# FINANCIAL RISK MANAGEMENT

## RISK MEASUREMENT

# Risk Measurement

- Why measure risk?
  • *Risk measurement* is necessary to support the management of risk.
  • Risk measurement is the specialized task of quantifying and communicating risk.
- Three goals:
  1. Uncovering "known" risks
  2. Making the "known" risks easy to see, understand and compare.
  3. Try to understand and uncover the "unknown" or unanticipated risks

# Risk Measurement

- Which we can measure using:
  1. Value-at-Risk (VaR)
- 2. Expected Shortfall
  3. Expected Credit Loss
  4. Scenario based measurement
  5. Sensitivity based measurement

# Risk Measurement

- Risk measurement techniques are tools and methods used to assess and quantify the level of risk associated with an investment, project, or business decision. These techniques help organizations identify, prioritize, and manage risks to make informed decisions and achieve their objectives. There are several risk measurement techniques, each with its strengths and weaknesses.

# Risk Measurement

- Standard Deviation: Standard deviation is a statistical measure that quantifies the amount of variation or dispersion of a set of values, such as investment returns. A higher standard deviation indicates a greater degree of risk, as returns can be more volatile.
- Value at Risk (VaR): VaR is a widely used risk measurement technique that estimates the maximum potential loss of an investment or portfolio over a given period and at a specified confidence level. It's useful for measuring the potential loss in extreme market conditions.
- Conditional Value at Risk (CVaR): Also known as Expected Shortfall, CVaR estimates the expected loss when the actual loss exceeds the VaR threshold. It is considered a more robust measure of risk, as it takes into account the entire tail of the loss distribution, rather than just the maximum potential loss.

# Risk Measurement

- Stress Testing: Stress testing is a risk measurement technique that simulates extreme scenarios to assess how an investment or portfolio would perform under adverse conditions. It helps identify vulnerabilities and allows for better risk management.
- Scenario Analysis: Scenario analysis is a method of assessing the potential impact of different future events or conditions on an investment or portfolio. It involves identifying various plausible scenarios, estimating their probabilities, and analyzing their potential effects.
- Sensitivity Analysis: Sensitivity analysis measures the impact of changes in one or more variables on the overall risk of an investment or portfolio. It helps identify which variables have the greatest influence on risk and allows for more targeted risk management.
- Monte Carlo Simulation: Monte Carlo simulation is a computational technique that uses random sampling and statistical modeling to estimate the probability distribution of potential outcomes. It can be applied to various types of risks, including market, credit, and operational risks.

# Market Risk

- Market risk and credit risk are easier to measure than non-financial risk and several techniques have been developed to measure these.
- Market risk refers to the exposure associated with actively traded financial instruments - particularly those exposed to changes in interest rates, exchange rates, equity prices, commodity prices or some combination of them
- The most widely used (and very simple) tool for measuring market risk is the standard deviation of price outcomes associated with a certain asset.

# Market Risk

- A portfolio's exposure to losses due to market risk typically takes one of two forms:
  – Sensitivity to adverse movements in the value of a key variable in valuation(primary or first order measures of risk) and
  – risk measures associated with changes in sensitivities (secondary or second order measures of risk)

# Market Risk

- Measures of primary sources of market risk
  • For a stock or stock portfolio, beta measures sensitivity to market movements and is linear
  • For bonds, duration measures the sensitivity of a bond or bond portfolio to a small parallel shift in the yield curve and is a linear measure.
  • Delta for options measures an option's sensitivity to a small change in the value of the
  underlying and is a linear measure.
  Second-order measures of risk
  These deal with changes in price sensitivity:
  – Convexity measures how interest rate sensitivity changes with changes in interest rates
  – Gamma measures delta's sensitivity to a change in the underlying's value
  N.B. Delta and gamma together capture first and second order effects of a change in the asset

# Backtesting vs Historical Simulation

- *Backtesting*: A process for systematically comparing the VaR forecasts with actual returns.
  - It is useful to risk managers since it:
  – Detects weaknesses in the models
  – Points to areas of improvement
  – Is a criterion used to determine whether a bank should be allowed to use its internal models in
  calculating regulatory capital.

