



MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH

University of Setif I – Ferhat ABBAS

Department of Management



Lectures dedicated to
Financial Management 2nd year Master Students

Educational handout on:

FINANCIAL RISK MANAGEMENT



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I- مفهوم إدارة المخاطر

- 1- تعريف المخاطر وتحديدها
- 2- قياس مستوى الخطر والعوائد
- 3- الأساليب والأدوات المناسبة لقياس المخاطر

II- مفهوم الخطر المالي

- 1- تعريف الخطر المالي
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III- أنواع المخاطر المرتبطة بنشاط المؤسسة

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- 2- مخاطر الائتمان، الأسعار والأموال
- 3- مخاطر التركيز، التغطية والمخاطر السياسية والقانونية

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Introduction

In an era of challenging finances, it is vital to identify risk and how it works. In decision-making, corporate finance, and portfolio management, possessing the ability to spot risk and deal with it is a must. The “Financial Risk Management” Module is for second-year master’s students in Financial Management. It is meant to help them understand the difference between the types of risk and to choose the best strategy of the mitigation and reduction.

The course of study begins with foundational concepts, defining what risk means in financial terms and how it differs from uncertainty before progressing to a classification of risk types. The ability to recognize risks necessitates accurate measurement. The module then explores three broad categories of tools used to quantify and analyze risk:

- **Statistical Tools**, like: variance, standard deviation, beta coefficient and Value at Risk, that help understand how financial outcomes operates and how they are distributed;
- **Financial Analysis Tools**, including ratios which enable a deeper assessment of company’s exposure to internal and external financial threats;
- **Advanced Tools**, such as Stress Testing, Monte Carlo simulation and Scenario Analysis, which help make better predictions and decisions.

This module enables students not only to provide knowledge, but also to embrace uncertainty not only as a threat, as variable to be anticipated where they have the ability to identify risks, assess them, implement useful risk management strategies, in light of business goals.



Pre-Requisites

Descriptive Statistics



Financial Theory



Financial Analysis



Stock Markets



Financial Engineering



Financial Portfolio Management



Content



Educational objectives of the lecture

Dear student, by the end of this lecture, you will be able to:



Define investment and distinguish between the different types of investors.



Define return and its types.



Identify the Methods of Measuring Return on a Financial Asset.



Define risk and distinguish it from uncertainty.



Describe risk characteristics.



Identify internal and external risk sources.

Introduction

Decision making while managing risk is critical for financial managers as their task goes beyond resources allocation and returns maximization to the well distribution of capital among different types of assets. The assessment of the risk-return trade-off and the balance between uncertainties and gains in the chosen investments is challenging for financial managers. Their investment decisions are crucial in ensuring the alignment of risk tolerance with safeguarding shareholder and the organization's financial goals and long-term success.



J. What is Investment?

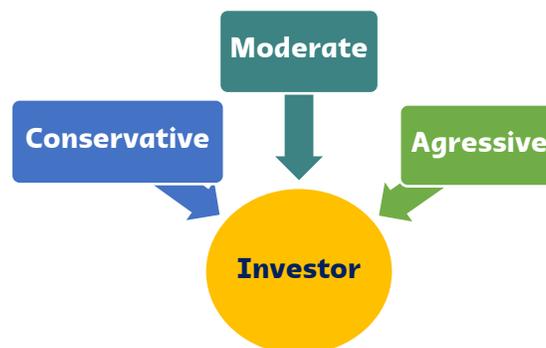
1.1. Definition

An investment refers to the current allocation of money or other sources in the expectation of future positive returns. That means to sacrifice current liquidity or consumption in order to realise in a later date a benefit, utility or appreciation.

1.2. Types of Investors

Based on risk appetite and tolerance, which is the amount of risk is ready to be handled, investors are classified into three categories; Conservative, Moderate and Aggressive.

Figure 1. Types of Investors based on Risk Tolerance



Source: CFI : <https://corporatefinanceinstitute.com/>

- **Conservative Investor:** prefer to protect his capital by investing in low-risk assets, government bonds and blue chips, for instance. Security is more important than high returns.
- **Moderate Investor:** seeks controlled risk exposure with steady growth. Investments are mix between safe and risky assets; bonds, equities and alternative assets are included.
- **Aggressive Investor:** seeks high returns and accept huge risks in exchange, often invests in emerging markets, growth stocks, derivatives, or startups.

2. What is Return?

2.1. Definition

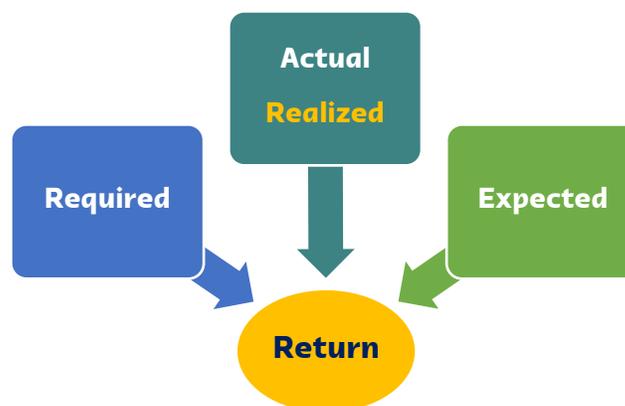
Return refers to the received gain or loss from an investment over a specified time. Return is often a percentage of the primary investment amount. A positive income (interest/ dividends) indicates a profit, while a negative return indicates a loss.



2.2. Types of Return

Return is usually categorised into three types: Actual, Expected and Required.

Figure 2. Types of Return



Source: Mulyaningsih, S., & Heikal, J. (2022).

Financial decision making takes in consideration each of the three types:

- **Actual Return:** Also known as “Realized return”, and refer to the **gain or loss actually earned** over a specified period, because of the asset’s price changes. **AR focuses on historical performance;**
- **Expected Return:** Refers to the average gain or loss you can expect to get from an investment in the future. **ER serves in estimating future outcomes;**
- **Required Return:** Represents the minimum rate of return expected by the investor, based on the investment’s risk level. **RR sets the benchmark to justify the investment.**

By understanding the main differences between these types of return, investors and financial managers can take more rational investment decisions balancing risk and return.

2.3. Methods for calculating Return on a Financial Asset

a. Actual Return

For Shares

For a single asset (a share), the actual return is calculated using the following formula:

$$R_A = \frac{D_{iv} + (P_1 - P_0)}{P_0} \times 100$$

$$R_A = \frac{D_t + (P_S - P_B)}{P_B} \times 100$$

Where:

R_A : The Actual return for Share ‘A’

P_B : Buying price of Share ‘A’ Security Value at the beginning of the evaluation period = original value)

P_S : Selling price of Share ‘A’ (Security Value at the end of the evaluation period = current value)

D_t : Dividends received during the evaluation period.

Example:

An investor **bought (purchased) 100 shares** of a Company in January at a price of **2500 DZD** per share. During the holding period, the company distributed dividends of **400 DZD** per share, and the investor **sold** them in June at **2950 DZD**.

- ➔ Calculate the actual return rate and the amount of these shares during this period.

6. Actual Return

For Bonds

The Actual return of a bond is calculated using the following formula:

$$R_X = \frac{I_t + (P_S - P_B)}{P_B} \times 100$$

Where :

R_X : Actual return for Bond 'X'

P_B : Buying price of Bond 'X' (Security Value at the beginning of the evaluation period = original value)

P_S : Selling price of Bond 'X' (Security Value at the end of the evaluation period = current value)

I_t : The interest occurred on the bond during the holding period (t).

Example:

For an investor who **bought 200 bonds** from Sonelgaz at **1300 DZD** per bond in July and **sold** them at **1420 DZD** in February the next year, receiving an annual interest rate of **12%**.

- Calculate the actual return rate and the amount of these bonds during this period.

c. Expected Return

Historical Data

For historical returns over multiple periods, the expected return is the same as the mean square and it is calculated as:

$$E(R_i) = \bar{R}_i = \frac{\sum_{i=1}^N R_i}{N}$$

Where:

$E(R_i)$: The Expected return of Security 'i'.

R_i : The Return of Security 'i'.

N : The Number of periods (observations) for collected returns of Security 'i'.

Example:

Given returns for past years, what is the expected return rate of security (A)?

Year	2020	2021	2022	2023	Σ
Return on Share 'A'	-0.36	0.9	0.36	0.18	1.08

d. Expected Return**Probabilities**

When probabilities are given for possible returns, the expected return is calculated as:

$$E(R_i) = \sum_{i=1}^N R_i \times P(R_i)$$

Where:

$E(R_i)$: The Expected return of Security 'i'.

$P(R_i)$: The Probability of Return of Security 'i'.

Example:

Using probable returns under different economic conditions, what is the expected rate of return of security (A)?

Condition	Return	Probability
Recession	-20%	20%
Normal	15%	30%
Boom	25%	40%
Inflation	30%	10%

3. What is Risk?

There are several meanings of the term "risk" in the economic domain, some of which are mentioned below:

- Uncertainty about returns or yields.
- Uncertainty about the occurrence of a specific loss.
- Deviation between actual and expected returns.
- Dispersion of actual and expected results.
- Possibility of actual results differing from desired or expected results.



3.1. Definition

“**Risk**” can be defined as an opposite deviation from the desired, expected, or hoped-for outcome; caused by an undesired event.



3.2. Risk vs Uncertainty

“**Risk** describes a situation in which a decision maker **relies on historical information** to develop the probability distribution of future flows and assesses the associated risk.

“**Uncertainty** describes a situation where the decision maker **does not have such historical information** and can only conceptualise what the probability distribution of future flows will be.

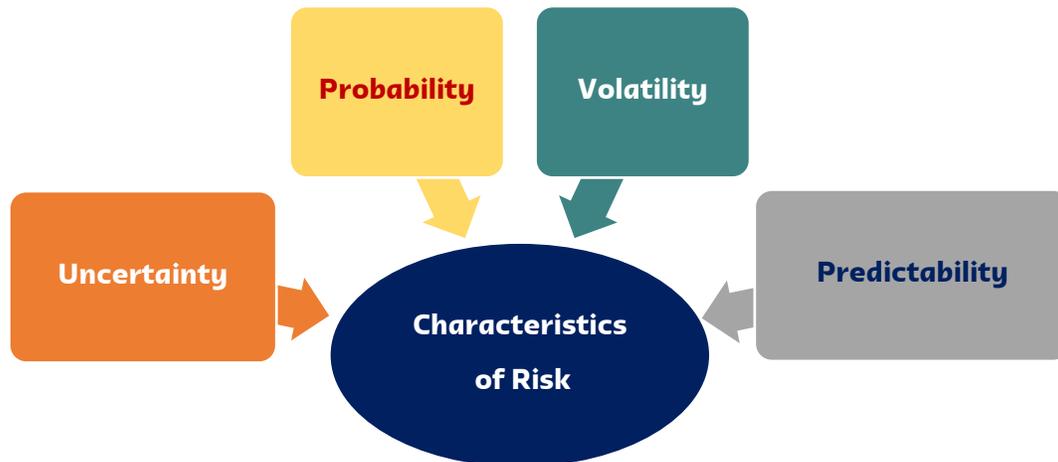
Table 1. Risk vs Uncertainty

Risk	Comparison Basis	Uncertainty
States where outcomes are unrecognized but probabilities are quantifiable or estimable.	Definition	States where outcomes are unrecognized and probabilities cannot be quantifiable or assigned
Can be measured using statistics (Variance, SD, VaR)	Measurability	Not quantifiable; no statistical probabilities available.
Bond default probabilities, stock volatility, insurance claims.	Examples	Sudden political shifts, disruptive technology, unexpected regulations.
Typically short-to medium-term (data-driven models)	Time Horizon	Often long-term or structural changes in environment
Diversification, hedging, insurance, risk modeling.	Management Tools	Scenario planning, flexibility, judgement, adaptive strategies.

Source: Knight, F. H. (1921), De Groot, M., & Thurik, A. R. (2018), Alhabeeb, M. J. (2021).

3.3. Characteristics of Risk

Figure 3. Risk Characteristics



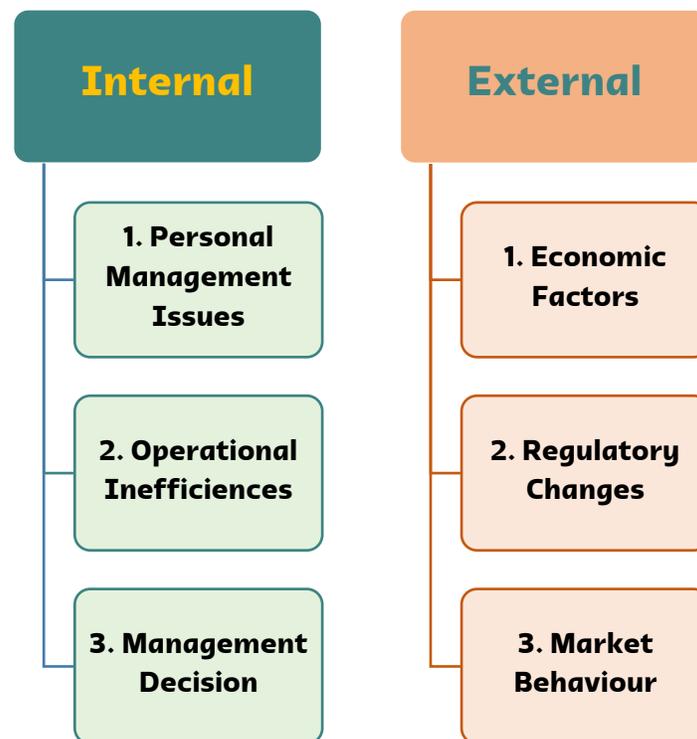
Source: Iriani, N., Agustianti, A., Sucianti, R., Rahman, A., & Putera, W. (2024).

- **Uncertainty:** the relationship between risk and uncertainty is fundamental, financial managers cannot know in advance the results of their decisions. Even if there are probabilities but the future is never certain, this uncertainty makes investments outcomes accompanied with risk.
- **Probability:** there are situations where risk probabilities can be statistically measured through the likelihood of defaults, loss, or return outcomes. Probability then makes financial decisions easier; giving measurable shape to risk.
- **Volatility:** the fluctuations in asset's return and prices is refers to volatility, which indicates a crucial indicator of risk. Statistics like variance or standard deviation are the common used measures of volatility, the bigger their value, the higher uncertainty is.
- **Predictability:** certainty is far of reality, even advanced risk predictive models results are remains closer to probability. Predictability shows the advantaged and weaknesses of these models ensuring that risk in only estimated but never eliminated.

3.4. Risk Sources

The importance of differentiating between the different sources of risk is contributes fundamentally in rationally choosing risk management tools.

Figure 4. Risk Sources



Source: Hanggraeni, D., Ślusarczyk, B., Sulung, L. A. K., & Subroto, A. (2019).

- I. **Internal Risks:** the risks occurred inside the organization, often related to processes, decisions, or structures under management's control. They can be predictable and though dominated through internal controls and governance.
 - a **Personal Management Issues:** actions linked to human error, such as skills, experiences and ethics that may cause unsuitable practices, fraud or misaligned strategies.

- b **Operational Inefficiencies:** problems caused by failure in internal processes, systems, or technology. For instance, a bank's IT system failure could disrupt online transactions and destroy customer trust.
 - c **Management Decision:** related to the lack of good leadership, which can lead to poor financial planning; a cause of liquidity risk, for instance or a decision to enter a highly volatile market without proper risk assessment.
- II. **External Risks:** factors that are out of an organization's control. A company cannot prevent these risks from occurring, but it can be prepared to respond to them.
- a **Economic Factors:** broad macroeconomic factors are a constant external threat. For example a recession can lead to a drop in consumer spending, directly affecting a company's revenue, inflation can also be a significant risk, increasing a company's cost's and squeezing its profit margins.
 - b **Regulatory Changes:** governments and regulatory bodies are constantly changing the rules of the game, increasing operational costs and creating compliance challenges. Political instability in the other hand can disrupt supply chains and international trade, creating market uncertainty that is difficult to navigate.
 - a **Market Behaviour:** this is perhaps the most familiar external risk. It's driven by unpredictable, large-scale movements in the market. For example, changes in central bank policy can cause interest rate fluctuations that affect a company's borrowing costs, while currency risk can impact the value of international earnings for companies that operates globally.

