FINC2011 Formula Sheet

Interest Rates

Simple Interest

$$FV = PV[1 + (r \times n)]$$

where:

FV	=	the accumulated future value
PV	=	the initial amount invested or borrowed
r	=	the simple interest rate each period
n	=	the number of periods

- If applied to periods of 1 year or less, the interest rate is:

$$1 + (r \times \frac{dtm}{365})$$

Compound Interest

$$FV = PV(1 + r)^n$$

where:

FV	=	the accumulated amount in period *n*
PV	=	the initial amount invested or borrowed
r	=	the interest rate per period
n	=	the number of periods

- If compounding period is not a year, you can convert the rate to an effective annual rate and then n becomes how many years it lasts for.

Effective Interest Rates

$$\text{Effective Rate} = (1 + \frac{r_{\text{nom}}}{m})^{mn} - 1$$

where:

r_{nom}	=	the nominal rate
m	=	the number of compounding periods underlying the nominal rate
n	=	the period/s of the effective rate

- If effective ANNUAL rate, $n = 1$. If for example it's effective daily rate, $n = \frac{1}{365}$.
- Comparing interest rates can be done by converting all rates into effective annual rates.

Comparing Interest Rates

$$\text{Simple Interest Rate} = \frac{(1 + \text{Compound Interest Rate})^{mn} - 1}{n}$$

where:

compounding interest rate$_m$ = interest rate with compounding frequency *m*

m = the compounding interval

n = the number of years over which the amount is invested or borrowed

Continuous Compounding

$$FV = PVe^{rt}$$

where:

PV = the initial amount invested or borrowed

r = the continuously compounded rate of return

t = the time over which the cash flow is invested or borrowed

e = the base of natural logarithm, a constant equal to 2.718

Present and Future Value of Multiple Amounts

$$PV = \sum_{t=1}^{n} \frac{CF_t}{(1 + r)^t}$$

where:

PV = present value of multiple future cash flows

CF_t = cash flow received in period t

r = the compound interest rate

t = the number of periods before CF_t is received or paid

- Take each cash flow, and then discount by how far away they are.

$$FV = \sum_{t=1}^{n} CF_t(1 + r)^{n-t}$$

where:

FV = future value of multiple cash flows

CF_t = cash flow received in period t

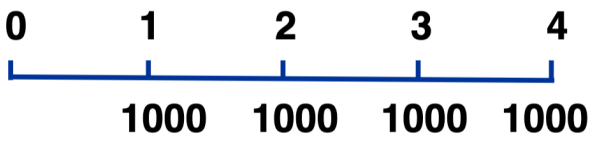
r = the compound interest rate

t = the number of periods before CF_t is received or paid

- Take each cash flow, and gross them up by how many periods are left.

Annuities

Ordinary Annuity



$$PV = A[\frac{1-(1+r)^{-n}}{r}]$$

where:

PV	=	the present value of the annuity
A	=	the cash flow received/paid under the annuity
n	=	the number of cash flows that form the annuity
r	=	the compound interest rate per period

$$FV = A[\frac{(1+r)^{n}-1}{r}]$$

where:

FV	=	the accumulated or future value of the annuity
A	=	the cash flow received/paid under the annuity
n	=	the number of cash flows that form the annuity
r	=	the compound interest rate per period

Note: **1) There is no cash flow at time 0**

2) There *is* a cash flow at time *n*

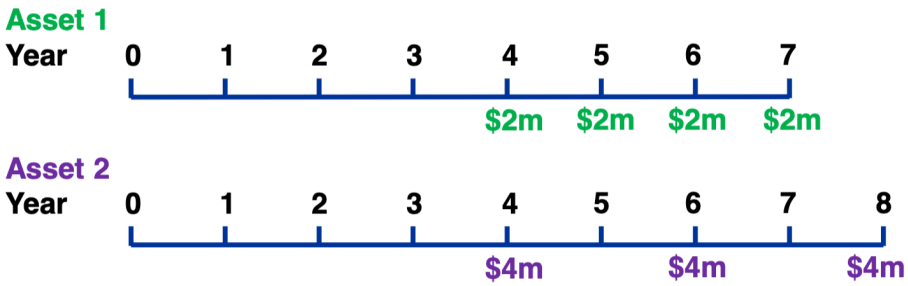
Annuity Due

- Payment made at the beginning of the month.
- Essentially, take the first payment as current value, and then use an ordinary annnuity on the $n-1$ payments that happen afterwards.

$$PV = A + A[\frac{1-(1+r)^{-(n-1)}}{r}]$$

- To calculate FV, calculate it as an ordinary annuity with $n-1$ payments, and then add on the first value as a future value.

Deferred Annuity



- **Asset 1** is an ordinary annuity that begins in three years (first cash flow is in four years), whilst **Asset 2** is an ordinary annuity that begins in two years.

$$PV = \frac{A \times 1 - (1+r)^{-n}}{r} / (1+r)^{x-1}$$

where:

x = the number of periods before the first cash flow occurs

Growing Annuity

- Grows at a constant rate until maturity.

$$PV = \frac{CF_1}{r-g} \times [1 - \frac{(1+g)^n}{(1+r)^n}]$$

where:

g = the constant growth rate over the life of the annuity

- Also note that $r > g$. Often in questions where CF is money going out (whilst growing at rate g, but PV investment is growing at rate r.

