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Operational Risk and the New Basel Capital Accord

The Federal Reserve Bank of Boston

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Contents

From *Fraud and Errors* to *Rogue Trading* and *E-Banking*

- Insurance has long protected banks against the financial losses resulting from certain operational risks.
- Traditional insurance policies, such as BBB, E&O and D&O policies, are ubiquitous and well tested.

Bankers Blanket Bond
Covers losses arising out of: Employee Dishonesty; Loss of Property (broadly defined) on Premises Or In Transit; Forgery or Alteration, Counterfeit or Forged Securities and Counterfeit Currency.

Errors & Omissions
Covers losses arising out of the alleged negligence of the Insureds (includes subsidiaries, directors, officers, and employees) in the rendering or failure to render professional services

Directors & Officers Liability
Covers losses in which the Directors and Officers are not indemnified by the company and which become legally obligated to pay for a Claim made against them. Some policies cover losses which the Company becomes legally obligated to pay by reason of any Securities Claim.

From *Fraud* and *Errors* to *Rogue Trading* and *E-Banking*

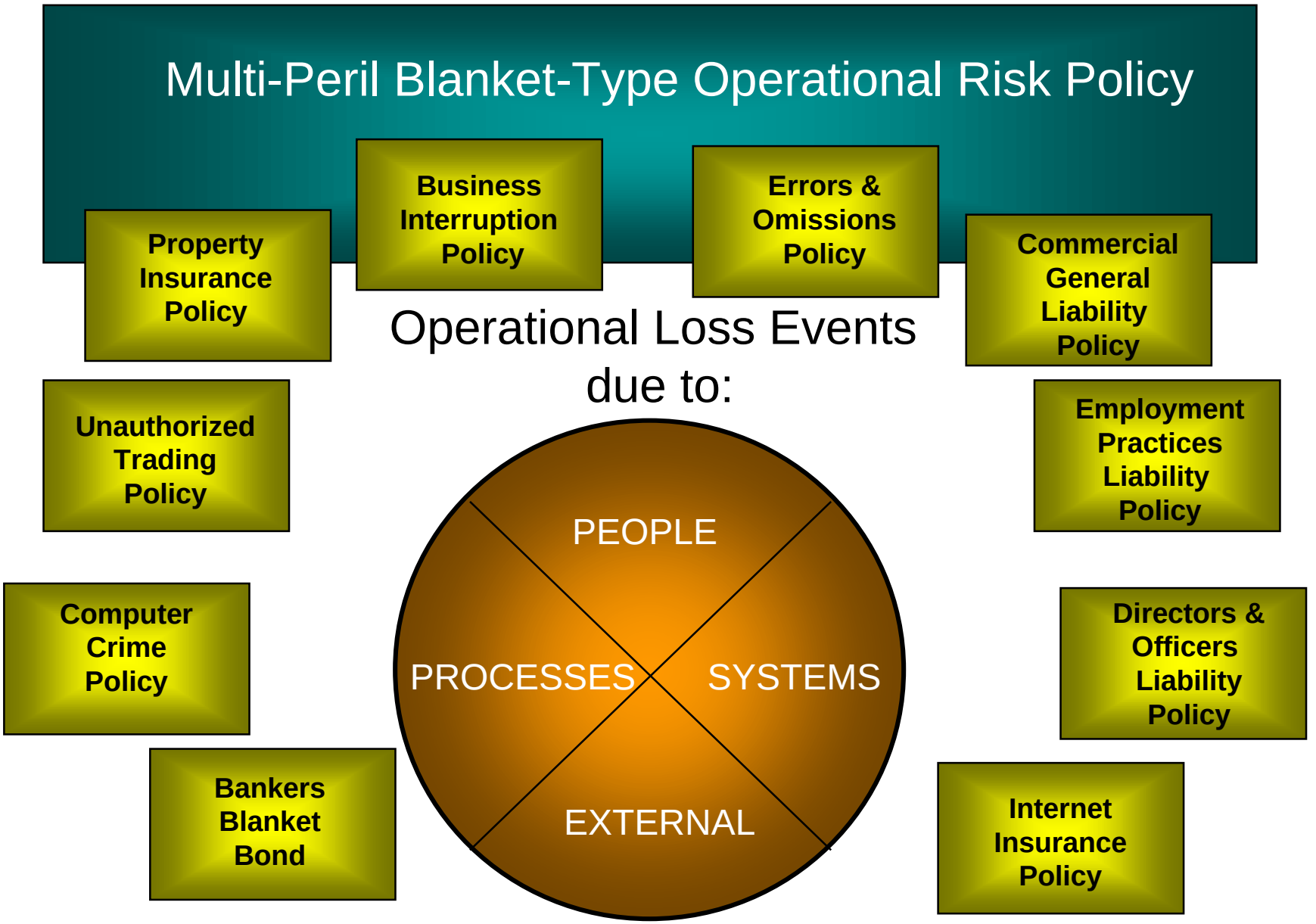
- Underwriters, brokers, and banks work together to design, develop, and place insurance coverages that respond to emerging operational risks.

- Coverage, for example, has recently been developed for rogue trading and e-banking related losses.

Unauthorized Trading
Covers losses arising out of unauthorized Proprietary Trading on the part of a financial institution's employee/traders. An unauthorized trade is an intentional act that exceeds financial Limits; is outside of permitted product lines or not with an approved counter party and is concealed or falsely recorded.