Lecture Two

Types of Risk



Educational objectives of the lecture

Dear student, by the end of this lecture, you will be able to:



Recognize and categorize the primary types of risks.



Differentiate between specific financial risks.



Explain the risk-return tradeoff principle and its applications in financial management.

Introduction

Types of Risk vary based on their sources and impacts. By examining scientific literature regarding the risks that an organization may face. Risks are classified based on three foundations, which are:

- The source of risk;
- The association with the organization;
- The competitive information advantage.



1. Types of Risk Based on the source of Risk



1. Business Risk

Risk associated with the industry and the core area in which the company operates.

2. Operational Risk

Risk associated with the internal systems (or the individuals working within these systems) of the company.

3. Management

Risk associated with the administrative functions and practices carried out by the management of the company.

4. Credit Risk

Risk associated with the failure of the counter party to meet its obligations.

5. Funding Risk

Risk resulting from the failure of the company to meet its debt obligations according to the terms agreed upon with the financiers or lenders.

6. Market Risk

Risk associated with unwanted movements (upward and downward) in market prices.

7. Legal/Political

Risk arising from entering into contractual agreements with other parties, as well as risks resulting from government decisions such as taxes, pricing customs, and nationalization

8. Hedging Risk

Risk resulting from errors in hedging or the failure to achieve adequate coverage for the risks faced by the institution.

9. Concentrate Risk

Risk arising from concentrating investments in a single sector or several small sectors, commonly referred to as 'concentration risk' or 'lack of diversification.'



Market Risks

1. Interest Rate Risk



The changes in interest rates that affect an investment negatively are referred to **interest rate risk**. For instance, the value of bonds tends to fall as a result of an increase in interest rates. This is because new bonds will offer higher income, making older bonds less attractive.

Example:

In 2022, in order to reduce inflation rates, interest rates were raised by the U.S. Federal Reserve. Consequently, bond prices in the market fell, especially for long-term bonds.

2. Exchange Rate Risk



The possibility of losing money due to changes in one currency relative to another currency refers to **exchange rate risk**, also known as **currency risk**. This risk often accompanies investors or companies dealing with foreign currencies.

Example:

A U.S. company with significant sales in Europe may face a loss in revenue when the euro gets weaker compared to the dollar, because the money earned in euros is worth less once it's converted back to U.S. dollars.

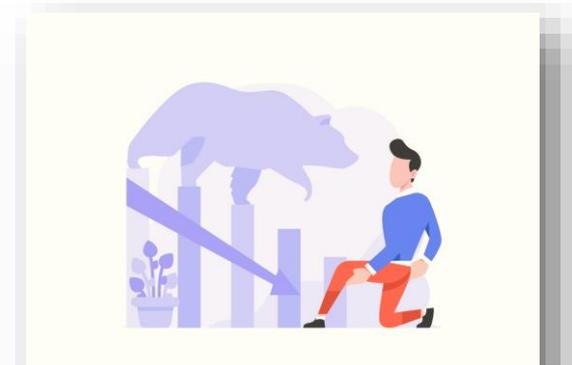


3. Commodity Risk

Commodity risk refers to the price fluctuations in raw materials such as oil, gold, or agricultural products. These prices can be volatile due to factors like geopolitical events, natural disasters, or supply-demand imbalances.

Example:

The oil price crash in 2020, triggered by a combination of oversupply and reduced demand during the COVID-19 pandemic, severely impacted oil-dependent companies and economies.



4. Equity Risk

It is the risk of investment's value reduction in the stock market due to factors such as market volatility, poor company performance, or broader economic downturns.

Example:

The fear investors occur in the 2008 financial crisis, lead to global stock markets crashes due to the collapse of major financial institutions, significant losses in equity investments were the outcome.

2. Types of Risks associated the organization

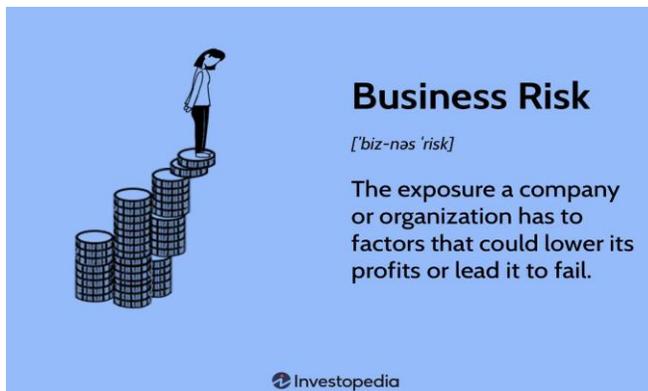


Table 2. Systematic Risks vs Unsystematic Risks

Systematic Risks	Comparison Basis	UnSystematic Risks
Risk that affects the whole market	Definition/Scope	Risk that affects specific companies or industries
Inflation, market crashes, rate hikes, recession	Examples	Products recalls, fraud, sector downturns, strikes
Beta, CAMP	Measurement	Fundamental analysis Statistical tools: variance, SD, Sharpe Ratio
Hedging, asset allocation	Mitigation	Diversification

Source: Bajaj Finserv. (2025, June 30). *Systematic risk and unsystematic risk – Key differences*. Retrieved from <https://www.bajajfinserv.in/investments/systematic-vs-unsystematic-risk>

3. Types of Risks in terms of information competitive advantage



1. Financial Risks

The Risks that are not faced because of informational competitive advantage, but that the organization faces because of its operations in the broader market. These risks are not linked to the primary activities of the organization, but it must adopt effective strategies to mitigate, avoid or control them; in order to reduce unnecessary costs.



2. Business Risks

Risks that the organization must bear in order to perform its core activities. The organization must possess some informational competitive advantages regarding the variables arising from these risks, as these variables represent essential elements for carrying out the organization's activities and generating cash flows. Furthermore, the organization achieves economic returns in exchange for these risks.

Lecture Three

Risk Measurement

I. Statistical Tools



Educational objectives of the lecture

Dear student, by the end of this lecture, you will be able to:



Understand key statistical measures.



Analyze financial risk using statistical tools.



Evaluate individual assets risk.



Make informed risk decisions.

Introduction

Statistical tools are vital for quantifying and understanding the uncertainties and risks in financial markets. These tools enable financial institutions and investors to make informed decisions by analyzing volatility, correlations, and potential losses.

Throughout this lecture, we will delve into key concepts such as **standard deviation, variance, Beta coefficient**, etc. These are fundamental techniques used to evaluate risk in **individual assets** and portfolios.

1. Range



Definition: The **range** is the difference between an investment's most and least **expected cash flow** a company can make. The larger this difference, the greater the **risk**.

Formula:

$$Range = R_{max} - R_{min}$$

Example: If a stock's returns over 5 days are:

3%, 5%, 2%, -1%, and 4%, the range is:

$$Range = 5\% - (-1\%) = 6\%$$

2. Variance

Definition: Variance shows how much an investment's returns are spread out from the average return. It's calculated by averaging the squared differences between each return and the mean, giving a single number that reflects the overall volatility or variability of the returns. **Formula:** There are two cases; if the data:

a. Historical Data

$$\delta^2 = \frac{\sum [R_i - E(R_i)]^2}{n - 1}$$

Where:

R_i : Asset 'i' Actual Return.

$E(R_i)$: Asset 'i' Expected return.

n : The Number of periods (observations) for collected returns of Security 'i'.

Example 01: Calculate the variance of stock "F" prices over five days.

Day	Stock Price
1	100
2	105
3	102
4	98
5	104

b. Probabilities

$$\delta^2 = \sum_{i=1}^n P(R_i) \times [R_i - E(R_i)]^2$$

Where:

R_i : Asset 'i' Actual Return.

$E(R_i)$: Asset 'i' Expected return.

$P(R_i)$: Asset 'i' Probability of Return.

Example 02: A stock "G" has the following expected returns and probabilities. Calculate the variance of stock "G".

Return (%)	Probability
10	0.3
5	0.5
-5	0.2

3. Standard Deviation



Definition: the square root of the variance is refer to the standard deviation (SD). It is a way to assess how much an investment's returns tend to stray from the mean. It tells how much **volatility** to expect.

A higher SD means that returns are more spread out and therefore riskier. When the SD is zero, it means that there's no dispersion at all, and the investment's return is **certain** and **risk-free**.

a. Historical Data

$$\delta = \sqrt{\frac{\sum_{i=1}^n [R_i - E(R)]^2}{n - 1}}$$

Where:

R_i : Asset 'i' Actual Return.

$E(R_i)$: Asset 'i' Expected return.

n : The Number of periods (observations) for collected returns of Security 'i'.

b. Probabilities

$$\delta = \sqrt{\sum_{i=1}^n P(R_i) \times [R_i - E(R)]^2}$$

Where:

R_i : Asset 'i' Actual Return.

$E(R_i)$: Asset 'i' Expected return.

$P(R_i)$: Asset 'i' Probability of Return.

Example 01: The table below shows the historical annual returns (%) of three investment projects over 4 years:

Year	Project A	Project B	Project C
1	10	12	9
2	8	15	7
3	11	9	12
4	9	10	8

- Calculate the standard deviation of returns for each project.
- Which project is favorable for the investor?

Example 02: The table below shows the probability distribution of expected returns for three projects:

Return	Project X	Project Y	Project Z
5	0.3	0.4	0.2
10	0.5	0.3	0.4
15	0.2	0.3	0.4

- Calculate the standard deviation of returns for each project.
- Which project is favorable for the investor?

4. Coefficient of Variation

Definition: As a risk quantifier, the Coefficient of Variation (CV) **compares** an investment's **risk** to its **average return**. It is determined through dividing the standard deviation (a measure of risk) by the mean (the average return).



Since the CV accounts for differences in expected returns, it's the best tool for comparing the risk of two investments that have **different average returns**. It shows how much risk an investor is taking on for each unit of potential return. A lower CV is better, as it indicates a more favorable risk to reward ratio.

Formula:

$$CV = \frac{\delta_{R_i}}{E(R_i)}$$

Where:

CV : The Coefficient of Variation.

$E(R_i)$: Asset 'i' Expected return.

δ_{R_i} : Asset 'i' Standard deviation.

Example 01: You are given the following data for three different investment portfolios over five years.

Year	Project A	Project B	Project C
2019	8	12	5
2020	10	14	7
2021	12	16	6
2022	9	15	8
2023	11	13	6

- Calculate the coefficient of variation (CV) for each portfolio
- Determine which portfolio has the least risk relative to its return.

Example 02: The following table shows the annual returns for Company X and Company Y over the last four years.

Year	Company X Return	Company Y Return
1	15	18
2	12	20
3	14	22
4	13	19

- Calculate the coefficient of variation for both companies.
- Decide which one has a more stable return relative to its risk.

5. Covariance

Definition: A statistical measure that tells the direction of their relationship between two variables, it shows if they move together in the same or opposite direction.

- ⇒ **A positive covariance** = if one variable increases, the other one tends to increase as well;
- ⇒ **A negative covariance** = if one variable increases, the other one tends to decrease.

Formula:

$$\text{Cov}(R_x, R_y) = \frac{\sum_{i=1}^n [R_x - E(R_x)] \times [R_y - E(R_y)]}{n - 1}$$

Where:

R_i : Asset 'i' Actual Return.

$E(R_i)$: Asset 'i' Expected return.

$\text{Cov}(R_x, R_y)$: The Covariance between Security X returns and Security Y

Example 01: The monthly returns of a portfolio given in the following table. Calculate the covariance between the two stocks, over four months.

Month	Stock A Return	Stock B Return
1	2	3
2	4	5
3	3	2
4	5	4

Example 02: Given the annual returns for a bond fund and a stock index over three years.

Year	Bond Fund (%)	Stock Index (%)
1	6	12
2	8	14
3	5	9

➤ Calculate the covariance between these two assets.

6. Correlation Coefficient

Definition: Correlation takes the concept of covariance and standardizes it, creating a number that always falls between: -1 to +1. This helps understand both direction and strength of linear relationship between two variables, regardless of their units.

A **correlation of +1** means there is a perfect positive relationship,

A **correlation of -1** means there is a perfect negative relationship,

A **correlation of 0** means no linear relationship.

Formula:

$$r = \frac{Cov(R_i, R_m)}{\delta_i \times \delta_m}$$

Where:

r : Correlation coefficient.

$Cov(R_i, R_m)$: Covariance between Security i returns and market returns..

δ_i, δ_m : Security 'i' / Market Standard Deviation.

Example 01: Calculate the coefficient of correlation between the stock prices of Company A and Company B over five days.

Day	Company A Stock Price	Company B Stock Price
1	100	50
2	102	52
3	105	53
4	107	54
5	110	55

Example 02: Calculate the coefficient of correlation between the returns of two stocks over four months.

Day	Stock A Return (%)	Stock B Return (%)
1	5	7
2	8	9
3	6	5
4	10	12

7. Beta Coefficient

Definition: it measures the volatility or systematic risk of an asset relative to the market.

Formula:

$$\beta = \frac{\text{Cov}(R_i, R_m)}{\delta_m^2}$$

Where:

β : Beta coefficient.

$\text{Cov}(R_i, R_m)$: Covariance between Security i returns and market returns.

δ_m^2 : Market variance.



Example 01: Use the beta values of two stocks to evaluate their risk compared to the market.

Month	Stock A Return (%)	Stock B Return (%)
1	5	3
2	10	6
3	-2	2
4	8	7
5	12	10

Example 02: Calculate the beta coefficient for Stock A based on its historical returns compared to the market returns.

Stock	Beta Coefficient
Stock B	1.2
Stock C	0.8

Interpret Beta:

If β is greater than 1: The security is expected to be more volatile than the market (Stock B).

If $\beta < 1$: The security is expected to be less volatile than the market (Stock C).

Estimate the impact of market changes:

Stock B is expected to increase by $1.2 \times 10\% = 12\%$, if the market increases by 10%.

Stock C is expected to decrease by $0.8 \times 10\% = 8\%$, if the market decreases by 10%.

Conclusion: Stock B will likely show a higher return in bullish markets but more significant losses in bearish markets compared to Stock C, which is more stable.

Lecture Four

Risk Measurement

II. Financial Analysis Tools



Educational objectives of the lecture

Dear student, by the end of this lecture, you will be able to:



Measure risk depending on Financial analysis measures.



Use Financial Ratios to analyze financial risk.



Know the difference between financial prediction models.



Evaluate companies insolvency.

Introduction

Financial analysis tools focus on assessing an organization's solvency, especially towards creditors; by the time they come due, ensuring sufficient cash flows to support shareholders. The measurement of financial risk for an entity relies on a set of ratios and financial indicators, which serve as approximate measures of the entity's expected cash flows, profit margins, and coverage of liabilities.



Financial Analysis Tools

1. Ratios

These ratios, together offer a quick summary of a company's financial condition, its power to make money, and its ability to pay what it owes.

1. Debt Ratio

Debt Ratio

Measures the extent of an entity's leverage.

Formula

$$\frac{\text{Total Debt}}{\text{Total Assets}}$$

Example: If a company has \$600,000 in total debt and \$1,200,000 in assets.

$$\text{Debt Ratio} = \frac{\text{Total Debt}}{\text{Total Assets}} = \frac{600,000}{1,200,000} = 0.5 \text{ or } 50\%$$

It signals that the company's assets are financed equally by its own capital and by money owed to others (debt).