Equivalent Annuity

- Calculate the present value of the cash flow stream. Determine the A (cash flow) of the annuity with the same PV.

Sometimes to compare CF streams with different LIVES we need to convert them to an EQUIVALENT annuity to make a valid comparison!
To do so, we follow a two-step procedure to collapse the CF stream into a single series of constant CFs per period starting in exactly one period's time.

Step 1: Find PV of the CF stream

Machine A		**Machine B**	
n(annuity)	4	n(annuity)	7
A	-3	A	-4
r	0.1	r	0.1
PV(annuity)	-9.509596	PV(annuity)	-19.47368
PV(A)	**-19.5096**	**PV(B)**	**-25.47368**
	This equals PV(annuity) plus the initial CF!		

Step 2: Find constant cash flow annuity with the SAME PV (i.e., the equivalent annuity)
Here, we need to solve for A in the annuity equation!

Machine A		**Machine B**		
EA (A)	-6.154708	EA (B)	F9)	-5.232433

ANSWER: Machine B is preferred! Even though it technically has a LOWER PV (i.e., it is more "expensive" when incorporating ALL costs), is only $5.232m rather than $6.155m for Machine A! because the machine lasts longer and won't need to be replaced for 7 years, it's equivalent annual cost

Perpetuities

Constant Cash Flow

- What does the annuity tends towards when $n \to \infty$?

$$PV = \frac{CF}{r}$$

where:

PV	=	the present value of the perpetuity
CF	=	the cash flow received/paid under the perpetuity
r	=	the compound interest rate per period

Constant Growth

- What PV, growing at rate r, will generate enough interest to cover the growing cash flows, which grow at rate g?

$$PV = \frac{CF_1}{r - g}$$

where:

g	=	the constant growth rate

- Also that $r > g$,

Company Valuation

- Company valuation calculated with cash flows generated by company's real assets OR flow through to share and debholders of company as dividends and interest.

$$V = \sum_{t=1}^{\infty} \frac{CF_t}{(1+r)^t}$$

where:

CF_t = free cash flow (FCF) generated by the company in period t

r = required rate of return (an appropriate discount rate for the company)

- Second method is by calculating the present value of individual debt and equity securities that make up a company's capital structure (proportion of debt, equity, securities).

$$V = D + E$$

where:

V = the present value of cash flows generated by the company

D = the present value of cash flows generated by **debt** securities

E = the present value of cash flows generated by **equity** securities

- In this case, the market value of E = (number of shares) $\times$ (price of share).

	Debt	Equity
Cash flow	Coupon	Dividend
Return	Fixed	Variable
Maturity	Fixed (redeemed)	Indefinite
Redemption	Face value	-
Claim on income and assets	Priority	Residual
Management influence	Usually little	Varies
Tax consequences	Deductible	Non-deductible

Debt Valuation

$$D = C[\frac{1-(1+r_d)^{-n}}{r_d}] + \frac{F}{(1+r_d)^n}$$

where:

D = price or value of debt security

C = coupon payment made by the bond each period

F = face value of the bond

n = number of periods until the bond reaches maturity

r_d = required return on debt (yield to maturity)

- Two important notes:

- $C = F/c$ where c is the listed coupon rate.
- Commonwealth bond yields are componded semi-annually if it is not explicitly stated.

- As the maturity date approaches, the market value of the bond (D) approaches its face value,

	YTM drops to 9%	YTM = 12%	YTM rises to 15%
Par value	$1000	$1000	$1000
Coupon rate	12%	12%	12%
Maturity date	5 years	5 years	5 years
Bond value	$1116.69	$1000.00	$899.44

Bond trades at	Price and Face Value	YTM and Coupon Rate
Premium	Price > Face value	YTM < Coupon rate
Par	Price = Face value	YTM = Coupon rate
Discount	Price < Face value	YTM > Coupon rate

Equity Valuation

Valuation of Ordinary Shares

n-year Investment

$$E = \frac{\text{Div}_1}{1+r_e} + \frac{\text{Div}_2}{(1+r_e)^2} + \frac{\text{Div}_3}{(1+r_e)^3} + \ldots + \frac{\text{Div}_n + P_n}{(1+r_e)^n}$$

where:

E	=	price or value of equity security
Div_t	=	dividend paid in period t
r_e	=	required return on equity
n	=	number of time periods

Infinite Horizon Investor

- Thereotically the same as n-year, since P_n is derived by future dividends.

$$E = \sum_{t=1}^{\infty} \frac{\text{Div}_t}{(1+r_e)^t}$$

where:

E	=	price or value of equity security
Div_t	=	dividend paid in period t
r_e	=	required return on equity

Constant Dividend Model

$$E = \frac{\text{Div}}{r_e}$$

where:

E	=	price or value of equity security
Div	=	(constant) dividend per period
r_e	=	required return on equity

Constant Growth Model

- Dividends growth at a constant rate g.

$$E = \frac{\text{Div}_1}{r_e - g}$$

where:

E	=	price or value of equity security
Div_1	=	$\text{Div}_0(1+g)$ = dividend at end of the first period
r_e	=	required return on equity
g	=	constant growth rate (r_e must be > g)

- g can be estimated using:

$$g = (1 - \text{payout ratio}) \times \text{ROE}$$

where:

g	= expected rate of growth of future dividends
$1 – payout\ ratio$	= retention rate or plowback ratio
$payout\ ratio$	= dividend per share / earnings per share
ROE	= return on equity capital

- Earnings per share (used in the calculation of payout ratio) can be calculated using: EPS = total earnings/shares outstanding.

