Portfolio Management

CFA一级培训项目

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101% Contribution Breeds Professionalism

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讲授课程：CFA一、二、三级

参与出版：曾参与出版了注册金融分析师系列丛书、金程教育CFA课堂笔记、CFA冲刺宝典、CFA中文NOTES等公开出版物及内部出版物。并参与翻译CFA协会官方参考书《企业理财》，《国际财务报告分析》等书籍。

Topic Weightings in CFA Level I

Session NO.	Content	Weightings
Study Session 1	Ethical and Professional Standards	15
Study Session 2-3	Quantitative Methods	10
Study Session 4-5	Economics	10
Study Session 6-9	Financial Reporting and Analysis	15
Study Session 10-11	Corporate Finance	10
Study Session 12-13	**Portfolio Management**	**6**
Study Session 14-15	Equity	11
Study Session 16-17	Fixed Income	11
Study Session 18	Derivatives	6
Study Session 19	Alternative Investments	6

Framework
Portfolio Management

- **Portfolio Management**
  - R38 Portfolio Management: An Overview
  - R39 Portfolio Risk and Return: Part I
  - R40 Portfolio Risk and Return: Part II
  - R41 Basics of Portfolio Planning and Construction
  - R42 Risk Management: An Introduction
  - R43 Fintech in Investment Management

Portfolio Risk and Return: Part I

Portfolio Risk and Return: Part I

- **HPR**
- **Average return**
  - Arithmetic mean return: unbiased estimator of the true mean
  - Geometric mean return: compound annual rate
  - Money-weighted rate of return: IRR
- **Other return measures**
  - Gross return: total return before management and administration fees
  - Pretax nominal return
  - After-tax nominal return
  - Real return: $(1+r_{real})=(1+r_{nominal})/(1+\pi)$
  - Leveraged return: the return on the investor's own money. (real estate)

Portfolio Risk and Return: Part I

- A higher return is not possible to attain in efficient markets and over long periods of time without accepting higher risk.
- Liquidity should be considered when invest, especially in emerging markets and for securities that trade infrequently.

Portfolio Risk and Return: Part I

- **An individual investment:**
  - Expected Return $E(R)=\sum_{i=1}^{n}P_iR_i=P_1R_1+P_2R_2+\cdots+P_nR_n$
  - Variance of Return $\text{Var}=\sigma^2=\sum_{i=1}^{n}[R_i-E(R)]^2P_i$
  - Standard Deviation of Return $\text{SD}=\sigma=\sqrt{\sum_{i=1}^{n}[R_i-E(R)]^2P_i}$
  - Covariance $Cov_{1,2}=\sum_{i=1}^{n}P_i[R_{i,1}-E(R_1)][R_{i,2}-E(R_2)]$
  - Correlation

$$\rho_{1,2}=\frac{Cov_{1,2}}{\sigma_1\sigma_2} \qquad Cov_{1,2}=\rho_{1,2}\sigma_1\sigma_2$$

Portfolio Risk and Return: Part I

- **The portfolio standard deviation formula**

$$\sigma_P=\sqrt{\sigma_P^2}=\sqrt{\sum_{i=1}^{n}w_i^2\sigma_i^2+\sum_{i=1}^{n}\sum_{j=1}^{n}w_iw_jCov_{i,j}}$$

  - The risk of a portfolio of risky assets depends on the asset weights and the standard deviations of the assets returns, and crucially on the correlation (covariance) of the asset returns.
  - The lower the correlation between the returns of the stocks in the portfolio, all else equal, the greater the diversification benefits.
  - Variance of N-asset portfolio (same covariance, same weight, same volatility)

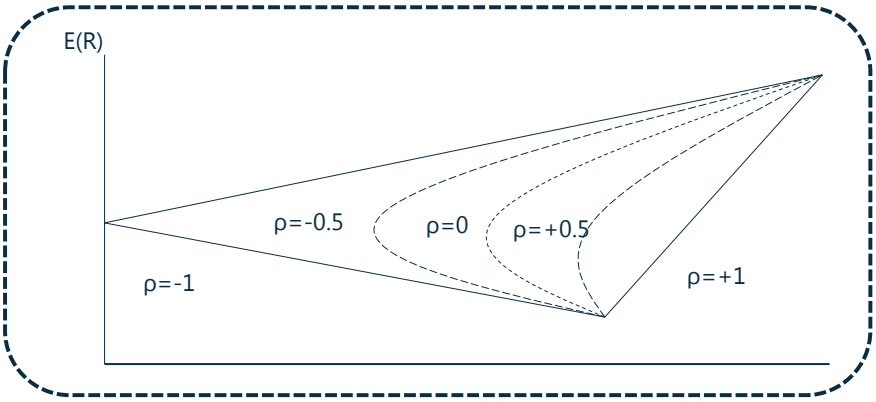
$$\sigma_p^2=\frac{\overline{\sigma}^2}{N}+\frac{N-1}{N}\overline{Cov}$$

  - Two-asset portfolio:

$$\sigma_p^2=w_1^2\sigma_1^2+w_2^2\sigma_2^2+2w_1w_2COV_{1,2}=w_1^2\sigma_1^2+w_2^2\sigma_2^2+2w_1w_2\sigma_1\sigma_2\rho_{1,2}$$

Portfolio Risk and Return: Part I

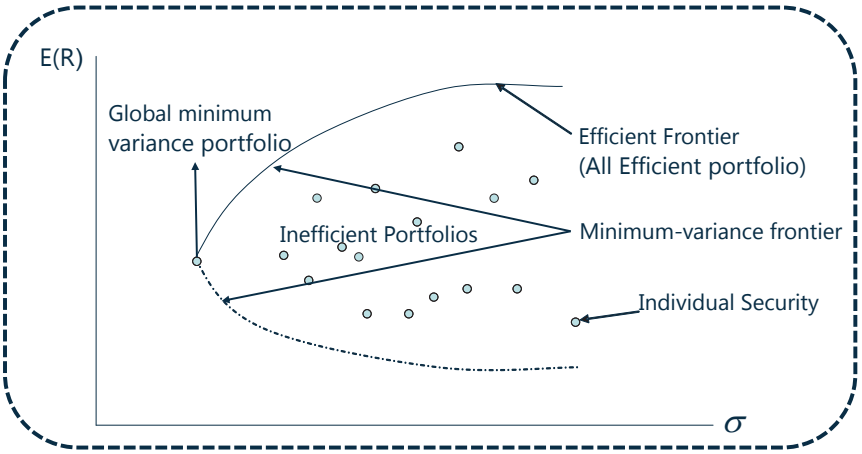
- **Risk and return for different values of correlation**



Portfolio Risk and Return: Part I

- **The Markowitz assumptions**
  - Returns distribution: Each investment can be measured by a probability distribution of expected returns over a given horizon
  - Utility maximization: Investor intends to maximize their expected utility over time horizon
  - Risk is variability: Risk is measured in terms of variance (standard deviation) of expected returns
  - Risk/return: Investors make their decision based on expected return and the risk
  - Risk aversion: Investors prefer less risk and given the same risks by given the same returns

Portfolio Risk and Return: Part I



Portfolio Risk and Return: Part I

- **Minimum variance frontier**
  - **Minimum-variance portfolio** is the portfolio available that has the lowest standard deviation with a given expected return.
  - **Minimum-variance frontier** is the entire collection of minimum-variance portfolios.
- **Global minimum-variance portfolio:** The portfolio with the **minimum variance** among all portfolios of risky assets, which is the **left-most** point on the minimum-variance frontier.
- **Efficient frontier**
  - The curve that **lies above and to the right** of the global minimum-variance portfolio is referred to as the **Markowitz efficient frontier.**
  - Those portfolios that have the greatest expected return with a given level of risk make up the efficient frontier.
  - All portfolios of risky assets that rational, risk-averse investors will choose.
  - **Efficient portfolio**: well-diversified or fully-diversified.

Portfolio Risk and Return: Part I

- **Risk seeking**
  - Prefer higher risk to lower risk for a given level of expected returns
  - Will accept less expected return because of the extra utility from the risk
  - The gamble has an uncertain outcome, but with the same expected value as the guaranteed outcome. Thus, an investor choosing the gamble means that the investor gets extra "utility" from the uncertainty associated with the gamble.
- **Risk neutral**
  - An investor is indifferent about the gamble or the guaranteed outcome
  - Risk neutrality investor cares only about return and not about risk, so higher return investments are more desirable even if they come with higher risk.
- **Risk averse**
  - Prefer lower to higher risk for a given level of expected returns
  - Will only accept a riskier investment if they are compensated in the form of greater expected return

Portfolio Risk and Return: Part I

- **Utility Theory**
  - Assumption:
    - ✓ Investors are risk averse.
    - ✓ They always prefer more to less (greater return to lesser return).
    - ✓ They are able to rank different portfolios in the order of their preference.