2. Current Ratio

Current Ratio

Assesses liquidity, the company's capacity to pay off its immediate obligations.

Formula

$$\frac{\text{Current Assets}}{\text{Current Liabilities}}$$

Example: Example: If a company has \$200,000 in current assets and \$100,000 in current liabilities, the current ratio is:

$$\text{Current Ratio} = \frac{\text{Current Assets}}{\text{Current Liabilities}} = \frac{200,000}{100,000} = 2$$

Indicates that for every \$1 in debt the company has, it possesses \$2 in assets, means good liquidity.

3. Degree of Total Leverage Ratio

Degree of Total Leverage

Indicates earnings per share sensitivity to changes in sales.

Formula

$$\frac{\% \text{ Change in EPS}}{\% \text{ Change in Sales}}$$

Example: If a 10% increase in sales leads to a 15% increase in earnings per share (EPS), the DTL is:

$$\text{DTL} = \frac{\% \text{ Change in EPS}}{\% \text{ Change in Sales}} = \frac{15\%}{10\%} = 1.5$$

This means EPS is 1.5 times as sensitive to changes in sales.

4. Equity to Total Debt Ratio

Equity to Total Debt Ratio

Measures the amount of total funding comes from equity.

Formula

$$\frac{\text{Total Equity}}{\text{Total Debt}}$$

Example: If a company has \$300,000 in equity and \$150,000 in debt, the equity to total debt ratio is:

$$\text{Equity to Total Debt Ratio} = \frac{\text{Total Equity}}{\text{Total Debt}} = \frac{300,000}{150,000} = 2$$

This ratio indicates that the company has \$2 in equity for every \$1 in debt.

5. Long-Term Debt Ratio

Long-Term Debt Ratio

Assesses the amount of total funding comes from long-dated debt.

Formula

$$\frac{\text{Long - Term Debt}}{\text{Total Capital}}$$

Example: With \$200,000 in long-term debt and \$800,000 in total capital, the long-term debt ratio is:

$$\text{Long-Term Debt Ratio} = \frac{\text{Long-Term Debt}}{\text{Total Capital}} = \frac{200,000}{800,000} = 0.25 \text{ or } 25\%$$

A quarter of the company's total long-term financing is supplied by debt.

6. Long-Term Debt to Long-Term Assets Ratio

Long-Term Debt to Long-Term Assets Ratio

This metric reveals what proportion of the company's enduring assets are funded by its long-term debt.

Formula

$$\frac{\text{Long - Term Debt}}{\text{Long - Term Assets}}$$

Example: If a company has \$150,000 in long-term debt and \$300,000 in long-term assets, the ratio is:

$$\text{LTD to LTA Ratio} = \frac{\text{Long-Term Debt}}{\text{Long-Term Assets}} = \frac{150,000}{300,000} = 0.5 \text{ or } 50\%$$

Fifty percent of the company's long-term assets are financed by its long-term debt.

7. Net Working Capital to Assets Ratio

Net Working Capital to Assets Ratio

Evaluates if the company possesses sufficient working capital, the liquid resources needed for daily operations to sustain its total assets..

Formula

$$\frac{(\text{Current Assets} - \text{Current Liabilities})}{\text{Total Assets}}$$

Example: For a company possessing \$200,000 in current assets, \$100,000 in current liabilities, and \$500,000 in total assets.

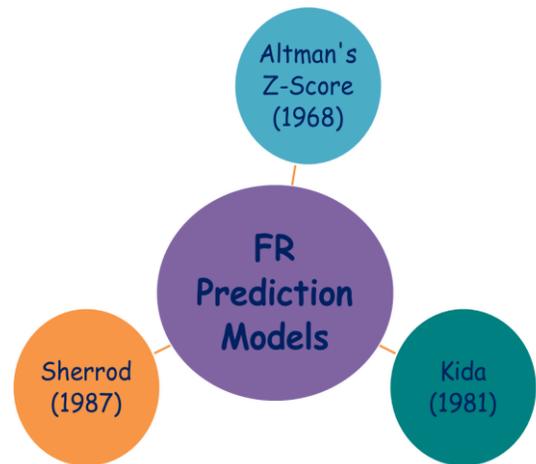
$$\text{Net Working Capital to Assets Ratio} = \frac{(\text{Current Assets} - \text{Current Liabilities})}{\text{Total Assets}} = \frac{200,000 - 100,000}{500,000} = 0.2 \text{ or } 20\%$$

This ratio shows that 20% of total assets are supported by working capital.

2. Financial Risk Prediction Models

There are numerous studies that have focused on creating a single financial tool that uses multiple indicators to assess an institution's financial risk, particularly financial distress and bankruptcy.

Each model from the following builds on previous research, improving accuracy and application for risk management.



2.1. Altman Z-Score

The Altman Z-Score, created by Professor Edward Altman, is a predictive model used to measure a company's immediate risk of facing bankruptcy or financial collapse (insolvency).

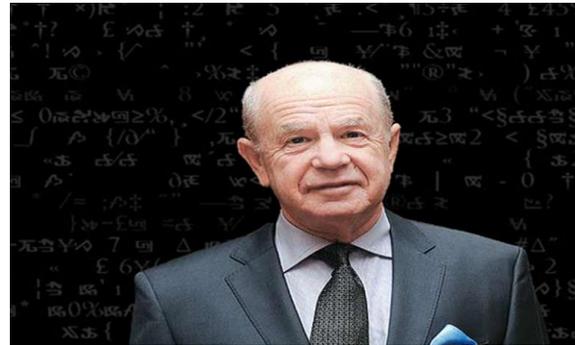


Table 3. Original Altman Z-Score Model

Original Altman Z-Score Model	
$Z = 1.2 \times X_1 + 1.4 \times X_2 + 3.3 \times X_3 + 0.6 \times X_4 + 1 \times X_5$	
X_1	= Working Capital ÷ Total Asset
X_2	= Retained Earnings ÷ Total Asset
X_3	= EBIT ÷ Total Asset
X_4	= Market Capitalisation ÷ Total Asset
X_5	= Sales ÷ Total Asset

Source: <https://www.wallstreetprep.com/knowledge/altman-z-score/>

2.1.1. Altman Z-Score Definition and Purpose



The Altman z-score was first created to assess the likelihood of bankruptcy specially within the manufacturing sector. The model works by applying a weighted system to several different financial ratios, with each ratio designed to measure a distinct aspect of a company's financial health.



The main goal of z-score model is to gauge a company's financial well-being and assign a specific probability that the company will face bankruptcy or require a major financial restructuring in the immediate future, typically within the next two years.



This score is often used in credit analysis, particularly by lenders or investors dealing with troubled companies who are trying to shield themselves from losses. It works by combining various financial ratios that collectively assess a company's essential operational strength, its ability to pay short-term bills (liquidity), its long-term debt-paying ability (solvency), its profit margins, and its amount of debt (leverage), boiling them all down into a single score.

2.1.2. Altman Z-Score Components

$$Z = 1.2 \times X_1 + 1.4 \times X_2 + 3.3 \times X_3 + 0.6 \times X_4 + 1 \times X_5$$

Here is a description of the five elements that make up the Z-Score calculation:

$$X_1 = \frac{\text{Working Capital}}{\text{Total Assets}}$$



Measures Liquidity

The ratio of working capital to total assets measures how readily a company's can cover its short-term debts.



You should generally exclude any intangible assets when calculating total assets.

$$X_2 = \frac{\text{Retained Earnings}}{\text{Total Assets}}$$

Measures accumulated profitability

This measures the degree to which a company depends on debt to finance its day-to-day operations. A strong result here is a good sign, indicating the company can manage its expenses mainly with the money it earns, rather than having to depend on borrowing.

$$X_3 = \frac{\text{EBIT}}{\text{Total Assets}}$$

Indicates asset productivity

The ratios measure how efficiently a company operates: they assess its skill at turning its assets into profits. A higher score means the company is both bringing in more money and utilizing its assets more effectively.

$$X_4 = \frac{\text{Market Capitalization}}{\text{Total Liabilities}}$$

Measures solvability

It gauges the potential decline in the value of a company's stock if it were to collapse financially (become unable to settle its debts). Consequently, if the company's total stock value (market capitalization) is small compared to what it owes, it signals that the market is doubtful about the company's future prospects.

$$X_5 = \frac{\text{Sales}}{\text{Total Assets}}$$

Measures Efficiency

A higher percentage signals greater efficiency in generating revenue, which translates to higher profitability since the firm relies less on reinvesting its money.

2.1.3. Altman Z-Score Interpretation

The Altman z-score is a tool that puts a number on a company's financial stability, helping to forecast its immediate likelihood of insolvency (financial collapse).

A lower Z-score generally signals a much greater risk of bankruptcy, and vice-versa. While a high score isn't a guaranteed sign of lasting financial health, a low one is a serious red flag, indicating you need to investigate the company's core finances more closely.

For manufacturing companies who are publicly traded, the following scores are typically used as benchmarks:

Table 4. Z-Score Interpretation

Z-Score	Interpretation
> 2.99	Safe Zone: Low Likelihood of Bankruptcy
1.81 – 2.99	Grey Zone: Moderate Risk of Bankruptcy
<1.81	Distress Zone: High Likelihood of Bankruptcy

Source: <https://www.wallstreetprep.com/knowledge/altman-z-score/>

2.1.4. Altman Z-Score Calculation Example

Imagine a public manufacturing company is struggling and showing signs of potential failure due to several quarters of poor financial results, especially low profits.

We will use the original Z-score model to estimate this hypothetical company's risk of bankruptcy. Our modeling exercise will rely on the following initial assumptions:



Current Assets	\$60 million
Current Liabilities	\$40 million
Fixed Assets	\$100 million
Net Income	\$10 million
Dividends	\$2 million
Sales	\$60 million
COGS and SG&A	\$40 million
P/E Multiple	8.0x
Total Liabilities	\$120 million



2.2. Kida Z-Score

The Kida model uses financial ratios to predict financial failure. It integrates variables that are particularly useful for understanding companies with volatile cash flows and non-manufacturing businesses.



2.2.1. Kida Z-Score Components

$$\text{Z-Score} = -1.5042 \times X_1 + -0.427 \times X_2 - 0.461 \times X_3 - 0.463 \times X_4 + 0.271 \times X_5$$

Kida's model depends on five distinct financial indicators:

X_1 : net income/total assets.

X_2 : total shareholder's equity/total debt.

X_3 : quick assets/current liabilities.

X_4 : sales (revenue) / total assets.

X_5 : cash / total assets.

A negative Z-Score implies a problem firm, where as a positive Z-score implies a non-problem firm.

2.2.2. Kida Z-Score Application



Kida's model has been widely used in various international studies, including financial assessments of banks and high-volatility sectors.

For example, banks listed on the Iraqi Stock Exchange (ISE) have been analyzed using Kida's model, which helped highlight the institutions' financial vulnerabilities during 2011–2014.

2.3. Sherrod Z-Score

The Sherrod model is considered a sophisticated tool for predicting financial failure. This model relies on six distinct financial indicators and assigns a specific weight to each of them within its core formula. This formula, known as a discriminant function, was designed by Sherrod to help identify companies at risk of financial distress.



2.3.1. Sherrod Z-Score Components

$$\text{Z-Score} = 17 \times X_1 + 9 \times X_2 + 3.5 \times X_3 + 20 \times X_4 + 1.2 \times X_5 + 0.10 X_6$$

The Sherrod model focuses on ratios that assess a company's liquidity, leverage, and profitability:

X_1 : working capital / total assets.

X_2 : cash assets / total assets.

X_3 : total shareholder's equity / total assets.

X_4 : earnings before interest and taxes / total assets.

X_5 : total assets / total liabilities.

X_6 : total shareholder's equity / tangible fixed assets.

Table 5. Sherrod Z-score Interpretation

Category	Risk Degree	Z score
1st	Company is not exposed to the risk of bankruptcy	$Z > 25$
2nd	Little likelihood of exposure to the risk of bankruptcy	$25 \geq Z > 20$
3rd	Difficult to predict the risk of bankruptcy	$20 \geq Z > 5$
4th	The company is exposed significantly to the risk of bankruptcy	$5 \geq Z > -5$
5th	The company is exposed to the risk of bankruptcy	$Z \leq -5$

Source: Babela, I., & Mohammed, R. (2016).

These ratios together help in determining a company's likelihood of financial failure and overall financial health.

2.3.2. Sherrod Z-Score Application

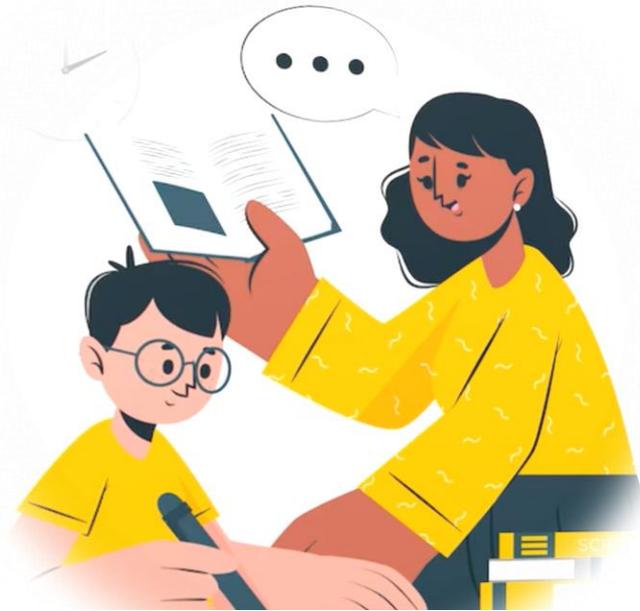


Sherrod's model has proven effective in evaluating companies beyond traditional financial indicators, predicting industrial company failures in empirical studies. However, it is less commonly applied in banking sectors, where its components do not align as closely with the capital-heavy structure of commercial banks.

Lecture Five

Risk Measurement

III. Advanced Tools



Educational objectives of the lecture

Dear student, by the end of this lecture, you will be able to:



Highlight the Value at Risk (VaR) concept and applications.



Define sensitivity analysis.



Differentiate between stress testing and scenario analysis.



Apply these risk measurement techniques to assess portfolio risk.

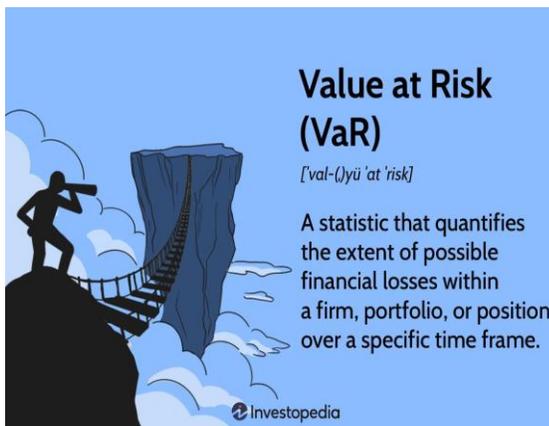
Introduction

As financial markets become increasingly complex and interconnected, accurately measuring risk is essential for effective risk management and strategic decision-making. This lesson covers modern risk measurement methods: Value at Risk (VaR), stress testing, sensitivity and scenario analysis, analysis. Each method provides unique insights into potential losses, helping financial professionals understand and manage risks under a variety of conditions.



1. Value at Risk "VaR"

1.1. Definition



"VaR" Value at Risk is an index of a single value that estimates the maximum potential loss on one asset or a portfolio during a particular period of time. VaR represents the worst expected loss under normal market conditions. Developed in 1990s by JPMorgan, **VaR** calculations are based on historical data, market volatility, and past price movements to forecast future risk.

1.2. Elements

VaR usually has three elements:



1-Risk of loss



2-Time period



3-Confidence level

For example, over the next four days, there is a 97% chance that the portfolio's value won't drop by more than 5%. That's what: VaR of 5% at 97% for the next four days means.