# Value at Risk

- Value at Risk (VaR) generalises the likelihood of underperforming by providing a statistical measure of downside risk.
  • VaR assesses the potential losses on a portfolio over a given future time period with a given confidence level. VaR is a probability based measure of loss potential for a company, a fund, a portfolio, a transaction or a strategy.
  • It is usually expressed either as a percentage or in units of currency.
  • Any position or activity that exposes one to loss is potentially a candidate for VaR measurement.

# Value at Risk

- VaR is formally defined as: an estimate of the loss in money terms that we expect to be exceeded with a given level of probability over a specified time period
- • VaR can be seen as an estimate of the loss that we expect to be exceeded hence it is a minimum loss associated with a given probability.
- • VaR also has a time element meaning that VaRs of different time periods are not comparable.
- • VaR is often used by regulators of financial institutions and by the financial institutions themselves to determine the amount of capital they should keep.

# Value at Risk

- One drawback to VaR is that it does not estimate losses in the tail of the returns distribution.
- Expected shortfall (ES) does, however, estimate the loss in the tail (i.e., after the VaR threshold has been breached) by averaging loss levels at different confidence levels.

# Value at Risk

- One of the biggest criticisms regarding the use of VaR is that, in general, it is not subadditive.
- This subadditive property states that if two different portfolios $p_1$ and $p_2$ are combined to make a new portfolio then its risk should not be greater than the sum of the risks of $p_1$ and $p_2$. This property is designed to encourage diversification; the risk of the whole trading portfolio should be at most as big as the sum of the risks of any possible breakdown of it.

# Value at Risk

- It is helpful to recall the computations of arithmetic and geometric returns.
- Note that the convention when computing these returns (as well as VaR) is to quote return losses as positive values.
- For example, if a portfolio is expected to decrease in value by $1 million, we use the terminology “expected loss is $1 million” rather than “expected profit is –$1 million.

# Statistical Historical Estimates

**Expected Return and Standard Deviation**

Considering investing in a stock-index fund. The fund currently sells for $100 per share. With an investment horizon of 1 year, the realized rate of return on your investment will depend on (*a*) the price per share at year's end and (*b*) the cash dividends you will collect over the year.

- The holding period return

$$HPR = \frac{Ending\ Price\ of\ Share - Beginning\ Price + Cash\ Dividend}{Beginning\ Price}$$

- There is considerable uncertainty about the price of a share plus dividend income 1 year from now, however, so you cannot be sure about your eventual HPR. We can quantify our beliefs about the state of the market and the stock-index fund in terms of possible scenarios with probabilities.

# Returns

- **Arithmetic return data:** Assumption is that interim payments do not earn a return (i.e., no reinvestment). Hence, this approach is not appropriate for long investment horizons.

$$r_t = \frac{P_t + D_t - P_{t-1}}{P_{t-1}} = \frac{P_t + D_t}{P_{t-1}} - 1$$

# Returns

- **Geometric return data:** Assumption is that interim payments are continuously reinvested. Note that this approach ensures that asset price can never be negative

$$R_t = \ln\left(\frac{P_t + D_t}{P_{t-1}}\right)$$

# Expected Returns

- $E(r) = \sum_s p(s)r(s)$ where $p(s)$ is the probability of each scenario and $r(s)$ is the HPR in each scenario.
- $real\ rate\ of\ return = \frac{1+Nominal\ return}{1+Inflation\ rate} - 1$

Geometric average= $(1+r_1)(1+r_2)..(1+r_n)^{\frac{1}{n}} - 1$

Normal, Bull, Bearish – 0.5, 0.3,0.2

# Standard Deviation

Standard deviation of the rate of return (s) is a measure of risk. It is defined as the square root of the variance, which in turn is the expected value of the squared deviations
from the expected return.

$$\sigma^2 = \sum_s p(s)(r(s) - E(r))^2$$

$$\sigma^2 = \frac{1}{N-1}\sum_s (r(s) - E(r))^2$$

- What would trouble potential investors in the index fund is the downside risk of a crash or poor market, not the upside potential of a good or excellent market. The standard deviation of the rate of return does not distinguish between good or bad surprises; it treats both simply as deviations from the mean

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# Value at Risk

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  • VaR can be seen as an estimate of the loss that we expect to be exceeded hence it is a minimum loss associated with a given probability.
  • VaR also has a time element meaning that VaRs of different time periods are not comparable.
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# Value at Risk

