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# Regulatory and Economic Capital

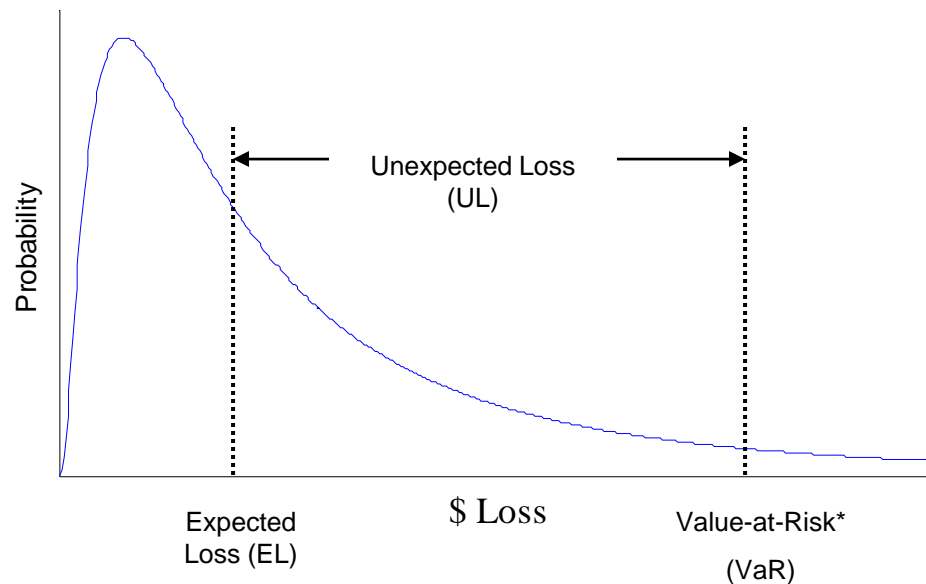
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Measurement and Management

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# What is Economic Capital?

- Capital available to the bank to absorb losses to stay solvent



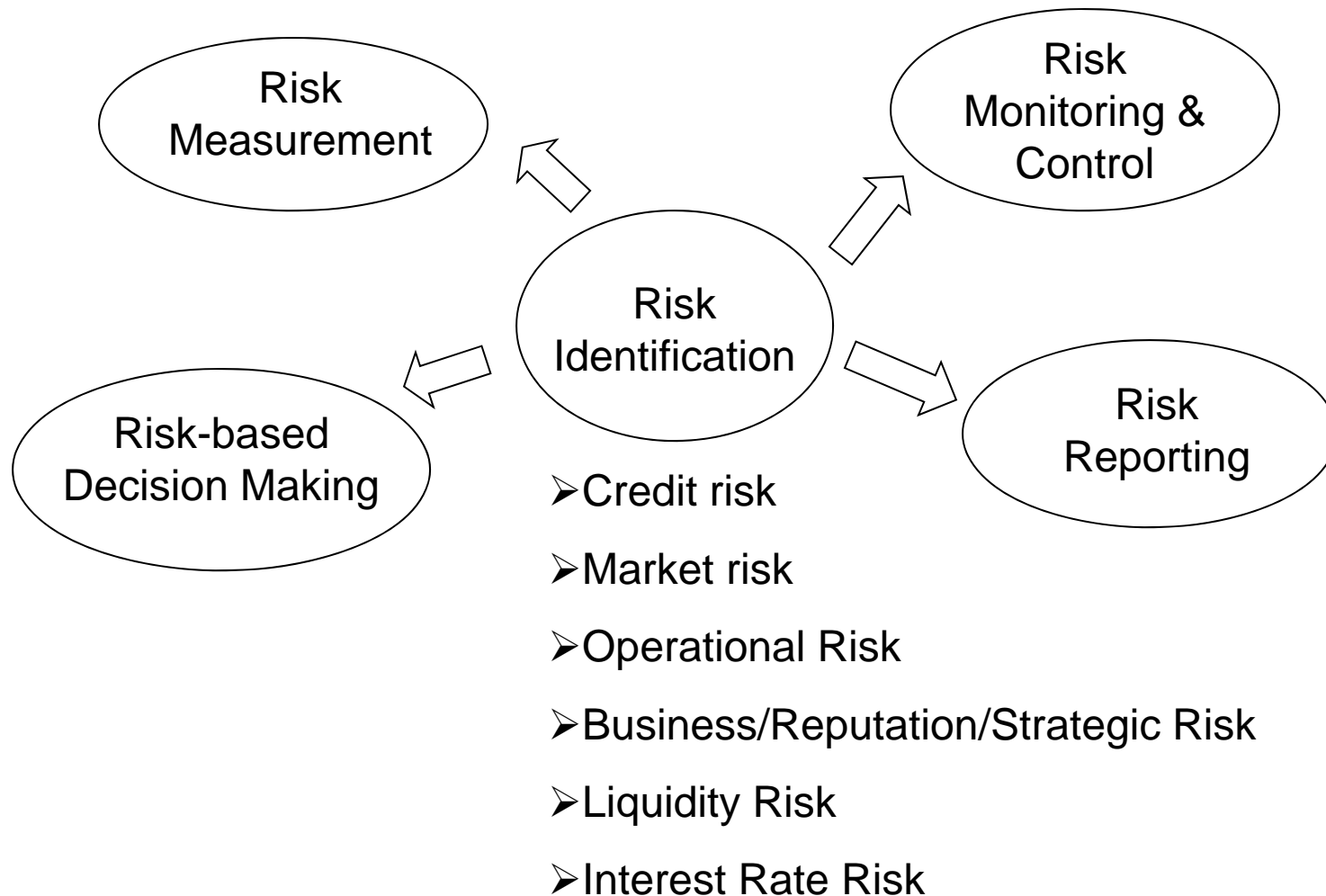
Economic Capital (K)