1

5%

2

4 Days

3

97%

1.3. Importance

- **VaR** helps companies get a single, consolidated view of their risk across the entire organization, which allows them to allocate capital more effectively to different business units.
- **VaR** simplifies a portfolio's risk of loss by summarizing it into a single number that represents the maximum potential loss over a specific time and with a defined level of certainty.

1.4. Methods of Calculation

1. Parametric Method

It adjusts multiple variables simultaneously to model extreme conditions.

2. Historical Simulation

It is an approach that changes one Variable at a time to observe its direct effect on the outcome.

3. Monte Carlo Simulation

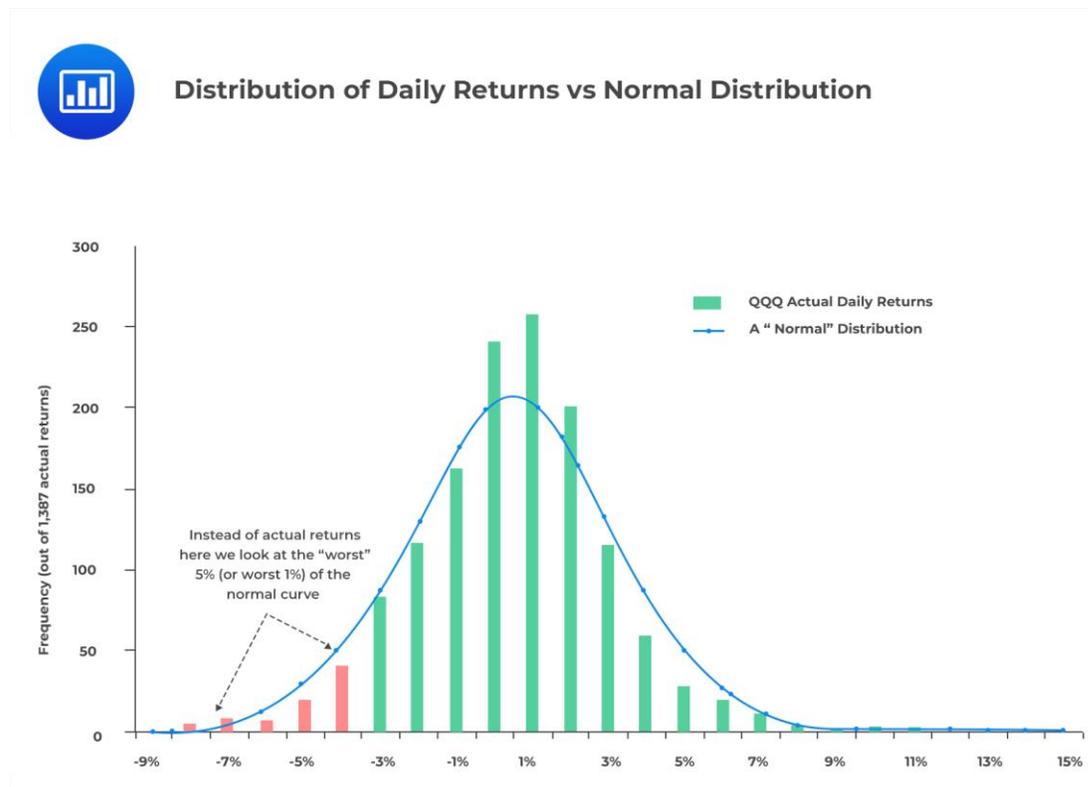
Simulates worst-case scenarios, pushing Variables to their extremes.

1.4.1. Parametric Method

a. Definition

The parametric method, also known as the variance-covariance method, is a way to calculate VaR. This method analyses historical price changes and uses statistical measures like the mean and standard deviation to determine a portfolio's maximum potential loss. It assumes that the returns and volatility of the assets follow a normal distribution (a bell curve) to calculate the maximum loss with a certain level of confidence.

Figure 5. Distribution of Daily Returns vs Normal Distribution



Source: <https://analystprep.com/>

The parametric method for calculating VaR assumes that investment returns follow a normal distribution curve. This is different from methods that rely on actual historical data.

The main advantage of using this bell-shaped curve is that it's easy to mathematically identify the worst-case scenarios. For example, the point on the curve that represents the lowest 5% or 1% of returns can be quickly found, which helps determine the maximum potential loss.

6. Formula and Example

Formula:

Parametric VaR: $VaR = -1 \times (Z - \text{score}) \times (\text{standard deviation of returns}) \times (\text{portfolio value})$

$$VaR = -1 \times (Z - \text{score}) \times \delta \times (\text{portfolio value})$$

Example

Given the mean and SD of asset's A which has a value of \$200,000, and a year of 250 trading days. The 5% annual VaR estimated using the formula is \$59,660.

Interpretation

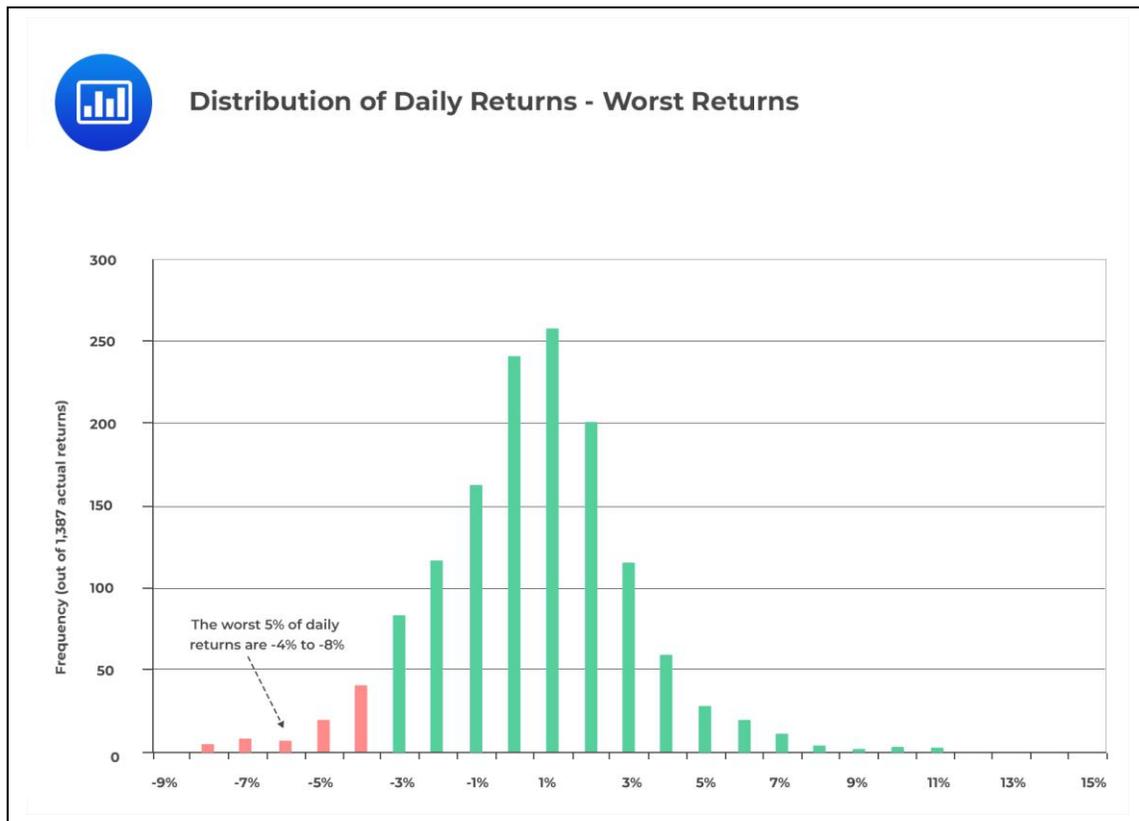
If there is no trading, this indicates that 5% probability that the asset's value by will exceed \$59,660.

1.4.2. Historical Simulation

a. Definition

A significant drawback of this method is that VaR estimates are highly dependent on the historical period the financial manager choose to analyse. For example, if the chosen period was very volatile, the calculated VaR will be overestimated, suggesting a greater potential loss than is typical. Conversely, if the period was unusually calm, the VaR will be underestimated, making the risk seem smaller than it really is.

Figure 6. Distribution of Daily Returns – Worst Returns



Source: <https://analystprep.com/>

Looking at a histogram of daily returns, the worst outcomes (the biggest losses) are located on the far left side. Based on this distribution, we can say that 95% confidence that the worst daily loss we can expect will be no more than 4%.

6. Formula and Example

Formula:

$$\text{Var} = V_m (V_i / V_{i-1})$$

The goal of the formula is to determine the percentage change in the value of a specific risk factor, such as a stock's price, for each day in this period where V_m represents the number of days of historical data used to analyse the asset and V_i is the number of variables on day i .

Example

Objective: The objective is to calculate the 1-day 95% VaR for a portfolio of stocks using the historical simulation method.

Instructions:

1-Details of the Portfolio : Assume you have a portfolio with equal investments in three stocks: A, B, and C. The total portfolio value is \$1,000,000.

2-Data Collection: Obtain historical daily returns for each stock over the past 250 trading days.

3-Calculate Portfolio Returns: Compute the portfolio's daily returns by averaging the daily returns of the three stocks, assuming equal weights.

4-Rank Historical Returns: Rank the 250 daily portfolio returns from worst to best.

5-Determine VaR at 95% Confidence Level: Identify the return at the 5th percentile (worst 5%) of ranked daily returns. Multiply this return by the portfolio value to find the 1-day 95% VaR.

6-Interpretation: Describe the meaning of the 1-day 95% VaR in terms of potential loss and probability.

Solution:

If the 5th percentile return is -2%, then the 1-day 95% VaR is:

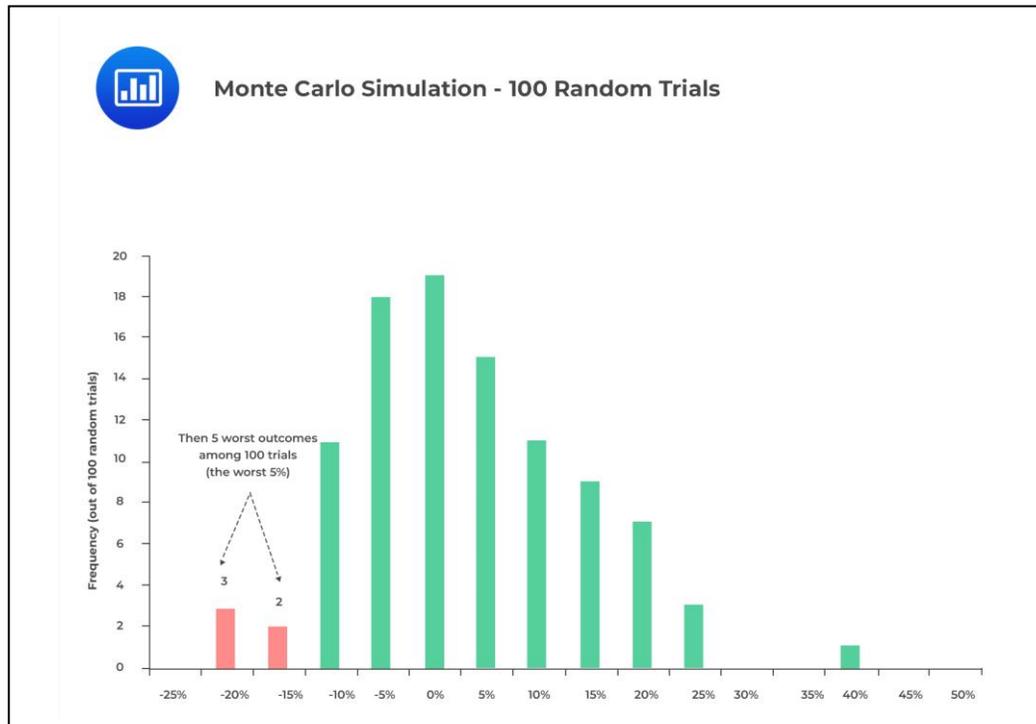
$$\text{VaR} = -2\% \times \$1,000,000 = \$20,000$$

This indicates that there is a 5% chance of losing \$20,000 or more in one day based on historical data.

1.4.3. Monte Carlo Simulation

a. Definition

Monte Carlo simulation is a method that creates thousands of hypothetical scenarios to estimate an asset's or portfolio's return. Unlike historical simulation, which uses past performance data, the monte Carlo method doesn't rely on actual historical events or assume they'll repeat. Instead, it generates random numbers to simulate a wide range of possible outcomes and predict potential losses. It's like having a "what-if" machine that runs countless simulations to explore all the possibilities.

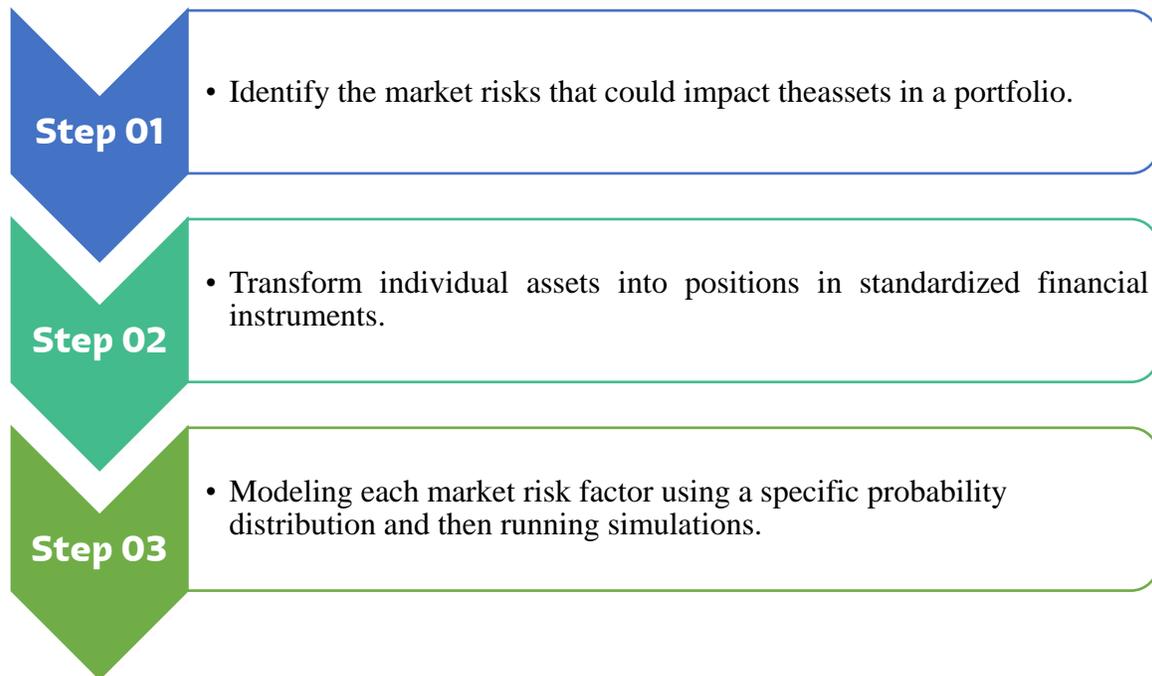
Figure 7. Monte Carlo Simulation – 100 Random Trials

Source: <https://analystprep.com/>

The histogram illustrates the distribution of monthly returns after running 100 random simulations using the Monte Carlo method.

The Monte Carlo procedure is repeated thousands of times, and the VaR is determined by finding the value at a specific percentile of all generated outcomes. The accuracy of the VaR estimate depends heavily on the assumptions made about the data's distribution and the number of trials. Interestingly, if enough simulations are run, the Monte Carlo method will produce the same results as the parametric method, provided by both use the same assumptions.

