Quantifying operational risk

CAS: seminar on reinsurance

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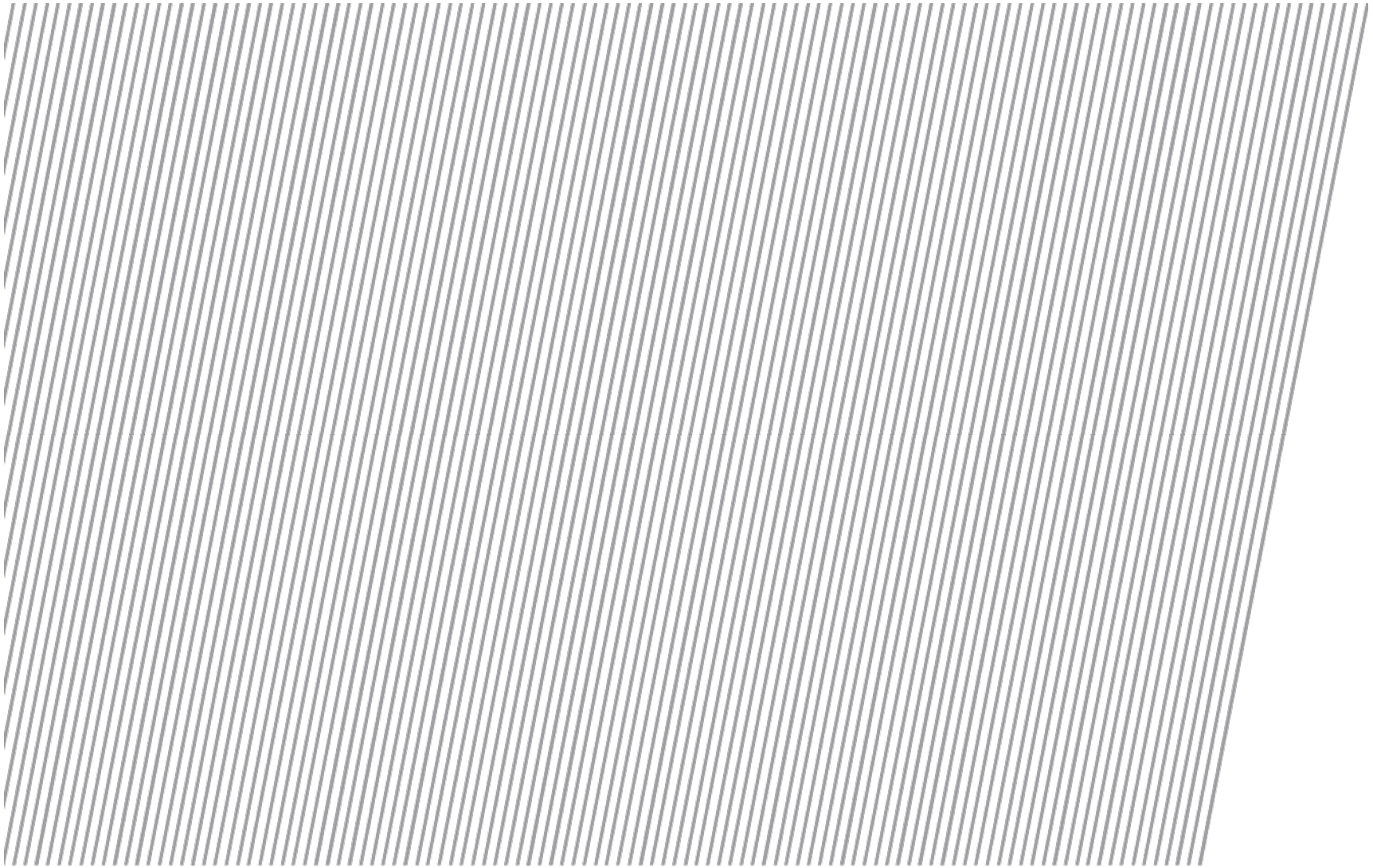
Operational risk

- Operational risk overview
- Operational risk framework
- Methodologies
- Quantification
- Risk mitigation
- Concluding remarks

Operational risk overview



Overview

- Basel II and Solvency II definition of operational risk:

  "The risk of loss resulting from inadequate or failed internal processes, people and systems or from external events".
  (including legal risk, excluding strategic and reputational risk).
- Operational risk is arguably the least managed risk for a Property & Casualty (P&C) company to date.
- Capital charges range from 5% – 30% depending upon:
  - The complexity of the company.
  - The robustness of overall risk management.
- Most of operational risk work to date has been done with Basel II (99.9% one year VaR) and Solvency II (99.5% one year VaR).
- A Solvency II operational risk assessment for internal model approval is being developed.

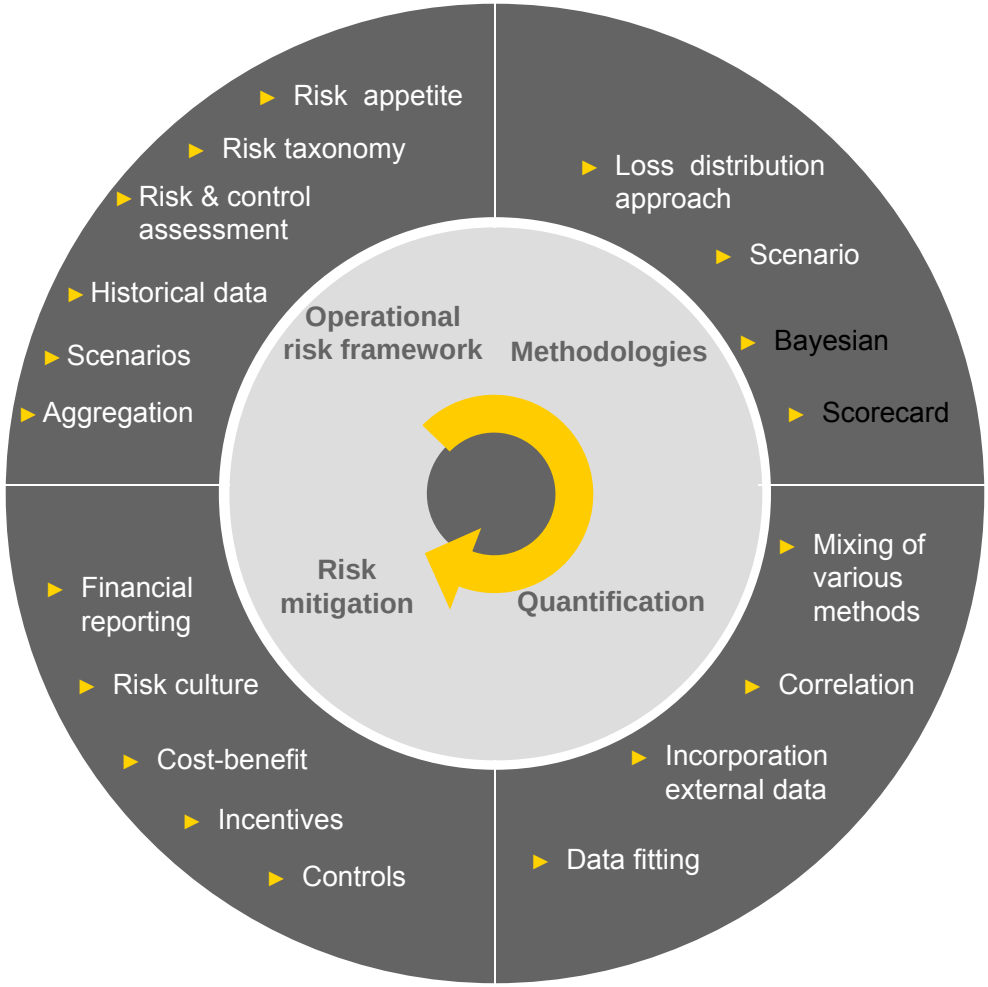
Motivation: why should you care?