Two-Stage Growth Model

- Calculate the first stage manually, then use a constant growth model for the second stage into perpetuity (not forgetting to discount back by the number of periods in the first stage).

Valuation of Preference Shares

- Preference shares pay a fixed dividend yield.

$$PS = \frac{\text{Div}}{r_{ps}}$$

Individual Asset Risk and Return

Expected Risk and Return - Historical Time Series

- Calculating from past risk and return.

Realised Rate of Return

- Rate of Return = Cash Return/Beginning Price = (Capital Gain + Income Stream)/Beginning Price
- Rate of Return = Capital Gain Yield + Dividend Yield

$$R_{t+1} = \frac{(P_{t+1} - P_t) + \text{Div}_{t+1}}{P_t}$$

- Used to standardise realised returns for better comparisons.

$$R_{t+1} = \ln(\frac{P_{t+1} + \text{Div}_{t+1}}{P_t})$$

Expected/Mean Return

- Arithmetic average of actual returns over a specific period.

$$E(r) = \bar{r} = \frac{r_1 + r_2 + \ldots + r_n}{n} = \frac{1}{n}\sum_{t=1}^{n} r_t$$

Geometric Rate of Return

$$\text{Geometric average return} = \left[\left(1 + \text{Rate of return for year 1, } r_{year\,1}\right) \times \left(1 + \text{Rate of return for year 2, } r_{year\,2}\right) \times \cdots \times \left(1 + \text{Rate of return for year } n, r_{year\,n}\right)\right]^{1/n} - 1$$

Total Risk

- Extent to which payoffs on an asset are expected to vary from their average or expected value.
- Calculated using variance (in percentage squared) and standard deviation (in percentage).

$$\text{Variance} = \sigma^2 = \frac{\sum_{t=1}^{n}(r_t - \bar{r})^2}{n-1}$$

$$\text{Standard Deviation} = \sigma = \sqrt{\frac{\sum_{t=1}^{n}(r_t - \bar{r})^2}{n-1}}$$

Expected Risk and Return - Probability Distribution

- What the investor expects to earn from an investment in the future.
- Calculating from possible returns, and weights determined by the probability they occur.

Expected/Mean Return

$$E(r) = \bar{r} = (r_1 \times P_1) + (r_2 \times P_2) + \ldots + (r_n \times P_n) = \sum_{i=1}^{n}(r_i \times P_i)$$

Total Risk

$$\text{Variance} = \sigma^2 = \sum_{t=1}^{n}(r_t - \bar{r})^2 \times P_i$$

$$\text{Standard Deviation} = \sigma = \sqrt{\sum_{t=1}^{n}(r_t - \bar{r})^2 \times P_i}$$

Portfolio Risk and Return

- A portfolio is a group of assets held by an investor.

Expected Return of Portfolio

$$E(r_p) = \bar{r_p} = \sum_{i=1}^{n} w_i E(r_i)$$

- where:
  - $E(r)$ is the expected return on an individual security.
  - w is the proportion of the portfolio that the security makes up.

Risk of a Portfolio

- Variability or dispersion of the portfolio return around its mean or expected value. Not a simple weighted average of risk of individual security returns.

$$\sigma_p^2 = w_i^2\sigma_i^2 + w_j^2\sigma_j^2 + 2w_i w_j \sigma_{ij}$$

$$\sigma_p^2 = w_i^2\sigma_i^2 + w_j^2\sigma_j^2 + 2w_i w_j \rho_{ij}\sigma_i\sigma_j$$

where:

σ_i, σ_j = the standard deviation of returns on asset *i* or *j*

w_i, w_j = proportion of the portfolio invested in asset *i* or *j*

σ_{ij} = the covariance between assets *i* and *j*

ρ_{ij} = the correlation coefficient between assets *i* and *j*

Covariance

- Raw measure of the degree of association between two variables.

$$\sigma_{ij} = \frac{\sum_{t=1}^{n}(r_{i,t} - \bar{r}_i)(r_{j,t} - \bar{r}_j)}{n-1}$$

where:

$r_{i,t}$ = return on security *i* during interval *t*

$r_{j,t}$ = return on security *j* during interval *t*

$\bar{r}_i$ = the mean return on security *i*

$\bar{r}_j$ = the mean return on security *j*

n = the number of observations

- Positive/Negative covariance $\rightarrow$ Positively/Negatively correlated returns on two assets.