6. Steps



C. Formula / Calculation Example

Objective: Determine the portfolio's 1-day 95% VaR by running a Monte Carlo simulation.

Instructions:

1-Details of the Portfolio: Assume a portfolio with a \$1,000,000 investment in a single stock. The stock has an annualized mean return of 10% and a standard deviation of 20%.

2-Convert Returns to Daily Values: Convert the annual return and standard deviation to daily values:

Daily return = $(10\%) / \sqrt{252}$

Daily standard deviation = $(20\%) / \sqrt{252}$

3-Simulate Price Paths:

Generate 10,000 random daily returns using the daily mean and standard deviation in a normal distribution.

For each simulation, calculate the ending portfolio value after one day.

4-Calculate VaR:

Sort the 10,000 simulated portfolio values in ascending order.

Based on this distribution, identify percentile 5 value. Calculate the difference between this value and the initial portfolio value to get the 1-day 95% VaR.

5-Interpretation: Explain what this VaR represents in terms of the likelihood of daily losses based on simulated scenarios.

Solution:

If the 5th percentile loss is \$25,000, the 1-day 95% VaR is:

$$\text{VaR} = \$25,000$$

This indicates a 5% chance of losing \$25,000 or more in one day based on the simulated price paths.

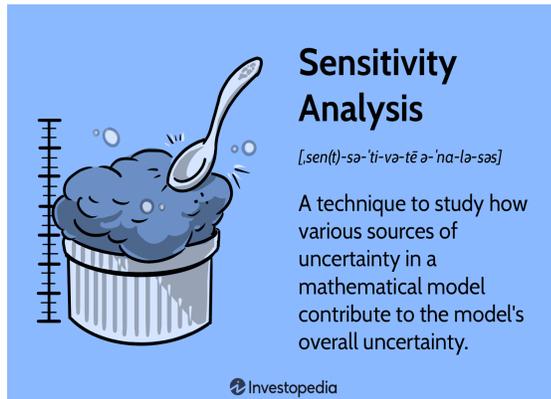
1.5. VaR Benefits and Limitations**Table 5. VaR Benefits and Limitations**

Benefits	Limitations
1-Simple to grasp: VaR is a one index that is easily interpretable as a percentage or dollar value;	1- Measurement of Significant Events: VaR does not capture rare, catastrophic events like market crashes;
2-Applicability: VaR can be applied to compare risk across different asset classes and portfolios;	2-Capturing liquidity: VaR does not measure liquidity differences between assets;
3-Acceptability: VaR is a standard metric accepted by regulators and commonly seen in financial reports;	3- Difficult to calculate given large portfolios: Calculating VaR for diverse, large portfolios is challenging due to correlations;
4-Reliability: VaR can be verified by historical backtesting to check accuracy;	4-Inconsistent results: Different calculation methods can produce varying VaR values for the same portfolio;
5-Measurement of financial securities: VaR measures risk across various assets, including stocks, bonds, and derivatives.	5-Subjectivity: VaR results vary based on subjective choices, such as estimation parameters and time frames.

Source: Krause, A. (2003).

2. Sensitivity Analysis

2.1. Definition



Sensitivity Analysis is a method used in financial risk market to measure how different factors have an impact on results. By adjusting one Variable at a time while keeping others constant, analysts can understand how sensitive a financial metric, like net present value (NPV) or portfolio return, is to changes in input factors.

2.2. Importance

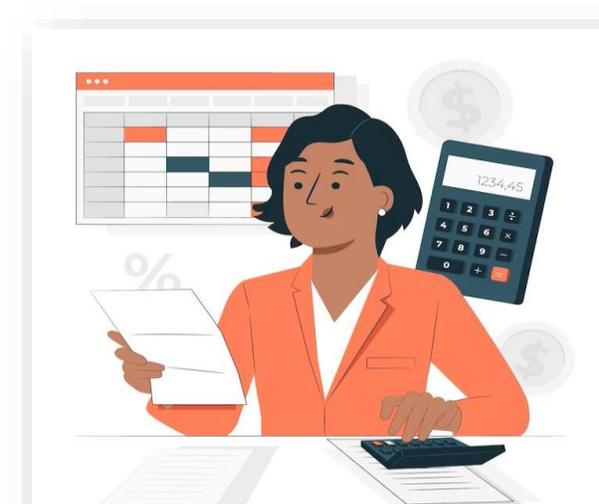
- Sensitivity analysis helps identify high-risk Variables, informs financial decision-making, and allows for proactive risk management;
- Different types of sensitivity analysis, such as scenario analysis and stress testing, are valuable in evaluating a range of possible outcomes;
- In practice, sensitivity analysis empowers firms and investors to make informed decisions by understanding how assumptions affect financial outcomes.

Example:

Imagine a company projecting its annual revenue growth at 5% with an NPV of \$1,000,000. We can use sensitivity analysis to see how this NPV changes if revenue growth deviates by $\pm 2\%$ (so, rates of 3% and 7%).

At 3% growth: NPV drops to \$800,000.

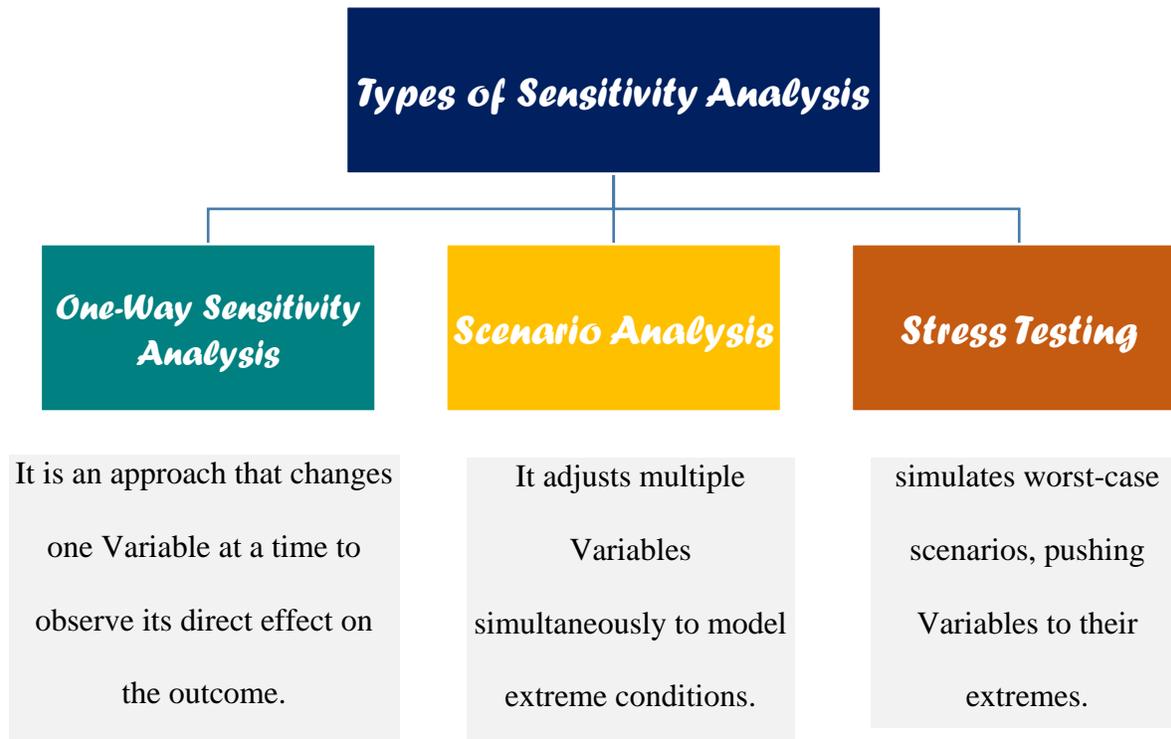
At 7% growth: NPV rises to \$1,200,000.



This example shows that a 2% change in revenue growth could swing the NPV by \$200,000, highlighting the importance of accurate growth rate assumptions.

2.3. Types of Sensitivity Analysis

Figure 8. Types of Sensitivity Analysis



Source: Swan, J. (2016).

a. One-way Sensitivity Analysis

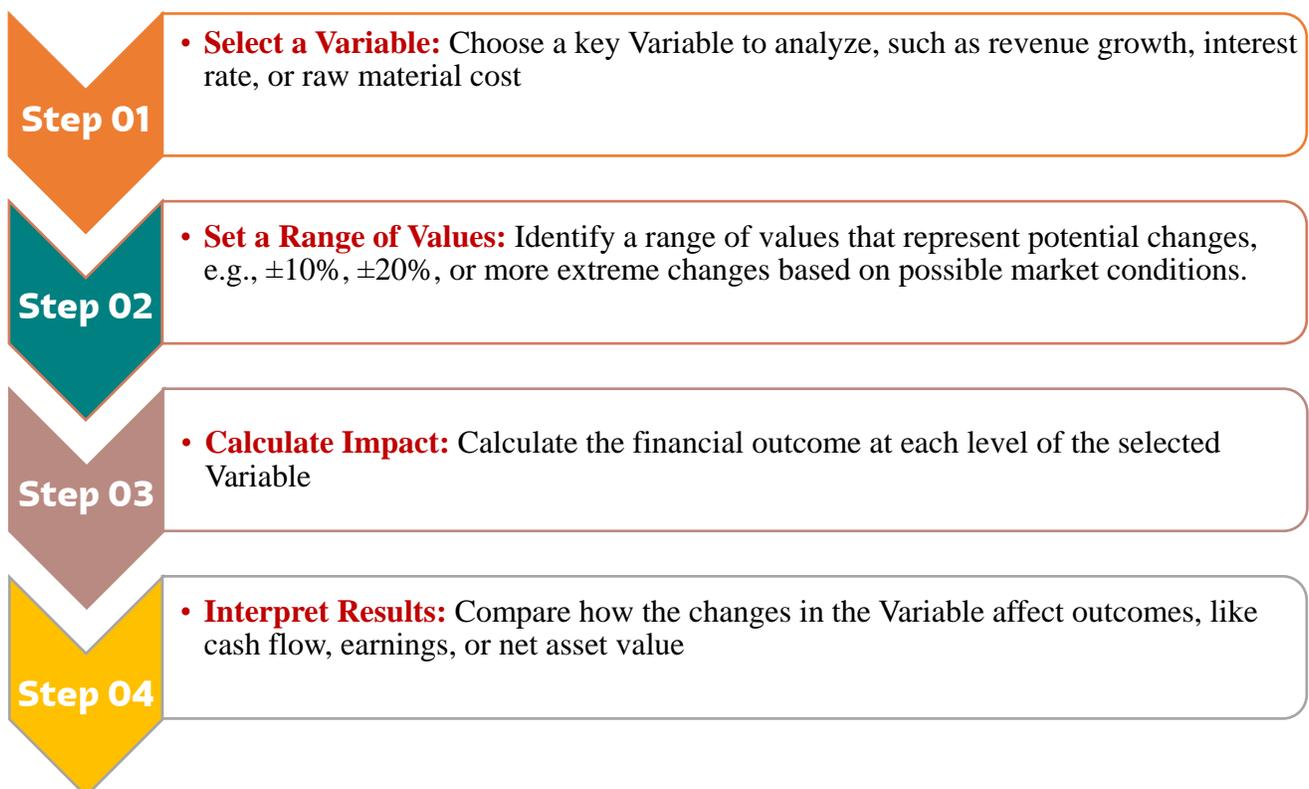


One-Way Sensitivity analysis, often called "what-if" analysis, explores how changes in one variable affect the outcome of a financial model or projection. It isolates the effect of a single variable, like interest rate, sales volume, or cost, while holding other variables constant to analyse the degree of risk associated with that specific variable.

- **Purpose:**

- Identify key Variables that significantly affect financial outcomes;
- Determine the robustness of financial projections to changes in assumptions;
- Assess risk exposure by highlighting which factors have the most impact on profitability or asset values.

- **Steps:**



- **Example 01:** Identify the market risks that could impact the assets in a portfolio.

01: Scenario

A manufacturing company forecasts a net profit of \$500,000 based on a projected sales volume of 10,000 units. Using one-way sensitivity analysis, they assess the impact of changing sales volume.

02: Steps

Variable: Sales volume.

Range: Vary sales volume from 8,000 units to 12,000 units in increments of 1,000 units.

Results:

At 8,000 units, net profit = \$300,000.

At 9,000 units, net profit = \$400,000.

At 10,000 units, net profit = \$500,000.

At 11,000 units, net profit = \$600,000.

At 12,000 units, net profit = \$700,000.

03: Analysis

This sensitivity analysis reveals that every additional 1,000 units in sales volume increases profit by \$100,000, while a decrease of 1,000 units reduces profit by the same amount. This highlights how sales volume is a critical factor in profitability and demonstrates the risk posed if sales fall below projections.

- ***Example 02: Interest Rate Impact on Bond Portfolio***

01: Scenario

Consider an investment portfolio holding \$1 million in bonds with a fixed return. The firm wants to know how changing interest rates will affect the portfolio's market value.

02: Steps

Variable: Interest rate.

Range: Increase/decrease by 0.5%, 1%, 1.5%, and 2%.

Results:

With a 1% increase, bond value **drops** by 5%.

With a 1% decrease, bond value **rises** by 5%.

03: Analysis

This analysis shows that bond values are highly sensitive to interest rate changes. If rates rise, the firm risks losses on its bond holdings, emphasizing the importance of monitoring interest rate trends for portfolio risk management.

- **Benefits and Limitations**

Table 6. One-way Sensitivity Analysis Benefits and Limitations

Benefits	Limitations
1-Clear Insights: Highlights the impact of a single Variable, simplifying the analysis;	1- Simplicity: Ignores interactions between Variables, which may not capture complex real-world risks;
2-Decision Support: Identifies the most impactful risk factors, supporting better planning and decision-making.	2- Data Static Analysis: Assumes other Variables remain constant, which may not hold in volatile markets.
<i>One-way sensitivity analysis is a valuable tool for financial risk measurement, allowing managers to assess which Variables most affect their financial outcomes. By understanding the sensitivity of profit, cash flow, or asset values to individual factors, firms can identify areas of risk and plan accordingly to mitigate potential losses.</i>	

Source: Gaytán Cortés, J. (2022).

6. Scenario Analysis

• Definition



Scenario Analysis is a method for forecasting a portfolio's value at a future date by modeling what would happen if specific, hypothetical events occurred. For example, it might estimate a portfolio's value by simulating the effect of a change in interest rates.

