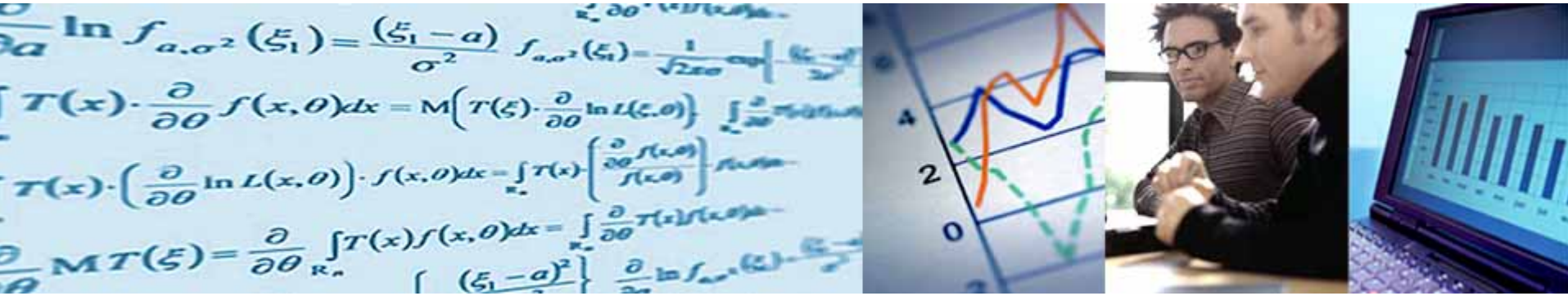
Using External Data in AMA Capital Modeling



Algorithmics, Inc.
March 2008

Algorithmics

Agenda

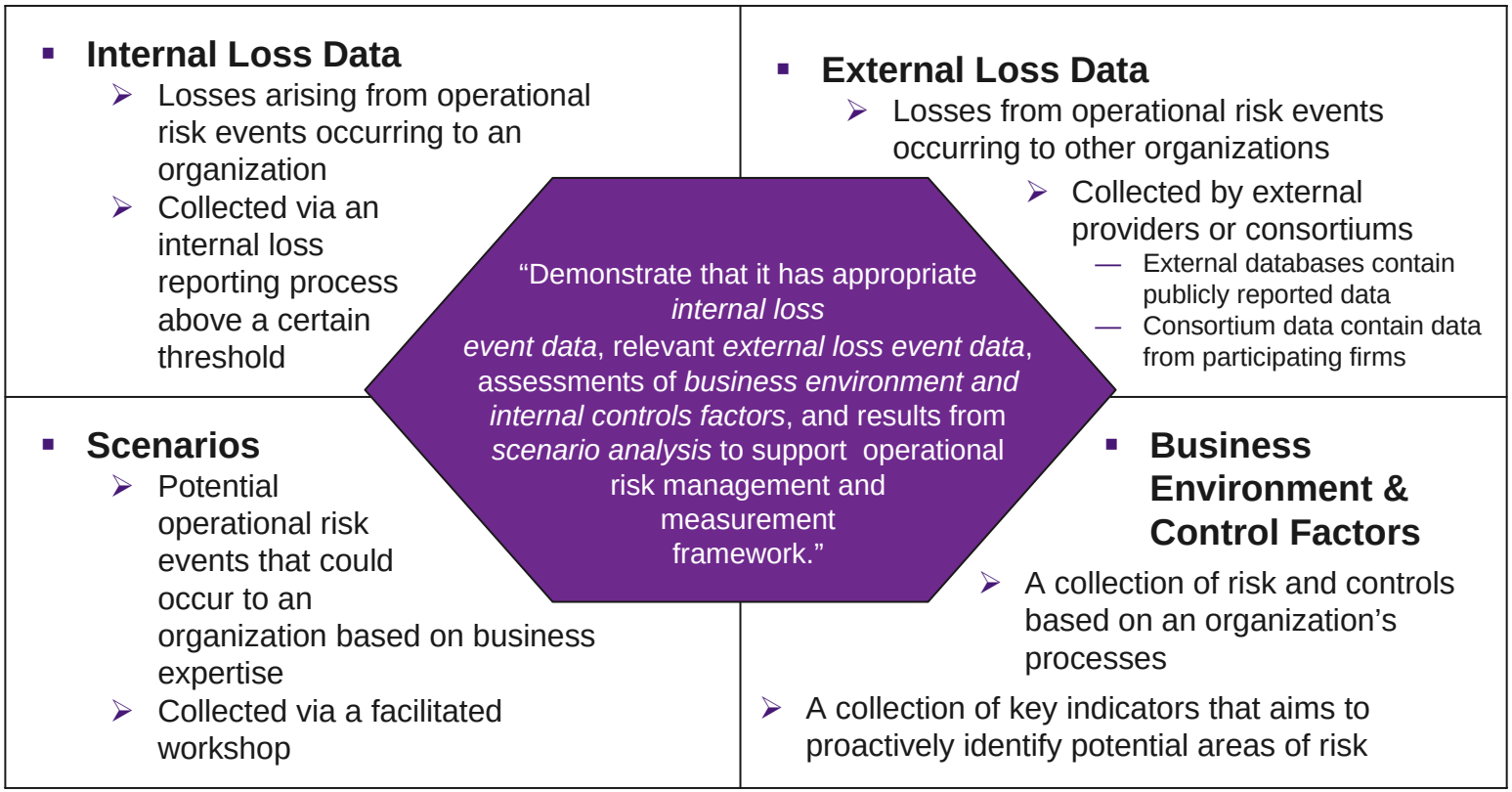
- Regulatory Directive
- Operational Risk Elements
- Algo's External Data
- External Data Uses
- Conclusion