- Risk identification and mitigation:
  - Can be a meaningful yard stick to raise the awareness of senior management to the existence and magnitude of operational risks
  - Can lead to meaningful risk mitigation
  - Can help improve the control environment
  - Can make underlying risks within the company more transparent
- Recognizing risks, even if “soft,” has value. Leaving the line “blank” is perhaps an even greater risk.
- Looking at risk adjusted returns can help management prioritize high economic value added (EVA) projects.
  - Ideal but a long way to go.

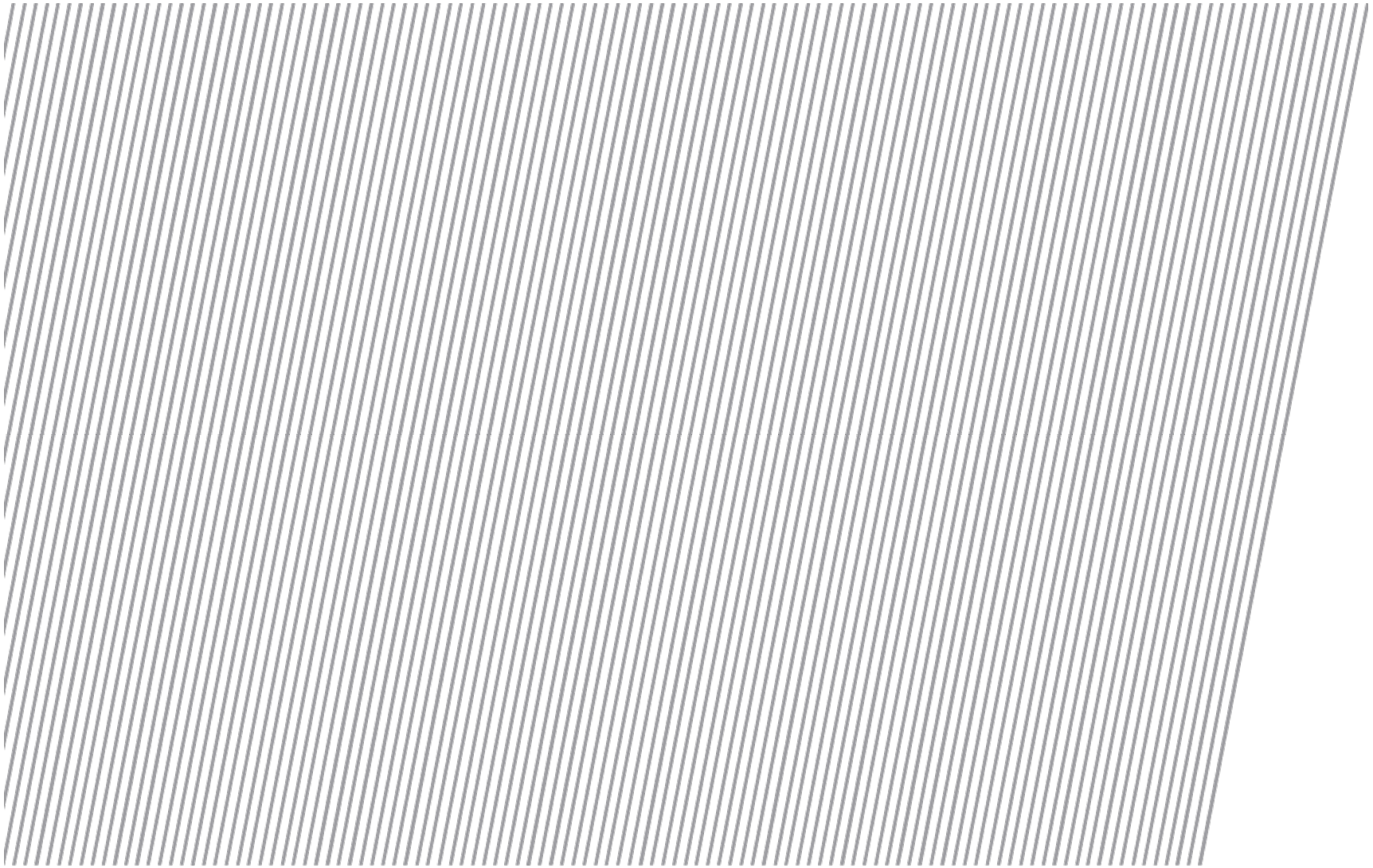
Motivation: why should you care?

- Pricing – not necessarily a driver
  - Favorable : operational risk helps minimize parameter uncertainty, which should be the risk load reflected in pricing
  - Unfavorable: excessive capital charges that others in the market are not reflecting may not be practical
- Regulatory – not pressing in the US
- Consider cost benefit analysis: spending $30m to reduce/mitigate a $10m charge is not worth the effort. Try more cost effective and quicker top-down approaches first!