= UL (when reserves for EL are taken)

= VaR (when reserves are not taken)

- Economic capital can be defined as the methods or practices that allow banks to attribute capital to cover the economic effects of risk-taking activities –Bank for International Settlements, 2008

# Components of Economic Capital



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# Regulatory vs. Economic Capital

- Regulatory capital is conceptually similar to Economic Capital
  - Regulators, through Basel Accord, prescribe measurement approach and/or parameters that may not be based on the bank's individual risk profile
    - Basel I
    - Basel II
    - Basel III
  - Economic capital is based on bank's internally derived risk measurement methodology and parameters that may not align with the framework prescribed by the regulators
  - Economic capital may calculate VaR at a different percentile than regulatory capital
  - Banks may use the more conservative of the two capital estimates in assessing its capital requirements
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# Credit Risk

- Credit Risk is the risk of default or downgrade by obligor
  
  - Measurement of credit risk requires three parameters, which should be empirically based long run averages which include economic downturns
    - Probability of Default (PD)
    - Loss Given Default (LGD)
    - Exposure at Default (EAD)
  
  - Methods of estimating the above parameters vary by portfolio
    - Retail Portfolio
    - Wholesale Portfolio
    - Other
      - Securitization
      - Equity
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# Asymptotic Single Risk Factor Model

- Basel Committee on Banking Supervision specified model based on Merton's option theoretic framework that links asset values to credit quality
- Changes in asset value for each sub-portfolio are linked to one latent factor which drives the changes in returns in the following manner:

$$X_i = \sqrt{\rho_i} Y + \sqrt{1 - \rho_i} \varepsilon_i$$

where  $X_i$  is the return on asset  $i$ ,  
 $\rho_i$  or  $R_j$  is correlation between asset  $i$  and factor  $Y_k$   
 $\varepsilon_i$  is idiosyncratic risk associated with security  $i$   
 $X_i, Y_k$ , and  $\varepsilon_i \sim N(0,1)$

- Credit Risk VaR is given by simple analytical formula:

$$K = \left[ LGD \times N \left( \frac{N^{-1}(PD) + \sqrt{R} \times N^{-1}(0.999)}{\sqrt{1 - R}} \right) - (LGD \times PD) \right] \quad \text{For Retail Portfolios}$$

$$K = \left[ LGD \times N \left( \frac{N^{-1}(PD) + \sqrt{R} \times N^{-1}(0.999)}{\sqrt{1 - R}} \right) - (LGD \times PD) \right] \times \left( \frac{1 + (M - 2.5) \times b}{1 - 1.5 \times b} \right) \quad \text{For Wholesale Portfolios}$$

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# Internal Credit Risk Models