- ***Normal VaR***

  Intuitively, the VaR for a given confidence level denotes the point that separates the tail losses from the remaining distribution.
- The VaR cutoff will be in the left tail of the returns distribution.
- Hence, the calculated value at risk is negative, but is typically reported as a positive value since the negative amount is implied (i.e., it is the value that is at risk). In equation form, the VaR at significance level $\alpha$ is

# Value at Risk

- Recall that the confidence level, $(1 - \alpha)$, is typically a large value (e.g., 95%) whereas the significance level, usually denoted as $\alpha$, is much smaller (e.g., 5%).
- where $\mu$ and $\sigma$ denote the mean and standard deviation of the profit/loss distribution and $z$ denotes the critical value (i.e., quantile) of the standard normal. In practice, the population parameters $\mu$ and $\sigma$ are not likely known, in which case the researcher will use the sample mean and standard deviation.

# Value at Risk

- **CONCEPTUAL EXAMPLE: Identifying the VaR limit**
- **Identify** the ordered observation in a sample of 1,000 data points that corresponds to VaR at a 95% confidence level.

  **Answer:**

  Since VaR is to be estimated at 95% confidence, this means that 5% (i.e., 50) of the ordered observations would fall in the tail of the distribution. Therefore, the 51st ordered loss observation would separate the 5% of largest losses from the remaining 95% of returns.

# Value at Risk

- **TECHNICAL EXAMPLE: Computing VaR**
  A long history of profit/loss data closely approximates a standard normal distribution (mean equals zero; standard deviation equals one). **Estimate** the 95% VaR using the historical simulation approach.

# Value at Risk

- **Answer:**

The VaR limit will be at the observation that separates the tail loss with area equal to 5% from the remainder of the distribution. Since the distribution is closely approximated by the standard normal distribution, the VaR is 1.65 (5% critical value from the *z*-table). Recall that since VaR is a one-tailed test, the entire significance level of 5% is in the left tail of the returns distribution.

# Value at Risk

- In contrast to the historical simulation method, the parametric approach explicitly assumes a distribution for the underlying observations. We will analyze two cases: (1) VaR for returns that follow a normal distribution, and (2) VaR for returns that follow a lognormal distribution.

# Value at Risk

- Practitioners commonly estimate the 5% VaR, meaning that 95% of returns will exceed the VaR, and 5% will be worse. Therefore, the 5% VaR may be viewed as the best rate of return out of the 5% *worstcase* future scenarios.
- What is the 10% VaR over a 1-year horizon of $2 million invested in a fund whose annual returns in excess of the risk free rate are assumed to be normally distributed with mean 5% and volatility 12%?

# Value at Risk

- **EXAMPLE: Computing VaR (normal distribution)** Assume that the profit/loss distribution for XYZ is normally distributed with an annual mean of $15 million and a standard deviation of $10 million. **Calculate** the VaR at the 95% and 99% confidence levels using a parametric approach.

# Value at Risk

- **Answer:**
  VaR(5%) = -\$15 million + \$10 million × 1.65 = \$1.5 million. Therefore, XYZ expects to lose at most \$1.5 million over the next year with 95% confidence. Equivalently, XYZ expects to lose more than \$1.5 million with a 5% probability.
  VaR(1%) = -\$15 million + \$10 million × 2.33 = \$8.3 million. Note that the VaR (at 99% confidence) is greater than the VaR (at 95% confidence) as follows from the definition of value at risk

# Value at Risk

- **EXAMPLE: Computing VaR (arithmetic returns)** A portfolio has a beginning period value of $100 million. The arithmetic returns follow a normal distribution with a mean of 10% and a standard deviation of 20%. **Calculate** VaR at both the 95% and 99% confidence levels.

# Value at Risk

- What is the 10% VaR over a 1-year horizon of $2 million invested in a fund whose annual returns in excess of the risk free rate are assumed to be normally distributed with mean 5% and volatility 12%?
- Consider a fund whose future active returns are normally distributed, with an expected active return over the next year of 1% and a standard deviation about this expected active return (i.e. tracking error) of 3%. What is the probability of underperforming the benchmark by 2% or more over the next year?

# Scaling VaR

- Frequently market VaR is measured over a short-term risk horizon such as 1 day and then scaled up to represent VaR over a longer risk horizon.
- How should we scale a VaR that is estimated over one risk horizon to a VaR that is measured over a different risk horizon? And what assumptions need to be made for such a scaling?
- For h periods , the variance and mean of the portfolio is scaled by muliply by h i.e for 10-day VaR we would scale the daily mean and variance by multipling by h.