Internet Liability
Covers risks that can result in serious financial impact to vital information assets (including intellectual property), revenues, and exposure to lawsuits from outside constituencies who have been financially harmed through participation or use of the bank's network.

Insurance Coverage of Operational Risks



Mapping of Insurance to Operational Risk Loss Events

MMC Level 1	MMC Level 2	MMC Level 3	MMC Level 4	**Description/ Applicability / Examples**	**First Party Coverage**	**Coverage Issues**	**Consequential Coverage**
	BCBS 1	**BCBS 2**	**BCBS 3**				
People /Product (Internal)							
	Internal Fraud	Losses which results from the misdeeds of a firm's employees which are intended to defraud, misappropriate property, etc.					
		Theft and Fraud : Employee Fraud, Theft, Criminal Acts, Embezzlement, etc.					
			Check kiting	Losses to a firm resulting from cash drawn on or interest paid on accounts which have been credited with fictitious funds through check kiting by an employee	BBB (Bankers Blanket Bond) for first party loss.	If you have a first party loss that does not result in a third party claim/ loss AND you do not have Manifest Intent there would be an argument over coverage under BBB. However, Manifest Intent language can be negotiated on a case-by-case basis.	NA
MMC Level 1	MMC Level 2	MMC Level 3	MMC Level 4	**Description/ Applicability / Examples**	**First Party Coverage**	**Coverage Issues**	**Consequential Coverage**
	BCBS 1	**BCBS 2**	**BCBS 3**				
Process (automated and manual)							
	Execution, Delivery & Process Management	Losses from failed transaction processing or process management					
		Monitoring and Reporting: Failed Internal / External Reporting, Compliance					
			Failed mandatory reporting obligation	Failure to report to a group such as SEC, IRS, ect…	N/A, possible fines and penalties	Fines and penalties excluded, under most insurance contracts	Bank Professional Liability, D&O

Bold indicates the BCBS wording. Wording not in bold came from other sources.

Yellow areas not part of BCBS model (part of MMC and Insurance Industry model).

Blue areas flow with BCBS categorization / taxonomy.

Insurance for Operational Risk: Examples of How it Works in Practice

Example 1: **A number of shareholder class action suits are brought against a large commercial bank.**

Complaints assert that the bank engaged in numerous unlawful practices in order to increase profits, that the bank's earnings had been overstated and were not prepared in accordance with GAAP, and that the bank failed to disclose a number of material events.

Insurance

- Combined D&O, BPL, EPL, Pension Trust Liability, and Bond and Computer Crime policies.

Resolution

Combined suits were settled for $45 MM (excluding defense costs). The bank contributed the first $10 MM (policy deductible). Insurance paid the remaining $39 MM.

Example 2: **A government treasury suffers significant market losses. The entity sues its brokers and financial advisors.**

Complaint asserts that the advisors were negligent in allowing numerous transactions to be made which were at odds with the government entity's trust and fiduciary duties.