- Address certain limitations of the Basel ASRF model
    - Bank's credit portfolio is infinitely granular
    - Loan defaults at a bank are driven by a single systematic risk factor
    - Systematic and non-systematic risk factors are log-normal random variables
    - Assumptions regarding correlations among credit losses on various types of assets
  - Provide flexibility in modeling through explicitly accounting for the macroeconomic drivers and bank's own risk profile
  - These models account for loan characteristics, borrower characteristics, and macroeconomic environment
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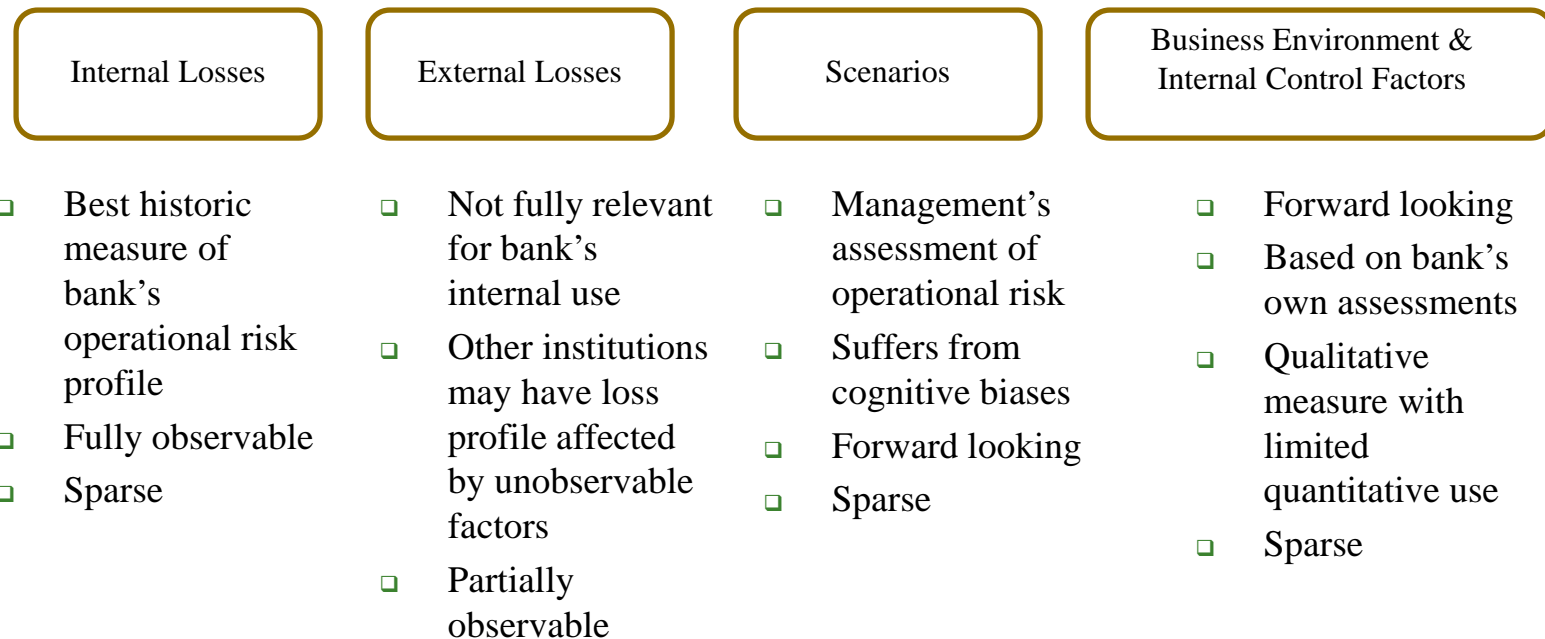
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# Operational Risk

- Risk of loss due to errors, infringements, interruptions, damages caused by internal processes, personnel or systems, or caused by external events
    - Technology and Infrastructure Failure
    - Damage to Physical Assets
    - Clients Products and Business Practices
    - Employment and Workplace Safety
    - Execution Delivery and Process Management
    - Internal Fraud
    - External Fraud
  
  - Three approaches to modeling operational risk
    - Basic Indicator Approach
    - Standardized Approach
    - Advanced Measurement Approach (AMA)
  