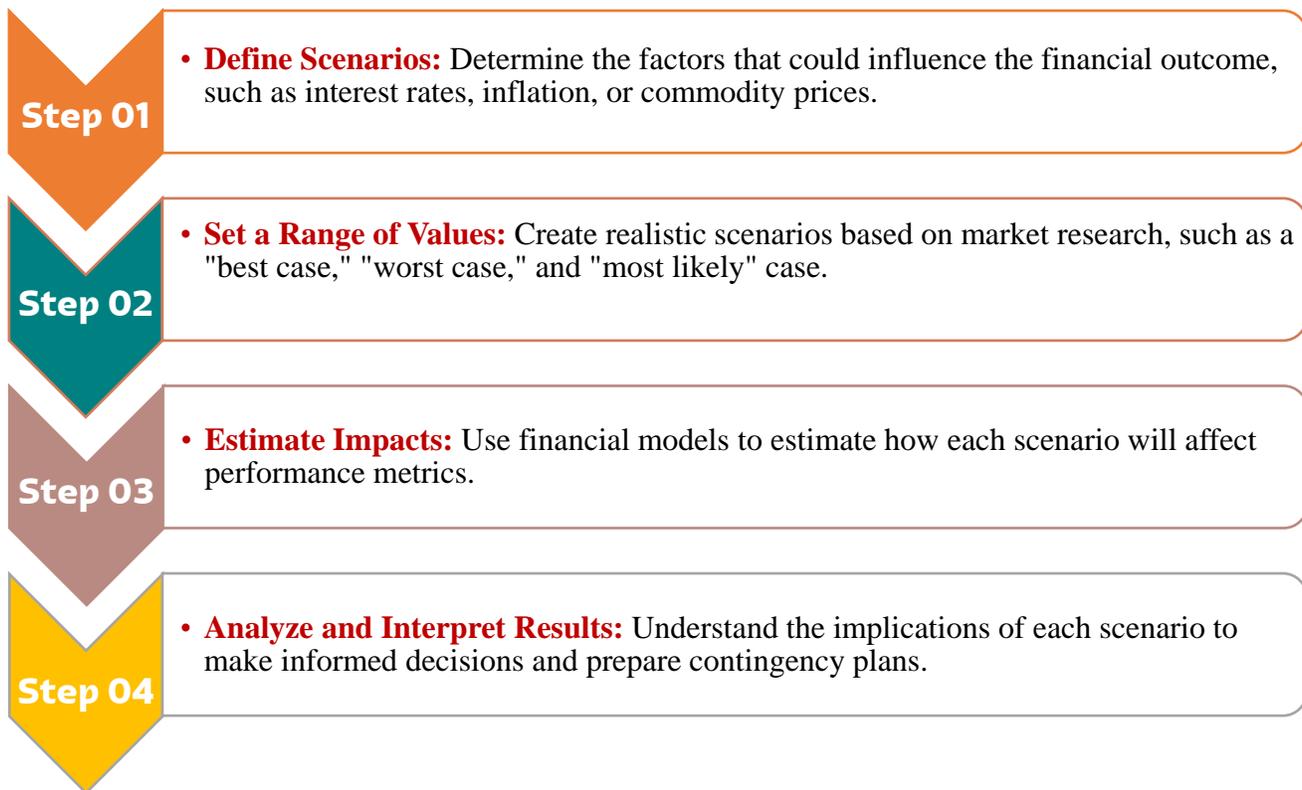
• Practical Application

Scenario Analysis is widely used for portfolio management, project finance, and strategic planning. It enables firms to avoid severe financial shocks by preparing for plausible but impactful situations, making it an essential tool in financial risk management and investment decision-making.

• Importance

- Scenario analysis Helps identify and measure risks associated with different market conditions;
- Supports strategic planning by showing the potential results of Varied decisions or external events;
- Allows businesses to prepare for adverse conditions by understanding potential losses and impacts on assets.

- **Steps**



- **Example 01: Interest Rate Changes on Bond Portfolio**

An analyst managing a bond portfolio could use scenario analysis to evaluate how different interest rate changes (e.g., a 1% increase or decrease) would impact bond values. This helps predict portfolio performance in both a rising and falling rate environment, helping the manager optimize the risk-return profile.

- **Example 02: Currency Fluctuations for Multinational Companies**

A company with significant international revenue could perform scenario analysis on currency fluctuations. By modeling scenarios where a major currency appreciates or depreciates by 10%, the company can gauge the potential impact on net income, which assists in hedging and planning for international operations.

- **Benefits and Limitations**

Table 7. Scenario Analysis Benefits and Limitations

Benefits	Limitations
<p>1-Enhanced Strategic Planning: SA allows organizations to anticipate future events, enabling better preparation for potential risks and opportunities;</p>	<p>1- Time-Intensive: Scenario analysis requires significant time and resources, as it involves complex modeling and detailed market research;</p>
<p>2-Improved Risk Management: By modeling good and bad scenarios, scenario analysis helps companies identify vulnerabilities, which can help in planning for adverse market conditions;</p>	<p>2- Reliance on Assumptions: The accuracy of the calculation depends on the used assumptions. If these are inaccurate or overly optimistic, the scenarios may mislead decision-makers;</p>
<p>3-Better Decision Making: Businesses can assess different courses of action, leading to more informed investment and strategic choices.</p>	<p>3-Limited Scope: It may not cover all possible outcomes, especially in highly unpredictable markets, leading to gaps in risk assessment.</p>

Source: Majka, M. (2024).

c. **Stress Testing**

- **Definition**



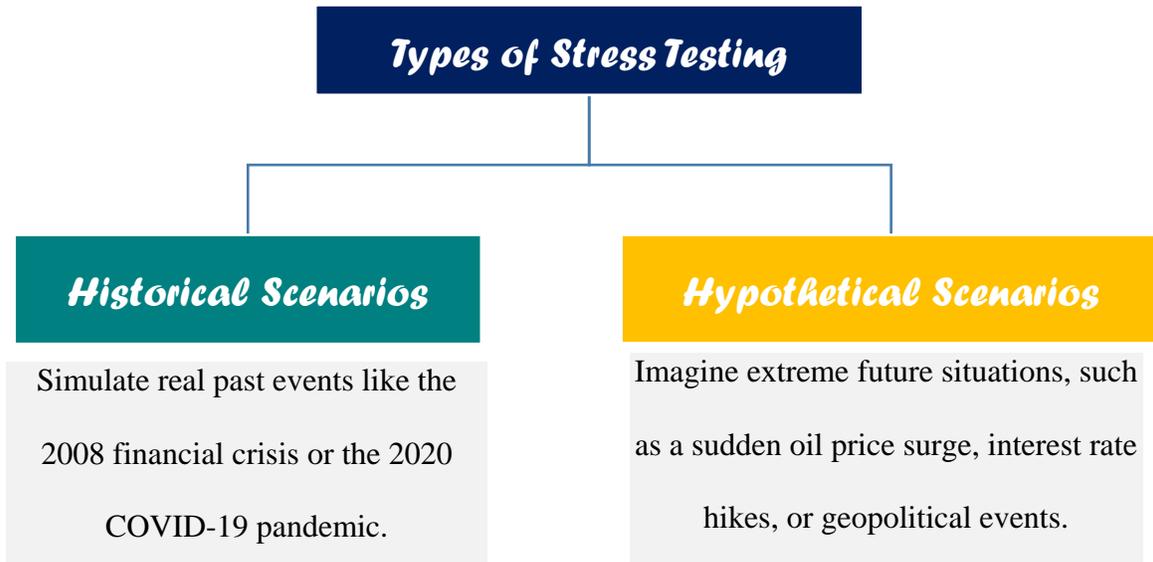
- **Purpose:**

- Identify vulnerabilities in a firm's financial position;
- Estimate potential losses under extreme conditions;
- Guide management decisions on capital allocation, risk exposure, and contingency planning;
- Inform regulators about a firm's capacity to withstand market shocks.

Stress Testing is a tool used by financial institutions to assess the resilience of portfolios, investments, and entire companies against severe but plausible adverse conditions. It helps determine how unexpected scenarios, such as a sharp market decline or an interest rate spike, would impact financial stability, liquidity, and capital adequacy.

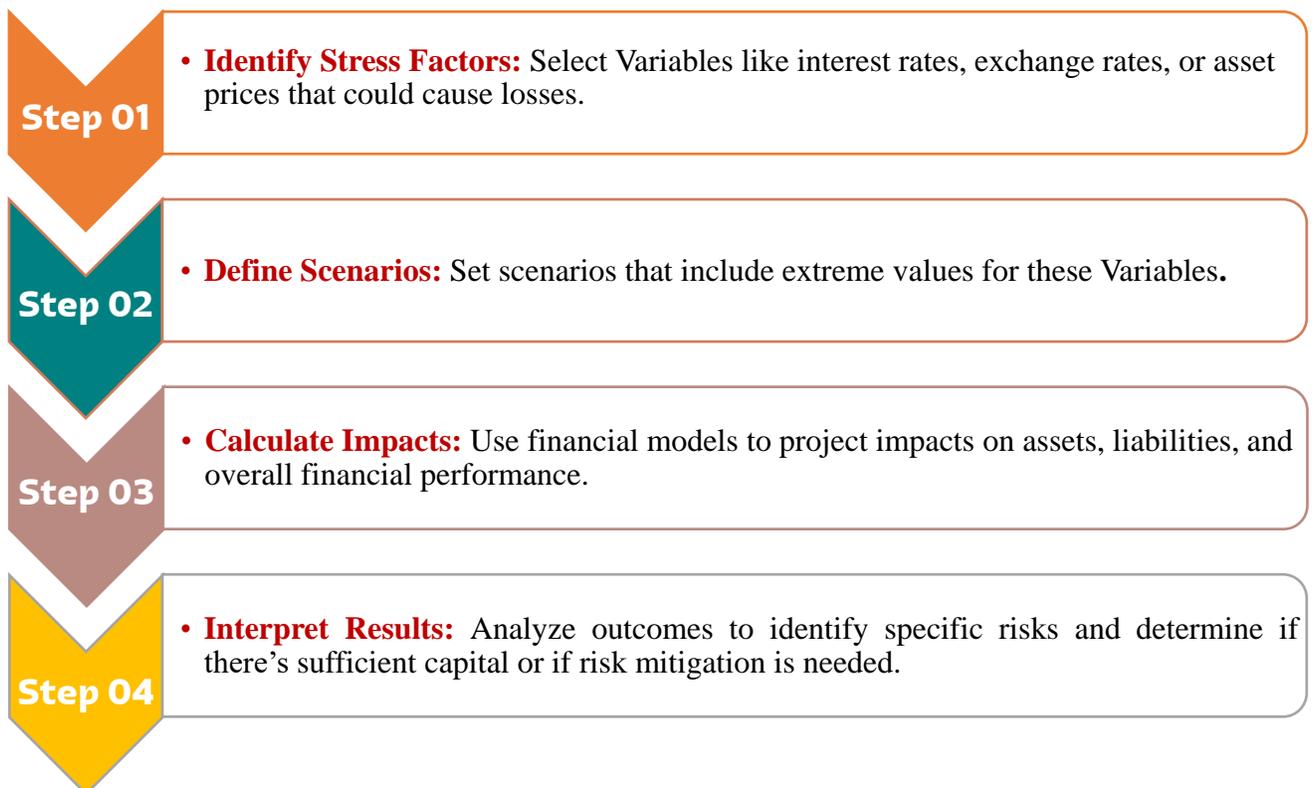
- **Types**

Figure 9. Types of Stress Testing



Source: Paraschiv, F. (2015).

- **Steps**



- **Example 01: Interest Rate Shock**

A bank wants to test its portfolio's vulnerability to a sudden 2% rise in interest rates.

Step 01: Set the Scenario:

Define the interest rate increase and select portfolio assets most likely to be affected.

Step 02: Impact Analysis:

- **Loan Portfolio:** Higher rates might lead to higher loan defaults as borrowers struggle to meet increased payments.
- **Bond Holdings:** Bond prices may decline as yields rise, potentially causing losses.

Step 03: Interpret Results:

Calculate the potential impact on earnings, capital ratios, and liquidity. Suppose the stress test shows a 15% drop in portfolio value; this outcome could prompt the bank to increase its capital cushion or reduce high-interest loans.

- **Example 02: Market Collapse**

Consider an investment fund holding a mix of stocks, bonds, and derivatives.

The stress test models a 30% equity market crash.

Step 01: Set the Scenario:

Model the effects of a rapid, steep market decline.

Step 02: Impact Analysis:

- **Equity Holdings:** A 30% market drop causes significant capital losses.
- **Derivatives Exposure:** Losses on derivative contracts tied to market indexes could magnify the fund's exposure.

Step 03: Interpret Results:

If results show the fund's value would decline by 25%, management might decide to diversify or hedge positions to limit potential losses.

- **Benefits and Limitations**

Table 8. Stress Testing Benefits and Limitations

Benefits	Limitations
1-Preparedness: Helps firms prepare for rare but impactful events;	1- Hypothetical Assumptions: Results depend on assumptions, which may not cover all possible risks;
2-Risk Identification: Pinpoints specific areas of vulnerability in the portfolio;	2- Data Sensitivity: Requires accurate, detailed data for reliable results;
3-Regulatory Compliance: Meets regulatory requirements for risk oversight and transparency.	3-Over-Simplification: Real-world events may evolve differently, especially in prolonged crises

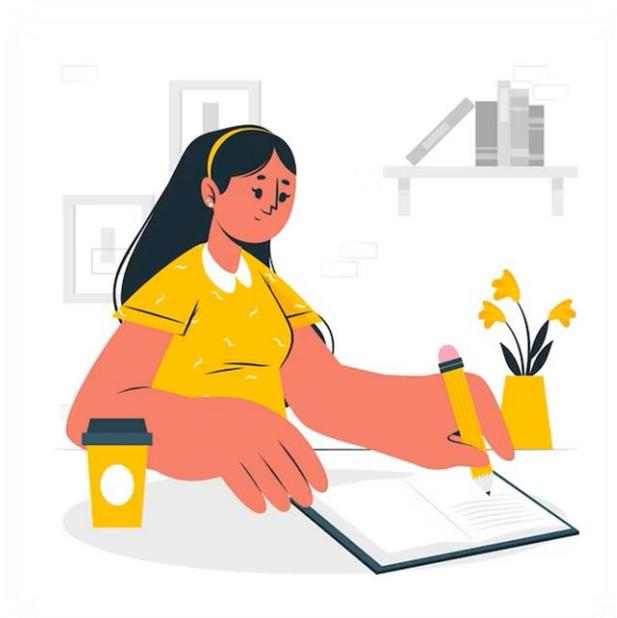
Source: Majka, M. (2024).

Stress Testing is essential in risk management for assessing potential losses under extreme conditions.

By regularly stress testing, firms can ensure they have adequate capital and a resilient strategy to face severe market disruptions.

Lecture Six

Risk-Return Relationship



Educational objectives of the lecture

Dear student, by the end of this lecture, you will be able to:



Explain the Risk-Return relationship.



Control of risk portfolio measurement tools.



Explain the risk-return tradeoff principle and its applications in financial management.

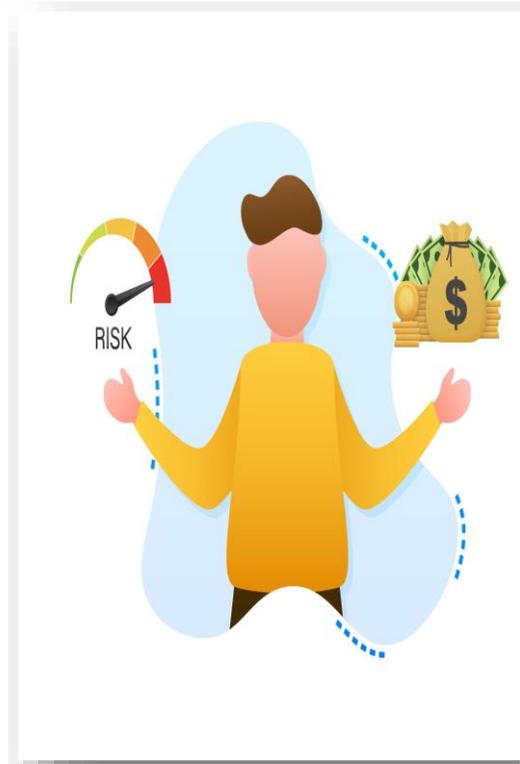


Compare between the different portfolio selection.

Introduction

The relationship between risk-return is a basic concept of finance. The more risk the investor willing to take on with an investment, the greater the potential return he can expect to receive. This is often summarized as “high risk, high reward”.

However, this trade-off is between risk and expected return, not the actual return. An investment with higher risk doesn't guarantee a higher return; it simply offers the potential for one. Additionally, this relationship isn't always a simple, straight line and can heavily influenced by market conditions and the specific nature of the investment.



1. The relationship between Risk and Return

1- Direct Correlation: Higher risk brings the possibility of greater return. For instance, emerging market stocks carry high risk but may offer higher returns compared to low-risk government bonds.

2- Risk Premium Principle: An additional compensation required, for taking on extra risk.