OR Capital Options under Pillar 1

- **Basic Indicator Approach (BIA)**
  - Capital Requirement = 15% of Gross Income
- **The Standardized Approach (TSA)**
  - Capital Requirement = 3-year average $\Sigma \beta$ * Gross Income across business lines
- **Advanced Measurement Approach (AMA)**
  - Modeling to 99.9% Confidence Level over 1-year horizon

Pillar 1 AMA Requirements

- Capital model must consider four elements
- Internal loss data complete for five years (three years, initially)
- Chief Executive sign off on comprehensive waiver application



Challenges to Modeling Operational Risk Capital

Understanding strengths and weaknesses of each of the elements allows for appropriate use within the capital modeling methodology and overall management of operational risk

	Internal Data	External Data	Scenario	RCSA
Strengths	▪ Used to track aggregate performance ▪ "Sum" loss events both up and across	▪ **Public and consortium providers** ▪ **Used for potential events**	▪ Used to identify potential events ▪ Engages business units	▪ Used to escalate risk concerns and control deficiencies ▪ Can be used as an incentive
Weaknesses	▪ Takes a long time to collect sufficient information ▪ Lags business and environmental changes	▪ **Relevance** ▪ **Scaling issues** ▪ **Reporting bias**	▪ Subjective ▪ Can be difficult to "sum" because of overlaps/gaps in scenario generation	▪ Difficult to "sum" risks, especially with qualitative rankings ▪ Subjective ▪ Time intensive

Use ‘Good’ External Data Sets

- Comprehensive as possible in terms of inclusion of loss events
- Accurate and verifiable
- Factual and quantitative information about losses
  - Company name, size, organization type, business unit, product line
  - Dates of event, duration, settlement details, recovery amount, event scaling
- Detailed information on control breakdowns, event triggers and 'lessons learned‘
- Qualitative information about losses
  - Implications for industry, emerging patterns, warning signs, lessons, correlation (size, geography, duration), direct vs indirect losses
- Identify homogeneous data sets

Algo's External Data

- **Over 11,000 real-life loss events**

- **Based on small to large firms**
  - Total Assets: $15million to excess of $100 trillion
  - Total Equity: $5million to excess of $8 trillion
  - # Employees: 18 to over 500,000

- **Across banking, brokerage, Central Bank, corporations, exchanges, government entities, insurance companies, managed funds, professional and other services, and other non-banking entities (energy, retail, healthcare, manufacturing, software, travel and others)**

- **Various geographical areas - Asia, Caribbean, Europe, Middle East & Africa, North/South America, Oceania**

- **Range of losses from $0 amount (near misses) to over $500 million, with extensive and in-depth coverage on losses greater than $500 million**

- **Groups events according to relevant categories including Basel Risk Categories, Basel Business Lines, Loss Detection Sources, Organization Types, Geographies, etc.**

- **Addresses exposures related to corporate governance, strategic issues, market practices and business risk**

Which to use? How to use?