Correlation Coefficient

- Standardises covariance between -1 and 1. Gives a more interpretative measure of the strength of association, not just whether it is positive or negative.

$$\rho_{ij} = \frac{\sigma_{ij}}{\sigma_i \sigma_j}$$

where:

$r_{i,t}$ = return on security *i* during interval *t*

$r_{j,t}$ = return on security *j* during interval *t*

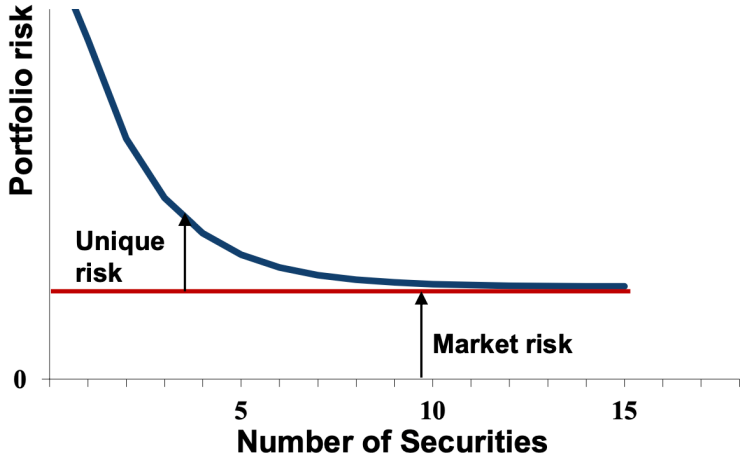
$\bar{r}_i$ = the mean return on security *i*

$\bar{r}_j$ = the mean return on security *j*

n = the number of observations

Measures of Risk

- Total risk can be separated into non-systematic and systematic risk.
    - Non-systematic risk relates to price movements that are caused by an event that influences a single company alone. Known as diversifiable risk because it can be diversified away.
    - Systematic risk relates to macroeconomic events that affect the price of all securities and are reflected in broad market movements. Known as non-diversifiable.



Beta

- The beta of a security measures the responsiveness of the security's return to the overall market return.

$$r_i = \alpha + \beta r_m$$

- where:

r_m = return on the market
r_i = return on stock *i*
α = the intercept coefficient (Y intercept)
β = the slope coefficient (slope of the line)

$$\beta_{i,m} = \frac{\sigma_{i,m}}{\sigma_m^2}$$

- Beta tells us the tendency of an individual's security's return to co-vary with the market portfolio.

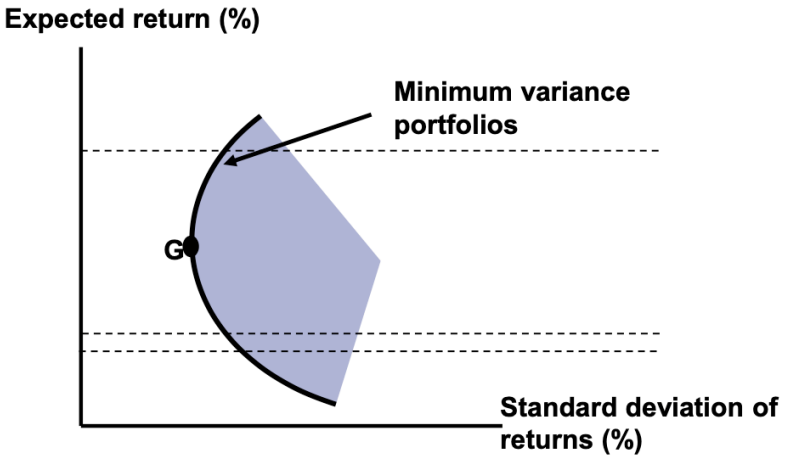
	Interpretation
$\beta = 1$	Share as risky as market
$\beta > 1$	Share more risky than market
$\beta < 1$	Share less risky than market