3- Risk and Expected Returns: low-risk investments, like government bonds, are the slow and steady option. They offer predictable and stable returns. On the other hand, high-risk assets, like stocks or real estate returns are more volatile, with the potential for both big gains and big losses.

2. Practical Application



This understanding is what helps you build a well-balanced portfolio. The fundamental trade-off in finance is to get the most profit possible without taking on too much risk, which is why diversification is so important. By spreading your investments around, you can optimize your portfolio's balance and stay within your comfort zone.

Ultimately, making smart investment decisions comes down to knowing your own goals and how much risk you're willing to handle.

3. Risk Measurement in Financial Portfolio

1- Portfolio Definition: a multiple collected financial assets like stocks, bonds, and cash equivalents refers to a portfolio. Portfolio managers' primary goal maximizing return while minimizing the risk.

2- Expected Return: Once expected return and SD of a single asset is known, the logical next step is to analyse how those characteristics change when the investments are combined to form a portfolio.



Imagine you have two investments with returns R_1 and R_2 . If you put a proportion (w_1) of your money into the first one and the rest ($w_2 = 1 - w_1$) into the second, the overall return of this combined investment (your portfolio) is:

$$w_1R_1 + w_2R_2$$

The formula to calculate a portfolio's expected return is:

$$E(R_P) = w_1 E(R_1) + w_2 E(R_2)$$

where:

$E(R_1)$: the expected return of the first investment.

$E(R_2)$: the expected return of the second investment.

The financial portfolio's risk can be measured using several metrics.

A. Standard Deviation (σ):

This measures the total volatility (risk) of a portfolio "Two Assets".

The SD of the portfolio is calculated as:

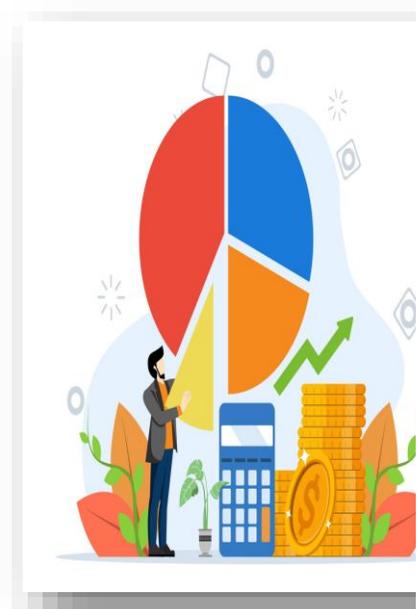
$$\delta_P = \sqrt{(w_1^2 \delta_1^2 + w_2^2 \delta_2^2 + 2 w_1 w_2 r \delta_1 \delta_2)}$$

where:

W_1 ; W_2 : the assets' weights in the portfolio.

δ_1 ; δ_2 : the individual assets SD.

r : the correlation between the 2 assets.



• Example 01: Expected Portfolio Return:

Suppose you have a portfolio with two assets

- **Stock A: Weight = 60%, Expected Return = 12%**
- **Stock B: Weight = 40%, Expected Return = 8%**

The portfolio's expected return is calculated as:

$$(R_P) = (0.6 \times 0.12) + (0.4 \times 0.08) = 0.072 + 0.032 = 0.104 = 10.4\%$$

- **Example 02: Portfolio risk**

If the previous portfolio consists of Standard Deviation of the two assets: $\delta_A=15\%$ and $\delta_B=10\%$, with a correlation coefficient $r=0.3$, the portfolio risk (standard deviation) is calculated as:

$$\delta_P = \sqrt{(0.6^2 \times 0.15^2) + (0.4^2 \times 0.10^2) + (2 \times 0.6 \times 0.4 \times 0.3 \times 0.15 \times 0.10)}$$

$$\delta_P = 11.84\%$$

B. Sharpe Ratio:

- It measures the performance of the investment. It compares the portfolio's generated excess return by a relative to the level of risk it undertakes. It helps investors select investments with the highest risk-adjusted returns
- Measures the risk-adjusted return and is used to compare portfolio performance.

Sharpe Ratio formula is:

R_P : The return of the portfolio.

R_F : The return's risk-free.

δ_P : Standard deviation of the portfolio.

Interpretation:

- **High Positive Sharpe Ratio:** Indicates an investment with high returns relative to its risks.
- **Low or Negative Sharpe Ratio:** Indicates that the risks are not justified by the returns or that the investment fails to outperform the risk-free rate.

C. The correlation coefficient

Quantifies how two financial assets move together. Values range from -1 to +1: :

- **+1** Perfect positive correlation (asset 1 move in the same direction as asset 2).
- **-1** Perfect negative correlation (asset 1 move in the opposite direction of asset 2).

- **0** No relationship between the assets.

Practical Applications:

1. **Risk Diversification:** Choosing negatively or weakly correlated assets reduces portfolio risk **while maintaining returns. Example:** Gold and stocks often have a negative correlation.
2. **Enhancing Returns:** Assets with moderate positive correlation (0.3–0.6) offer stability with good return potential.

Importance of Correlation:

- Helps construct balanced portfolios.
- Avoids concentration in highly correlated assets, reducing portfolio volatility.

- **Example 01: Sharpe Ratio:**

Portfolio with expected return (R_p)=12%, risk-free rate R_f =2%, and standard deviation δ_p =10%.

$$S = \frac{R_p - R_f}{\delta_p} = \frac{12 - 2}{10} = 1$$

Interpretation: The portfolio generates an additional 10% return for every unit of risk taken.

- **Example 02: Correlation Coefficient:**

The correlation coefficient between two stocks: A and B is of -0.4.

If Stock A decreases, Stock B is likely to increase, reducing portfolio volatility.

3. Risk-Return Trade-off

The advent of Modern Portfolio Theory (MPT) in 1952 revolutionized how portfolios are managed. Along with the existing ideas of active and passive management, MPT introduced the crucial concept that diversification is key to lowering a portfolio's overall risk. This is because a well-diversified portfolio can effectively eliminate specific risks tied to individual investments.

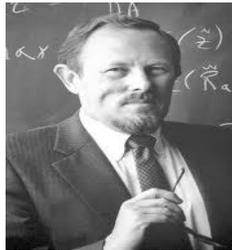
In 1960s, a new framework called the Capital Asset Pricing Model (CAPM) was developed by William Sharpe and others. This model offers an idealized view of how financial markets set security prices. It

helps investors determine the expected return of an asset based on its price and risk. The core idea of CAPM is that to get a higher return, an investor must be willing to take on more risk.

Created by Stephen Ross in 1976, the Arbitrage Pricing Theory (APT) presented a new perspective on asset pricing, standing as a distinct alternative to Modern Portfolio Theory. This framework established a linear connection between an asset's expected return and a number of macroeconomic variables that influence its systemic risk.



Markowitz (1952)



Sharpe (1964)



Ross (1976)

4.1. Markowitz Theory (MPT)

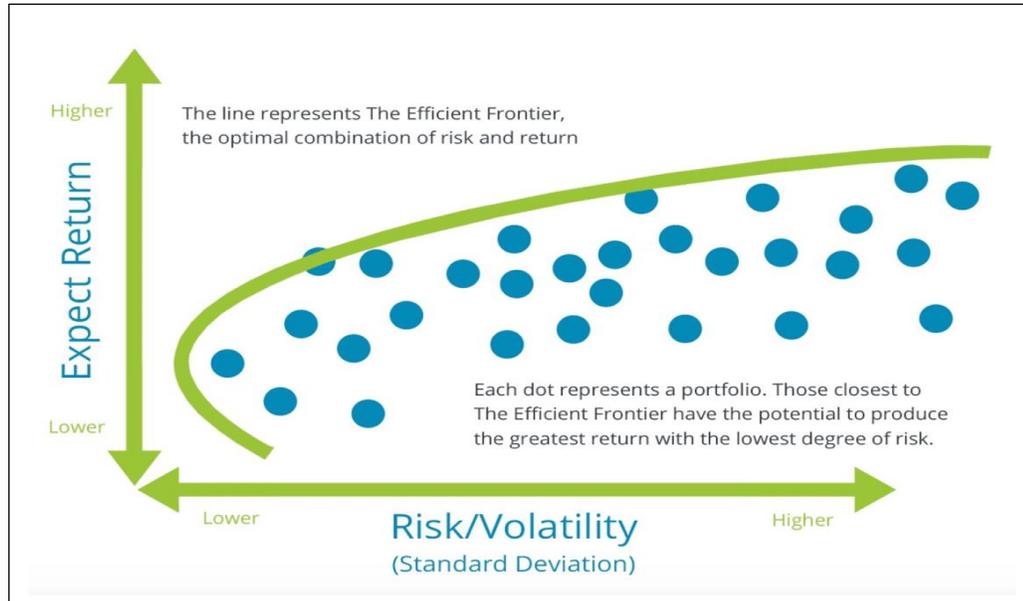
a. Definition: In 1952, Harry Markowitz presented the foundation of modern portfolio management, which is the Modern Portfolio Theory (MPT). It focuses on optimizing investment portfolios by balancing expected returns and risks.

6. Key Principles:

- **Diversification:** an investment strategy that involves putting money into a collection of divergent assets in order to mitigate the total risk. The purpose of this strategy is to ensure that if one investment loses money, the gains from another will help cancel out the loss, which in turn helps stabilize the overall portfolio's returns.
- **Risk and Return:** higher risk generally leads to higher returns.
- **Efficient Frontier:** the collection of portfolios that are the most efficient at maximizing an investor's potential profit for a certain amount of risk (optimal portfolios).
- **Unsystematic Risk:** Can be diversified and as a result can be mitigated.

- **Systematic Risk:** Cannot be diversified as it stems from market-wide factors like inflation or economic policies.

Figure 10. Modern Portfolio Theory Efficient Frontier



Source: <https://www.reddit.com/>

c. Why it Emerged:

This theory gave investors a mathematical framework for making informed choices, allowing them to depend on data rather than intuition. It provided a quantitative method for constructing the most effective portfolio and demonstrated how essential diversification is for minimizing risk. Ultimately, the theory maps out the optimal return you can expect for any given level of risk you are willing to accept.

4.2. The Capital Asset Pricing Model (CAPM)

a. Use:

The Capital Asset Pricing Model (CAPM), The main idea of MPT is that you shouldn't look at an investment by itself. Instead, you should evaluate how it affects your entire portfolio. The goal is to add assets that will increase the portfolio's return without significantly adding to its risk. By looking at all the investments together, MPT reduces the overall volatility of the portfolio. It also encourages investors

to first figure out their personal risk profile: how much risk they are comfortable with, and then build a portfolio that matches it.

6. Formula:

$$E(R_i) = R_F + \beta_i [E(R_m) - R_F]$$

Where:

$E(R_i)$. The Expected return of the asset

R_F . The Risk-free rate

β . Beta coefficient, measuring the asset's sensitivity to market volatility.

$E(R_M)$ Expected market return

$E(R_i) - R_F$ Market risk premium



Example: Think about utility company, like one that provides electricity. Its stock tends to be very stable because people need power regardless of the economy's ups and downs. Let's say this stock has a beta of 0.8 meaning it's only 80% as volatile as the overall market.

- You see that government bonds (the risk-free-rate) are paying 2%. You also expect the stock market as a whole to deliver a 7% return for the utility stock like this:
- Start with the guaranteed 2% return from the risk-free bond;
- Then, calculate the extra return, or "risk premium", the market offers for taking on risk: 7% (market return) Minus 2% (risk-free-rate) equals 5%
- Since this particular stock is less risky than the market, you only take 80% of that market risk premium: 0.8 multiplied by 5% equals 4%.
- Add that to your base return: 2% + 4% = 6%.

So, because the utility stock is less volatile, you should reasonably expect a lower return of 6% compared to the market's 7%.

4.3. Arbitrage Pricing Theory (APT)

- **Use:**

The Arbitrage Pricing Theory (APT) allows a professional investor, or arbitrageur, to identify these temporary mispricing and potentially profit from them with very little risk. While the market is expected to eventually self-correct, the brief period of mispricing presents a valuable opportunity.

Unlike the CAPM, which is a single-factor model that only considers the overall market risk, APT is multi-factor model. This makes APT more flexible and customizable, allowing investors to tailor their analysis to specific economic conditions. However, this flexibility comes with a trade-off: APT is significantly more complex and time-consuming to apply because it requires a great deal of effort to identify all the relevant factors that could influence an asset's price.

- **Formula:**

$$E(R_i) = R_F + \lambda_1 F_1 + \lambda_2 F_2 + \dots + \lambda_n F_n$$

where:

F_1, F_2, \dots, F_n Factors affecting returns (e.g., inflation, interest rates).

λ_n Sensitivity of the asset to each factor.

- **Key advantages:**

- ✓ It considers a wider range of economic variables, providing a more comprehensive view of risk.
- ✓ Because it's not restricted by some of the assumptions of the CAPM, it can be a more accurate model for a broader range of assets and market conditions.

Comparative Summary

Model	Purpose	Key Feature
MPT	Optimize risk-return tradeoff	Diversification and efficient frontier
Sharpe Ratio	Measure risk-adjusted return	Simplicity, suitable for comparison
APT	Predict returns using multiple factors	Focus on macroeconomic and industry risks

- **Example 01: CAPM:**

Given the following data:

- Risk-free rate (R_f) = 3%.
- Expected return of the market : $R_m = 9\%$.
- Beta of the asset (β) = 1.2.
- Using CAPM, calculate the asset's expected return.

- **Example 02: CAPM:**

Assume the actual expected return of the asset is 11%, but the CAPM-calculated return (from the previous exercise) is 10.2%.

1. Is the asset undervalued or overvalued?
2. What should an investor do?

- **Example 01: APT:**

Given the following:

- Risk-free rate (R_f) = 2%.
- Factor 1 (inflation) (F_1) = 1.5%.
- Factor 2 (interest rates) (F_2) = 2%.
- Sensitivity to factors ($\lambda_1 = 1.2, \lambda_2 = 0.8$).
- Calculate the asset's expected return using the APT formula.

- **Example 02: APT:**

Asset A: $\lambda_1=1.1, \lambda_2=0.9$.

Asset B: $\lambda_1=0.9, \lambda_2=1.2$.

- Calculate the expected return for each asset and determine which has lower risk.

Lecture Seven

Financial Risk Management



Educational objectives of the lecture

Dear student, by the end of this lecture, you will be able to:



Define financial risk management and understand its purpose.



Identify and describe the steps of managing financial risk.



Explore key strategies and tools used to manage in financial risks.



Analyze case studies demonstrating the application of financial risk management.



Introduction

Financial risks are caused by fluctuations in market conditions, default of counterparties, insufficient cash flow, or system failures. The organization or the investor faces these risks should adopt effective risk management strategies including diversification, hedging, and the use of derivatives like options and futures.



1. Financial Risk Management Definition



The process of identifying, analyzing, and mitigating uncertainties in decision-making in order to reduce potential losses and optimize financial performance refers to **financial risk management**.

2. The Process of Risk Management



Source: International Organization for Standardization. (2018)

2.1. Identify the risk

Identifying and understanding risk is the critical first step in managing it. This involves considering all potential events that could have a negative financial impact.

Often, these risks are grouped by category, such as lumping all credit-related risks together. You can pinpoint these risks using several methods:

- Analyzing your current finances to spot vulnerabilities;
- Brainstorming with a group to uncover risks you might not have considered;
- Reviewing past financial crises to learn from what happened before;
- Talking to internal and external experts who can provide insight;
- Using checklists designed to catch common financial risks.

- **Tools for Risk Identification**

2.1.1. SWOT analysis



Source: <https://www.bitesizelearning.co.uk/>

To handle risk effectively, an organization uses a SWOT analysis to evaluate how often risks happen and how big their impact is. This analysis is a structured way to identify the company's strengths, weaknesses, opportunities, and threats, which then helps in shaping its strategy.