Portfolio Risk and Return: Part I

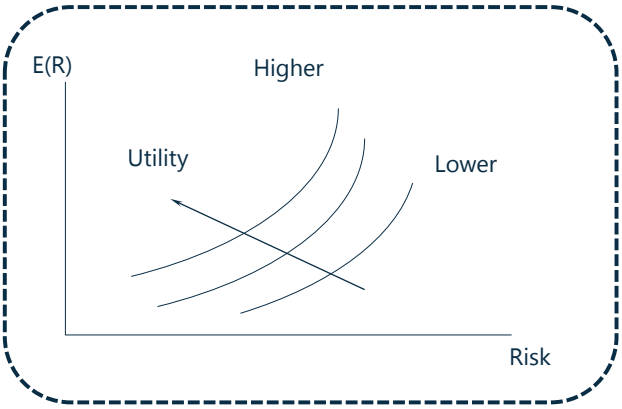
- **Utility Theory**
  - **Utility function**:

$$U = E(r) - \frac{1}{2} A\sigma^2$$

  - ✓ U: the utility of an investment
  - ✓ E(r): the expected return
  - ✓ σ^2: the variance of the investment
  - ✓ A: a measure of risk aversion, which is measured as the marginal reward that an investor requires to accept additional risk.
    - ◆A is higher for more risk-averse individuals.
    - ◆Risk-aversion: A>0
    - ◆Risk-neutral: A=0
    - ◆Risk-seeking: A<0

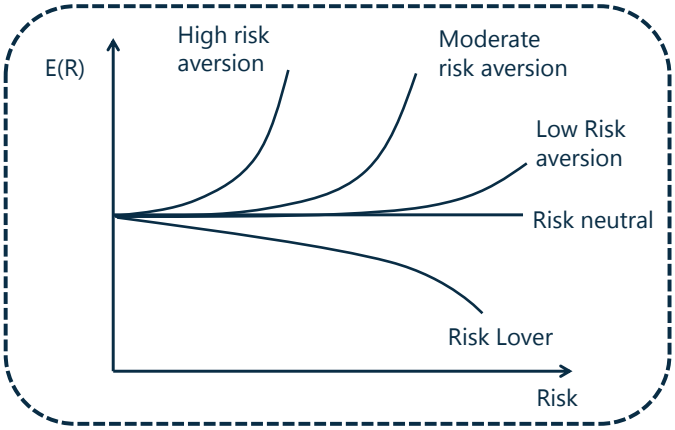
Portfolio Risk and Return: Part I

- **Indifference curve:** plots combinations of risk(standard deviation) and expected return among which an investor is indifferent.



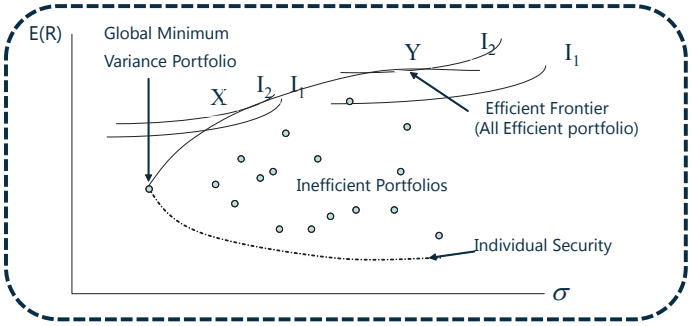
Portfolio Risk and Return: Part I

- **Indifference Curve for various types of investors**



Portfolio Risk and Return: Part I

- **The optimal portfolio for an investor**
  - At the point of where an investor's (highest) risk-return indifference curve is tangent to the efficient frontier.



- **Optimal portfolio**
  - The highest indifference curve that is tangent to the efficient frontier
  - Different investors may have different optimal portfolios

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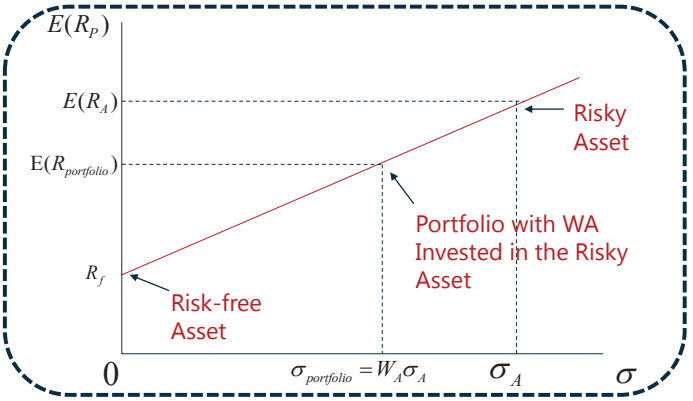
Portfolio Risk and Return: Part II

Portfolio Risk and Return: Part II

- **Two-fund separation theorem:**
  - Combining a risky portfolio with a risk-free asset
  - All investors' optimum portfolios will be made up of some combination of an optimal portfolio of risky assets and the risk-free asset.
- **CAL**
  - If a risky asset is combined with a risk free asset, the relationship between the portfolio risk and return is linear.
- **Optimal CAL**
  - The optimal capital allocation line connects the risk-free assets and **the optimal risky asset portfolio**.
  - The optimal risky portfolio is at the tangent of CAL and the efficient frontier of risky assets.

Portfolio Risk and Return: Part II

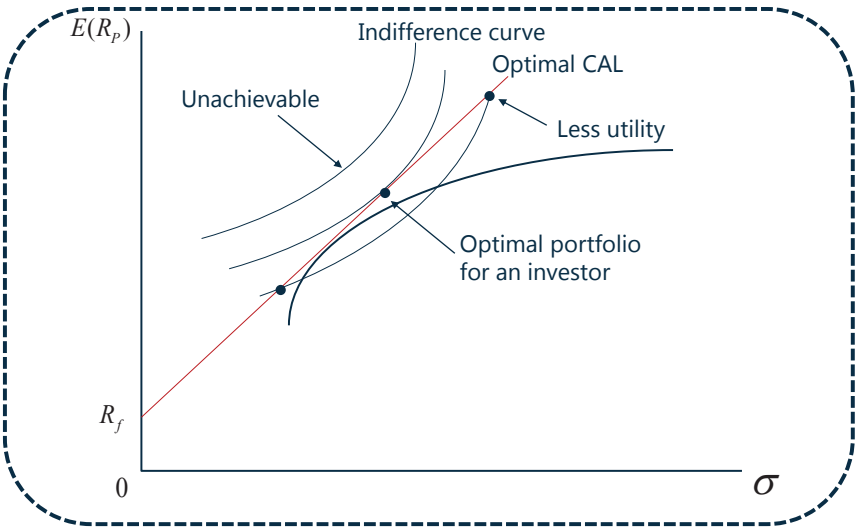


$$E(R_P) = W_A E(R_A) + W_B E(R_B)$$

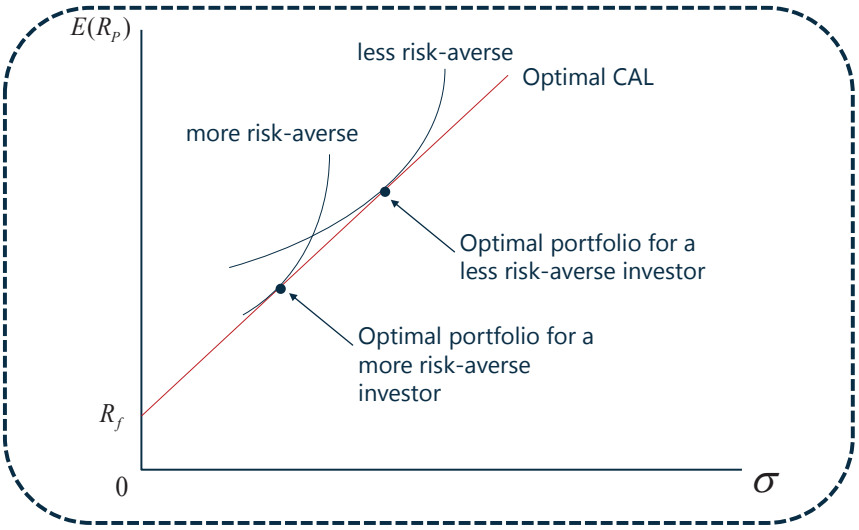
$$\sigma_P = \sqrt{W_A^2\sigma_A^2 + W_B^2\sigma_B^2 + 2W_A W_B \rho_{AB}\sigma_A\sigma_B}$$

$$\sigma_P = \sqrt{W_A^2\sigma_A^2} = W_A\sigma_A$$

Portfolio Selection



Portfolio Selection



Portfolio Risk and Return: Part II

- **Capital market line**
  - Difference between the CML and the CAL
    - ✓ homogeneity of expectations: there are many CALs, but only one CML.
  - The Market Portfolio:
    - ✓ Is the tangent point where the CML touches the Markowitz efficient frontier.
    - ✓ Based on the assumption of **homogeneity of expectations.**
    - ✓ Consists of every risky assets.
    - ✓ The weights on each asset are equal to the percentage of the market value of the asset to the market value of the entire market portfolio.