# Backtesting VaR

- **Backtesting** is the process of comparing losses predicted by a value at risk (VaR) model to those actually experienced over the testing period.
- It is an important tool for providing *model validation*, which is a process for determining whether a VaR model is adequate.
- The main goal of backtesting is to ensure that actual losses do not exceed expected losses at a given confidence level. The number of actual observations that fall outside a given confidence level are called *exceptions*.

# Backtesting VaR

- If a VaR model were completely accurate, we would expect VaR loss limits to be exceeded (this is called an **exception**) with the same frequency predicted by the confidence level used in the VaR model.
- For example, if we use a 95% confidence level, we expect to find exceptions in 5% of instances. Thus, backtesting is the process of systematically comparing actual (exceptions) and predicted loss levels

# Backtesting VaR

- VaR models are based on static portfolios, while actual portfolio compositions are constantly changing as relative prices change and positions are bought and sold.
- Multiple risk factors affect actual profit and loss, but they are not included in the VaR model. For example, the actual returns are complicated by intraday changes as well as profit and loss factors that result from commissions, fees, interest income, and bid-ask spreads.
- Such effects can be minimized by backtesting with a relatively short time horizon such as a daily holding period

# Expected Shortfall

- A major limitation of the VaR measure is that it does not tell the investor the amount or magnitude of the actual loss. VaR only provides the maximum value we can lose for a given confidence level.
- The **expected shortfall** (ES) provides an estimate of the tail loss by averaging the VaRs for increasing confidence levels in the tail. Specifically, the tail mass is divided into *n* equal slices and the corresponding n - 1 VaRs are computed.
- Note that as *n* increases, the expected shortfall will increase and approach the theoretical true loss

# Expected Shortfall

- Expected shortfall is also called **conditional value at risk** (**CVaR**), **average value at risk** (**AVaR**), **expected tail loss** (**ETL**),

$$\mathrm{ES}_\alpha(X) = -\frac{1}{\alpha}\int_0^\alpha \mathrm{VaR}_\gamma(X)\,d\gamma$$

- If the loss of a portfolio follows normal distribution, the expected shortfall is equal to

$$\mathrm{ES}_{\alpha}(L) = \mu + \sigma \frac{\varphi(\Phi^{-1}(\alpha))}{\alpha}$$

# Summary VaR and ES

- Value at Risk (VaR):

1. Definition: VaR measures the maximum potential loss that could be incurred on an investment or portfolio over a specified period at a given confidence level. For example, a 1-day VaR of $1 million at the 95% confidence level means that there is a 5% chance that the investment or portfolio will lose more than $1 million in a single day.
2. Quantile approach: VaR estimates the specific point (quantile) in the loss distribution where the specified confidence level is met. It focuses on the worst-case loss within the given confidence level.
3. Limitations: VaR has some limitations, including its inability to capture the tail risk (the risk of extreme losses beyond the VaR threshold). It also does not provide any information on the expected loss when the actual loss exceeds the VaR estimate.

# Summary VaR and ES

- Expected Shortfall (ES):

1. Definition: ES measures the expected loss that would be incurred on an investment or portfolio if the actual loss exceeds the VaR threshold. In other words, it estimates the average loss in the worst-case scenarios beyond the VaR level.
2. Tail risk focus: ES considers the entire tail of the loss distribution, providing a more comprehensive understanding of the potential losses in extreme scenarios.
3. Advantages: ES addresses some of the limitations of VaR by taking into account the severity of losses beyond the VaR threshold. It is considered a more robust and informative risk measure, especially for portfolios with non-normal or asymmetric return distributions.

# Non-Parametric Vs Parametric Estimation

- One of the advantages of non-parametric density estimation is that the underlying distribution is free from restrictive assumptions.
- Therefore, the existing data points can be used to "smooth" the data points to allow for VaR calculation at all confidence levels.
- The simplest adjustment is to connect the midpoints between successive histogram bars in the original data set's distribution.

# Non-Parametric Vs Parametric Estimation

- Non-parametric estimation does not make restrictive assumptions about the underlying distribution like parametric methods, which assume very specific forms such as normal or lognormal distributions.
- Non-parametric estimation lets the data drive the estimation. The flexibility of these methods makes them excellent candidates for VaR estimation, especially if tail events are sparse.

