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Part 1

Capital-Budgeting Techniques

Capital Budgeting Concepts -:

- *Capital Budgeting involves evaluation of (and decision about) projects. Which projects should be accepted? Here, our goal is to accept a project which maximizes the shareholder wealth. Benefits are <u>worth</u> more than the cost.*
- *The Capital Budgeting is based on forecasting estimate future expected cash flows.*
- *Evaluate project based on the evaluation method.*

Classification of Projects

- Mutually Exclusive - accept ONE project only
- Independent - accept ALL <u>profitable</u> projects

Cash Flows

- *Initial Cash Outlay - amount of capital spent to get project going.*
- *Initial Cash Outlay - amount of capital spent to get project going.*
- *If spend $10 million to build new plant then the Initial Outlay (IO) = $10 million*

CF_0 = Cash Flow time 0 = -10 million

Annual Cash Inflows--after-tax CF

Cash inflows from the project

CF_n = Sales - Costs

Capital Budgeting Methods

Payback Period: *Number of years needed to recover your initial outlay.*

Project:-

Time	**A**	**B**
0	**(10,000.)**	**(10,000.)**
1	**3,500**	**500**
2	**3,500**	**500**
3	**3,500**	**4,600**
4	**3,500**	**10,000**

Payback 2.86 years project (A) -Payback = 3.44 years(B)

The payback method is not a good method as it does not consider the time value of money.
Also, the payback method is not a good method as it does not consider the cash flows beyond the payback period.

- ***Which project should you choose?***

	CF0	***CF1***	***CF2***	***CF3***
A	***-100,000***	***90,000***	***9,000***	***1,000***
B	***-100,000***	***1,000***	***9,000***	***90,000***

- ***Which project should you choose?***

	CF0	***CF1***	***CF2***	***Cf3***	***CF4***
A	***-100000***	***90000***	***10000***	***0***	***0***
B	***-100000***	***90000***	***9000***	***80000***	***1000000***

Methods that consider time value of money and all cash flows

Net Present Value:

Present Value of all costs and benefits of a project.

Present Value of all costs and benefits of a project.

Concept is similar to Intrinsic Value of a security but subtracts cost of the project.

NPV = PV of Inflows - Initial Outlay

$$NPV = \frac{CF_1}{(1+k_1)} + \frac{CF_2}{(1+k_2)} + \frac{CF_3}{(1+k_3)} + \ldots\ldots + \frac{CF_n}{(1+k)_n} - 10$$

	Project	
Time	**A**	**B**
0	**(10,000.)**	**(10,000.)**
1	**3,500**	**500**
2	**3,500**	**500**
3	**3,500**	**4,600**
4	**3,500**	**10,000**

k=10%

PV Benefits > PV Costs

$11,154 > $ 10,000

$1,154 = NPV project B

$1,095= NPV project A

NPV Decision Rules

If projects are independent then accept all projects with NPV more or equal 0.

ACCEPT A & B

If projects are independent then accept all projects with NPV more or equal 0.

ACCEPT A & B

If projects are mutually exclusive, accept projects with higher NPV.

ACCEPT B only

Internal Rate of Return

Measures the rate of return that will make the PV of future CF equal to the initial outlay.

Definition:

The IRR is that discount rate at which NPV = 0

IRR is like the YTM. It is the same concept but the term YTM is used only for bonds.

Measures the rate of return that will make the PV of future CF equal to the initial outlay.

The IRR is the discount rate at which NPV = 0

$$= \frac{CF_1}{(1+IRR)_1} + \frac{CF_2}{(1+IRR)_2} + \frac{CF_3}{(1+IRR)_3} + \ldots\ldots \frac{CF_n}{(1+IRR)_n} - 10$$

$$10 = \frac{CF_1}{(1+IRR)_1} + \frac{CF_2}{(1+IRR)_2} + \frac{CF_3}{(1+IRR)_3} + \ldots\ldots \frac{CF_n}{(1+IRR)_n}$$