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Portfolio Risk and Return: Part II

- **Capital market line**
  - When investors share identical expectations about the mean returns, variance of returns, and correlations of risky assets, the CAL for all investors is the same and is known as the capital market line (CML):

$$E(R_P) = R_F + \frac{E(R_M) - R_F}{\sigma_M}\sigma_P$$

  - Investment using CML follows a
    - ✓ passive investment strategy
      - ◆i.e., invest in an index of risky assets that serves as a proxy for the market portfolio and allocate a portion of their investable assets to a risk-free asset.
    - ✓ leverage strategy

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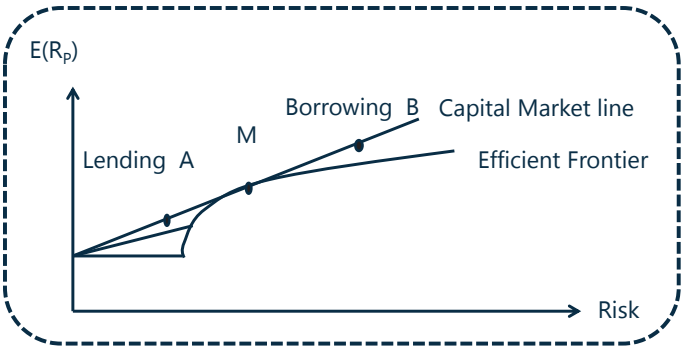
Portfolio Risk and Return: Part II

- **Borrowing portfolio and lending portfolio**
  - If $\sigma_p > \sigma_m$, borrow money at risk free rate and invest the proceed in market portfolio.
  - If $\sigma_p < \sigma_m$, sell a portion of market portfolio and deposit the proceed in bank.



Example

- The capital market line, CML, is the graph of the risk and return of portfolio combinations consisting of the risk-free asset and:
  - A. Any risky portfolio
  - B. The market portfolio
  - C. The leveraged portfolio
- **Correct Answer: B**

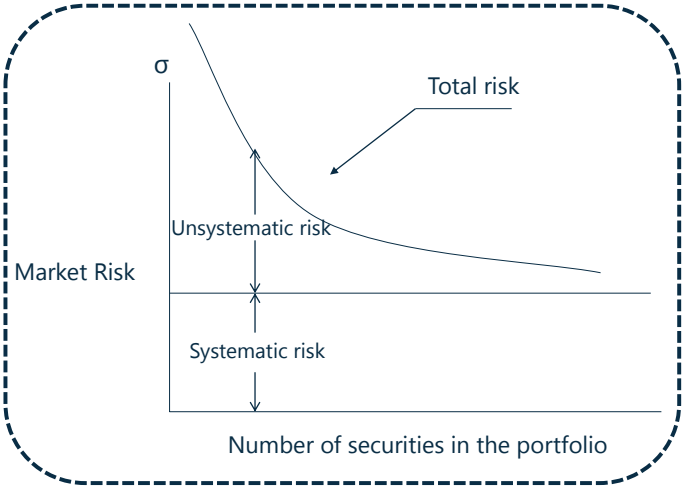
- A portfolio on the capital market line with returns greater than the returns on the market portfolio represents a(n):
  - A. Lending portfolio
  - B. Borrowing portfolio
  - C. Unachievable portfolio
- **Correct Answer: B**

Portfolio Risk and Return: Part II

- **Nonsystematic risk (or idiosyncratic, diversifiable, company-specific risk):**
  - Nonsystematic risk is local or limited to a particular asset or industry
  - The risk that disappears in the portfolio construction process
- **Systematic risk (or non-diversifiable, market risk):**
  - The risk that cannot be diversified away.
  - Total variance = systematic variance + nonsystematic variance, or
  - Total risk = systematic risk + nonsystematic risk
- **Since nonsystematic risk can be eliminated through diversification, only systematic risk is compensated.**

Portfolio Risk and Return: Part II

- **Risk vs. Number of portfolio Assets**



Portfolio Risk and Return: Part II

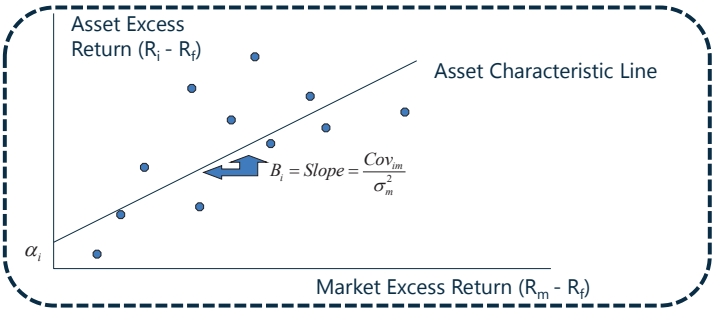
- **An assumptions of the model :**
  - Diversification has no cost, because investors will not be compensated for bearing risk that can be eliminated for free.
- **An important conclusion of capital market theory:**
  - A security's equilibrium return depends **only on systematic risk**, not its total risk which is measured by standard deviation.

Portfolio Risk and Return: Part II

- **Beta:** the sensitivity of an asset's return to the return on the market index in the market model. A standardized measure of systematic risk.

$$\beta_i = \frac{Cov_{i,mkt}}{\sigma^2_{mkt}} = (\frac{\sigma_i}{\sigma_{mkt}}) \times \rho_{i,mkt}$$

- **Asset characteristic line** (regression of asset excess returns against market asset returns)



Portfolio Risk and Return: Part II

- **Return generating models: multifactor models**

$$E(R_i) - R_f = \sum_{j=1}^{k} \beta_{i,j} \times E(Factor_j) = \beta_{i,1}[E(R_m) - R_f] + \sum_{j=2}^{k} \beta_{i,j} \times E(Factor_j)$$

  - Macroeconomic factors: GDP growth, interest rate, inflation rate, productivity, employment or consumer confidence
  - Fundamental factors: earnings, earnings growth, firm size, and research expenditures
  - Statistical factors: no obvious economic interpretations with asset returns
- **Market model**
  - The single factor model
  - The only factor is the expected excess return on the market portfolio (market index)

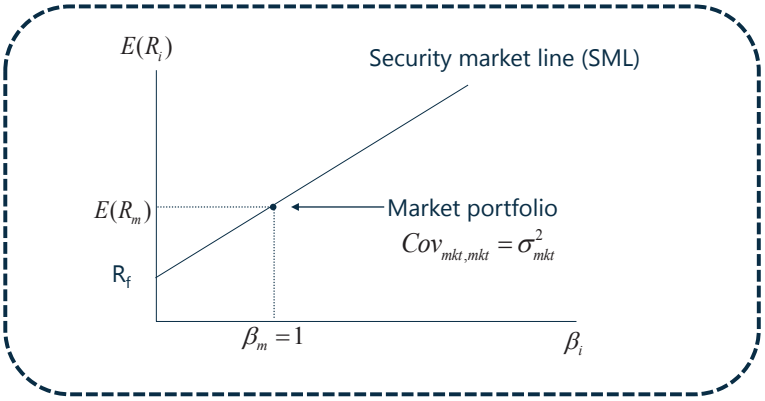
$$R_i = \alpha_i + \beta_i R_m + e_i$$

Portfolio Risk and Return: Part II

- **Assumptions of the CAPM**
  - Investors are **risk-averse**, **utility-maximizing**, rational individuals.
  - Markets are **frictionless**, including no transaction costs and no taxes.
  - Investors plan for the same **single holding period**.
  - Investors have **homogeneous expectations** or beliefs.
  - All investments are **infinitely divisible**.
  - Invstors are **price takers**.

Portfolio Risk and Return: Part II

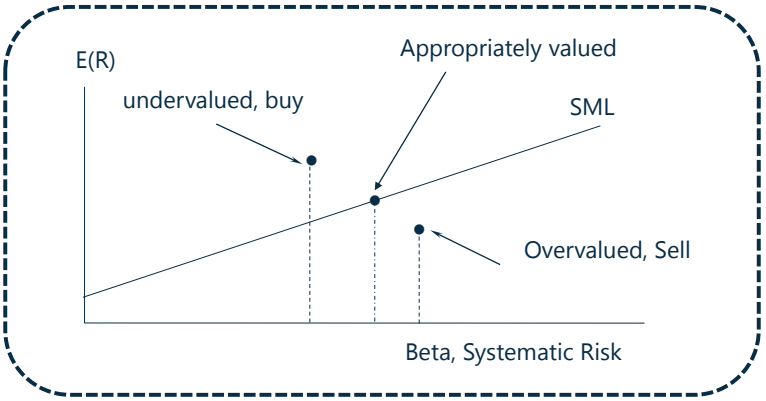
- **Security market line (SML):** Graphical representation of CAPM



- **The Equation of SML:** $E(R_i) = R_f + \beta_i[E(R_m) - R_f]$

Portfolio Risk and Return: Part II

- **How to judge if a stock is properly valued**



Portfolio Risk and Return: Part II

- **How to judge if a stock is properly valued**
  - Undervalued
    - ✓ Estimated return > Required return from the SML
    - ✓ Investors should buy.
  - Overestimated
    - ✓ Estimated return < Required return from the SML
    - ✓ Investors should sell.
  - Properly valued
    - ✓ Estimated return = Required return from the SML
    - ✓ Investors are indifferent between buying or selling

