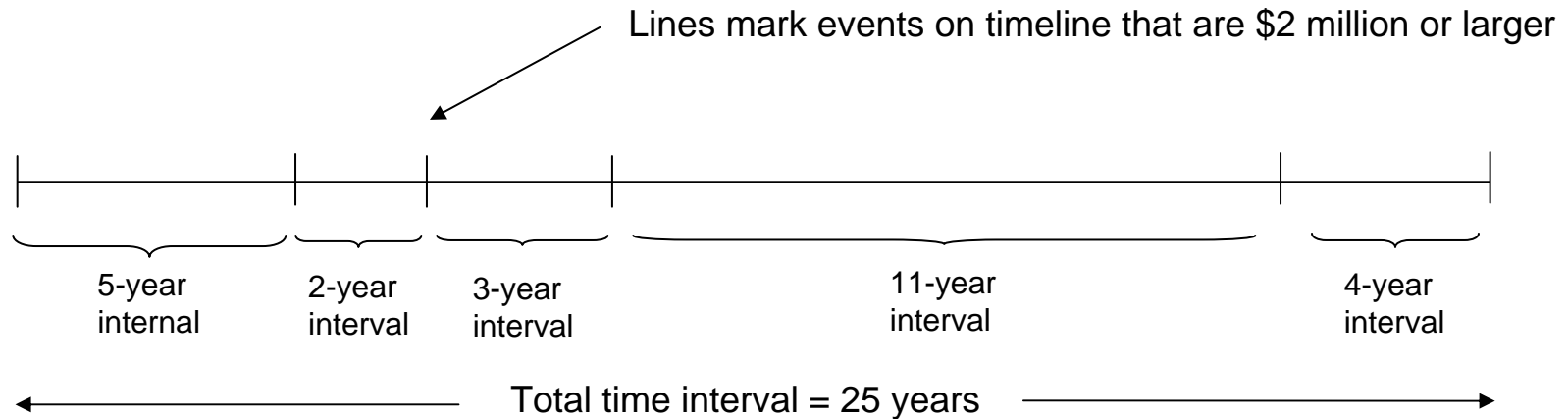A game in which the Red Sox score **19** runs or more occurs once every *5* years, on average.

A game in which they score **21** runs or more occurs once every *10* years, on average.

A game in which they score **24** runs or more occurs once every *25* years, on average.

A game in which they score **25** runs or more occurs once every *50* years, on average.

# Workshop education: 1-in-5-year event defined

Lines mark events on timeline that are $2 million or larger

| 5-year internal | 2-year interval | 3-year interval | 11-year interval | 4-year interval |

Total time interval = 25 years

> The above timeline marks events that are $2 million or more during a period of 25 years
> On the timeline, we can calculate five time intervals between events
> If we begin measuring time after the first event, the average time interval between events that are $2 million or more is five years, i.e., average (5, 2, 3, 11, 4) = 5
> $2 million is the 1-in-5-year event

# Workshop education: Other distributions

| Frequency | One-Day Percentage Drop in Dow Jones Average | Lives Lost to Tsunami or Wave Surges Per Country |
|---|---|---|
| 1-in-5 years | $    7% | 102 |
| 1-in-10 years | $    8% | 539 |
| 1-in-25 years | $    11% | 8,345 |
| 1-in-50 years | $    13% | 35,399 |

# Workshop process: Alternative response formats

**Option #1: Provide severity and ask frequency**

| Loss Range in $Millions | Frequency |
|---|---|
| 0 to 1 | ? |
| 1 to 3 | ? |
| 3 to 5 | ? |
| 5+ | ? |

**Option #2: Provide frequency and ask severity**

| Frequency | Amount in $Millions |
|---|---|
| 1-in-5 years | ? |
| 1-in-10 years | ? |
| 1-in-25 years | ? |
| 1-in-50 years | ? |

**State Street selected Option #2:**

- Workshop respondents liked it
- Avoids arbitrary selection of loss ranges needed for Option #1
- Natural upper bound: 1-in-50-year loss roughly corresponds to a working lifetime