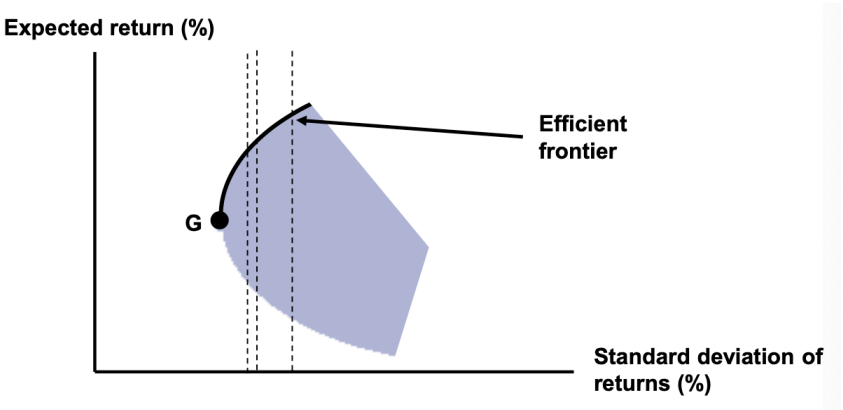
Portfolio Construction

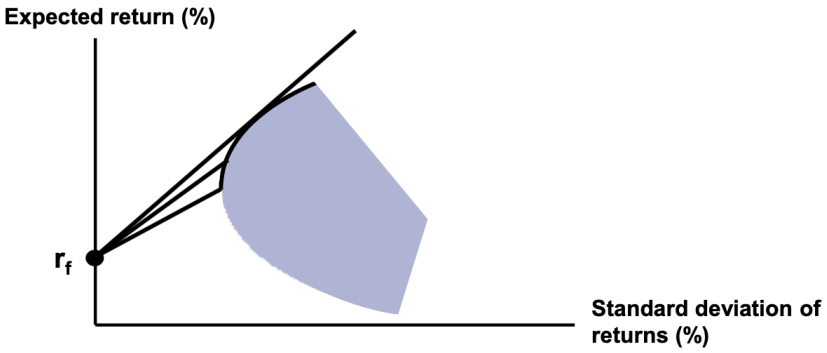
- Portfolio A is preferred or dominates Portfolio B if and only if:
  - $E[r_{p(A)}] \geq E[r_{p(B)}]$ and
  - $\sigma(r_{p(A)}) \leq \sigma(r_{p(B)})$
- i.e. Portfolio A is expected to return more with less risk. Note: at least one of the inequalities must be strict.
- The set of feasible portfolios (all risk return outcomes from combinations of stocks in all ways) is known as the **opportunity set** of risky portfolios.

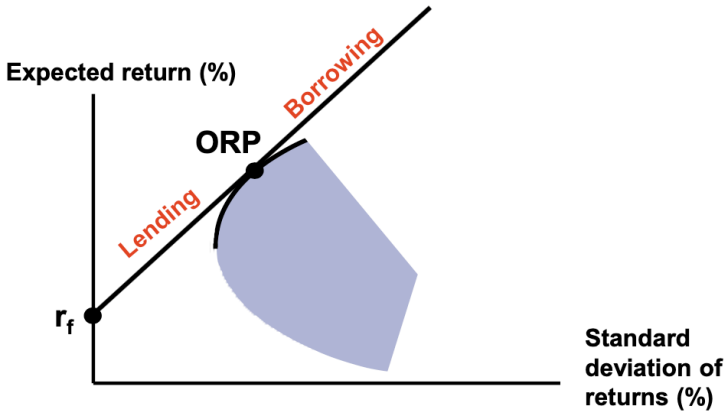
- The **minimum variance frontier** is the subset with the lowest risk at each level of expected return.
- The **efficient frontier** is the subset of the minimum variance frontier with the highest expected returns at each level of risk.
- Inclusion of a **risk-free asset** ($\sigma = 0$) expands the opportunity set.
- The portfolio with the highest **Sharpe ratio** (risk to reward ratio, gradient) is the portfolio where the line from the risk-free investment is tangential to the efficient frontier, known as the **optimal risky portfolio**.
- This creates the **capital market line (CML)**, known as the combination between the risk free asset and the **market portfolio**.

$$\text{Sharpe Ratio} = \frac{r_p - r_f}{\sigma_p}$$









Capital Asset Pricing Model (CAPM)

› The equation for the CML gives us an expression for the expected return of any efficient portfolio:

$$r_p = r_f + \frac{r_m - r_f}{\sigma_m}\sigma_p$$

where:

r_p, r_f, r_m = return on the portfolio, the risk-free asset and the market, respectively

σ_p, σ_m = standard deviation of the portfolio and the market, respectively

› This equation can be rearranged to give:

$$r_p = r_f + (r_m - r_f)\frac{\sigma_p}{\sigma_m}$$

› The expected ratio of the standard deviation of the portfolio to that of the market (σ_p/σ_m) is the beta (β) of the *portfolio*:

$$E(r_p) = r_f + E(r_m - r_f)\beta_p$$

› To describe how *individual securities* are priced:

$$E(r_i) = r_f + E(r_m - r_f)\beta_i$$

where:

r_f = risk-free rate of return

$E(r_p)$, $E(r_i)$ = expected return on the portfolio and security *i*, respectively

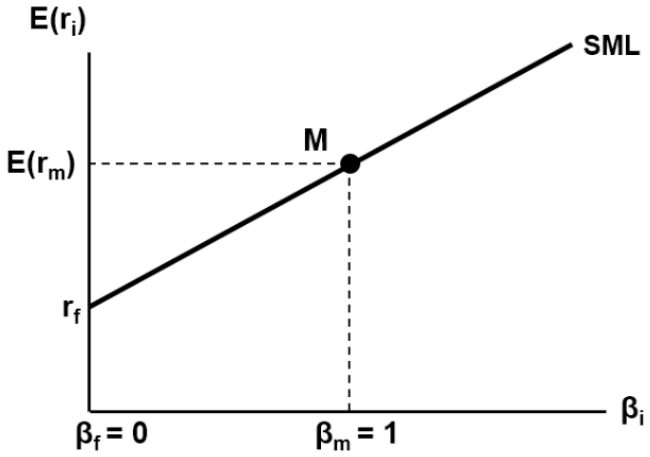
$E(r_m)$ = expected return on the market

β_p, β_i = beta of the portfolio and security *i*, respectively

- Derived from the straight line equation of the capital market line. The bottom equation represents the

security market line.

- It can be interpreted as the expected return equalling the risk-free rate plus a risk premium, which is the product of the quantity of risk, β, and the price of risk, $E(r_m - r_f)$.