Portfolio Risk and Return: Part II

- **Differences between the SML and the CML**

	SML	CML
Measure of risk	Uses systematic risk (non-diversifiable risk)	Uses standard deviation (total risk)
Application	Tool used to determine the appropriate expected (benchmark) returns for securities	Tool used to determine the appropriate asset allocation (percentages allocated to the risk-free asset and to the market portfolio) for the investor
Definition	Graph of the capital asset pricing model	Graph of the efficient frontier
Slope	Market risk premium	Market portfolio Sharpe ratio

Example:

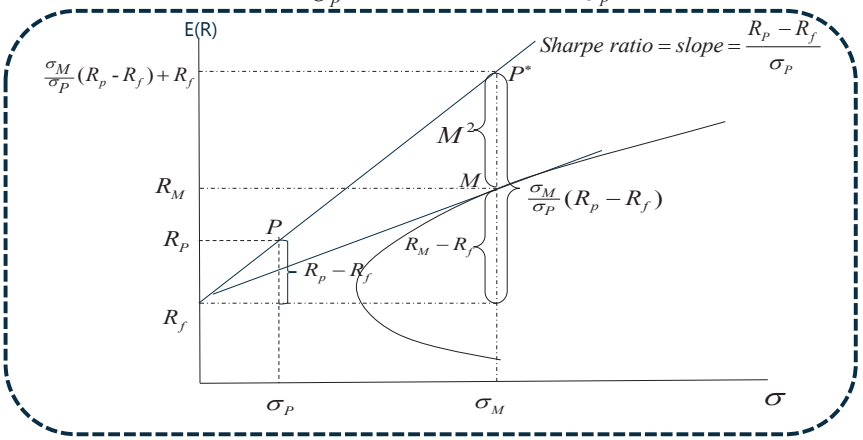
- With respect to the capital asset pricing model, the primary determinant of expected return of an individual asset is the:
  - A. Asset's beta.
  - B. Market risk premium
  - C. Asset's standard deviation
- **Correct Answer: A**

- Analysts who have estimated returns of an asset to be greater than the expected returns generated by the capital asset pricing model should consider the asset to be:
  - A. Overvalued
  - B. Undervalued
  - C. Properly valued
- **Correct Answer: B**

Portfolio Risk and Return: Part II

➢ **Sharpe ratio & M square (total risk)**

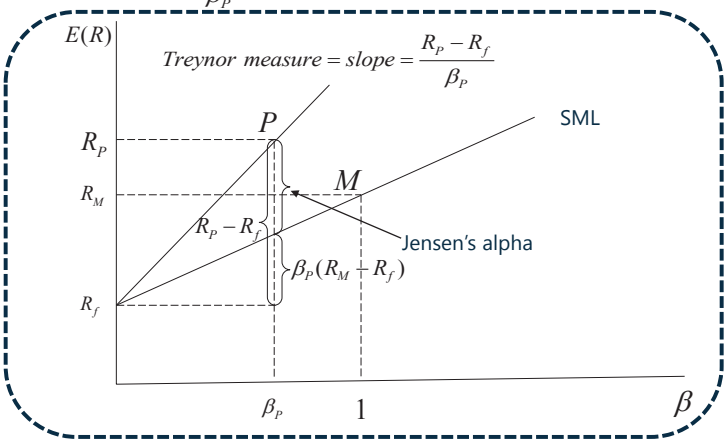
$$Sharpe\ ratio = \frac{R_P - R_f}{\sigma_P} \qquad M^2 = (R_P - R_f)\frac{\sigma_M}{\sigma_P} - (R_M - R_f)$$



Portfolio Risk and Return: Part II

➢ **Treynor measure & Jensen's alpha (systematic risk)**

$$Treynor\ measure = \frac{R_P - R_f}{\beta_P} \qquad \alpha_P = (R_P - R_f) - \beta_P(R_M - R_f)$$



Portfolio Risk and Return: Part II

➢ **Comparison of four measures**

- Jensen's alpha and M-squared
  - ✓ We are not only able to determine the rank of a portfolio but also which, if any, of our portfolios **beat the market** on a risk-adjusted basis.
  - ✓ Comparable only when **sharing same beta** (Jensen's alpha) but no requirement to M-squared.
- Sharpe ratio and Treynor measure
  - ✓ to rank portfolios, the Sharpe ratio or Treynor ratio of one portfolio must **be compared with the Sharpe ratio or Treynor ratio of another portfolio.**
- Systematic risk and non-systematic risk
  - ✓ For non-diversified portfolio , Sharpe ratio and M-squared are appropriate.
  - ✓ For fully diversified portfolio , Jensen Alpha and Treynor are appropriate.

Example:

- Which of the following performance measures is consistent with the CAPM?
  - A. M-squared.
  - B. Sharpe ratio.
  - C. Jensen's alpha.
- **Correct Answer: C**

- Which of the following performance measures does not require the measure to be compared to another value?
  - A. Sharpe ratio
  - B. Treynor ratio
  - C. Jensen's alpha
- **Correct Answer: C**

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Portfolio Management: An Overview

Portfolio Management: An Overview

- **Portfolio approach**
  - Definition:
    - ✓ **From the perspective of risk and returns**, evaluate individual securities in relation to their contribution to the investment characteristics of the whole portfolio.
  - **Diversification** provides an investor with a way to reduce the risk without necessarily decreasing their expected rate of return.
    - ✓ During times of severe market turmoil, correlations among assets tend to **increase**, which makes the **diversification less effective**.

Portfolio Management: An Overview

➢ **The types of investment management clients**

- Individual investors
  - ✓ DC plan: the individual makes the investment decisions and bears the investment risk.
- Institutional investors
  - ✓ DB plan: be funded by company contributions and have an obligation to provide specific benefits to retirees.
  - ✓ University endowments: dedicated to providing continuing financial support to a university and its students.
    - ◆E.g. Harvard University Endowment.
  - ✓ Charitable foundations: established for funding grants that are consistent with the charitable foundation's objectives.
    - ◆E.g. Bill & Melinda Gates Foundation.
  - ✓ Banks.
  - ✓ Insurance companies.
  - ✓ Investment companies. E.g. Mutual funds.
  - ✓ Sovereign wealth funds (SWFs): investment funds owned by a government.

Portfolio Management: An Overview

➢ **Mutual funds and other forms of pooled investments**

- Mutual funds: Open-end fund and Closed-end funds; Money market funds, Bond funds, Stock funds, Hybrid or balanced funds.
  - ✓ Index fund: track the performance of a particular index.
- Exchange traded funds (ETFs)
- Separately managed account
- Hedge funds
- Buyout funds
- Venture capital funds

Portfolio Management: An Overview

➢ **Characteristics of different types of investors**

Investor	Risk Tolerance	Time Horizon	Liquidity Needs	Income Needs
Individuals	Varies by individual	Varies by individual	Varies by individual	Varies by individual
DB plan	High	Long	Quite low	High—mature funds Low—growing funds
Banks	Quite low	Short	High	Pay interest and operational expenses
Endowments and foundations	High	Very long	Quite low	Meet spending commitments
Insurance	Quite low	Long—life Short—P&C	High	Low
Mutual funds	Varies by fund	Varies by fund	High	Varies by fund

Portfolio Management Process

- **Planning step:**
  - Analyse the investor's needs: investment objectives and constraints
  - Develop an IPS: describes the investor's investment objectives and constraints; state an objective benchmark; reviewed and updated regularly.
- **Execution step:**
  - Asset allocation: top-down& bottom-up analysis;
  - Security analysis;
  - Portfolio construction.
- **Feedback step:**
  - Monitor and rebalance the portfolio;
  - Measure portfolio performance and report.

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Basic of Portfolio Planning and Construction

Basic of Portfolio Planning and Construction

- **The need for a policy statement**
  - Understand and articulate realistic investor goals, needs and risk tolerance
  - Ensure that goals are realistic
  - Provide an objective measure of portfolio performance
- **Major components of IPS**
  - Description of client
  - Statement of the purpose
  - Statement of duties and responsibilities
  - Procedures to update IPS and to respond to various possible situations
  - Investment objectives
  - Investment constraints
  - Investment guidelines
  - Evaluation of performance
  - Appendices: information on asset allocation

Basic of Portfolio Planning and Construction

- **Investment objectives: risk and return**
- **Risk objective**
  - The risk objective limits how high the investor can set the return objective
  - Risk measurement:
    - ✓ Absolute: variance or standard deviation
    - ✓ Relative: relate risk relative to one or more benchmarks perceived to represent appropriate risk standards (tracking risk),
    - ✓ Downside risk: VAR
  - Risk tolerance: willingness and ability

Situation		Risk tolerance
Willingness > Ability		Ability (Education)
Willingness < Ability	Return Objective = Willingness	Willingness (Reevaluation)
	Return Objective = Ability	Ability (Education)

Basic of Portfolio Planning and Construction

- **Return objectives: absolute or relative basis**
  - Return measurement:
    - ✓ Absolute basis:
      - ◆ percentage rate of return: total return(balance between capital gains and income), inflation-adjusted return(real)
    - ✓ Relative basis:
      - ◆ Relative to a benchmark return: Some institutions also set their return objective relative to a peer group or universe of managers
  - Stated return desire vs. Required return
  - Consistent with risk objective

Example

- Which of the following factors is least likely to impact an individual's ability to take risk?
  - A. Time horizon
  - B. Personality type
  - C. Expected income
- **Correct Answer: B**

Basic of Portfolio Planning and Construction

- **Investment constraints**
  - **Liquidity**—for cash spending needs (anticipated or unexpected)
  - **Time horizon**—the time between making an investment and needing the funds
  - **Tax concerns**—the tax treatments of various accounts, and the investor's marginal tax bracket
  - **Legal and regulatory factors**—restrictions on investments in retirement, personal, and trust accounts
  - **Unique circumstances**—investor preferences or other factors which has not been considered before
    - ✓ E.g. religions, ethical behavior

Basic of Portfolio Planning and Construction

- **Strategic asset allocation:**
  - the set of exposures to IPS-permissible asset classes that is expected to achieve the client's **long-term objectives** given the client's investment constrains.
  - Correlations within the class is **higher** than correlations between asset classes.