# A loss frequency model is fitted to the workshop responses



Dollars

1/50    1/25    1/10    1/5

**Expected Annual Frequency of Loss Events ≥ $X**
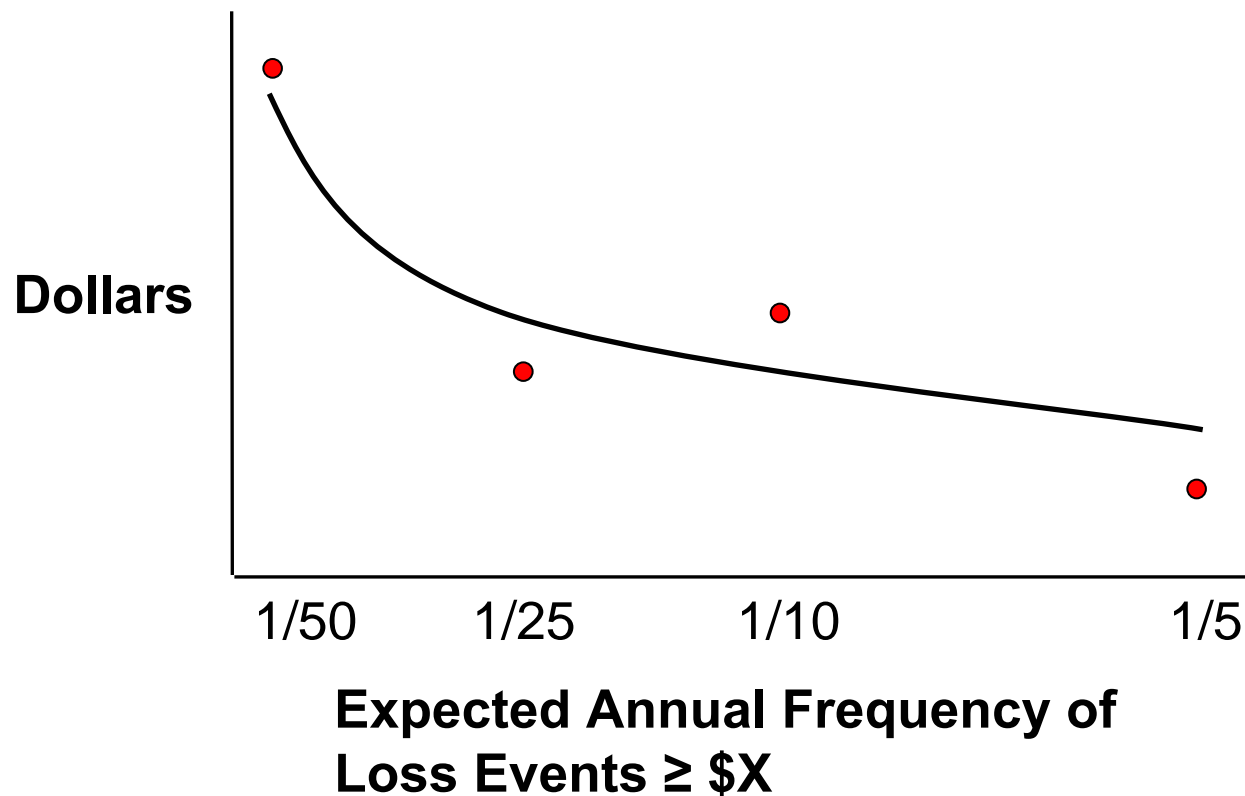
# Modeling dependence and justifying assumptions

> **Dependence modeling is a key component of any AMA model**
> **Example:**
>> – Seven UOMs and each UOM has $100 capital on a stand-alone basis
>> – Total capital under AMA rules without justification for correlation assumptions = $700
>> – Total capital with different average correlation assumptions using "Gaussian" approximation
>>> – 0% correlation = $265
>>> – 20% correlation = $392
>>> – 40% correlation = $488
>> – Justifying the correlation assumptions matters—a lot
> **State Street is working to develop its correlation assumptions**
>> – Empirically: using internal and external data
>> – Theoretically: thinking about whether and how underlying driving factors are correlated
>> – There are many different ways to measure correlation: frequency, severity, total loss, quarterly, annually, rank vs. linear
> **State Street is willing to exchange its correlation data with other banks**
>> – We have a standardized format for computing correlations and are open to other formats
>> – We have already exchanged data with another bank

# Gaining acceptance by senior management and business units

> **Senior Management:**

– The primary mechanism for gaining acceptance for the operational risk models is through a working group of senior management that meets periodically to discuss issues

– As the working group has become familiar with issues such as workshop design, correlation assumptions, statistical distributions and external data, acceptance has increased

> **Business Units:**

– Business units have not yet had much exposure to the models, but once capital is more directly allocated to them, they will no doubt want to understand what drives the model

– Preliminary meetings with selected business unit staff have been held and interest in the model results and what drives the results is keen

# Building an AMA model is a challenging undertaking

> **Scenario workshops need to be conducted with care**
>> – Important to frame questions in a meaningful manner
>> – Senior people with experience are critical to workshop success

> **Difficult to directly incorporate all four elements — internal data, external data, scenarios, and BEIC — into model**
>> – Internal data has limited history
>> – External data suffers from underreporting biases and the relevance of loss events at other institutions for your institution is questionable
>> – Directly combining different sources of data into the econometric and statistical estimation of severity causes significant quantitative complexity
>> – Choice of different statistical distributions or modeling methodologies can markedly affect capital—considerable potential for model error

> **Correlation assumptions are critical and require thoughtful justification**
> **Tension between conducting research and getting the model done**