Insurance

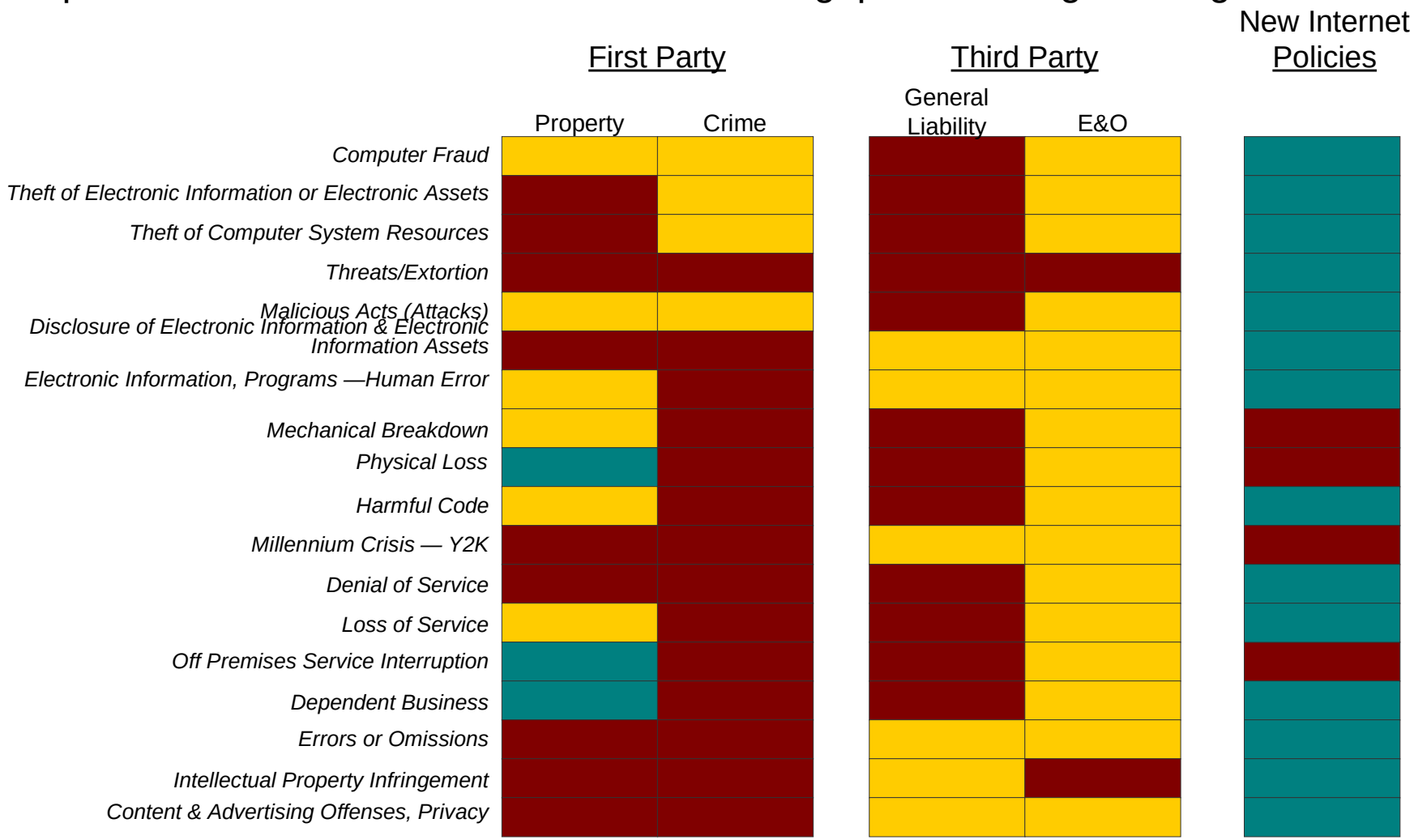
- Professional Liability

Resolution

Suit settled for $58 MM (excluding defense costs). The broker/dealer paid an initial $20 million (policy deductible), and insurance paid the remaining $38 MM.

Evolution of Operational Risk Insurance: Responding to Cyber Risks

- New policies evolve to address new risks and fill gaps in existing coverages



Insurance and the Basel Capital Accord

- Evolution of Operational Risk Insurance
  - Refine & reposition insurance solution to more fully address operational risk
  - Expand coverage to include new/expanding exposures
  - Structure insurance as an effective capital reserve replacement

Insurance and Pillar 2 of the Basel Capital Accord: An Example

- Security self-assessments and third-party assessments required by underwriters provide an important complement to supervisory review of e-banking risks.

- Insurers require self-assessments to initially evaluate insurability for security-related e-business risk.

- These assessments address the security posture of the bank, the level and type of internet activities, operating arrangements, and loss history

- If these results are acceptable, insurers will then require third-party assessments, including penetration testing and scanning.

Insurance and Pillar 3 of the Basel Capital Accord: An Example

- Assessments are used as a screening devices to determine whether a bank meets baseline risk management standards for insurability.

  -If overall score is low, insurers will ask for significant upgrades before issuing a policy.

  -If overall scores are high, insurers may still ask for remediation in targeted areas.

- Answers to the self-assessment can become a warranty to the insurance policy, thereby assuring the integrity of the assessment.

- Recently, premium discounts have become available to “middle market” banks that purchase fully managed security services from pre-approved security firms.

- Because of the nature of e-banking risks, insurers are likely to require third-party assessment before annual renewals for a number of years.

Key Quantitative Criteria for AMA

- Capital charge will equal the greater of (1) the risk measure generated by the bank's internal operational risk measurement system and (2) a floor equal to 75% of the Standardized Approach capital charge.

- Must be able to demonstrate that the risk measure used for regulatory capital purposes reflects a *holding period of one-year and a confidence level of 99.9%.*

- Must capture "low frequency/high severity" events.

- Must be consistent with the scope of operational risks defined by supervisors and supported by loss database systems that are consistent with the definition of operational risk.

- Must be based on a minimum historical observation period of five years. (During an initial transition period, a three year historical data window might be accepted for all business lines and event types.)