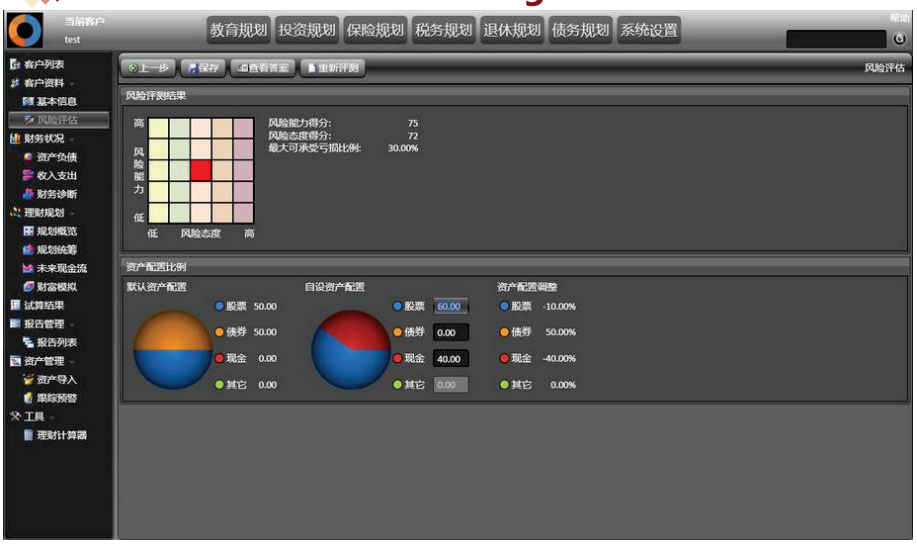
Asset Class	Target
Cash	0%
U.S. large-cap equity	12%
U.S. small-/mid-cap equity	6%
International (developed) equity	12%
Emerging market equity	6%
U.S. bonds	18%
Global bonds	8%
High –yield bonds	5%
Emerging market debt	3%
Inflation-protected bonds	3%
Real estate	5%
Hedge funds	5%
Private equity	2%
Commodities	0%
Tactical asset allocation and other	15%
TOTAL	100%

Basic of Portfolio Planning and Construction

- **Active portfolio management**
  - **Tactical asset allocation**: is the decision to **deliberately deviate** from the policy exposures to systematic risk factors with the intent to add value based on forecasts of the **near-term returns** of those asset classes.
    - ✓ The manager's ability to identify shot-term opportunities in specific asset classes;
    - ✓ The existence of such short-term opportunities.
  - **Security selection**: is an attempt to generate higher returns than the asset class benchmark by **selecting securities with a higher expected return**.
    - ✓ The manager's skill
    - ✓ The opportunities with in a particular asset class.

Basic of Portfolio Planning and Construction

Basic of Portfolio Planning and Construction



Basic of Portfolio Planning and Construction

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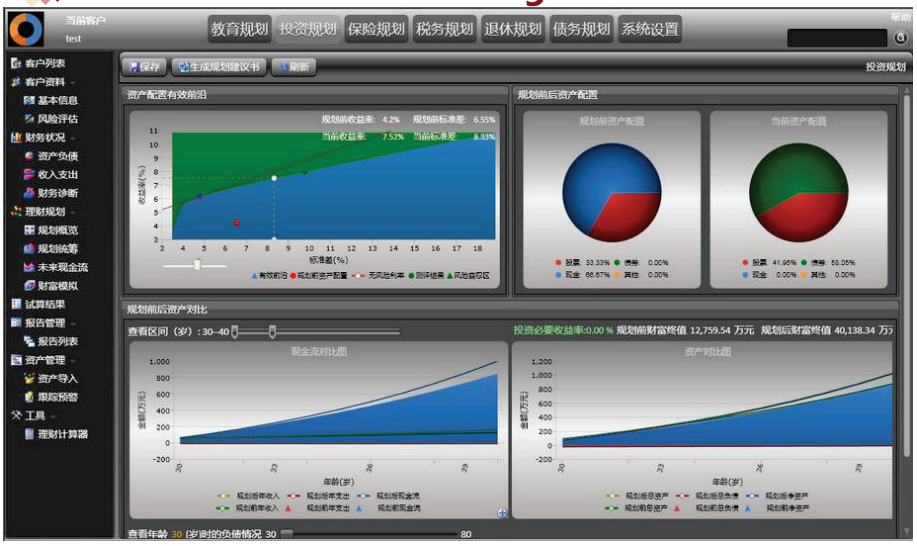


Reading 42

Risk Management: An Introduction

Risk management: An introduction

- **Risk**
  - Exposure to uncertainty
  - Many decision makers focus on return, which is not something that is easily controlled, as opposed to risk, or exposure to risk, which may actually be managed or controlled
- **Risk exposure**
  - The extent to which an entity's value may be affected through sensitivity to underlying risks.
- **Risk management**
  - Risk management is the process by which an organization or individual **defines** the level of risk to be taken, **measures** the level of risk being taken, and **adjusts** the latter toward the former; with the goal of **maximizing** the company's or portfolio's value or the individual's overall satisfaction, or utility.
  - It is comprises all the decisions and actions needed to best achieve organizational or personal objectives while **bearing a tolerable level of risk**.
  - **Not about minimizing risk.**

Risk management: An introduction

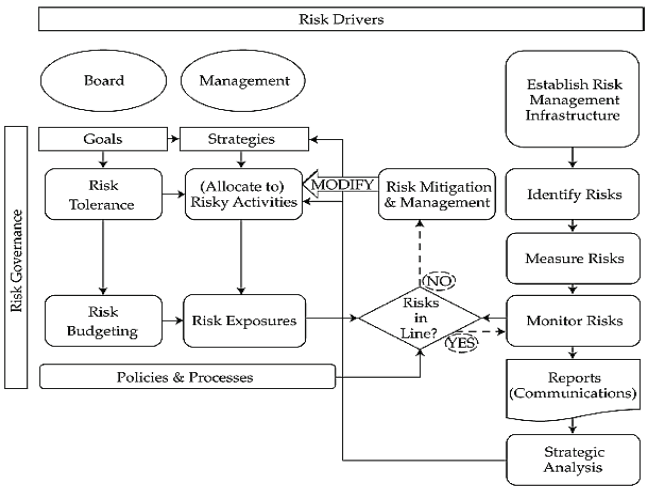
- **Risk management framework**
  - Risk governance
  - Risk identification and measurement
  - Risk infrastructure
  - Defined policies and processes
  - Risk monitoring, mitigation, and management
  - Communications
  - Strategic analysis or integration

Risk Management: An Introduction

- **Risk governance** is the top-level foundation for risk management, including risk oversight and setting risk tolerance for the organization.
- **Risk identification and measurement** is the quantitative and qualitative assessment of all potential sources of risk and the organization's risk exposures.
- **Risk infrastructure** comprises the resources and systems required to track and assess the organization's risk profile.
- **Risk policies and processes** are management's complement to risk governance at the operating level.
- **Risk mitigation and management** is the active monitoring and adjusting of risk exposures, integrating all the other factors of the risk management framework.
- **Communication** includes risk reporting and active feedback loops so that the risk process improves decision making.
- **Strategic risk analysis** and integration involves using these risk tools to rigorously sort out the factors that are and are not adding value as well as incorporating this analysis into the management decision process, with the intent of improving outcomes.

Risk Management: An Introduction

Exhibit 1. The Risk Management Framework in an Enterprise Context



Risk Management: An Introduction

- **Risk governance**
  - Risk governance is the foundation for risk management.
  - **Risk governance** refers to senior management's determination of the **risk tolerance** of the organization, the elements of its optimal **risk exposure strategy**, and the framework for oversight of the risk management function.
  - Employing a risk management committee, along with a chief risk officer (CRO), are hallmarks of a strong risk governance framework.
    - ✓ **Risk management committee** provides top decision makers with a forum for regularly considering risk management issues.