Successful operational risk implementation



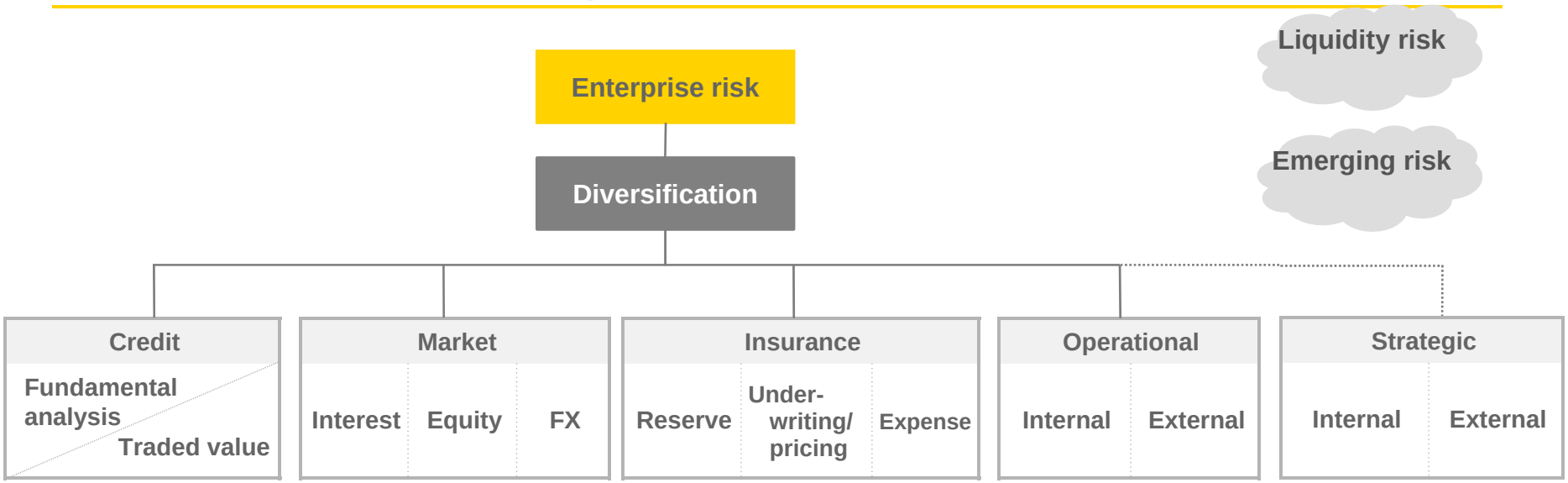
Operational risk framework



Taxonomy

- There is a need for greater consistency, transparency and clarity on which “risks” are being managed.
- The taxonomy should be mutually exclusive (i.e. no double counting), exhaustive (no gaps), yet manageable.
- Solvency II Level 1 operational risk taxonomy is the same as Basel II Level 1.
- Level 2 for both Solvency II and Basel II are likely to be the same with differences at Level 3.

Enterprise risk taxonomy: Basel II, Solvency II



The risk of loss caused by a counterparty's inability to repay debt.

The risk of loss caused by fluctuations in market value of equities, debt or derivative contracts.

The risk of loss caused by adverse development in reserves, inaccurate pricing/underwriting or high expenses.

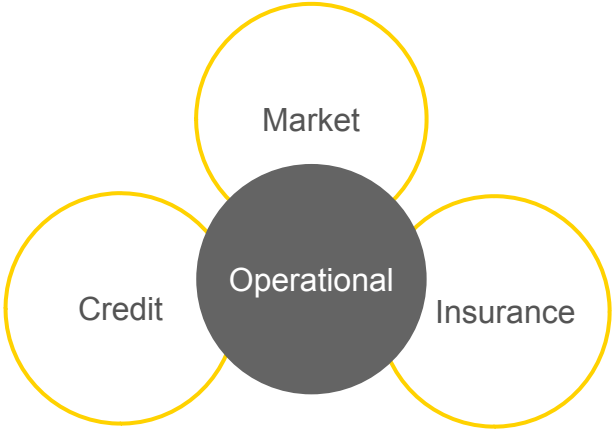
"The risk of loss resulting from inadequate or failed internal processes, people and systems or from external events" (including legal risk, excluding strategic and reputational risk).
Basel II and Solvency II definition

The risk of loss caused by changes in regulatory/political environment, rating agency assessments, customer demands, competition, "bad judgment" and reputation.

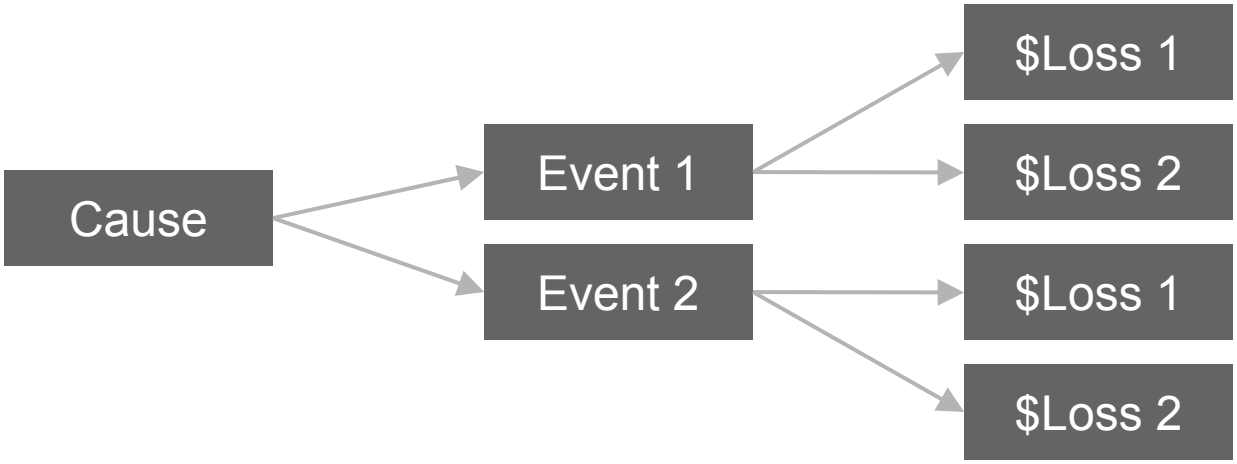
Operational risk taxonomy:
Level 1, 2 – Solvency II, Basel II, Operational Risk Insurance Consortium (ORIC)

Event – Type Category (Level 1)	Categories (Level 2)
I. Internal fraud	1. Unauthorized activity
	2. Theft and fraud
II. External fraud	1. Theft and fraud
	2. Systems security
III. Employment practices and workplace safety	1. Employee relations
	2. Safe environment
	3. Diversity and discrimination
IV. Clients, products and business practices	1. Suitability, disclosure and fiduciary
	2. Improper business or market practices
	3. Product flaws
	4. Selection, sponsorship and exposure
	5. Advisory activities
V. Damage to physical assets	1. Disasters and other events
VI. Business disruption and system failures	1. Systems
VII. Execution, delivery and process management	1. Transaction capture, execution and maintenance
	2. Monitoring and reporting
	3. Customer intake and documentation
	4. Customer/client account management
	5. Trade counterparties
	6. Vendors and suppliers