  - Under AMA operational losses are not segregated by “portfolios” but by clusters of homogeneous loss events called Units of Measure
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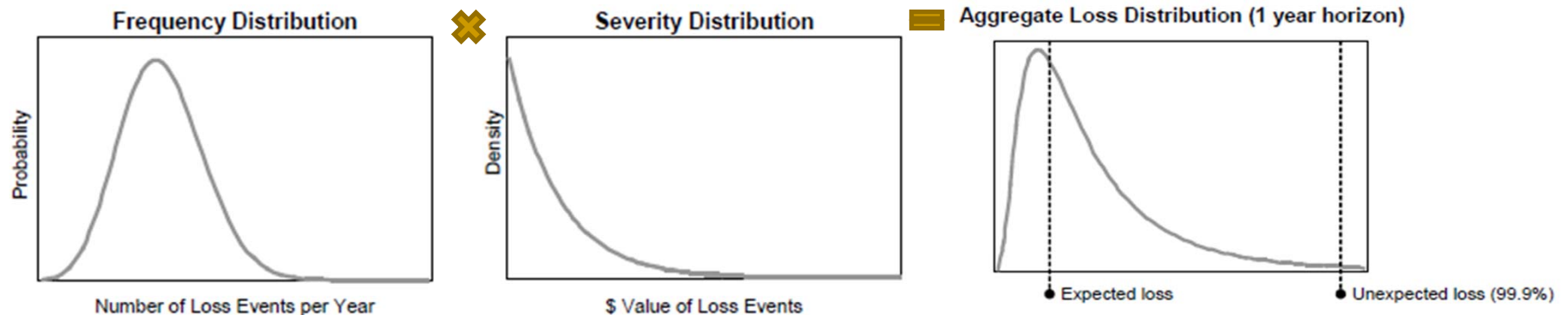
# Operational Risk Data Elements

- Key challenge in modeling operational risk is data scarcity and incompleteness
- Key inputs used in measurement



# Modeling Operational Risk

- Measurement methodology is Loss Distribution Approach (LDA) based on collective risk model



- Frequency distributions

- Poisson
- Negative binomial

- Severity distributions

- Empirical distribution
- Single parametric distributions – Lognormal,
- Mixture distributions
- Piecewise distributions that use Extreme Value Theory (EVT)

- Compound Poisson Process

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# Market Risk

- Market risk is defined as risk of loss due to adverse movement in a market risk factors for the bank's trading portfolios
  - Key inputs are the portfolio positions and market risk drivers
  - VaR Measurement methodology is fairly standard
    - Monte Carlo Simulation Method
    - Historical Simulation Method
    - Variance-Covariance Approach
  - Market risk capital is  $3 \times \text{VaR}$  calculated at 99<sup>th</sup> percentile with one-day horizon
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# Business Risk

- No consensus definition on business risk – risk of being in business
    - Reputation Risk

*the potential that negative publicity or press regarding a company's business practices or products, whether true or not, will cause a decline in the customer base, or revenue reductions.*
    - Strategic Risk/Earnings Risk

*the risk to earnings or capital arising from adverse business decisions or improper implementation of those decisions.*
  - No industry standard on measuring business risk.
    - Event study analysis on stock price change related to other loss-related events
    - Earnings volatility approach
    - Scenario based loss distribution models
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# Risk Aggregation

Aggregation methodology	Advantages	Disadvantages
<p><b>Summation:</b> Adds together individual capital components</p>	<p>Simplicity</p> <p>Typically considered to be conservative</p>	<p>It does not discriminate across risk types; imposes equal weighting assumption</p> <p>Does not capture non-linearities</p>
<p><b>Constant diversification:</b> Similar to summation but subtracts fixed percentage from overall figure</p>	<p>Simplicity and recognition of diversification effects</p>	<p>The fixed diversification effect is not sensitive to underlying interactions between components.</p> <p>Does not capture non-linearities</p>
<p><b>Variance-Covariance:</b> Weighted sum of components on basis of bilateral correlation between risks.</p>	<p>Better approximation of analytical method</p> <p>Relatively simple and intuitive</p>	<p>Estimates of inter-risk correlations difficult to obtain</p> <p>Does not capture non-linearities</p>
<p><b>Copulas:</b> combine marginal distributions through copula functions</p>	<p>More flexible than covariance matrix</p> <p>Allows for nonlinearities and higher order dependencies</p>	<p>Parameterisation very difficult to validate</p> <p>Building a joint distribution very difficult</p>
<p><b>Full modelling/Simulation:</b> Simulate the impact of common risk drivers on all risk components and construct the joint distribution of losses</p>	<p>Theoretically the most appealing method</p> <p>Potentially the most accurate method</p> <p>Intuitive</p>	<p>Practically the most demanding in terms of inputs</p> <p>Very high demands on IT</p> <p>Time consuming</p> <p>Can provide false sense of accuracy</p>