Risk Management: An Introduction

- **Risk tolerance**
  - At the governance level, the duty is generally not to select these activities—a job that usually falls to management—but to **establish the organization's risk appetite.**
    - ✓ Certain risks or levels of risks may be deemed acceptable, other risks deemed unacceptable, and in the middle are risks that may be pursued in a risk-limited fashion.
    - ✓ Said differently, risk tolerance identifies the extent to which the entity is willing to experience losses or opportunity costs and to fail in meeting its objectives
  - When analyzing risk tolerance, management should examine risks that may exist within the organization as well as those that may arise from outside. **("inside" view and "outside" view)**
  - The risk tolerance should be chosen and communicated **before** a crisis, and will serve as the high-level guidance for management in its strategic selection of risks.
  - If a company has **the ability to adapt quickly to adverse events** may allow for a higher risk tolerance.

Risk Management: An Introduction

- **Risk budgeting** is any means of allocating investments or assets by their risk characteristics.
  - The process of risk budgeting forces the firm to consider **risk tradeoffs**.
  - The **goal** is to allocate the overall amount of acceptable risk to the mix of assets or investments that have the greatest expected returns over time. (**The return per unit of risk is the highest**.)

Risk Management: An Introduction

- **Financial risks** refer to the risks that arise from events occurring in the financial markets. Examples are:
  - **Market risk**
    - ✓ Arises from movements in stock prices, interest rates, exchange rates, and commodity prices
  - **Credit risk**
    - ✓ The risk that a counterparty will not pay an amount owed
  - **Liquidity risk**
    - ✓ The risk that, as a result of degradation in market conditions or the lack of market participants, one will be unable to sell an asset without lowering the price to less than the fundamental value
    - ✓ Liquidity risk could also be called transaction cost risk and is most associated with **a widening bid-ask spread.**

Risk Management: An Introduction

- **Non-financial risks** consist of a variety of risks, including settlement risk, operational risk, legal risk, regulatory risk, accounting risk, tax risk, model risk, tail risk, and sovereign or political risk.
  - **Operational risk** is the risk that arises from within the operations of an organization and includes both human and system or process errors.
  - **Solvency risk** is the that an entity does not survive or succeed because it runs out of cash to meet its financial obligations.
- **Interaction between risks:**
  - Risks are not necessarily independent because many risks arise as a result of other risks; risk interactions can be extremely non-linear and harmful.

Risk Management: An Introduction

- **Risk metrics**
  - standard deviation or volatility;
  - asset-specific measures, such as beta or duration;
  - derivative measures, such as delta, gamma, vega, and rho;
  - and tail measures such as Value at risk, CVaR and expected loss given default.
    - ✓ **Value at risk or VaR** is a measure of the size of the tail of the distribution of profits on a portfolio or for an entity.
      - ◆ Example: a London bank determines that its VaR is £3 million at 5% for one day.
      - ◆ Means: the bank expects to lose **a minimum** of £3 million in one day 5% of the time.
    - ✓ **Conditional VaR or CVaR** is a common tail loss measure, defined as the weighted average of all loss outcomes in the statistical distribution that exceed the VaR loss.

Risk Management: An Introduction

- **Subjective and market-based estimates of risk**
  - Two methods of risk assessment that are used to supplement measures such as VaR and CVaR are **stress testing and scenario analysis.**
    - ✓ **Stress testing** examines the effects of a specific (usually extreme) change in a key variable such as an interest rate or exchange rate.
    - ✓ **Scenario analysis** refers to a similar what-if analysis of expected loss but incorporates changes in multiple inputs.

Risk Management: An Introduction

- **Methods of risk modification:**
  - **Risk prevention and avoidance**
    - ✓ Not engage in the activity with the uncertain outcome.
  - **Risk acceptance:** self-insurance and diversification
    - ✓ **Self-insurance** is obtained by setting aside sufficient capital to cover losses.
    - ✓ Another form of accepting risk, but doing so in the most efficient manner possible, is **diversification.**
  - **Risk transfer (insurance)**
    - ✓ Risk transfer is the process of passing on a risk to another party, often, but not always, in the form of an **insurance policy.**
  - **Risk shifting (derivatives)**
    - ✓ Whereas risk transfer refers to actions taken that pass the risk on to other parties, risk shifting refers to actions that change the distribution of risk outcomes. Risk shifting generally involves **derivatives** as the risk modification vehicle.
- The determinants of which method is best for modifying risk are the benefits weighed against the costs.

Reading 43

Fintech in Investment Management

Framework

1. What is Fintech
2. Big Data and Data Science
3. Advanced Analytical Tools
4. Applications of Fintech
5. Distributed Ledger Technology

Learning Outcomes

- **The candidate should be able to**
  a. Describe "fintech";
  b. Describe Big Data, artificial intelligence, and machine learning;
  c. Describe fintech applications to investment management;
  d. Describe financial applications of distributed ledger technology.

1. What Is Fintech

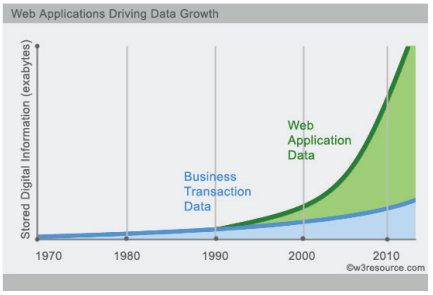
- **Basic concept of Fintech**
  - Broadly refers to technology – driven innovation occurring in the financial services industry (in its broadest sense);
  - Narrowly refers to technological innovation in the design and delivery of financial services and products (for the purpose of this reading).
- **The stages in development of Fintech**
  - **Early form:** Data processing and the automation of routine tasks;
  - **Then followed system:** Decision-making applications based on complex machine-learning logic, where computer programs are able to "learn" how to complete tasks over time.

What Is Fintech

- **Areas of Fintech development**
  - Analysis of large datasets
  - Analytical techniques
  - Automated trading
  - Automated advice
  - Financial record keeping

Areas of Fintech Development

- **1. Analysis of large datasets**
  - In addition to growing amounts of traditional data, massive amounts of alternative data generated from non-traditional data sources
    - ✓ **Traditional data source** : security prices, corporate financial statements, and economic indicators
    - ✓ **Non-traditional data source** : social media sensor networks

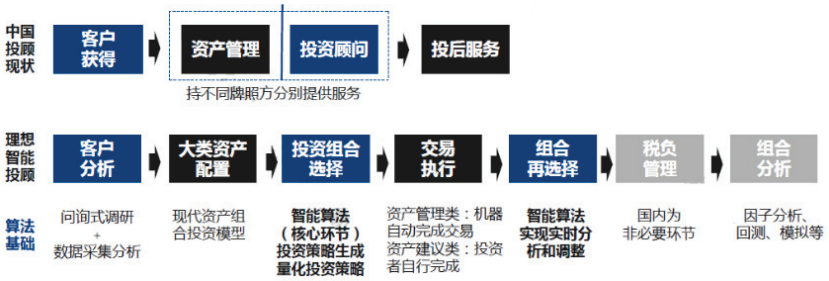


Areas of Fintech Development

- **2. Analytical tools**
  - **Artificial Intelligence (AI)** – computer systems capable of performing tasks that previously required human intelligence.
- **3. Automated trading**
  - Computer algorithms or automated trading applications may provide a number of benefits to investors
    - ✓ more efficient trading
    - ✓ lower transaction costs
    - ✓ anonymity
    - ✓ greater access to market liquidity

Areas of Fintech Development

- **4. Automated advice**
  - Robo-advisers or automated personal wealth management services
  - To provide investment services to retail investors at lower cost



* 资料来源：《中国智能投顾市场发展趋势研究报告》，慧辰资讯TMT互联网研究部

Areas of Fintech Development

- **5. Financial record keeping**
  - New technology, such as Distributed Ledger Technology (DLT), may provide secure ways to track ownership of financial assets on a peer-to-peer (P2P) basis, such as Bitcoin.

Example

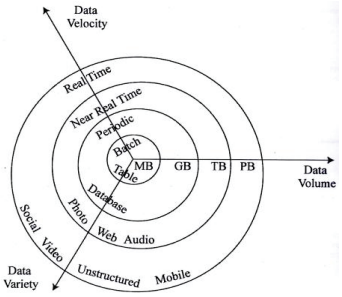
- A correct description of Fintech is that it:
  - A. is driven by rapid growth in data and related technological advances.
  - B. increases the need for intermediaries.
  - C. is at its most advanced state using systems that follow specified rules and instructions.

- **Correct Answer: A**

  Drivers of fintech include extremely rapid growth in data (including their quantity, types, sources, and quality) and technological advances enabling the capture and extraction of information from it.