Operational risk loss emergence



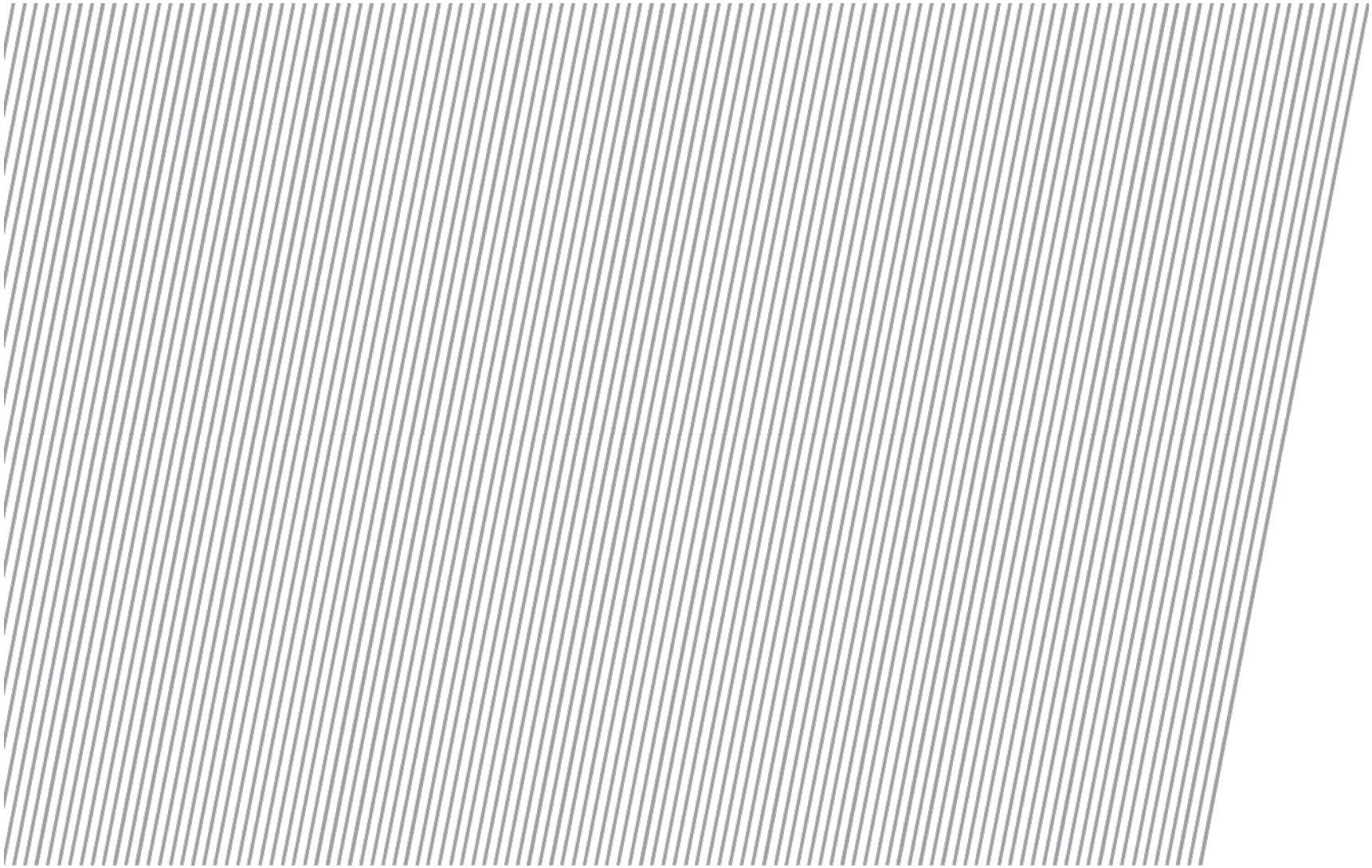
- Operational risks can permeate all aspects of the risk universe and manifest themselves in market, credit, and insurance losses.
- It is important to distinguish between “cause”, “event” and “loss”.
- Mitigation
  - It is best to focus on underlying root “causes”.
  - Establish effective controls to mitigate frequency and/or severity of events.



Boundary problem

- Difficulty establishing non-overlapping taxonomy can lead to double counting.
- A few things to consider:
  - Capital charge
    - Calculate the entire operational risk charge and apply a haircut for losses that are captured in other categories (i.e., insurance, market, credit). These are usually small, routine losses.
  - Risk identification and mitigation
    - The magnitude of the operational risk charge can be a meaningful yardstick to raise the awareness of senior management to the existence of operational risk and to serve as a mitigation tool.
  - Portfolio and risk steering: capital allocation, including operational risk charges lead to informed portfolio steering.
  - Focus on marginal and/or unexpected losses that are not adequately captured in the other risk categories.

Methodologies



Define the granularity of modeling

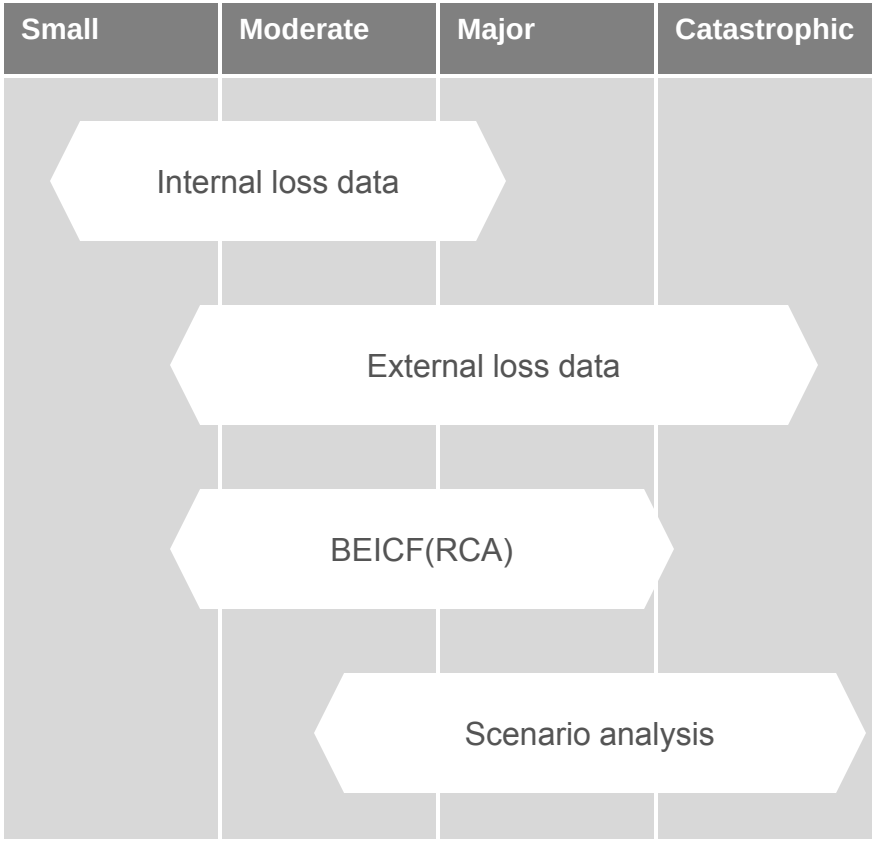
- Ideally, consider intersection of business units and taxonomy
- Considerations: data quality (internal/external), purpose, complexity of the firm, target audience