- **Establishing Relevance**
  - **Post-mortem analysis** – identifying ***event trigger***, ***control failings*** and ***contributory factors*** to event - could happen to own organization?
  - **Risk identification** – demonstrating an institution's risk profile is accurate reflection of risks they face - risk identification in context broader than company's experience
  - **New product analysis** – Analyzing by service/product offering type gives integration of risk concerns within new product approval process to help establish proper controls against identified risks when new product is offered

- **Analyzing Impact**
  - Analyzing other organizations' exposure to same risks and using information to more reliably determine own risk exposures

External Data – two roles

Supporting

- Validating Internal Loss Data Models
  - Used to benchmark internal data/models assuming certain characteristics - nature and details of event, size, categorization, are comparable
- Informing Scenario Analysis
  - Provide depth of information to ensure sufficient context to analyze events for scenario generation
  - Use event detail as content to build own internally relevant scenarios
- Assessing Business Control & Environmental Factors
  - Identify potential areas of risk and control failures by analyzing how similar failures occur in own organization

Direct

- Addressing the Paucity of Internal Data
  - Statistical comparisons identify areas where external data used to '**fill in**' gaps
  - Statistical comparisons identify potential ways in which external data could be directly **combined** with internal data
  - Techniques
    - EVT Analysis, Body & Tail, Credibility Theory
    - Synthetic Data Points
    - Scaling
      - Conventional vs. Statistical Homogeneity Scaling
      - Bayesian Approach to derive severity distributions

Supporting Role: Validating Internal Loss Data Fits

Execution

Percentile	Theoretical	Empirical
50.00%	$16,000	$ 15,843
90.00%	$59,000	$ 69,974
99.00%	$308,000	$ 197,707
99.90%	$1,633,000	
99.97%	$3,880,000	

Internal Fraud

Percentile	Theoretical	Empirical
50.00%	$52,130	$ 51,967
90.00%	$173,559	$ 181,236
99.00%	$1,612,250	$ 1,595,018
99.90%	$7,279,000	
99.97%	$15,705,500	

How well does tail extrapolation compare to industry experience?

Risk Type	Theoretical	Internal Loss Max	Loss Amount	Description	Organization
Execution	$3,880,000	$1,500,000	$7,500,000	A US bank lost $7.5M as refunds of overpayments and forgiving underpayments of adjustable rate mortgage payments. It is suspected that errors occurred when the bank incorrectly rounded rates, calculated rates based on the wrong index, or recalculated rates at the wrong time.	Citigroup
Internal Fraud	$705,000	$350,000	$70,000,000	A US bank lost $70M through embezzlement. A banker used fake loan applications to funnel money through client accounts, requesting the loans without the approval of the bank customers.	UBS Warburg

Supporting Role: Informing Scenario Analysis

- Generate scenario examples of potential losses that ‘could happen’
- Used to determine appropriate size of maximum loss event for event type
- Interviews used to assess - control breakdowns, hence operational loss

Event Type	Estimated Annual Number of Events					Max. Single Event Loss	Notes
	20K - 100K	100K - 1MM	1MM - 10MM	10MM - 50MM	> 50M		
EXECUTION, DELIVERY & PROCESS MANAGEMENT							Instructions:
Risk Scenario 1							1. Enter business unit, name and date
Risk Scenario 2							2. Enter estimated # of annual events (enter frequency of less than 1 as decimal)
Risk Scenario 3							
Risk Scenario 4							3. Enter maximum amount of loss that could occur