2. Big Data

- **Definition**
  - The term **Big Data** refers to **the vast amount** of data being generated by industry, governments, individuals, and electronic devices, including data generated from **traditional sources** as well as **non-traditional data types** (also known as **alternative data**)
- **The characteristics of Big Data**
  - Volume (very large)
  - Velocity (real-time or near-real-time)
  - Variety (mainly unstructured)



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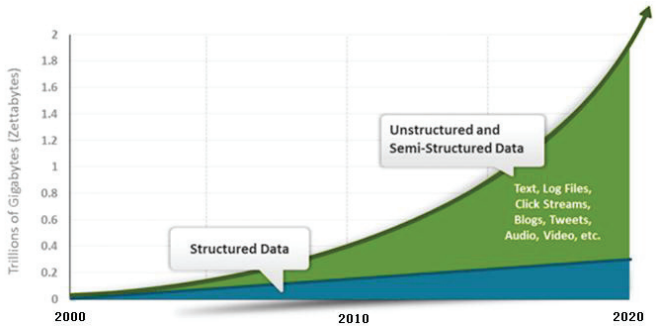
Big Data

- **Structured, semi-structured and unstructured data**
  - Structured data : SQL tables or CSV files
  - Semi-structured data : HTML code
  - Unstructured data : video message, blogs, WeChat messages



Big Data

- **Three main sources of alternative data**
  - Individuals
  - Business processes: Including direct sales information, such as credit card data, as well as corporate exhaust.
  - Sensors: Sensor data are collected from such devices as smart phones, cameras, RFID chips, and satellites that are usually connected to computers via wireless networks.

Individuals	Business Processes	Sensors
Social media	Transaction data	Satellites
News, reviews	Corporate data	Geolocation
Web searches, personal data		**Internet of Things**
		Other sensors

Big Data

- **Big Data challenges**
  - Big Data poses several challenges when it is used in investment analysis, including **the quality, volume, and appropriateness of the data.**
  - The data must be sourced, cleansed, and organized before analysis can occur. This process can be **extremely difficult** with alternative data owing to the unstructrued characteristics of the data involved.

Data Science

- **Definition**
  - An interdisciplinary field that harnesses advances in computer science (including machine learning), statistics, and other disciplines for the purpose **of extracting information from Big Data** (or data in general)
  - Mainly including **data processing** and **data visualization**

Data Science

- **Data processing methods**
  - **Capture**
    - ✓ how the data are collected and transformed into a format that can be used by the analytical process.
  - **Curation**
    - ✓ Data curation refers to the process of ensuring data quality and accuracy through a data cleaning exercise.
  - **Storage**
    - ✓ Data storage refers to how the data will be recorded, archived, and accessed and the underlying database design.
  - **Search**
    - ✓ Search refers to how to query data.
  - **Transfer**
    - ✓ Transfer refers to how the data will move from the underlying data source or storage location to the underlying analytical tool.

Data Science

- **Data visualization**
  - Visualization refers to how the data will be formatted, displayed, and summarized in graphical form.
  - Traditional structured data can be visualized using tables, charts, and trends, whereas non-traditional unstructured data require new techniques of data visualization.

Tag cloud

Example

- A characteristic of Big Data is that:
  - A. One of its traditional sources is business processes.
  - B. It involves formats with diverse types of structures.
  - C. Real-time communication of it is uncommon due to vast content.

- **Correct Answer: B**

  Big Data is collected from many different sources and is a variety of formats, including structured data (e.g., SQL tables or CSV files), semi-structured data (e.g., HTML code), and unstructured data (e.g., video messages).

3. Artificial Intelligence and Machine Learning

- **Artificial intelligence**
  - Artificial intelligence computer systems are capable of performing tasks that have traditionally required human intelligence. This is often accomplished through the use of **"if then" rules.**
- **Machine learning (ML)**
  - Machine learning (ML) is a technology that has grown out of the wider AI field.
  - ML algorithms are computer programs that are able to **"learn"** how to complete tasks, improving their performance over time with experience.

Machine Learning

- **How machine learning works?**
  - Dataset can be split into a **training dataset and validation dataset** (evaluation dataset)
    - ✓ The training dataset allows the algorithm to identify relationships between inputs and outputs based on historical patterns in the data.
    - ✓ These relationships are then tested on the validation dataset.
  - ML still **required human judgement** in understanding data and choosing the right analytic techniques.
  - Errors may arise from **overfitting** and **underfitted**
    - ✓ Overfitting: make too much use of the data
    - ✓ Underfitted: make too little use of the data
  - In addition, ML techniques can appear to be opaque or "**black box**" approaches, which arrive at outcomes that may not be entirely understood or explainable.

Machine Learning

- **Types of machine learning**
  - **1. Supervised learning**
    - ✓ Computers learn to model relationships based on **labeled training data**.
    - ✓ Trying to group companies into peer groups based on their industries.

Machine Learning

- **Types of machine learning**
  - **2. Unsupervised learning**
    - ✓ Computers are not given labeled data but instead are given only data from which the algorithm seeks to describe the data and their structure.
    - ✓ Trying to group companies into peer groups based on their characteristics rather than using standard sector or other acknowledged criteria.
    - ✓ More examples
      - ◆Identify whether it is money laundering is unsupervised learning
      - ◆Spam mail classification is unsupervised learning

Example

- In the use of machine learning:
  A. Some techniques are termed "black box" due to data biases.
  B. Human judgment is not needed because algorithms continuously learn from data.
  C. Training data can be learned too precisely, resulting in inaccurate predictions when used with different datasets

- **Correct Answer: C**

  Overfitting occurs when the ML model learns the input and target dataset too precisely. In this case, the model has been "over trained" on the data and is treating noise in the data as true parameters. An ML model that has been overfitted is not able to accurately predict outcomes using a different dataset and may be too complex.

4. Applications to Investment Management

- **1. Text analytics**
  - Computer programs that analyze and derive meaning typically from large, unstructured text- or voice-based datasets, which include
    - ✓ company filings, written reports, quarterly earnings calls, social media, email, internet postings, and surveys
  - An important application of text analytics is **natural language processing (NLP).**
    - ✓ A computer programs to analyze and interpret human language.
    - ✓ Applications include **translation, speech recognition, text mining, sentiment analysis, and topic analysis**.
    - ✓ Models using NLP analysis may incorporate **non-traditional information** to evaluate what people are saying such as their preferences, opinions, likes, or dislikes – in an attempt to **identify trends** and short-term indicators about a company, a stock, or an economic event that might have a bearing on future performance.

Applications to Investment Management

- **2. Robo-advisers services**
  - Robo-advisory services provide investment solutions through online platforms, reducing the need for direct interaction with financial advisers.
  - Regulations governing robo-advisers services, such as
    - ✓ **SEC** (Securities and Exchange Commission) in the United States (registered)
    - ✓ **FCA** (Financial Conduct Authority) in the United kingdom
    - ✓ **ASIC** (Australian Securities and Investments Commission) In Australia (license)

Applications to Investment Management

- **Robo-advisers services(cont'd)**
  - Current robo-advisory services include automated asset allocation, trade execution, portfolio optimization, tax-loss harvesting, and rebalancing for investor portfolios.
  - Two types of wealth management services dominate the robo-advice sector
    - ✓ **Fully automated digital wealth managers**
      - ◆Including direct deposits, periodic rebalancing, and dividend reinvestment options
    - ✓ **Adviser-assisted digital wealth managers**
      - ◆Involving a more holistic analysis of a client's assets and liabilities

Applications to Investment Management

- **Robo-advisers services**
  - The **characteristics** of robo-advisers' analyses and recommendations
    - ✓ Most following **a passive, or** fairly conservative **investment approach**
    - ✓ Typically having **low fees and low account minimums**
    - ✓ Robo-advisers can reach **underserved populations**
  - **Criticism** of robo-advisers
    - ✓ It may not always be completely transparent why a robo-adviser chooses to make a recommendation or take a trading action.
    - ✓ The growth of the complexity and size of an investor's portfolio makes a team of human advisers likely to endure.

Applications to Investment Management

- **3. Risk analysis**
  - **As mandated by regulators worldwide**, the global investment industry has undertaken major steps in stress testing and risk assessment that involve the analysis of **vast amounts of** quantitative and qualitative risk data.
    - ✓ **Stress tests** may also take qualitative information into consideration, such as capital planning procedures, expected business plan changes, business model sustainability, and operational risk.
    - ✓ There is increasing interest in monitoring risk in **real time**.
    - ✓ ML techniques may be used to help assess **data quality**.
    - ✓ The backtesting **simulations** in portfolio risk management are often computationally intense and may be facilitated through the use of advanced AI-based techniques.

Applications to Investment Management

- **4. Algorithmic trading**
  - Algorithmic trading is the computerized **buying and selling of financial instruments**, in accordance with pre-specified rules and guidelines.
  - Algorithmic trading is often used to execute large institutional orders, **slicing orders into smaller pieces** and executing across different exchanges and trading venues.
  - Many benefits provided by algorithmic trading
    - ✓ Including **speed** of execution, anonymity, and lower transaction costs
    - ✓ Over the course of a day, algorithms may **continuously update and revise** their execution strategy on the basis of changing prices, volumes, and market volatility.
    - ✓ Algorithms may also determine the **best way to price the order and most appropriate trading venue to route for execution**.

Applications to Investment Management

- **High-frequency trading (HFT)** is a form of algorithmic trading that makes use of vast quantities of granular financial data to automatically place trades when certain conditions are met.
- Trades are executed on ultra-high-speed, low-latency networks in fractions of a second.
- HFT algorithms decide what to buy or sell and where to execute on the basis of real-time prices and market conditions, seeking to earn a profit form intraday market mispricings.