Outflow = PV of Inflows

Internal Rate of Return for Project B

Cannot solve for IRR directly, must use Trial & Error

$$10\,000 = \frac{500}{(1+IRR)_1} + \frac{500}{(1+IRR)_2} + \frac{4600}{(1+IRR)_3} + \frac{10000}{(1+IRR)_4}$$

TRY 14%

$$10\,000 = \frac{500}{(1+14)_1} + \frac{500}{(1+14)_2} + \frac{4600}{(1+14)_3} + \frac{10000}{(1+14)_4}$$

10,000 = 9,849

PV of Inflows too low, try lower rate

10.000= 10.155

13% < IRR < 14%

Independent Projects:

Decision Rule for Internal Rate of Return:-

- Accept Projects with IRR ≥rate

Mutually Exclusive Projects: - Accept project with highest IRR ≥l required rate

Profitability Index

Very Similar to Net Present Value

PI = PV of Inflows

Initial Outlay

Instead of Subtracting the Initial Outlay from the PV of Inflows, the Profitability Index is the ratio of Initial Outlay to the PV of Inflows.

$$P1 = \frac{\frac{CF_1}{(1+k)} + \frac{CF_2}{(1+k)_2} + \frac{CF_3}{(1+k)_3} + \ldots\ldots \frac{CF_n}{(1+k)_n}}{10}$$

Profitability Index for Project B

Project:-

Time	A	B
0	(10,000.)	(10,000.)
1	3,500	500
2	3,500	500
3	3,500	4,600
4	3,500	10,000

$$P1 = \frac{\frac{500}{(1+.1)} + \frac{500}{(1+.1)_2} + \frac{4600}{(1+.1)_3} + \ldots\ldots \frac{10000}{(1+.1)_4}}{10}$$

P1 = $\frac{11,154}{10,000}$ = 1.1154

- *Independent Projects*

Accept Project if PI ≥ 1

- *Mutually Exclusive Projects*

Accept Highest PI ≥ 1 Project

Time Value of Money

- Payback - Does not adjust for timing differences (ignore Discounted Payback)
- NPV, IRR and PI take into account the time value of money
- *Relevant Cash Flows?*
- NPV, IRR and PI use all Cash Flows
- Payback method ignores Cash Flows that occur after the Payback Period.

NPV & PI indicated accept Project B while IRR indicated that Project A should be accepted. Why?

Sometimes there is a conflict between the decisions based on NPV and IRR methods.

The conflict arises if there is difference in the timing of CFs or sizes of the projects (or both).

The cause of the conflict is the underlying reinvestment rate assumption.

Reinvestment Rate Assumptions

- ❖ NPV assumes cash flows are reinvested at the required rate, k.
- ❖ IRR assumes cash flows are reinvested at IRR.

Reinvestment Rate of k more realistic as most projects earn approximately k (due to competition)

NPV *is the Better Method for project evaluation*

IRR

Because of its unreasonable reinvestment rate assumption, IRR method can result in bad decisions.

Another problem with IRR is that if the sign of the cash flow changes more than once, there is a possibility of multiple IRR. See p 340.

The problem of unreasonable assumption can be addressed by using Modified IRR

Part 2

Risk and Rates of Return

Learning Objectives

- Define and measure the expected rate of return of an individual investment.
- Define and measure the riskiness of an individual investment.
- Explain how diversifying our investment affects the riskiness and expected rate of return of a portfolio of assets.
- Measure the market risk of an individual asset.
- Calculate the market risk of a portfolio of investments.
- Explain the relationship between an investor's required rate of return on an investment and the riskiness of the investment.
- Explain recent criticisms of the capital asset pricing model.

Compare the historical relationship between risk and rates of return in the capital markets.

Interest rate:-

Interest rate represents the cost of money It is the opportunity cost of money:

- It shows the return lost from not investing in a comparable risk investment.

- It is expected to compensate the investor for the time, inflation, and risk.

    Interest Rate: - **1 + krf) = (1 + k*) (1 + IRP). This is known as the "Fisher Effect**

Suppose the real rate is 3%, and the nominal rate is 8%. What is the inflation rate premium?