Source: BIS

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# Other Risks

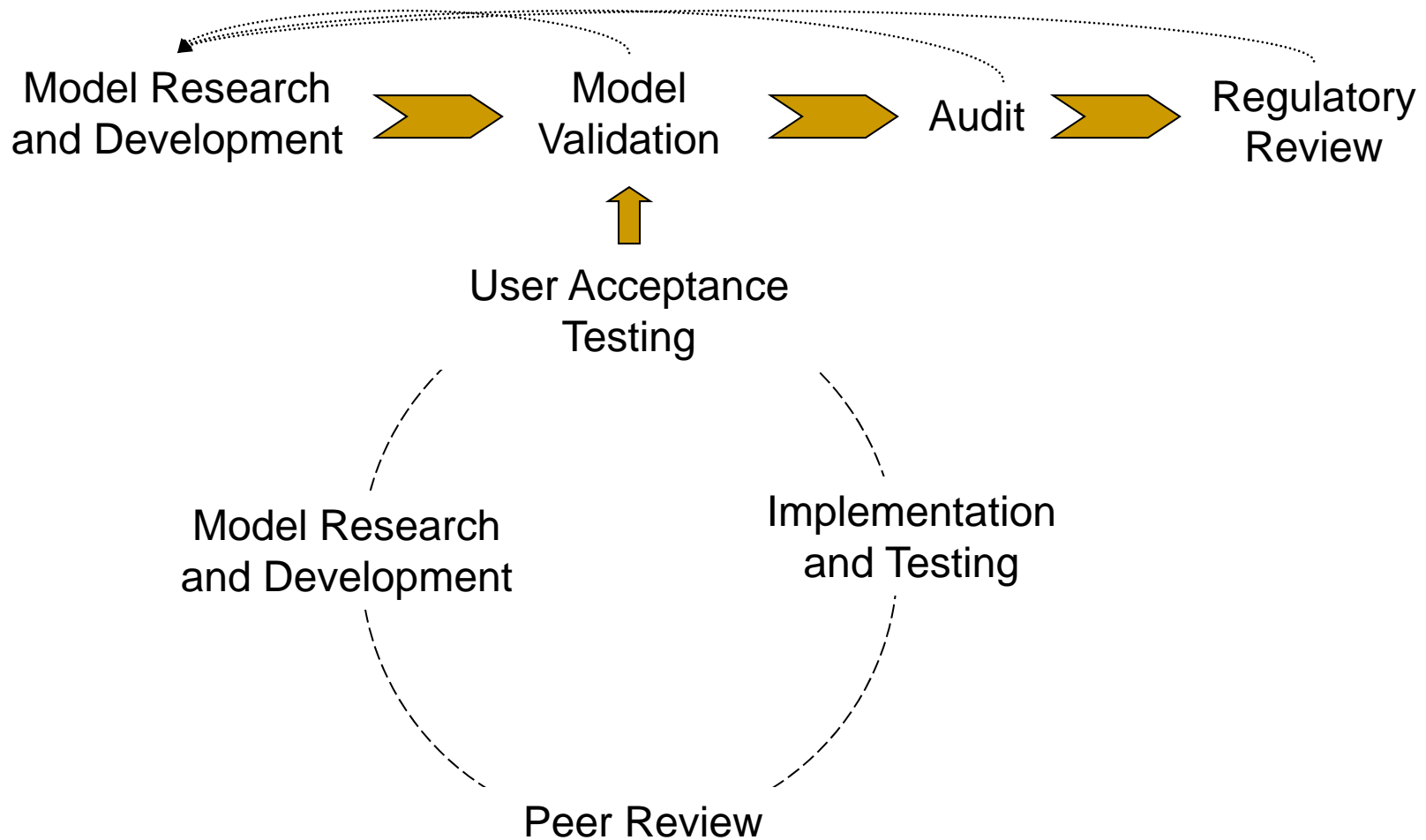
- Interest Rate Risk in the banking book
  - Liquidity Risk
  - Country Risk
  - Pipeline Risk
  - **Model Risk**
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# Model Risk

- Model risk occurs primarily for two reasons:
    - fundamental errors, inaccurate outputs – model does not meet its design objective and intended business uses
    - used incorrectly or inappropriately or misunderstanding about its limitations and assumptions
  
  - Model risk can be minimized through:
    - Robust model implementation
      - sensitivity analyses,
      - benchmarking (where possible),
      - stress testing.
      - explicit documentation of model assumptions and limitation
    - Model validation
      - conceptual soundness,
      - performance analysis and on-going monitoring
    - Sound governance, policies and controls
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# Model Life Cycle



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# How is Economic Capital Used?

- Capital adequacy
  - Risk-based pricing
  - Credit portfolio management
  - Capital budgeting, strategic planning, target setting
  - Risk-based performance management
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# Key Stakeholders in Economic Capital

- CEO, CFO
  - Business Lines
  - Enterprise Risk Management
  - Validators and Auditors
  - Regulators
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