	Solvency II Level I event categories						
Cell matrix	Internal fraud	External fraud	Employ-ment practices and workplace safety	Clients, products and business practices	Damage to physical assets	Business disruption and system failures	Execution, delivery and process manage-ment
Business lines							
Claims	Cell 1	Cell 2	Cell 3	Cell 4	Cell 5	Cell 6	Cell 7
Reinsurance purchasing	Cell 8	Cell 9	Cell 10	Cell 11	Cell 12	Cell 13	Cell 14
Underwriting LOB* 1	Cell 15	Cell 16	Cell 17	Cell 18	Cell 19	Cell 20	Cell 21
Underwriting LOB* 2	Cell 22	Cell 23	Cell 24	Cell 25	Cell 26	Cell 27	Cell 28
MGA** unit 1	Cell 29	Cell 30	Cell 31	Cell 32	Cell 33	Cell 34	Cell 35
Accounting	Cell 36	Cell 37	Cell 38	Cell 39	Cell 40	Cell 41	Cell 42
Legal	Cell 43	Cell 44	Cell 45	Cell 46	Cell 47	Cell 48	Cell 49
Marketing	Cell 50	Cell 51	Cell 52	Cell 53	Cell 54	Cell 55	Cell 56

*Line of Business
**Managing general agent

Basel II operational risk guidelines

- The current guidelines, as set out in International Convergence of Capital Measurement and Capital Standards, June 2004 (the Basel Accord), provide a set of qualitative and quantitative criteria that must be met for AMA approval:
  - Internal data
  - External data
  - Business environment and internal control factors (BEICF); risk and control assessment (RCA)
  - Scenario analysis
  - Satisfy the use test, i.e., be integrated into the risk management framework
- The guidelines do not dictate how this information should be used or what weights should be placed on the various information.
- For each “cell”, likelihood (i.e., frequency) and severity distributions are generated using the inputs above.



Two methodologies used in practice: loss distribution approach

- Loss distribution approach (LDA):
  - Uses internal data and external data which is then validated by scenarios
  - Can be either top-down or bottom-up
    - Top-down: apply judgment to overall distribution factor using RCA
    - Bottom-up: focus on granular residual risks after RCA
  - Is backwards looking
  - Usually validated by current/forward looking information

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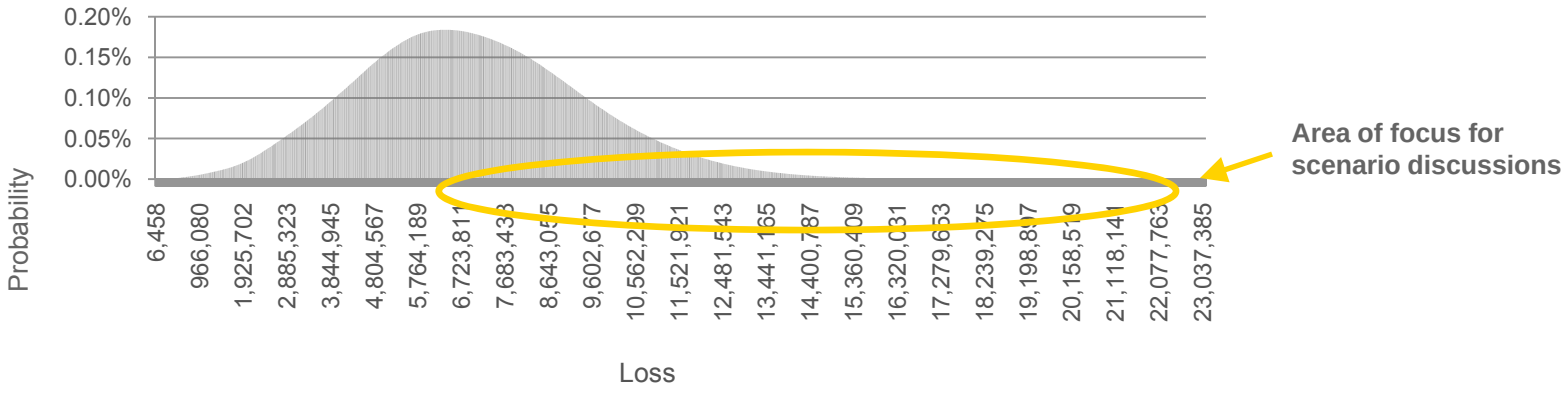
Two methodologies used in practice: loss distribution approach (con't)

- Pros:
  - LDA uses actual data.
  - It is easy to explain. Has a natural relationship to external data.
  - If RCA process is well documented and all events are well identified, it can reveal significant aggregation exposure.
- Cons:
  - There may be issues with relevance and mixing of external data.
  - There may be issues with scaling of internal data.
  - A lack of extreme events can lead to a tendency to focus on the body of the distribution.
  - Bottom-up approach can be time consuming and aggregation can be an issue.

Two methodologies used in practice: scenario approach

- Scenario approach
  - Facilitated scenario workshops conducted with the business units, risk managers and subject matter experts to calculate frequency and severity of operational risk loss for their respective business unit.
  - Forward looking, top-down approach is validated by historical data, (internal and external) within the current RCA environment and audit findings.
  - Smaller, more frequent losses can be reviewed using internal/external loss data.