(1 + krf) = (1 + k*) (1 + IRP)

(1.08) = (1.03) (1 + IRP)

(1 + IRP) = (1.0485), so

IRP = 4.85%

Term Structure of Interest Rates:-

The pattern of rates of return for debt securities that differ only in the length of time to maturity

For a Treasury security, what is the required rate of return?

Required rate of return = Risk-free rate of return

Since Treasuries are essentially free of default risk, the rate of return on a Treasury security is considered the "risk-free" rate of return

For a corporate stock or bond, what is the required rate of return?

Required rate of return= Risk-free rate of return + Risk premium

How large of a risk premium should we require to buy a corporate s Returns ecurity?

<u>Expected Return</u> - the return that an investor expects to earn on an asset, given its price, growth potential, etc.

<u>Required Return</u> - the return that an investor requires on an asset given its <u>risk</u> and market interest rates.

Two Components of return

<u>Periodic cash flows</u>

<u>Risk and Rates of Return</u>

Price Change (capital gains)

Holding Period return

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

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

Expected Return

Expected return is based on expected cash flows (not accounting profits

- ❖ In an uncertain world future cash flows are not known with certainty
- ❖ To calculate expected return, compute the weighted average of all possible returns
- ❖ Calculating Expected Return:

$$\bar{k} = \sum_{i=1}^{N} k_i P(k_i)$$

where

k_i = Return state i

$P(k_i)$	=	Probability of k_i occurring
N	=	Number of possible states

Example

You are evaluating ElCat Corporation's common stock. You estimate the following returns given different states of the economy

State of Economy	**Probability**	**Return**	
Economic Downturn	.10	–5%	-0.5%
Zero Growth	.20	5%	.1%
Moderate Growth	.40	10%	.4%
High Growth	.30	20%	.6%

$$\bar{k} = \sum_{i=1}^{N} k_i P(k_i)$$

Expected (or average) rate of return on stock is 10.5%

Risk

- ❖ Risk is the uncertainty of future outcomes
- ❖ Example
- ❖ You evaluate two investments: ElCat Corporation's common stock and a one year Gov't Bond paying 6%. The return on the Gov't Bond does not depend on the state of the economy--you are guaranteed a 6% return.

Measuring Risk

❖ Standard Deviation (s) measure the dispersion of returns.

$$\sigma = \sqrt{\sum_{i=1}^{N} (k_i - \bar{k})^2 P(k_i)}$$

Example

Compute the standard deviation on ElCat common stock. the mean (k) was previously computed as 10.5%

State of Economy	**Probability**	**Return**
Economic Downturn	.10	–5% – 10.5%)^2 = 24.025%^{2}
Zero Growth	.20	5% – 10.5%)^2 = 6.05%^{2}
Moderate Growth	.40	10% – 10.5%)^2 = 0.10%^{2}
High Growth	.30	20% – 10.5%)^2 = 27.075%^{2}

∂^2 = 57.25%^{2}

∂ = $\sqrt{7.25\%^2}$

∂ = 7.57%

Can compare the s of 7.57 to another stock with expected return of 10.5%

Measuring Risk

Standard Deviation (s) for historical data can be used to measure the dispersion of historical returns.

$$\sigma = \sqrt{\frac{1}{(n-1)} \sum_{i=1}^{N} (k_i - \bar{k})^2}$$

Use the following data to calculate the historical return of XYZ

Year	*Return*
1992	*12%*
1993	*16%*
1994	*-8%*
1995	*6%*

Risk and Diversification

Risk of a company's stock can be separated into two parts:

1- Firm Specific Risk - Risk due to factors within the firm
2- Market related Risk - Risk due to overall market conditions

Diversification: If investors hold stock of many companies, the firm specific risk will be canceled out: Investors ***diversify*** portfolio.

Even if hold many stocks, cannot eliminate the market related risk

- If an investor holds enough stocks in portfolio (about 20) company specific (diversifiable) risk is virtually eliminated

Measuring Market Risk

Market risk is the risk of the overall market, so to measure need to compare individual stock returns to the overall market returns.