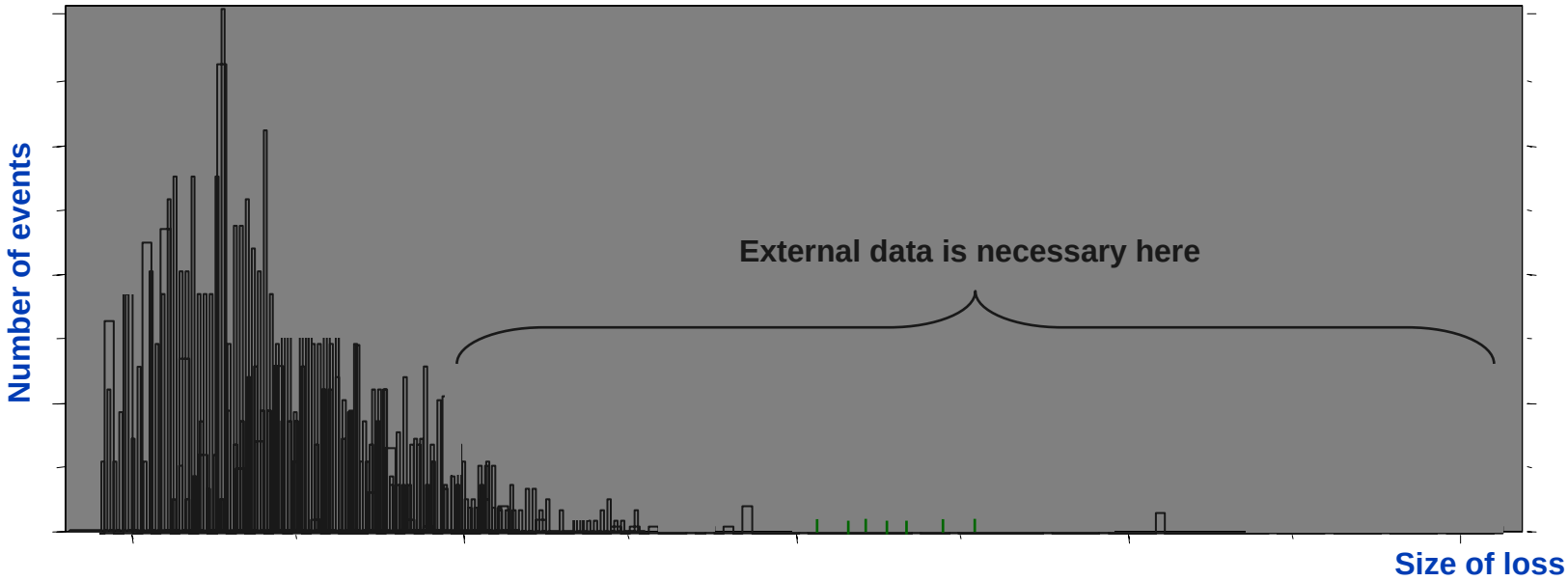
- Frequency and severity distributions can then be created using the output from an organization’s assessments of event types

Supporting Role: Assessing BC&E Factors

- Provides content / context for events used to investigate whether an organization is ….
  - Exposed to similar risks
  - Vulnerable to similar control weaknesses