Expert Judgments and Qualitative Data Under AMA

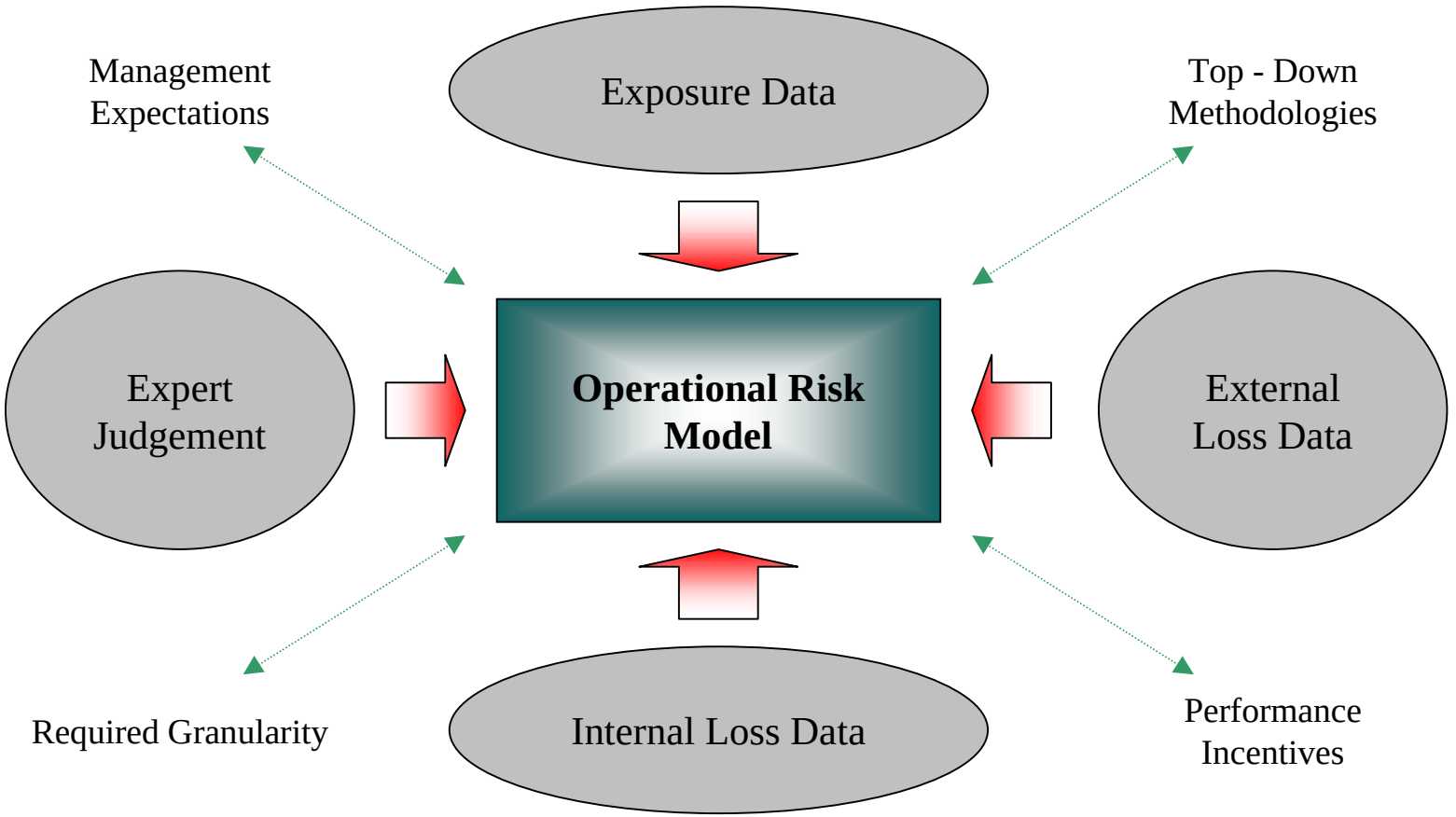
- Procedures in place to scale internal loss data when circumstances such as a significant merger/divestiture or the acquisition/sale of a significant new business line have altered the size of the bank's operations.
- Procedures in place for the use of external data as a supplement to its internal loss data. The use of external loss data would be appropriate only in certain instances.
- Must periodically review its methodologies and data inputs, considering historical data, developments that could alter the relevance of historical data, and emerging industry practice.
- Must identify, document and review exceptional situations in which judgment overrides may be used.
- May use qualitative adjustments or scorecards as a means to allocate and adjust operational risk capital and to recognize in a forward-looking manner possible improvement or deterioration in the firm's operational risk exposure and/or control environment, subject to standards that address the structure, comprehensiveness, and rigor of the adjustment.

On the Use of Qualitative Data in Operational Risk Modeling

- Operational risk modeling must use qualitative data and expert judgment.
  - Needed for loss credibility enhancement and interpretation:
    - When losses are rare or non-existent.
    - When losses exist, but data is unavailable.
    - When data exists, but is sparse:
  - Needed for the assessment of forward-looking changes in risk exposures through risk indicators and other non-loss data:
    - The quality of a bank's control environment is often available only in a qualitative form, e.g. audit scorecard.

- Qualitative data can produce quantitative results.
  - Traditional in insurance actuaries applying subjective judgment.
  - But more objective means are available:
    - Fuzzy set theory allows linguistic variables to be translated into quantitative estimates of frequency and severity.
    - The analytical hierarchy process can provide quantitative relative rankings of risks and their control potential.
    - Bayesian approaches can integrate qualitative and quantitative sources of information.

Risk Modeling and the Use and Collection of Information



- Ideally, a model of Operational Risk will draw from all the information sets available and incorporate new information.

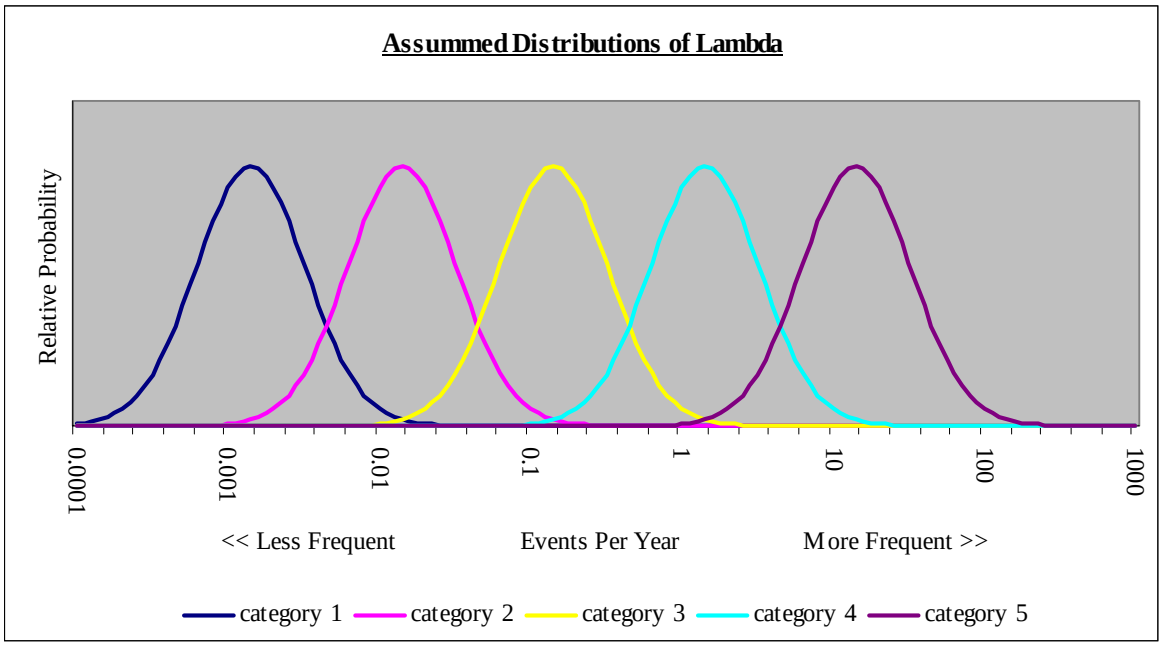
Quantitatively Interpreting Qualitative Scores