Estimation of Beta

- The CAPM equation can be written more generally as: expected return of a security = excess over market line (implied to be 0) + beta multiplied by the expected return of market portfolio over risk free.

$$Y_t = a + bX_t$$

- Beta can then be calculated as:

$$\beta = \frac{(\text{covariance})(X_t, Y_t)}{\text{variance}(X_t)}$$

- To calculate covariance and variance, we need the excess returns on a security:

$$r_{i,t} = \frac{P_t - P_{t-1} + \text{Div}_t}{P_{t-1}}$$

- And the return on the market calculated using an index:

$$r_{m,t} = \frac{I_t - I_{t-1}}{I_{t-1}}$$

- Covariance:

$$\sigma_{i,m} = \frac{\sum\left[\left\{\left(r_{i,t} - r_{f,t}\right) - \left(\overline{r_{i,t} - r_{f,t}}\right)\right\} \times \left\{\left(r_{m,t} - r_{f,t}\right) - \left(\overline{r_{m,t} - r_{f,t}}\right)\right\}\right]}{n-1}$$

- Variance of excess returns on the market:

$$\sigma_m^2 = \frac{\sum\left[\left\{\left(r_{m,t} - r_{f,t}\right) - \left(\overline{r_{m,t} - r_{f,t}}\right)\right\}\right]^2}{n-1}$$

- Combining it all together:

$$\beta_{i,m} = \frac{\sigma_{i,m}}{\sigma_m^2}$$

Adjusted Beta for Leverage

- Since the debt of a company increases the cash flow risk of shareholders, it is necessary to separate financial risk of a levered company from its systematic risk.

$$\beta_l = \beta_u[1 + (1 - t_c)\phi]$$

where:

β_l	=	levered beta of a corporation
β_u	=	unlevered beta of a corporation
t_c	=	corporation tax rate
Φ	=	debt/equity ratio

Company Cost of Capital

- WACC is the average of the cost of acquiring funds from investors, and thus required returns for all investors - can be used to value an entire company, discount rate on investment projects.

$$\text{Given no tax: } WACC = (r_d \times \frac{D}{D+E}) + (r_e \times \frac{E}{D+E})$$

where:

r_d	=	cost of debt capital
r_e	=	cost of equity capital
D	=	market value of debt
E	=	market value of equity

- r_{ps} = Next Dividend/Trading Price
- Given $\text{Cost of Debt Capital (A/T)} = r_d(1 - t_c)$, where t_c is the corporate tax rate.

$$\text{With Taxes: } WACC = (1 - t_c)(r_d \times \frac{D}{D+E}) + (r_e \times \frac{E}{D+E})$$

Cost of Debt Capital

- r_d can be implied by the price of a bond formula, but corporate debt is not actively traded so these market values are not easily observed. Instead:
  - $r_d = r_f$
  - $r_d = r_f + \text{risk premium}$
  - $r_d = \text{net interest}/\text{average net debt}$

Cost of Equity Capital

- r_e can be implied from current stock prices i.e. whatever equity valuation model they used or CAPM where $r_e = E(r_i) = r_f + E(r_m - r_f)\beta_i$. This is an effective annual rate.
  - Total MV of Ordinary Shares = Number of shares $\times$ Current Trading Price
  - If franked, grossed-up dividend = $Div/1 - t_c$.

Tax and WACC

- Companies pay tax at corporate level.
- Instead of paying at marginal rate on dividends in Classical, dividends are paid with franking credits (representing amount of company tax already paid). Shareholders pay tax at marginal rates on sum of cash dividend and franking credits.

For an investor on the highest income tax rate (45%):

	Classical	Imputation
Corporate level		
Taxable income	$100	$100
Company tax (30%)	30	30
Net profit after tax	70	70
Shareholder level		
Cash dividend	$70	$70
Taxable income	70	100
Personal tax liability (45%)	31.50	45
Franking credit	-	30
Personal tax paid	31.50	15
After-tax income	38.50	55

For an investor on the lowest income tax rate (19%):

	Classical	Imputation
Corporate level		
Taxable income	$100	$100
Company tax (30%)	30	30
Net profit after tax	70	70
Shareholder level		
Cash dividend	$70	$70
Taxable income	70	100
Personal tax liability (19%)	13.30	19
Franking credit	-	30
Personal tax paid	13.30	-11 (cash refund)
After-tax income	56.70	70 (dividend) + 11 (refund)

Capital Budgeting Techniques

- Decisions as to which projects should be undertaken are made depending on whether they increase shareholder wealth - projects often need to be ranked as well.
    - Shareholders have opportunity cost, and firm investments must be made that are more attractive.
- Projects are independent if there is no impact on each other's cash flows. Accept/reject one, more or all.
    - Mutually exclusive if the acceptance of one project leads to the rejection of all other options.

Criteria for Assessing and Selecting Projects

- Increase value for the firm = increase shareholder wealth
- Be based on cash flows
- Allow for time value of money
- Adjust for differences in risk
- Correctly rank competing projects
- Easily understandable.

Net Present Value

- Difference between investment's market value and initial investment.

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} + CF_0$$

- If independent projects, accept if NPV > 0, reject if NPV < 0, indifferent if NPV = 0.
    - If you need to rank, choose with the highest NPV.
- Weakness: requires forecasts.

Makes a decision which maximises the wealth of shareholders.

Takes into account the time value of money.

Considers all cash flows and cost of project.

Adjusts for risk.

Requires forecasts.