- **Strengths and Weaknesses** highlight internal factors that can mitigate or exacerbate risks (e.g., skilled workforce vs. outdated systems).
- **Opportunities and Threats** focus on external elements like market trends, competition, and regulatory changes.

2.1.2. Risk Register

The risk register is a formal document used to record and track risks. It includes key details about each risk, such as:

- **Description:** What is the risk?

- **Probability:** How likely is it to occur?
- **Impact:** What is the severity if it happens?
- **Mitigation Plan:** How will it be managed?

Practical Steps to Build a Risk Register:

1. Identify risks through brainstorming, expert interviews, and SWOT analysis.
2. Document each risk with a unique identifier and categorize it (e.g., financial, operational).
3. Make sure you keep the risk log up to date. You should add new risks as they appear and revise existing ones as their circumstances change.

PROJECT RISK REGISTER EXAMPLE – ADVANCED

REF ID	DATE RAISED	RISK CATEGORY	RISK DESCRIPTION (INCLUDING IF / THEN STATEMENT)	PROBABILITY 1 – 5	IMPACT 1 – 16	RISK SEVERITY SCORE Prob. x Impact	LIKELY TIMING OF RISK	RISK TRIGGER	MITIGATION / RESPONSE PLAN	STATUS OF MITIGATION / RESPONSE	OWNER	OTHER NOTES
10001	MM/DD/YY	Materials	If there are changes in architectural plans that require additional or different resources, then there will be delays.	1	8	8	The risk is present throughout the process of finalizing architectural plans.	There are changes in the architectural plans.	A designated team member will continually monitor any proposed changes in architectural plans and ensure communication between architectural and construction teams about proposed changes.	No current issues	Joe Smith, architectural liaison	
10002	MM/DD/YY	Contracts	If contractual issues among contractors, subcontractors, or vendors arise, then there will be delays or cost overruns.	2	4	8	The risk is present before most contract work commences. However, the risk will also be present when additional contracts are added in the early phases of construction.	The contracts manager reports any potential contract issues.	The contracts manager will continually monitor contracts, alert the team when there are issues, and ensure that the team addresses and resolves contract issues before they cause delays.	Working on one unresolved issue with the electrician's contract; meeting set for May 2nd	Sue Johnson, contracts manager	
10003	MM/DD/YY	Permits / Regulations	If obtaining appropriate construction permits takes longer than planned, then there will be delays.	2	8	16	The risk is present throughout the construction phase of the project, including when securing required permits at the beginning of construction.	Construction permits do not arrive within the required timeframe.	The construction manager, or another designated team member, will monitor the project schedule and deadlines and ensure that all permits can accommodate the project's construction schedule.	All deadlines currently being monitored	Dale Swenson, construction manager	
10004	MM/DD/YY	Construction Site	If unexpected hazardous waste is found on the property, it will require mitigation or cleanup.	1	8	8	The risk is present throughout the project, especially toward the beginning when conducting site preparation work.	On-site managers report an issue, especially during site preparation.	The construction manager will assign a team member to monitor and explore any possible issues with hazardous waste.	No issues found to this point	Jeff Baker, construction assistant	
				1	1	1						
				1	2	2						
				1	4	4						
				1	8	8						
				1	16	16						
				2	16	32						
				3	16	48						
				4	16	64						
				5	16	80						

		PROBABILITY				
		1	2	3	4	5
IMPACT	1	1	2	3	4	5
	2	2	4	6	8	10
	4	4	8	12	16	20
	8	8	16	24	32	40
	16	16	32	48	64	80

2.2. Analyze the risk

In this stage, the frequency of loss occurrences over a specific period is counted. To analyze risks, three key questions should be answered:

- What could happen (i.e., what could go wrong)?
- How likely is it to happen?

- If it does happen, what are the consequences?

The first step to answering these questions is to prepare a list of potential outcomes or scenarios, as shown in:

Table (1): Scenario List

Concequence	Likelihood	Scenario
X_1	P_1	S_1
X_2	P_2	S_2
.	.	.
.	.	.
X_N	P_N	S_N

Each row in Table (1) can be explained as follows:

S_i is the definition or description of scenario i .

P_i is the probability of scenario i occurring.

X_i is the outcome or assessment of scenario i , which refers to measuring the resulting damage.

The set that forms the risks R can be represented as:

$$R = \{ \langle S_i, P_i, X_i \rangle, i = 1, 2, 3, \dots, N \}$$

Each type of risk should be considered in three dimensions: size, probability of occurrence, and timing.

Once the frequency and severity of the loss for each type of exposure are estimated, along with the timing, the various types of exposure to loss can be classified according to their relative importance in the subsequent stage.

2.3. Evaluate the risk

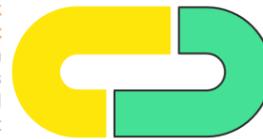
Focuses on ranking and prioritizing risks to determine their potential impact on an organization. Key elements include:

1-Risk Prioritization: Risks are categorized based on severity. Low-impact risks might cause minor inconveniences, while high-impact risks can lead to catastrophic consequences. Prioritization helps organizations allocate resources effectively, addressing critical risks requiring immediate intervention.

2-Types of Risk Assessments:

By combining these approaches, organizations gain a comprehensive view of their risk landscape and can manage risks more efficiently.

Quantitative Risk Assessment
Focuses on financial risks using numerical data like interest rates



Qualitative Risk Assessment
Evaluates non-numerical risks like environmental or reputational risks

2.4. Treat the risk

At this stage, strategies are developed to address identified risks or reduce them to acceptable levels. Therefore, the organization must be prepared with a list of potential solutions or reasonable steps to manage risks. These include options such as risk acceptance, avoidance, mitigation, or transfer, encompassing preventive plans, risk mitigation plans, and contingency plans.

2.5. Monitor and review the risk

After putting your plan into action, you need to monitor and review the risks. This means keeping a close eye on them, tracking their status, and regularly checking: in to make sure the information is current and your management strategy is still effective.

3. Risk response strategies and treatment



Risk management typically involves five key strategies. The process starts with avoiding a risk entirely, then moves on to transferring, spreading, or reducing it. These three methods are often used together to form a complete plan. Finally, any remaining risk is simply accepted.

3.1. Risk avoidance

The simplest way to handle the risk is to avoid it altogether. This means choosing not to engage in an activity that could lead to a loss. For example, a company might decide not to launch a new product to avoid the chance it could fail.

3.2. Risk reduction

With this approach, you acknowledge the risk but take steps to reduce its potential impact. The goal is to minimize the damage, not eliminate it completely. An example of this is a health insurance company promoting preventive care, which helps reduce the likelihood of major health issues and in turn, costly claims.

3.3. Risk sharing

Spreading risk means distributing the potential for loss among multiple parties. A corporation is a prime example of this: by pooling money from any investors, the potential for failure is shared so that no single person bears the full burden.

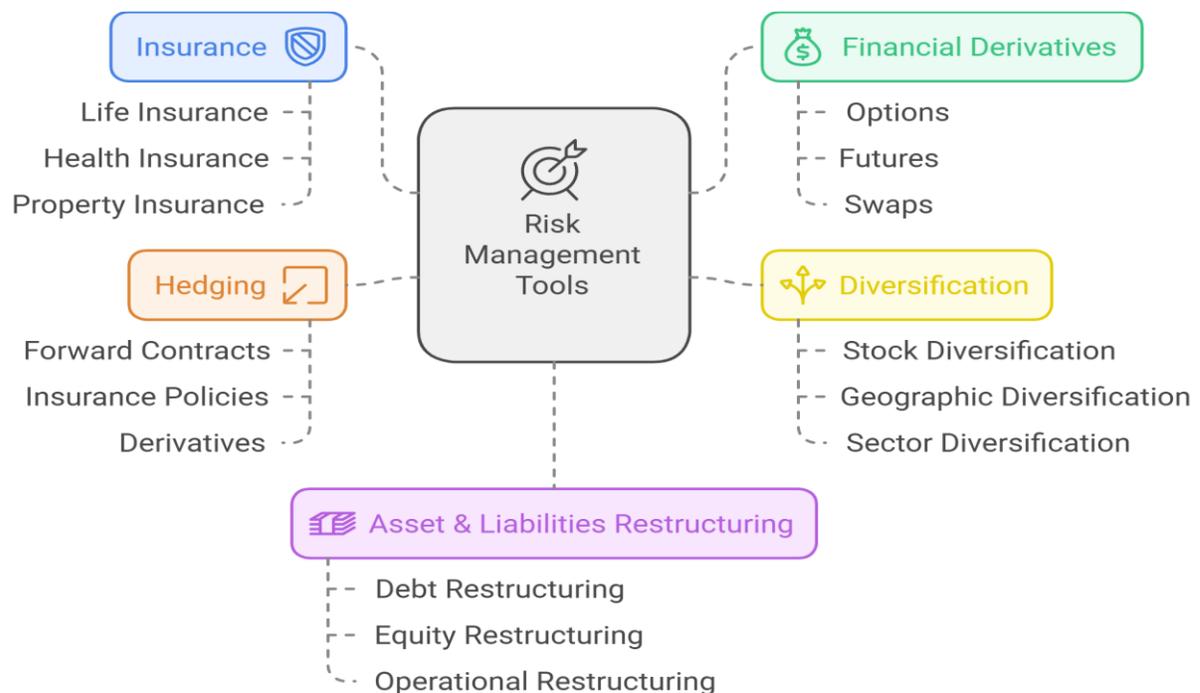
3.4. Risk Transfer

This is the practice of shifting a potential loss to another party, typically through a contractual agreement. A common example is buying insurance. When you get property insurance policy, you are shifting the risk of damage or injury from yourself to the insurance company.

3.5. Risk acceptance and retention

After all other measures are in place, some risk will usually remain. This is known as residual risk. Since it is nearly impossible to eliminate all risks (unless you are avoiding the activity entirely), the remaining risk is simply accepted and managed as part of doing business.

4. Financial Risk Management Tools



Several tools are employed to mitigate financial risks, ensuring long-term stability. The chart shows

some of the most commonly used financial risk management tools:

4.1. Insurance:

- **Definition:** Insurance allows companies to transfer specific risks (e.g., property damage, employee health) to a third party (the insurer) in exchange for a premium.

Example: A global company like Apple might take out insurance for its physical stores to cover potential property damage from natural disasters

4.2. Financial Derivatives:

- **Definition:** Financial derivatives are tools that get their value from another asset, like a stock or commodity. They allow people to trade specific financial risks on the market, separate from the underlying asset itself.
- **Importance:** Financial derivatives allow entities to transfer particular risks, like those associated with interest rates currency fluctuations, stock prices, or credit defaults, to other entities better equipped or more willing to handle them. This is often done without the underlying asset changing hands.
- **Types:**
 - **Futures:** these are agreements to buy or sell something at a fixed price on a specific date in the future. For instance, an airline might use a futures contract for oil to lock in its fuel costs and avoid price shocks.

- **Options:** these contracts give the holder the choice, but not the requirement, to buy or sell an asset at a predetermined price. A company like Google might use options to protect itself from changes in currency exchange rates.
- **Example:** In order to hedge against interest rate risk, Goldman Sachs may use interest rate swaps for its loans.
- **Uses:** derivatives are financial tools used for two main purposes: hedging and speculating.
 - **Hedging:** is about reducing or managing risk. It's like buying insurance. An airline, for instance, might be concerned about rising fuel costs. To lock in a future price for oil and avoid potential losses, it could use derivative to agree on a price today for a purchase to be made later. This shields the company from the risk of soaring oil prices.
 - **Speculating:** In contrast, speculating involves using derivatives to actively take on risk in hopes of earning a profit. A speculator might not own the underlying asset but instead bets on its future price movement. For instance, if you think a company's stock will go up, you could buy a call option. A call option grants you the right to purchase the stock later at a predetermined price. If the stock's value increases as you anticipated, you can act on this option and realise a considerable profit, larger than you would have made by just buying the shares directly.

4.3. Diversification

- **Definition:** investing in a wide range of assets can reduce the total risk of your portfolio.
- **Example:** BlackRock, a major investment management firm, diversifies its investments in stocks, bonds, and real estate in order to minimize risk exposure from market volatility.

4.4. Hedging

- **Definition:** to put it simply, hedging is using financial tools to protect yourself from losing money if the market moves against you.
- **Example:** British Airways hedges against fuel price volatility using financial derivatives such as fuel swaps.

4.5. Asset and Liability Restructuring:

- **Definition:** Asset and Liability Management (ALM) is a strategy to control financial risks that come from a mismatch between a company's assets and its liabilities. This practice helps organizations, like banks and governments, deal with risks such as not having enough cash on hand (liquidity risk), changes in interest rates, and challenges of refinancing debt.

ALM involves:

- **Liquidity Management:** Having enough cash and easily convertible assets on hand to cover immediate financial needs.
- **Interest Rate Management:** Mitigating risks arising from fluctuations in interest rates.
- **Credit and Market Risk:** Assessing risks in assets like loans or securities that may be impacted by market changes.
- **Example of ALM in Banking:** Banks face significant risks related to asset-liability mismatches, especially with long-term loans versus short-term deposits. For example:

- A bank may have long-term loans (mortgages) as assets, but its liabilities (deposits) are generally short-term. If interest rates rise, the bank may struggle to pay higher rates on short-term deposits while earning the same low rate on long-term loans.
- **Data Example:** Let's assume a bank has the following balance sheet components:

Item	Amount (\$ billion)
Assets	
Long-Term Loans	200
Short-Term Investments	50
Liabilities	
Short-Term Deposits	150
Long-Term Borrowings	100

The bank faces a risk if interest rates rise because the short-term deposits will need to be paid higher interest, while the long-term loans continue to earn lower interest. To mitigate this, the bank could:

- **Match the maturity of assets and liabilities:** Converting long-term assets into shorter-term ones to align the maturities with short-term deposits.
- **Use derivatives:** Hedging interest rate risk using swaps or futures to balance the impact of rate fluctuations
- **Example of Corporate ALM:** General Motors: In response to financial pressures, GM undertook asset and liability restructuring. GM reduced its debt levels by refinancing long-term liabilities into more manageable terms, improving liquidity and reducing its debt service costs, especially during financial crises.

Governmental ALM: Sovereign entities also engage in ALM to manage fiscal and liquidity risks.

For example, during the European debt crisis, Greece restructured its sovereign debt, extending maturities and reducing interest rates to alleviate short-term fiscal pressures.

Effective Asset and Liability Management helps businesses and banks manage financial risks while ensuring liquidity, profitability, and long-term solvency. It is particularly important during times of financial uncertainty, allowing organizations to adapt to changing market conditions and interest rate movements.

CONCLUSION

Having completed this module, you now possess a well-rounded understanding of both the **conceptual and practical dimensions of risk management** within financial environments. From grasping the essential definitions and **categorizing different types of risk**, to **applying measurement tools**—statistical, financial, and advanced—you are now better equipped to diagnose and respond to risk exposures that affect financial decision-making.

Through the study of **statistical tools**, you have learned how to quantify variability and volatility; through **financial analysis tools**, you have developed the ability to interpret the financial health and vulnerabilities of firms; and through **advanced modeling techniques**, you have gained skills in simulating and predicting the impact of uncertain events in high-stakes environments.

Crucially, the module culminates in the practical field of **Financial Risk Management**, where theoretical insights meet real-world application. You now understand how risk governance operates, how policies are set, and how institutions manage financial exposure through a combination of measurement, control systems, and informed decision-making.

As you move forward in your academic and professional path, remember that risk is inherent in all financial activity. What distinguishes effective managers and analysts is not the elimination of risk, but the ability to recognize it, measure it, and make strategic decisions in its presence. Let this module serve as both a foundation and a springboard into deeper areas of specialization in risk and finance—and above all, as a guiding framework for becoming a thoughtful, competent, and responsible financial leader.

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