A proxy for the market is usually used: An index of stocks such as the S&P 500

Market risk measures how individual stock returns are affected by this market

Regress individual stock returns on Market index

Measuring Market Risk

Market Risk is measured by Beta

Interpreting Beta

Beta = 1

Market Beta = 1

Company with a beta of 1 has average risk

Beta < 1

Low Risk Company

Return on stock will be less affected by the market than average

Beta > 1

High Market Risk Company

Stock return will be more affected by the market than average

Required Rate of Return =Minimum rate of return necessary to attract investors to buy funds

- Required rate of return, K, depends on the risk-free rate(K_{rf}) and the risk premium(K_{rp})
- Using the capital asset pricing model (CAPM) the risk premium(K_{rp}) depends on market risk Security Market Line

$$K_j = K_{rf} + \beta_j (K_m - K_{rf})$$

where:

K_j = required rate of return on the j^{th} security

B_o = Beta for the j^{th} security

Example:

If the expected return on the market is 12% and the risk free rate is 5%:

$K_j = 5\% + b_j (12\% - 5\%)$

Portfolio Return = $S\ w_i\ x\ k_i$

Return of a portfolio is the weighted average return of individual securities in the portfolio.

Portfolio beta = $\Sigma w_i x b_i$

Beta of a portfolio is the weighted average beta of individual securities in the portfolio.

Part 3

Risk and Return:
Capital Asset Pricing Model

Overview

1. Portfolio Returns and Portfolio Risk

Calculate the expected rate of return and volatility for a portfolio of investments and describe how diversification affects the returns to a portfolio of investments.

1. Systematic Risk and the Market Portfolio

Understand the concept of systematic risk for an individual investment and calculate portfolio systematic risk (beta).

1. The CAPM

Estimate an investor's required rate of return using capital asset pricing model.

Portfolio Returns and Portfolio Risk

- By investing in many different stocks to form a portfolio, we can lower the risk without lowering the expected return.
- The effect of lowering risk via appropriate portfolio formulation is called ***diversification***.
- By learning how to compute the expected return and risk on a portfolio, we illustrate the effect of diversification.

The Expected Return of a Portfolio

- To calculate a portfolio's expected rate of return, we *weight* each individual investment's expected rate of return using the fraction of money invested in each investment.

❑ Example 8.1 : If you invest 25%of your money in the stock of Cite bank (C) with an expected rate of return of -32% and 75% of your money in the stock of Apple (AAPL) with an expected rate of return of 120%, what will be the expected rate of return on this portfolio?

➢ Expected rate of return = .25(-32%) + .75 (120%) = **82%**

Portfolio Expected Rate of Return

$$E(r_{portfolio}) = [W_1 \times E(r_1)] + [W_2 \times E(r_2)] + [W_3 \times E(r_3)] + \cdots + [W_n \times E(r_n)]$$

Calculating a Portfolio's Expected Rate of Return

Penny Simpson has her first full-time job and is considering how to invest her savings. Her dad suggested she invest no more than 25% of her savings in the stock of her employer, Emerson Electric (EMR), so she is considering investing the remaining 75% in a combination of a risk-free investment in U.S. Treasury bills, currently paying 4%, and Starbucks (SBUX) common stock. Penny's father has invested in the stock market for many years

and suggested that Penny might expect to earn 9% on the Emerson shares and 12% from the Starbucks shares. Penny decides to put 25% in Emerson, 25% in Starbucks, and the remaining 50% in Treasury bills. Given Penny's portfolio allocation, what rate of return should she expect to receive on her investment?

STEP 3: Solve

We can use Equation (8–1) to calculate the expected rate of return for the portfolio as follows:

$$E(r_{portfolio}) = W_{Treasury\ Bills}E(r_{Treasury\ Bills}) + W_{EMR}E(r_{EMR}) + W_{SBUX}E(r_{SBUX})$$
$$= (1/2 \times .04) + (1/4 \times .08) + (1/4 \times .12) = .07 \text{ or } 7\%$$

Alternatively, by filling out the table described above we get the same result.