# Non-Parametric Vs Parametric Estimation

- The **bootstrap historical simulation** is a simple and intuitive estimation procedure. In essence, the bootstrap technique draws a sample from the original data set, records the VaR from that particular sample and “returns” the data. This procedure is repeated over and over and records multiple sample VaRs.

# Non-Parametric Vs Parametric Estimation

- Advantages of non-parametric methods include the following:
- Intuitive and often computationally simple (even on a spreadsheet).
- Not hindered by parametric violations of skewness, fat-tails, et cetera.
- Data is often readily available and does not require adjustments (e.g., financial statements adjustments).
- Can accommodate more complex analysis

# Non-Parametric Vs Parametric Estimation

- Disadvantages of non-parametric methods include the following:
- Analysis depends critically on historical data.
- Volatile data periods lead to VaR and ES estimates that are too high.
- Quiet data periods lead to VaR and ES estimates that are too low.
- Difficult to detect structural shifts/regime changes in the data.
- Cannot accommodate plausible large impact events if they did not occur within the sample period

# Stress Testing

- The risks that are incurred by extreme market events can be identified and investigated by financial stress testing.
- • Means: subjecting an asset portfolio or a block of business comprising both assets and liabilities to extreme market moves by radically changing the underlying assumptions and characteristics, in order to gain insight into the portfolio’s sensitivities to predefined risk factors.
- • Concerned with asset correlations and volatilities which are often observed to simultaneously increase during extreme market events

# Stress Testing

- Stress testing is a risk management technique used to evaluate the potential impact of extreme or adverse scenarios on the financial stability and performance of an investment, portfolio, or an entire financial institution. Stress tests are designed to identify vulnerabilities and assess the ability of the entity being tested to withstand exceptional but plausible events or market conditions. The process helps institutions make informed decisions, improve risk management practices, and ensure regulatory compliance.

# Stress Testing

- Stress testing can be applied across various risk types, including market risk, credit risk, liquidity risk, and operational risk.

# Stress Testing Process

- Identification of risk factors: The first step in stress testing is to identify the relevant risk factors that could affect the investment, portfolio, or institution. These may include interest rate changes, credit spreads, equity market fluctuations, exchange rate movements, or economic downturns.
- Development of stress scenarios: Once the risk factors have been identified, stress scenarios are developed to represent extreme but plausible adverse events or market conditions. Scenarios can be based on historical events (e.g., the 2008 financial crisis), hypothetical situations (e.g., a sharp increase in interest rates), or a combination of both. Typically, multiple scenarios are considered to account for various sources of risk and potential impacts.
- Specification of shock magnitudes: For each scenario, the magnitude of the shock (i.e., the degree to which the risk factors change) is specified. The severity of the shock should be large enough to represent a significant stress event but still be within the realm of plausibility.

# Stress Testing Process

- Application of shocks to the entity: The specified shocks are applied to the investment, portfolio, or institution to assess the potential impact on key financial variables, such as asset values, cash flows, capital adequacy, or liquidity. This may involve the use of sophisticated quantitative models or expert judgment.
- Analysis of results: The results of the stress tests are analyzed to evaluate the resilience of the entity being tested, identify vulnerabilities, and assess the potential need for management actions or capital adjustments. The analysis may include comparisons with regulatory requirements, industry benchmarks, or internal risk limits.
- Reporting and communication: The results of stress tests are typically communicated to senior management, regulators, and other stakeholders, as appropriate. Transparency in reporting is essential to ensure that the stress testing process is well-understood and that any necessary actions are taken.
- Review and feedback: The stress testing process should be reviewed regularly to incorporate new information, update risk factors and scenarios, and refine the methodologies used. Feedback from stakeholders, including regulators, can be used to enhance the stress testing framework and improve its effectiveness.

# Scenario Analysis

- Scenario analysis is a risk measurement technique used to assess the potential impact of different future events or conditions on an investment, portfolio, or a financial institution. It helps decision-makers understand the possible consequences of various situations, quantify potential risks, and develop strategies to manage those risks. Scenario analysis is particularly useful when dealing with uncertain or complex environments, as it allows for the consideration of multiple factors and their interactions.