Internal Rate of Return

- Discount rate that makes NPV equal 0 - implicit ROR generated by project taking into account time value of money.

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+irr)^t} + CF_0 = 0$$

- If conventional cash flows, NPV decrease as discount rate increases.
    - IRR > RROR, accept, IRR < RROR, reject.

Summarises project information into one number.

Takes into account the time value of money.

Considers all cash flows and cost of project.

- NPV and IRR have identical decisions UNLESS project NPV isnt a declining function of discount rate, you are ranking projects.

Pitfalls

1. If you earn money first and then lost it, you want low IRR instead of high.
2. Multiple IRRs possible if Discount vs NPV is a polynomial curve.
3. Higher IRR may have lower NPV for mutually exclusive project.
4. Ignore the magnitude or scale of project e.g. riskier project, higher IRR but largest safer project, higher NPV.

Profitability Index

- PV of an investment's future cash flows divided by initial costs. Accept if PI > 1, Reject if PI < 1.

$$PI = \frac{\sum_{t=1}^{n} PV}{CF_0}$$

Usually leads to same decision or ranking as NPV rule.

Takes into account the time value of money.

Considers all cash flows and cost of project.

Adjusts for risk.

When resources are limited, PI provides a tool for selecting amongst various project combinations and alternatives.

Difficult to calculate PI if projects have different useful lives or are mutually exclusive.

Payback Period

- Amount of time required to recover initial costs of a project. Discounted PBP takes into account time value of money.

$$\text{PBP} = \text{period before full recovery} + \text{unrecovered cost at start of period}/\text{CF during that period}$$

- Accept project with shortest PBP for mutually exclusive, lower than threshold for non-mutually exclusive.

Simplicity of calculation and interpretation of decision rule.

Ignores cash flows beyond the payback period.

No measurement of changes to shareholders' wealth.

Does not take into account the time value of money (unless using the discounted payback period method).

More on NPV

Revenues – Cash Expenses-Taxes OR EBDIT - Taxes

Free Cash Flow (FCF) = Operating Cash Flow

– Capital Expenditures

– Increase in Working Capital Requirements

Current year's working capital requirement MINUS (-) previous year's working capital requirement

› Cash expenses are accounting costs that result in cash outflows: e.g. Cost of Goods Sold (COGS), general and administrative expenses.

- Depreciation expense is NOT a cash expense

› *Taxes=Earnings Before Interest and Taxes (EBIT)* Taxation rate*

› **Exclude**: sunk costs, financing costs.

› **Include**: side effects and opportunity costs.

- Depends on free cash flows i.e. incremental effect of a project. Do not use accounting income - NPV requires recognition of cash flow when it actually occurs.

Note: Inflows have "+" and outflows have "-" signs

		0	1	2	3	4	5
1	Revenue						
2	(-) Cash/Operating Expenses						
3	(-) Depreciation						
4	Taxable Income						
5	(-) Income Tax Payable						
6	Operating Cash Flow (1-2-5)						
7	(-) Initial Outlay (CAPEX)						
8	(-) Any Maintenance Cost?						
9	Working Capital Requirements						
10	(-) Change in Working Capital						
11	Salvage Value						
12	(-) Tax on Salvage						
13	Any Opportunity Cost? (after tax)						
14	Any Side Effect? (after tax)						
	Net Cash Flow						
	R						
	NPV						

- EXCLUDE **sunk costs** (incurred regardless of project), **overhead costs** (incurred by firm, not attributed to a specific project), **financing costs** (financing comes after value assessment, included in discount rate)
- INCLUDE opportunity costs
- INCLUDE side effects (could be both positive and negative)
- INCLUDE CHANGES in net working capital, out at the start, in at the end usually.
- INCLUDE taxation on income tax payable, depreciation as a tax shield, salvage values/opportunity costs.
- Take care with inflation. Match nominal with nominal, real with real.

$$(1 + r_n) = (1 + r_r)(1 + \rho)$$

Equity Capital Markets

- Equity Capital Markets: markets that trade equity (stocks) instruments.
- Primary Market: markets in which corporations raise funds through new issue of shares.
  - IPO (Initial Public Offering): firms initially go public and list shares to be publicly traded.
  - SEO (Seasoned Equity Offering): new equity issued by an already publicly traded company.

- Secondary Market: markets that trades financial instruments once they are issued.

Trading Practices

- Price-Driven Trading System
  - Market maker quote the bid and ask price, guaranteeing the execution of order.
- Order-Driven Trading System
  - Display all buy and sell orders. Orders matched by market makers with no guarantee orders will be executed.
- Hybrid System

Process of Trading Shares

- Investor $\rightarrow$ Stockbroker. Sell Order placed. Stockbroker $\rightarrow$ Counterparty. Settlement = Ownership of Shares $\rightarrow$ Transfer of Cash.

Market Participants

- Buying and selling parties - individuals, institutions, fund managers (invests for clients, passive and active).
- Stockbroker - agency trading (on behalf of clients), principal trading (trade on broker's own account as conduit to market - for facilitation [opposite trade to complete transaction], house trading for own purposes).
- Securities exchange - provides facilities for trading and acts as self-regulatory body.