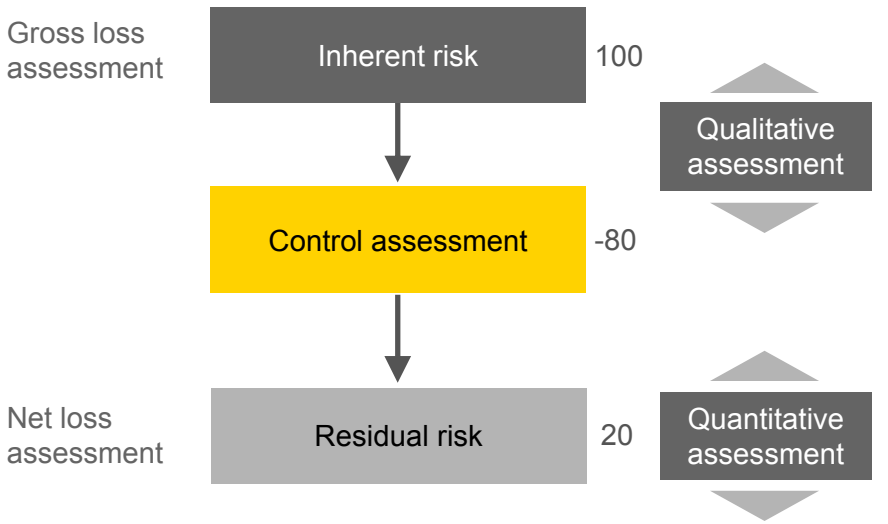


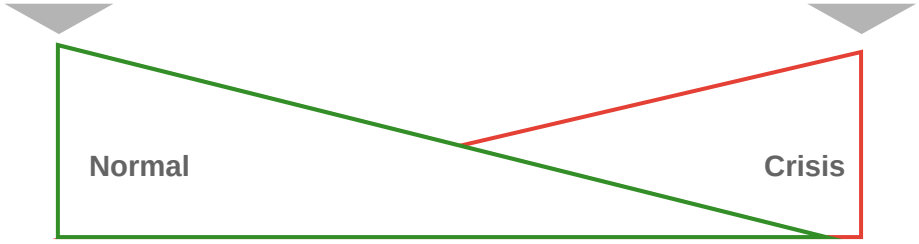
Two methodologies used in practice: scenario approach (cont'd)

- Pros:
  - It is forward looking and responsive to business changes.
  - Close business involvement raises risk awareness.
  - It is flexible to adjust to specific business needs.
  - It is based on "what if" questions which forms a good basis to perform stress testing.
  - It supports prioritization of risk management and mitigation actions.
  - It should be used for risk management purposes, but can also be used for capital setting.
- Cons:
  - It is subjective and can be difficult to explain without well thought out and well documented material.
  - Scenario creation and definition is time consuming.
  - Assessment of risk on residual level can be made only after direct linkage of risk and controls.
  - Estimating extreme severity and frequency is difficult.

Risk and control assessment – net vs. gross view

- In general, the risk assessment should be done on:
  - Inherent risk basis (gross) and
  - Residual risk basis (net)
- Risks have to be determined under normal scenarios as well as crisis scenarios (i.e., expected losses and worst-case scenarios have to be estimated).
- Skill set – modelers vs. RCA experts
  - Q: “What are your controls?”
  - A: A blank stare.
  - Q: “How do you know that you paid all claims today?”
  - A: A list of activities that contain the control (and then you decipher a bit).





Structure of risk and control assessments

1a Top-down scoping

	2 Risk identification	3 Control identification	4 Risk assessment	5 Control assessment	6 Measures

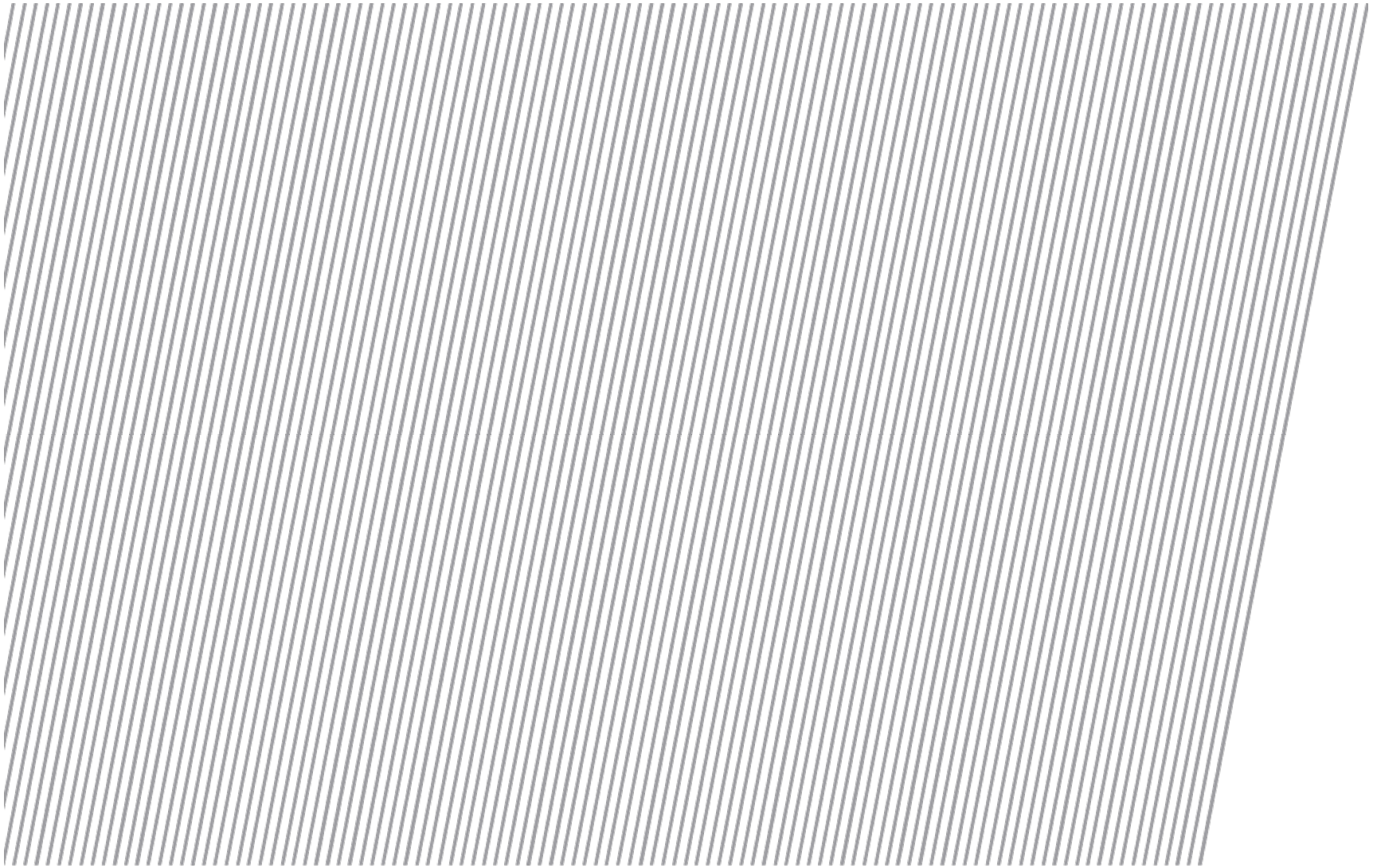
Financial reporting	▸ Risk description
	▸ Triggers/causes
	▸ Consequences
	▸ Risk taker
		▸ Control guideline:
		  ▸ Control description
		  ▸ Control frequency
		  ▸ Control designer
		  ▸ Control performer
		▸ Control types:
		  ▸ Manual
		  ▸ IT dependent manual application
			▸ Financial loss impact
			▸ Financial statement impact
			▸ Reputational impact
				▸ Control design
				▸ Control performance
					▸ Risk steering
					▸ Risk mitigation / control improvement measures