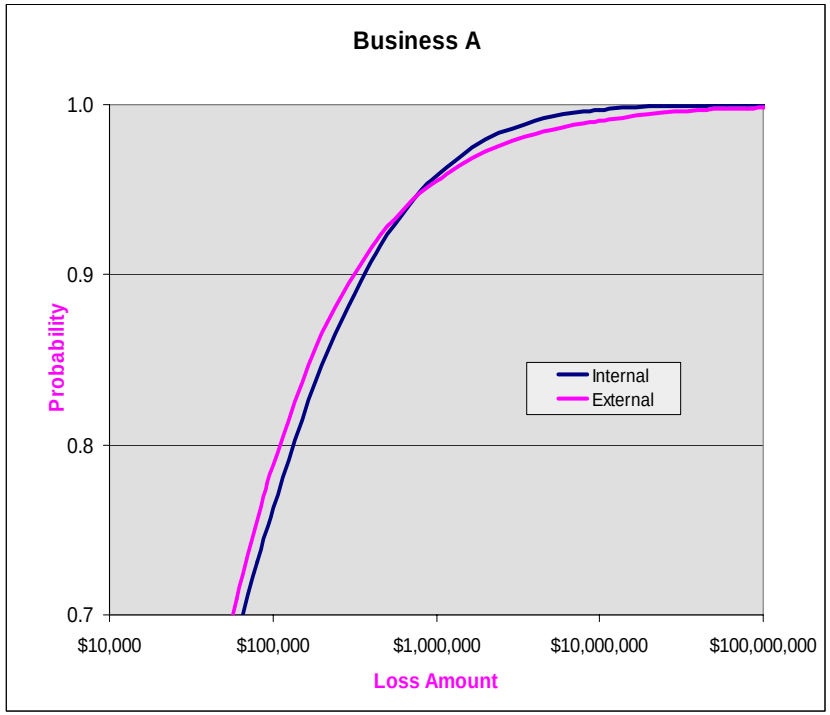
- Provides a way to 'connect the dots' and find commonalities among events
  - Identifying commonalities to identify characteristics of a specific type of event
  - Monitored over time to identify trends that would trigger a similar event to happen
  - Indicators could be internal as well as external (e.g., *Cyclicality of Operational Risk: The Tracking Phenomenon*)

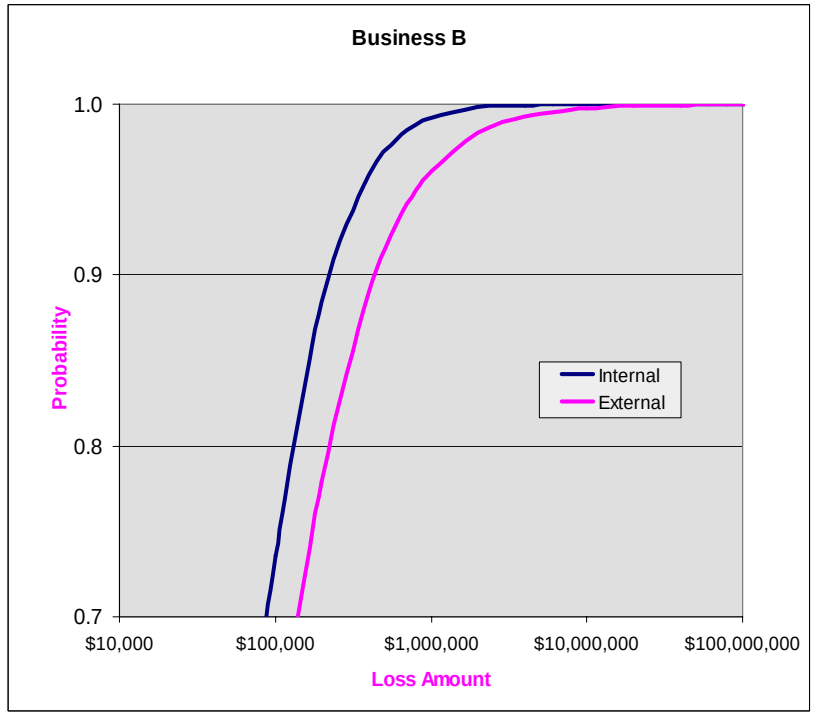
Direct Role: Addressing the Paucity of Internal Data



- **Prerequisite:** Good internal data but missing tail information, good external data to describe tail
- **Assumption:** Set of identified peers and indicates direct relevance to same external data set
- **Modeling Approaches:**
  - **Extreme Value Theory** principles used to complete the loss distribution
  - **Body & Tail** to generate complete risk profile, with internal / external for body tail of distribution
  - **Credibility Theory** to combine components of severity distribution
    - Useful in stress testing impact of use of external data