# Sensitivity Analysis Process

- Identification of risk factors: Start by identifying the relevant risk factors that could affect the investment, portfolio, or institution. These may include economic variables (e.g., GDP growth, inflation, interest rates), market variables (e.g., equity prices, credit spreads, exchange rates), or other factors specific to the entity or industry.
- Development of scenarios: Create a set of plausible scenarios that represent different future states of the world, considering various combinations of the identified risk factors. Scenarios can be based on historical data, expert judgment, or a combination of both. Typically, a minimum of three scenarios are developed: a base case (most likely outcome), an optimistic case (favorable conditions), and a pessimistic case (adverse conditions). More scenarios can be added to capture a wider range of possibilities.

# Sensitivity Analysis Process

- Assign probabilities: Assign probabilities to each scenario to reflect the likelihood of their occurrence. Probabilities can be determined based on historical data, expert opinion, or a combination of both. The probabilities should sum to 100% across all scenarios.
- Estimate impacts: For each scenario, estimate the potential impacts on the investment, portfolio, or institution. This may involve the use of financial models, simulations, or expert judgment to assess the effects on key variables, such as asset values, cash flows, or profitability.

# Sensitivity Analysis Process

- Analyze and compare results: Analyze the results of the scenario analysis to understand the potential risks and opportunities associated with each scenario. This may involve calculating the expected value of the investment, portfolio, or institution under each scenario (by multiplying the impact by the probability) and comparing the outcomes to identify the most favorable or unfavorable situations.
- Develop risk management strategies: Based on the results of the scenario analysis, develop strategies to manage the identified risks and capitalize on opportunities. This may involve adjusting the investment or portfolio composition, implementing contingency plans, or taking other actions to enhance the resilience of the entity being analyzed.
- Review and update: Regularly review and update the scenario analysis to incorporate new information, changes in the risk factors, or shifts in the external environment. This ensures that the analysis remains relevant and continues to inform decision-making.

# Monte Carlo Simulations

- Monte Carlo simulation is a computational risk measurement technique that uses random sampling and statistical modeling to estimate the probability distribution of potential outcomes for an investment, portfolio, or financial institution. It is particularly useful when dealing with complex systems or situations with a high degree of uncertainty, as it allows for the consideration of multiple variables and their interactions.
- Monte Carlo simulation is a powerful risk measurement technique that uses random sampling and statistical modeling to estimate the probability distribution of potential outcomes for complex and uncertain situations. By providing insights into the range and likelihood of different outcomes, it allows decision-makers to assess risks more effectively and make informed choices about risk management strategies.

# Monte Carlo Simulation Process

- Monte Carlo simulations are widely used in finance to assess various types of risks, including market risk, credit risk, and operational risk. The process works as follows:
- Model development: Start by developing a mathematical model that represents the investment, portfolio, or financial institution, incorporating relevant risk factors (e.g., asset prices, interest rates, exchange rates) and their relationships. The model should be able to capture the key features of the entity being analyzed and reflect the underlying dynamics of the risk factors.
- Identify probability distributions: For each risk factor, identify the appropriate probability distribution that represents its possible values and their likelihood. This may involve using historical data, expert judgment, or a combination of both. Commonly used distributions in finance include normal, lognormal, and Student's t-distributions.
- Random sampling: Generate a large number of random samples (scenarios) for each risk factor, based on their probability distributions. This involves drawing random values from the distributions and using them as inputs to the mathematical model.

# Monte Carlo Simulation Process

- Model calculations: For each randomly generated scenario, calculate the corresponding outcome (e.g., portfolio value, profit/loss, credit exposure) using the mathematical model. This will result in a large number of potential outcomes, reflecting the different combinations of risk factor values.
- Analysis of results: Analyze the distribution of the simulated outcomes to estimate various risk measures, such as expected value, standard deviation, Value at Risk (VaR), or Expected Shortfall (ES). This can provide insights into the potential range of outcomes, the likelihood of different levels of losses, and the overall risk profile of the investment, portfolio, or institution.
- Sensitivity analysis: Perform sensitivity analysis to understand the impact of changes in the risk factors or model assumptions on the risk measures. This can help identify which factors have the greatest influence on risk and inform risk management strategies.
- Review and update: Regularly review and update the Monte Carlo simulation to incorporate new information, changes in the risk factors, or shifts in the external environment. This ensures that the analysis remains relevant and continues to inform decision-making.

- End.