	E(Return)	Weight	Product
Treasury bills	4.0%	0.50	2.0%
Emerson Electric (EMR)	8.0%	0.25	2.0%
Starbucks (SBUX)	12.0%	0.25	3.0%
		Portfolio E(Return) =	7.0%

Checkpoint 8.1: *Check Yourself*

Evaluate the expected return for Penny's portfolio where she places 1/4th of her money in Treasury bills, half in Starbucks stock, and the remainder in Emerson Electric stock.

- Answer: 9%.

Evaluating Portfolio Risk

- Unlike expected return, standard deviation is not generally equal to the a weighted average of the standard deviations of the returns of investments held in the portfolio. This is because of diversification effects.

- The diversification gains achieved by adding more investments will depend on the degree of correlation among the investments.
- The degree of correlation is measured by using the **correlation coefficient ( )**.

Correlation and diversification

- The correlation coefficient can range from -1.0 (perfect negative correlation), meaning two variables move in perfectly opposite directions to +1.0 (perfect positive correlation), which means the two assets move exactly together.
- A correlation coefficient of 0 means that there is no relationship between the returns earned by the two assets.
- As long as the investment returns are not perfectly positively correlated, there will be diversification benefits.
- However, the diversification benefits will be greater when the correlations are low or negative.
- The returns on most stocks tend to be positively correlated.

Standard Deviation of a Portfolio

- For simplicity, let's focus on a portfolio of 2 stocks:

$$\sigma_{portfolio} = \sqrt{W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2W_1W_2\rho_{1,2}\sigma_1\sigma_2}$$

Important Definitions and Concepts:

- $\sigma_{portfolio}$ = the standard deviation in portfolio returns,
- W_i = the proportion of the portfolio that is invested in asset i,
- σ_i = the standard deviation in the rate of return earned by asset i, and
- $\rho_{i,j}$ = the correlation coefficient between the rates of return earned by assets i and j. The symbol $\rho_{i,j}$ (pronounced "rho") represents the correlation coefficient between the rates of return for asset 1 and asset 2.

Diversification effect

- Investigate the equation:

$$\sigma_{portfolio} = \sqrt{W_1^2\sigma_1^2 + W_2^2\sigma_2^2 + 2W_1W_2\rho_{1,2}\sigma_1\sigma_2}$$

- When the correlation coefficient =1, the portfolio standard deviation becomes a simple weighted average:

- If the stocks are perfectly moving together, they are essentially the same stock. There is no diversification.
- For most two ***different*** stocks, correlation is less than perfect (<1). Hence, the portfolio standard deviation is less than the weighted average. – This is the effect of diversification.

Example

Determine the expected return and standard deviation of the following portfolio consisting of two stocks that have a correlation coefficient of .75.

Portfolio	Weight	Expected	Standard

		Return	Deviation
Apple	**.50**	**.14**	**.20**
Coca-Cola	**.50**	**.14**	**.20**

Answer:-

- Expected Return = .5 (.14) + .5 (.14)= **.14 or 14%**
- Standard deviation

$= \sqrt{\{(.5^2 x.2^2)+(.5^2 x.2^2)+(2x.5x.5x.75x.2x.2)\}}$

$= \sqrt{.035}$= **.187 or 18.7%**

  - Lower than the weighted average of 20%.

Checkpoint 8.2

Evaluating a Portfolio's Risk and Return

Sarah plans to invest half of her 401k savings in a mutual fund mimicking S&P 500 ad half in an international fun.

The expected return on the two funds is 12% and 14%, respectively. The standard deviations are 20% and 30%, respectively. The correlation between the two funds is 0.75.

What would be the expected return and standard deviation for Sarah's portfolio?

- Verify the answer: 13%, 23.5%
- Evaluate the expected return and standard deviation of the portfolio, if the correlation is .20 instead of 0.75.
- The expected return remains the same at 13%.

Answer

- The standard deviation declines from 23.5% to 19.62% as the correlations declines from 0.75 to 0.20.
- The weight average of the standard deviation of the two funds is 25%, which would be the standard deviation of the portfolio if the two funds are perfectly correlated.
- Given less than perfect correlation, investing in the two funds leads to a reduction in standard deviation, as a result of diversification.