Example

For each of a bank's processes, risks are scored on a 1 to 5 scale for frequency and severity (separately) and across risk types.

Scores are *interpreted* as linguistic categories, i.e. fuzzy sets, whose members are risks that exhibit a range of actual behaviors.

The relative proportion of members assumed to exhibit a specific behavior is given by the specified distribution function for that category.

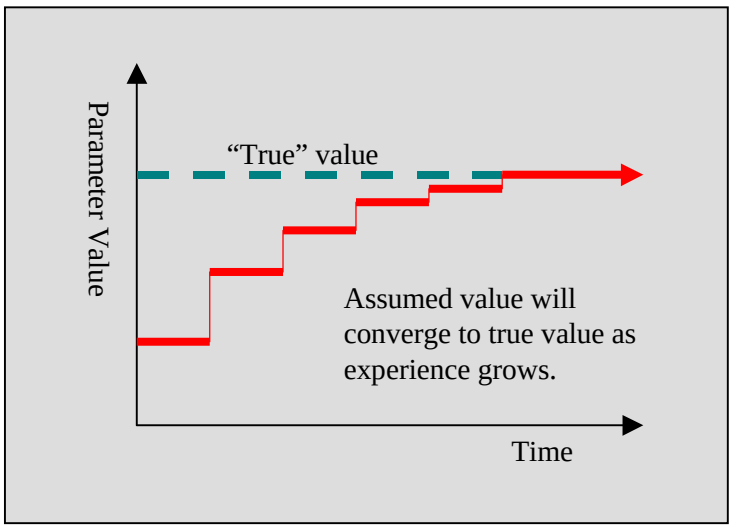


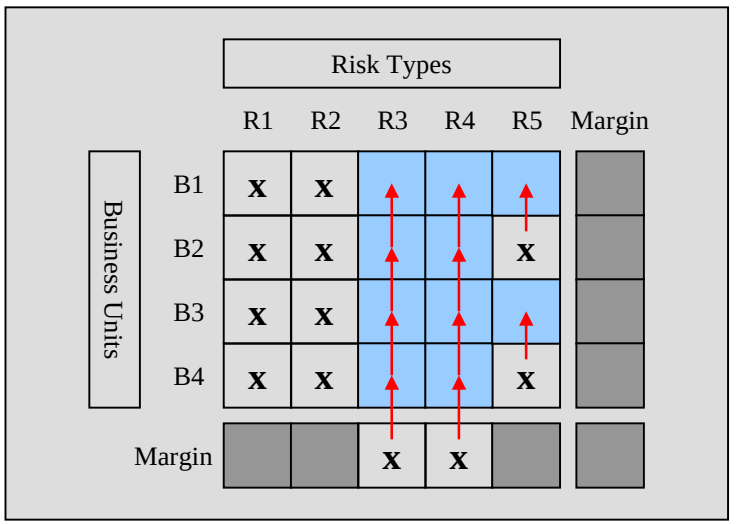
- Qualitative scores are interpreted as sets with "fuzzy" or random members.
  - The terms, "high", "medium", and "low", used in the scoring process do not have exact interpretations.
  - Though experts may not have scientifically precise knowledge, the qualitative information is captured in a structured (auditable) environment. The experiment is repeatable.

- Members of the sets are assumed to have properties distributed as random variables.
  - In example shown, lognormal distributions are used to describe the distribution of member risk's Poisson parameters. This important assumption is made explicit and is (presumably) reasonable.