Example

- Text Analytics is appropriate for application to:
  - A. Economic trend analysis.
  - B. Large, structured datasets.
  - C. Public but not private information.

- **Correct Answer: A**

  Through the Text Analytics application of natural language processing (NLP), models using NLP analysis may incorporate **non-traditional information** to evaluate what people are saying – via their preferences, opinions, likes, or dislikes – in the attempt to identify trends and short-term indicators about a company, a stock, or an economic event that might have a bearing on future performance.

Example

- In providing investment services, robo-advisers are most likely to:
  - A. Rely on their cost effectiveness to pursue active strategies.
  - B. Offer fairly conservative advice as easily accessible guidance.
  - C. Be free from regulation when acting as fully-automated wealth managers.

- **Correct Answer: B**

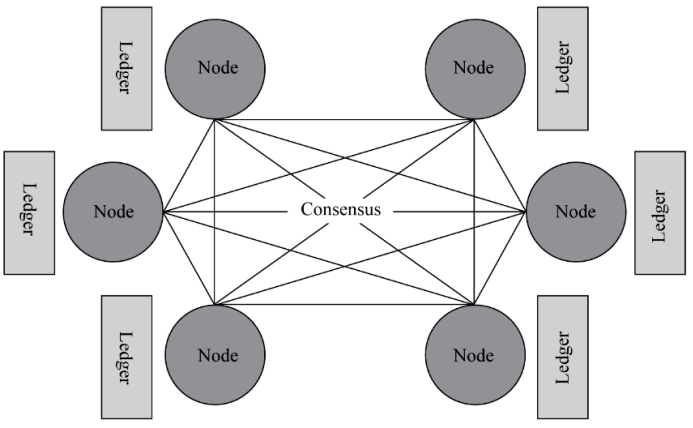
  Research suggests that robo-advisers tend to offer fairly conservative advice, providing a cost-effective and easily accessible form of financial guidance to underserved populations, such as the mass affluent and mass market segments.

5. Distributed Ledger Technology

- **Introduction**
  - Distributed ledger technology - technology based on a distributed ledger - represents a fintech development that offers potential improvements in the area of **financial record keeping**.
  - A distributed ledger is a type of **database** that may be shared among entities in a network.
  - In a distributed ledger, entries are recorded, stored, and distributed across a network of participants so that **each participant has a matching copy** of the digital database.

Distributed Ledger Technology

- **Distributed Ledger Network Setup**
  - Basic elements of a DLT network include a **digital ledger**, a **consensus mechanism** used to confirm new entries, and a participant **network**.



Distributed Ledger Technology

- **Consensus mechanism**
  - ✓ The consensus mechanism is the process by which the computer entities (or nodes) in a network **agree on a common state of the ledger**.
  - ✓ Consensus generally involves two steps: transaction validation and agreement on ledger update by network parties.
- Features of DLT include the use of **cryptography**
  - An algorithmic process to encrypt data, making the data unusable if received by unauthorized parties —— which enables a high level of network security and database integrity.
- DLT has the potential to accommodate **"Smart contracts"**
  - Computer programs that self-execute on the basis of pre-specified terms
    - ✓ automatic execution of contingent claims for derivatives
    - ✓ instantaneous transfer of collateral in the event of default.

Distributed Ledger Technology

- **Blockchain**
  - **A type of digital ledger** in which information, such as changes in ownership, is recorded sequentially within blocks that are then linked or "chained" together and secured using cryptographic methods.
  - **Steps** involved in adding a transaction to a blockchain distributed ledger.
    - ✓ Transaction takes place between buyer and seller.
    - ✓ Transaction is **broadcast** to the network of computers (nodes).
    - ✓ Nodes **validate** the transaction details and parties to the transaction.
    - ✓ Once verified, the transaction is combined with other transactions to **form a new block** (of predetermined size) of data for the ledger.
    - ✓ This block of data is then **added or linked** (using a cryptographic process) to the previous block(s) **containing data**.
    - ✓ Transaction is considered complete and ledger has been **updated**.

Distributed Ledger Technology

- **DLT can take the form of permissionless and permissioned networks.**
  - **1. Permissionless networks**
    - ✓ Permissionless networks are **open to any user** who wishes to make a transaction, and all users within the network can see all transactions that exist on the blockchain.
    - ✓ The main benefit of a permissionless network is that it does not depend on a **centralized authority** to confirm or deny the validity of transactions, because this takes place through the consensus mechanism.
    - ✓ A well-known example of an application of blockchain technology using an open, permissionless network is **bitcoin**.

Distributed Ledger Technology

- **DLT can take the form of permissionless and permissioned networks.(cont'd)**
  - **2. Permissioned networks**
    - ✓ In permissioned network, network members may be **restricted from participating** in certain network activities. (from adding transactions to viewing transactions with limited or selected details of the

* 资料来源：铅笔 - 信息技术行业分布式账本技术：超区块链接

BitCoin

- 比特币（BitCoin）的概念最初由中本聪在2009年提出，根据中本聪的思路设计发布的开源软件以及建构其上的P2P网络。比特币是一种P2P形式的数字货币。点对点的传输意味着一个去中心化的支付系统。
- 与大多数货币不同，*比特币不依靠特定货币机构发行，它依据特定算法*，通过大量的计算产生，*比特币经济使用整个P2P网络中众多节点构成的分布式数据库来确认并记录所有的交易行为，并使用密码学的设计来确保货币流通各个环节安全性*。
- 比特币网络通过“挖矿”来生成新的比特币。所谓“挖矿”实质上是用计算机解决一项复杂的数学问题，来保证比特币网络分布式记账系统的一致性。比特币网络会自动调整数学问题的难度，让整个网络约每10分钟得到一个合格答案。随后比特币网络会新生成一定量的比特币作为赏金，奖励获得答案的人。
- 比特币与其他虚拟货币最大的不同，是其总数量非常有限，具有极强的稀缺性。该货币系统曾在4年内只有不超过1050万个，之后的总数量将被永久限制在2100万个。2009年比特币诞生的时候，每笔赏金是50个比特币。诞生10分钟后，第一批50个比特币生成了，而此时的货币总量就是50。随后比特币就以约每10分钟50个的速度增长。当总量达到1050万时(2100万的50%)，赏金减半为25个。当总量达到1575万(新产出525万，即1050的50%)时，赏金再减半为12.5个。 （来自于网络）

Applications of Distributed Ledger Technology

- **1. Crytocurrencies, also known as a digital currency**
  - Most issued cryptocurrencies use a **decentralized distributed ledger** to record and verify all digital currency transactions.
  - Cryptocurrencies have not traditionally been government backed or regulated.
  - Many cryptocurrencies have a **self-imposed limit** on the total amount of currency they may issue.
  - It provides an attractive means of raising capital.
    - ✓ An ICO is an unregulated process whereby companies sell their crypto tokens to investors in exchange for fiat money or for another agreed upon cryptocurrency.

Applications of Distributed Ledger Technology

- **2. Tokenization**
  - Through tokenization, the process of representing ownership rights to physical assets on a blockchain or distributed ledger, DLT has the potential to streamline this process by creating a single, digital record of ownership with which to verify ownership title and authenticity, including all historical activity.
- **3. Post-trade clearing and settlement**
  - DLT has the ability to streamline existing post-trade processes by providing near-real-time trade verification, reconciliation, and settlement, thereby reducing the complexity, time, and costs associated with processing transactions.
- **4. Compliance**
  - DLT-based compliance may better support shared information, communications, and transparency within and between firms, exchanges, custodians, and regulators.

Example

- A benefit of distributed ledger technology (DLT) favoring its use by the investment industry is its:
  - A. Scalability of underlying systems.
  - B. Ease of integration with existing systems.
  - C. Streamlining of current post-trade processes.

- **Correct Answer: C**

  DLT has the potential to streamline the existing, often complex and labor intensive post-trade processes in securities markets by providing close to real-time trade verification, reconciliation, and settlement, thereby reducing related complexity, time, and costs.

Example

- What is a distributed ledger technology (DLT) application suited for physical assets?
  - A. Tokenization
  - B. Cryptocurrencies
  - C. Permissioned networks

- **Correct Answer: A**

  Through tokenization-the process of representing ownership rights to physical assets on a blockchain or distributed ledger – DLT has the potential to streamline this rights process by creating a single, digital record of ownership with which to verify ownership title and authenticity, including all historical activity.

It's not the end but just beginning.

If you have people you love, allow them to be free beings. Give and don't expect. Advise, but don't order. Ask, but never demand. It might sound simple, but it is a lesson that may take a lifetime to truly practice. It is the secret to true Love. To truly practice it, you must sincerely feel no expectations from those who you love, and yet an unconditional caring.

如果你有爱的人，允许他们自由随意的存在。给予而不指望；建议而不命令；请求而不要求；可能听起来简单，但这需要一辈子去实践。这就是真爱的秘诀。真正去实践它，你必须对那些你爱的人没有期望，并给予无条件的关爱。