Compliance					
Operations					

1b Bottom-up RCA

7. Integrated reporting

Quantification



Loss distribution approach

- Internal data
  - Frequency: fit two distributions together using Method of Moments
    - Choice 1: Poisson (one parameter)
    - Choice 2: either Neg Bin (mean < var) or Bin (mean > var)
    - Pick the “distribution”: is the extra parameter worth it? (Use the Likelihood Ratio
    - Test.)
  - Severity: use Maximum Likelihood Expectation (MLE) on spliced distribution
    - First 90%: high frequency/low severity losses
      - Consider Gamma, Weibull or Lognormal
      - Use Kolmogorov – Smirnov goodness of fit to choose
    - Last 10%: low frequency/high severity losses
      - Use generalized Pareto – the “peak over threshold” version of Extreme Value Theory (EVT)
      - Others: multivariate “g – and – h distribution”

Loss distribution approach

- External data
  - External data can be useful but must be incorporated with care.
  - There are two types of data: consortium data (e.g., ORIC) and public data.
    - Both are biased upward due to the “threshold” problem (public data being most biased) and makes the threshold itself a random variable.
      - Willingness to report losses above the “threshold”
      - Inflation
    - Near misses are hard to record.
    - Adjustments must be made for scale, threshold and relevance
  - Incorporate external data using the methodology described by Baud, Frachot and Roncalli in 2002 and MLE.

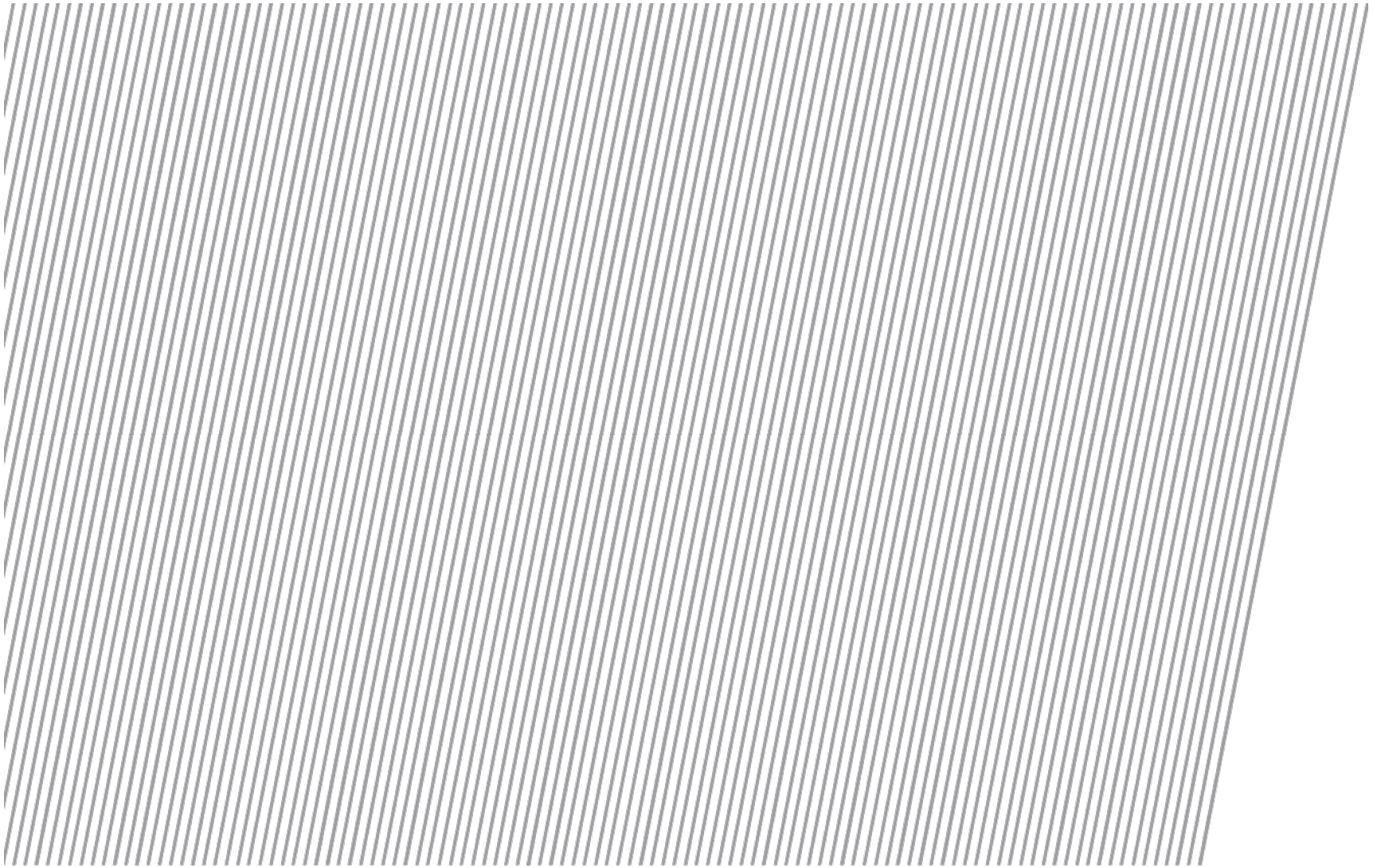
Scenario approach

- Fit a frequency distribution
  - Average loss frequency (AF) is the annualized average estimate for frequency.
  - Worst case (extreme) loss frequency (WF) is the worst case frequency at the specified confidence level.
  - Confidence level target probability is used to quantify worst case frequency, e.g., 99.5% (1/200 year event).
- Fit a severity distribution
  - Average loss severity (AS) is the average impact of loss severity within the context of the current control environment.
  - Worst case (extreme) loss severity (WS) is the worst case severity at the specified confidence level.
  - Confidence level target probability is used to quantify the worst case frequency, e.g., 99.5% (1/200 year event).
- Worst case scenarios are usually no greater than 1/100 year events, which are extrapolated into the tail.

Loss distribution generation mixing and aggregation

- LDA and scenario distributions are generated using:
  - Monte Carlo simulation
  - Fast Fourier Transform
    - Begin by discretizing the severity distribution using Matching Mean Method.
- Each “cell” is characterized by some mixing of LDA and scenario approaches
  - Current regulatory frameworks do not give guidance on weights.
  - Use of business judgment is required.
  - Depends on quality of internal data, complexity of business, and sophistication and preferences of the audience.
- Aggregation across cells
  - Requires correlation matrix.
  - Monte Carlo simulation based on a Gaussian Copula.