Adjusting Risk Estimates for New Information

- Bayes Theory: Posterior Parameter Distribution μ Prior Parameter Distribution * Likelihood of Observed Experience





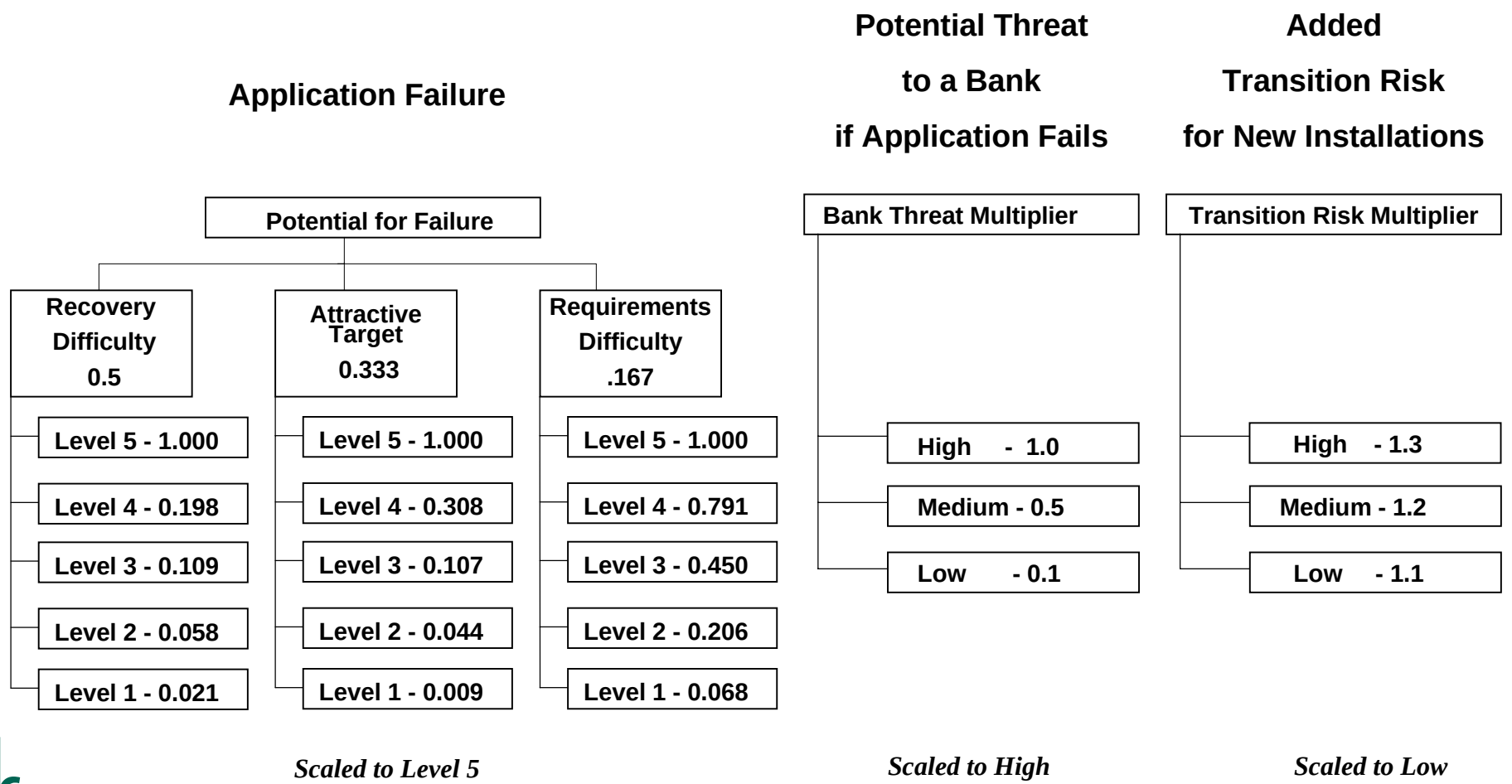
- **Parameter Updating**
  As data is collected and loss experience grows, prior assumptions about risk may be validated and updated objectively and consistently.

- **Credibility Enhancement**
  Within a risk type, rare events may be accumulated across business units to provide a prior parameter assumption that is then applied to cell.

Using Expert Judgment to Quantitatively Rank Relative Risks

- The Analytic Hierarchy Process(AHP) is a multi-attribute decision model designed to accommodate both quantitative and qualitative information.
- Designed to help make decisions where expert judgment is important by breaking decisions down into manageable parts.
- Facilitates the application of expert judgment to isolate those key factors that determine relative risk rankings.
- Results in a quantitative, relative ranking of risks or alternatives being evaluated that can be used directly or as inputs to further analysis.
- Highlights the role of key assumptions and judgments and facilitates the prioritization of data collection efforts.
- Procedure can be documented, results are reproducible, and sensitivity analysis can be performed.

Using AHP to Rank Technology Risk Based on Expert Judgment



Risk, Insurance and Pillar I of the Basel Capital Accord

- Insurance as a substitute for regulatory capital.
  - Recognized implicitly under Basic Indicator and Standardized Approaches through a reduction in the average regulatory capital requirement from 20% to 12%.
  - Recognized explicitly within Advanced Measurement Approaches.

- Recognition of insurance poses some modeling challenges.
  - Specified event types don't fall neatly into current insurance policies.
  - Timeliness and certainty of payment must be modeled.
  - Terms and conditions may not mesh with regulatory framework:
    - Contract renewals and structural changes mid-calendar year.
    - Multiple year policies.
  - The incoherence of traditional risk measures, such as VaR, is exacerbated when applied to risk measured net of insurance.

Ramifications of the Basel Committee's 99.9% Rule

- The BCBS has proposed that "risk measures used for regulatory capital purposes reflect a holding period of one-year and a confidence level of 99.9%."
- Under the 99.9% rule, events are either wholly recognized, or wholly ignored.