Direct Role Example

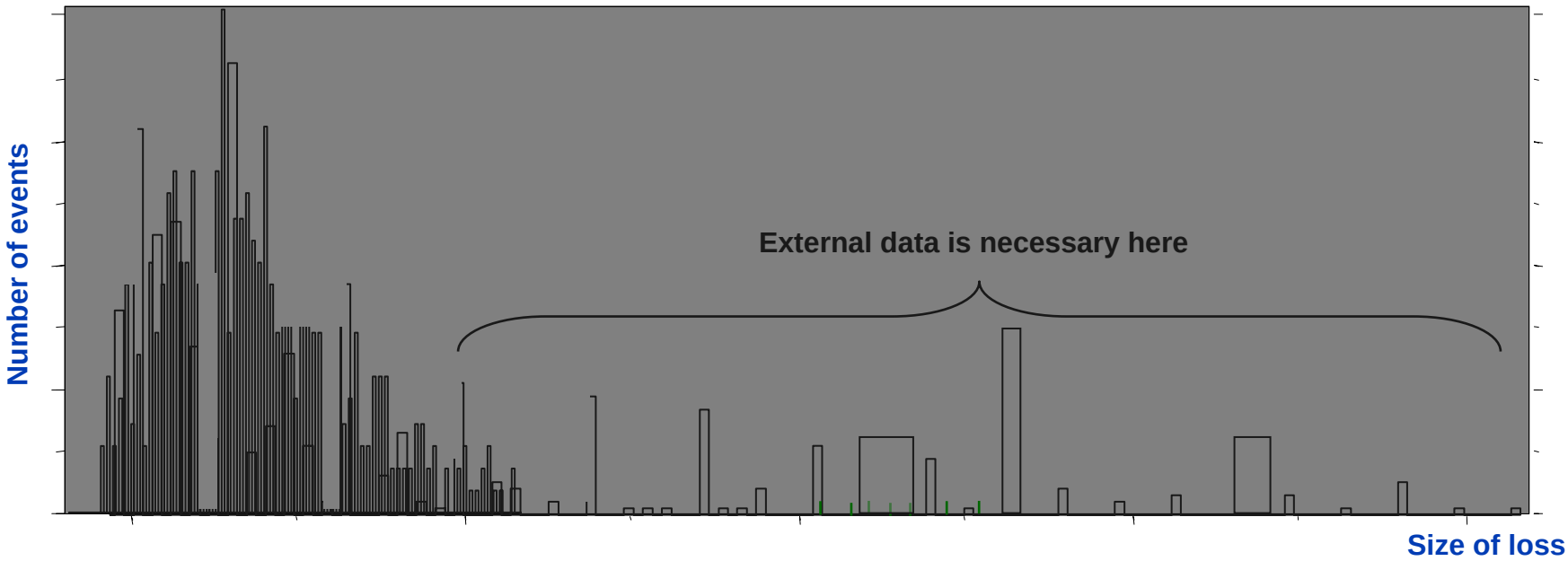




- External and internal data determined from the same distribution, the external data model combined with the internal data model to enhance the distribution
- Credibility Theory

- External is more severe than internal data, EVT and Body & Tail approaches used to combine external and internal data

Direct Role: 'Filling Out' the 'Fat Tail'



- **Prerequisite:** Available internal data but with gaps
- **Assumption:** External data from set of identified peers and direct relevance to same external data set
- **Modeling Approaches:**
  - **Synthetic Data Point** methodology use external data with assigned likelihoods into internal data set and fit a severity distribution across data set
  - Helps address the max loss question by directly incorporating loss amounts that could represent the max loss

Direct Role: Considerations & Issues of Scaling

- **Conventional vs. Statistical Homogeneity**
  - Conventional scaling uses factors commonly representative of organization's characteristics
    - Total Assets, Total Revenue, Equity
    - Linear application may over- or underestimate operational risk capital estimates
  - Statistical Homogeneity scaling depends on similar risk profiles
    - Applicable when data sets have been identified to be 'homogeneous' i.e., similar business activities, same Basel risk category, same Business Line
- **Bayesian Approach**
  - Generalized scaling technique
  - Use of external data to represent general shape of tail of distribution
  - Application of shape factors derived from external data tail to internal data

Conclusion

- External data used directly to address gaps or indirectly for other operational risk elements
- Important to understand drawbacks of external data and use it in most effective and credible manner
- Most effective and efficient use of external data is supporting role to internal data, scenarios and business control & environmental factors
- Direct role opens up other questions about assumptions - both internally to business managers and externally to regulators

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