Systematic Risk and Market Portfolio

- **It would be an onerous task to calculate the correlations when we have thousands of possible investments.**
- **Capital Asset Pricing Model or the CAPM provides a relatively simple measure of risk.**
- **CAPM assumes that investors choose to hold the optimally diversified portfolio that includes all risky investments. This optimally diversified portfolio that includes all of the economy's assets is referred to as the market portfolio.**
- **According to the CAPM, the relevant risk of an investment relates to how the investment contributes to the risk of this market portfolio.**

Risk classification

- ❑ To understand how an investment contributes to the risk of the portfolio, we categorize the risks of the individual investments into two categories:
    - ① Systematic risk, and
    - ② Unsystematic risk, or idiosyncratic risk
- ❑ The **systematic risk** component measures the contribution of the investment to the risk of the market. For example: War, hike in corporate tax rate.

The **unsystematic risk** is the element of risk that does not contribute to the risk of the market. This component is diversified away when the investment is combined with other investments.

Systematic versus Idiosyncratic Risk

- An investment's systematic risk is far more important than its unsystematic risk.
- If the risk of an investment comes mainly from unsystematic risk, the investment will tend to have a low correlation with the returns of most of the other stocks in the portfolio, and will make a minor contribution to the portfolio's overall risk.

Diversification and Systematic Risk

- Figure 8-2 illustrates that as the number of securities in a portfolio increases, the contribution of the unsystematic or diversifiable risk to the standard deviation of the portfolio declines.

- Systematic or non-diversifiable risk is not reduced even as we increase the number of stocks in the portfolio.
- Systematic sources of risk (such as inflation, war, interest rates) are common to most investments resulting in a perfect positive correlation and no diversification benefit.

Large portfolios will not be affected by unsystematic risk but will be influenced by systematic risk factors

Systematic Risk and Beta

- Systematic risk is measured by **beta coefficient,** which estimates the extent to which a particular investment's returns vary with the returns on the market portfolio.
- In practice, it is estimated as the slope of a straight line (see figure 8-3):

- Beta could be estimated using excel or financial calculator, or readily obtained from various sources on the internet (such as Yahoo Finance and Money Central.com)

Portfolio Beta

- The beta of a portfolio measures the systematic risk of the portfolio and is calculated by taking a simple weighted average of the betas for the individual investments contained in the portfolio.

Example 8.2 Consider a portfolio that is comprised of four investments with betas equal to 1.5, .75, 1.8 and .60. If you invest equal amount in each investment, what will be the beta for the portfolio?

- Portfolio beta= 1.5*(1/4)+.75*(1/4)+1.8*(1/4)+.6*(1/4) =**1.16**

8.3 The CAPM

- CAPM also describes how the betas relate to the expected rates of return that investors require on their investments.
- The key insight of CAPM is that investors will require a higher rate of return on investments with higher betas. The relation is given by the following linear equation:

$$E\left(r_{Asset\,j}\right) = r_f + \beta_{Asset\,j}\left[E(r_{market}) - r_f\right]$$

- R_{market} is the expected return on the market portfolio
- R_f is the risk free rate (return for zero-beta assets).

Example

Example 8.2 What will be the expected rate of return on AAPL stock with a beta of 1.49 if the risk-free rate of interest is 2% and if the **market risk premium**, which is the difference between expected return on the market portfolio and the risk-free rate of return is estimated to be 8%?

AAPL expected return = 2% + 1.49*8% = **13.92%.**

Checkpoint 8.3: *Check Yourself*

Estimate the expected rates of return for the three utility companies, found in Table 8-1, using the 4.5% risk-free rate and market risk premium of 6%. Use beta estimates from Yahoo:

AEP = 0.74, DUK = 0.40,CNP = 0.82.

Solution

- Beta (AEP) = 4.5% + 0.74(6%) = **8.94%**
- Beta (DUK) = 4.5% + 0.40(6%) = **6.9%**
- Beta (CNP) = 4.5% + 0.82(6%) = **9.42%**
- The higher the beta, higher is the expected return.