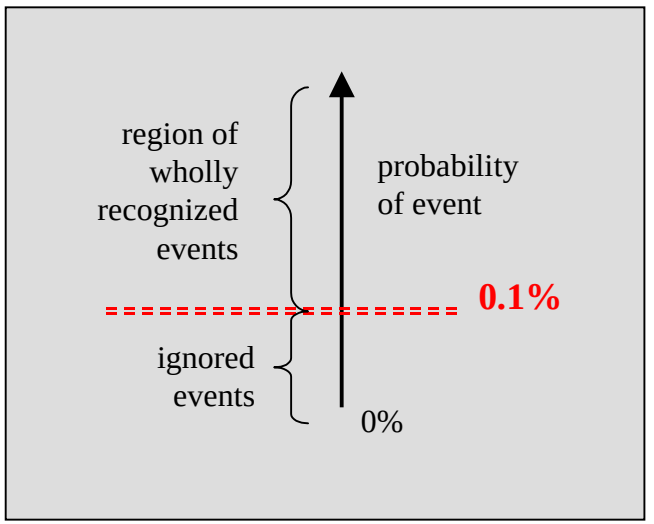
Example

The Bank owns an expensive building that that presents a property risk.

If the probability of the building burning down in a given year is 1:2000, this event will be ignored from the perspective of the 99.9th percentile.

If the probability is determined to be 1:500, then the event will need to be fully and wholly capitalized.

In either case, the potential event will contribute to expected losses.

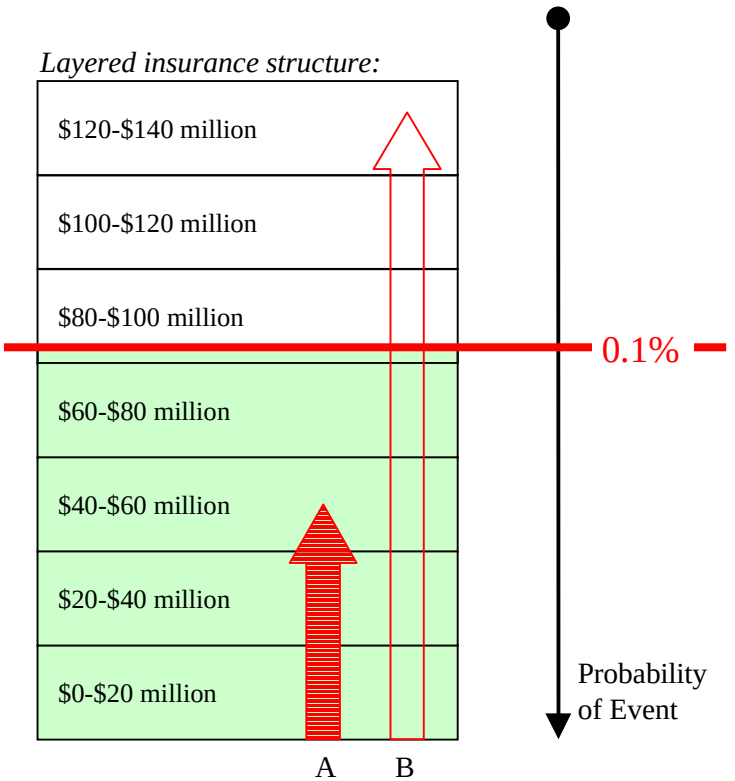


- Different sets of events contribute to the expected value and the 99.9%.
- Defining unexpected loss as difference leads to inconsistency.

The 99.9% Rule and the Value of Excess Layers of Insurance

- Layers of insurance would either be wholly recognized, or wholly ignored under the 99.9% rule.
  - "Working" layers will afford a 1:1 reduction in regulatory capital for insurance limits purchased.
  - "Excess" layers will afford no regulatory capital relief, though they do provide economic value.

- Proper recognition of insurance under Pillar I will require ability to flexibly decompose and reassemble risk.
  - Splitting individual events into insured and non-insured pieces.
  - Combining pieces of many events to determine treatment under aggregate stop loss provisions.



Example

High excess layers, responding to only the most infrequent and highest severity events, are not counted under 99.9% rule.

A Selection of Risk Measures for Capital at Risk

- **Standard deviation = σ**
  - Define the mean = E[X] = the expectation of a random variable X
  - then the variance = σ^2 = $\mathrm{E}[(x\text{-E}[X])^2]$

- **Down-Side Variance (Semivariance)**
  - conditional variance = E[$(x\text{-E}[X])^2$ | $x \geq \text{E}[X]$]

- **Value at Risk (VaR)**
  - also known as “Confidence Level” or a percentile of a distribution.
  - VaR_α = a such that Pr{ $x \leq$ a } = α

- **Average Loss Over Threshold (LOT)**
  - LOT_u = E[$\boldsymbol{x}$ | $\boldsymbol{x}$ > u]
  - here u is often taken to a (large) constant
  - or occasionally u = VaR_α for some α.

- **Average Worst Case (Block Maxima)**
  - n-year block maxima = μ_n = E[max(x_i ; i=1,2,…,n)] where the x_i are iid random draws from the distribution function F(x).