Risk mitigation



Risk mitigation:
Key components

- Financial reporting:
  - Ability to aggregate various risk measures in a meaningful fashion
    - Key for bottom-up approaches
  - Map risks back to causal matrix
  - IT systems/databases/data capture
  - Risk reporting:
    - Events over a certain threshold are reported to management.
    - What action has management taken?
  - Use insurance for mitigation. Qualified insurance should be considered.
- Culture: embrace or penalize “whistle blowers”?
- Cost benefit: even if costs outweigh benefits, it is useful to know a risk exists.
- Incentive: excessive risk taking vs. incentives based on risk adjusted returns.
- Controls: implement a system of checks and balances.

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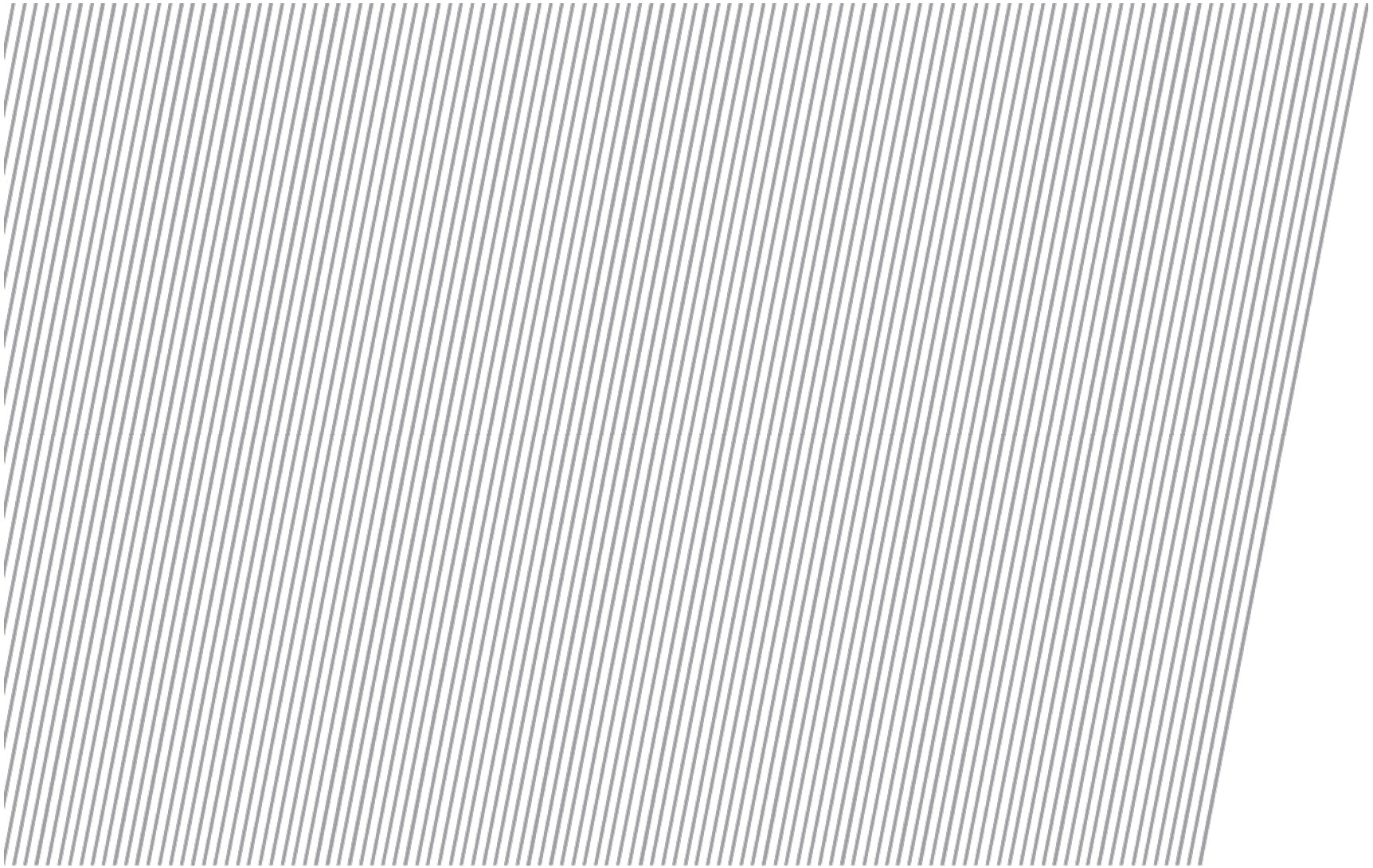
Concluding remarks



Conclusion

- Operational risk is a significant risk to P&C companies and has been largely ignored.
- The size of operational risk can be thought of as: "*intrinsic operational risk –robustness of overall ERM framework + complexity of firm".*
- A robust ERM and operational risk framework can help minimize parameter error which should be incorporated as a risk load that may provide a competitive edge.
- Regulatory reform in the EU will mandate more robust quantification/assessment of operational risk for the insurance industry.
- Forward looking scenarios validated by historical data, both internal and external, may be useful if analyzed and explained in a logical, consistent, transparent manner.

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Conclusion

- A clear taxonomy that feeds into a broader ERM framework is needed to assess and identify risks in a mutually exclusive yet exhaustive manner.
- While many operational risks manifest themselves as losses in other risk categories (i.e., insurance) there is still a benefit in quantification:
  - Helps to identify the underlying causes
  - Likely that current loss data (i.e., insurance) will not capture enough of a tail
  - May apply a haircut for losses that may be double counted
  - Helps with project steering
- Operational risk management should focus on the cause leading to events (frequency), with controls in place to mitigate the loss given an event (severity).
- Ultimately, the goal is risk mitigation as a function of financial reporting, incentives, controls, cost benefit and risk culture.

Operational risk resources

- Recent Paper by: Kabir K. Dutta and David F. Babbel, March 8, 2010, *Scenario Analysis in the Measurement of Operational Risk Capital: A Change of Measure Approach.*
  - Borrows logic from Financial Economics similar to a change of measure from real world probabilities to risk neutral probabilities.
- Marcelo Cruz – professor at NYU Stern, Chief Editor of *Journal of Operational Risk*
- Paper by: Shawn Wang, *Aggregation of Correlated Risk Portfolios: Models and Algorithms*
- Paper by: SOA/CAS/Towers Perrin, Dec 2009, *A New Approach for Managing Operational Risk*
- Paper by: Klaus Bocker & Claudia Kluppelberg, Jan 2004, *Operational VaR: A Closed Form Approximation*
- Paper by: Frachot, Antoine, Roncalli, Thierry and Salomon; *The Correlation Problem in Operational Risk*. OperationalRisk, Risk's Newsletter, 2004.
- *Consultation Papers* produced by: The Committee of European Insurance and Occupational Pension Supervisors (CEIOPS) – give the latest updates on Solvency II developments.
- *Best Practices for Meeting the Solvency II Operational Risk Challenge*: an Allianz webinar, Nov 30, 2009.

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