Coherent Risk Measures for Capital at Risk

- Desirable properties for a risk metric include:
  - Translation Invariance: $\rho(X+\alpha) = \rho(X)+\alpha$
  - Subadditivity: $\rho(X+Y) \leq \rho(X) + \rho(Y)$
  - Positive Homogeneity: $\rho(\lambda X) = \lambda\rho(X)$
  - Monotonicity: $[X \leq Y] \rightarrow [\rho(Y) \leq \rho(X)]$

- Value at Risk (VaR), defined as a percentile of a return distribution, is not coherent as it fails to be subadditive:
  - $\Pr\{A\} = .02 \Rightarrow \text{VaR}_{95\%} = 0$
  - $\Pr\{B\} = .04 \Rightarrow \text{VaR}_{95\%} = 0$
  - but then (assuming independence) $\Pr\{A \text{ or } B\} = .0592 \Rightarrow \text{VaR}_{95\%} > 0$

- Two important examples of coherent risk measures include:
  - standard deviation = σ.
  - block maxima = $\mu_n = E[\max(x_i ; i=1,2,\ldots,n)]$ where the x_i are iid random draws.

Performance of Measures on a Sample of Risks

Example

Each column represents a risk with specified loss given event (impact) and probability of event. The parameters have been chosen to provide for a common expected value, but with progressively rare occurrence. Multiple events are disallowed, and a random scenario will show either 0 or 1 event. A variety of risk measures are calculated for each risk.

impact ($) of event	$200	$500	$1,000	$2,000	$5,000	$10,000	$20,000	$50,000	$100,000
probability of event	50.0%	20.0%	10.0%	5.0%	2.0%	1.0%	0.5%	0.2%	0.1%
expected value	100	100	100	100	100	100	100	100	100
standard deviation	100	200	300	436	700	995	1,411	2,234	3,161
semivariance$^{0.5}$	100	400	900	1,900	4,900	9,900	19,900	49,900	99,900
95% VaR	200	500	1,000	0	0	0	0	0	0
peak over 95% VaR	200	500	1,000	2,000	2,000	2,000	2,000	2,000	2,000
block maxima (n=20)	200	494	878	1,283	1,662	1,821	1,908	1,962	1,981

- Only the standard deviation and block maxima provide coherent view of risk.
  - Disadvantage of standard deviation is that it is sensitive to both ends of a distribution, i.e. it is not specifically focused on the down-side tail events.
  - Block maxima performs best, as demonstrated by extreme value theory.

Sensitivity Testing of Capital at Risk Measures

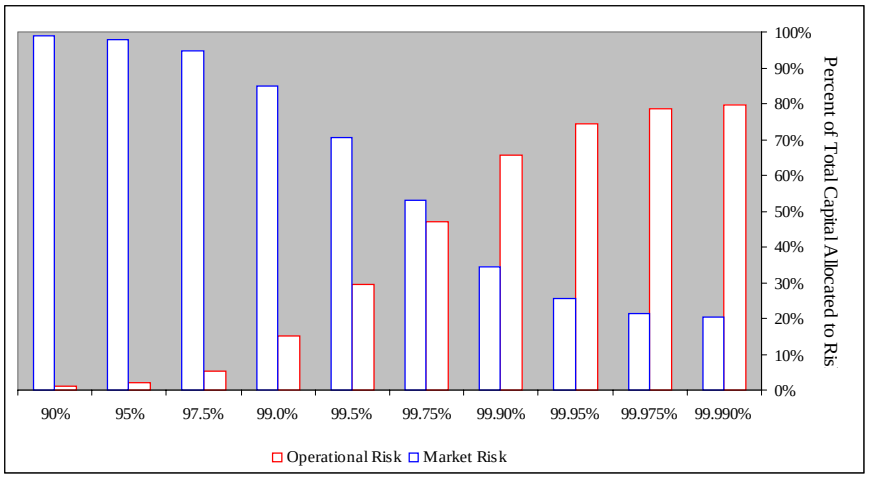
Example

Risk 1: ***Operational/Financial***
with terminal value: Lognormal(17, 0.6)
nominally large; relatively thin tail.

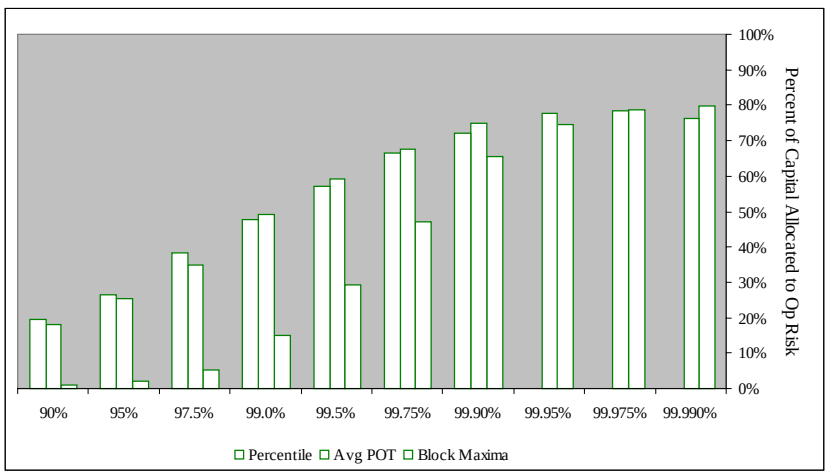
Risk 2: ***Operational/Hazard***
frequency: Poisson(0.2)
severity: Truncated Pareto(1e5, 0.7, 1e9)
classic low frequency high severity

Challenge is to allocate capital between the two risks.

Sensitivity of VaR allocation to α:



Sensitivity of allocation to Op Risk under three metrics:



Conclusions

↳ Allocation of Capital by VaR metric is highly sensitive to selected security threshold.

↳ Of the three metrics compared, allocation by block maxima metric is least sensitive to selected security threshold.