Limits vs Market

- Limit Order Book governed by price then time.
- If order involves a larger quantity than available at the best available price, order might be executed at multiple prices i.e. walking the book.
  - Market Impact Cost ($/%) = impact of walking the book, weighted average trade price - best available price/best available.

Features of Equity Markets

- Limited exchange trading hours because the demand is lesser and opening/closing prices are very important to market participants.
- Opening and Closing call auctions allow for market manipulation with titf bids/asks.
- Minimum tick sizes prevent annoying bids/asks that try to get to the top of their limit order book column without crossing the spread e.g. 0000001 above the max bid price.
- Dark pools are private exchanges.

Efficient Market Hypothesis

- An assets value is defined by the present value of expected future cash flows.
    - Market participants base their expectations on information.
    - Prices respond to changes in expectations which arise from NEW information.
- "In an efficient market, security prices fully reflect all available information".
    - Informational efficiency: degree of which depends on type of information reflection, and speed with which.
    - Since prices reflect all available info, it is difficult to make systematic trading profits used to beat the market. Supports passive investing i.e. well diversified market portfolio based on CAPM.
- Investors analyse and uncover information to value assets so that they can get higher return. Acting on this information makes profits, and causes security prices to reflect information uncovered (efficient).

Types of Information

- Past/public/private information can be systematic or firm-specific.
    - Historical trading data, past prices, volumes.
    - Publicly available information e.g. financial statements, announcements, new.
    - Private information e.g. inside information known to management (research data, takeover bid, unexpected earnings); private assessment of public information e.g. analyst reports
- If market prices reflect only information of a particular type, we can profit from trading on information not yet reflected in prices $\rightarrow$ market efficient means assessing intrinsic/true value vs market price.

Forms of Market Efficiency

Weak Form Efficiency

- Prices reflect all information contained in the record of past prices and volumes. Tomorrow's prices independent of today's prices.
- TA: not profitable. Filter rule used in TA as a trading rule.

Semi-Strong Form Efficiency

- Prices full reflect all public available information, and immediately react to release of any new information.
- FA: not profitable. If semi-strong form efficiency is violated, we can trade and make profits using FA.

Strong Form Efficiency

- All available information is fully reflected in current prices, including private information.
- Market reaction not driven directly by private information, but instead by related buying.

Tests of Market Efficiency

- Are trading rules using past prices profitable? No if WFE.
- Do prices react rapidly to information around particular events? Yes if SSFE.
- Is it possible for investors to profit from private information? No if SFE.
- Can active fund managers outperform their benchmarks? No if SFE.

Evidence Against EMH

- Market anomolies: allow prediction of future returns using known patterns.

Other anomalies uncovered in markets include:

- 'Day-of-the-week' effect: returns on Mondays are often lower than other days of the same week.
- 'January' effect: higher stock prices in January than other months of the year
- Size effect: Buy small stocks and sell large stocks
- Book-to-market effect: buy stocks with small B/M ratio and sell stocks with large B/M ratio
- Momentum effect: buy 'winner' stocks and sell 'loser' stocks of the previous period can generate trading profit

Are these real anomalies or the results from data mining or additional risk factors?

- Behavioural finance: investors do not always process information correctly or may make inconsistent/sub-optimal decisions. Prices differ from fundamental values.
  - Investors perceive investment risk as loss probability instead of standard deviation of returns.
  - Overconfidence bias: do well, always do well.
- Gamestop:
  - Herding instinct: investors follow or copy what others are doing - FOMO.
  - Small investors influenced by emotion, social media pressure, instinct instead of independent analysis.

Efficient Market Concepts	Behavioral Finance Concepts
Markets and investors are perfectly rational	Markets and investors are normal, not rational
Investors always seek to maximize their utility	Investors are risk-averse, i.e. they value a $1 loss more than a $1 gain
Investors have perfect self-control	Investors have limits to their self-control due to individual biases
Investors are never confused in their decision-making by cognitive errors	Investors often experience cognitive errors which may contribute to wrong decisions

Business Ethics

- Ethics: How are we to relate to each other in order to ensure that our individual and collective well-being is enhanced? This is to say, what do we see as good/right behaviour?

Three Main Principles

- **Compliance**: in accordance with the rules/law, principles of morality, customs and expectations of community, company policies, general concerns e.g. fairnes, professional code.
- **Contributions**: through value and quality of business products/services, providing employment, prosperity and usefulness of business activities to the community.
- **Consequences**: affecting internal and external to the company, intended and unintended, including to the reputation of the company and industry.

HELP TO:

- Increase confidence/trust in the global financial markets, both within financial industry and publicly.
- Clients reassured that investment professionals have their best interests in mind.
- Professionals benefit from more efficient and transparent operation of the financial market.

Short Selling

- Borrow the security, sell it for cash, wait in hope to buy back at a lower price e.g. shorting mortgage backed securities.

Arguments for short selling: positive consequences

- Trading using active analysis of stocks is to identify misplacing: selling overprice as legitimate as buying underpriced.
    - Corrects inflated prices or bubbles.
- Discipline: underperforming companies are penalised for declining stock prices e.g. accounting issues.
- Hedging: allow investors to hedge against long positions.

Arguments against short selling: negative consequences

- May induce panic selling during market crashes.
- Excessive short selling may overcorrect inflated prices.
- May impose excessive price pressures on company managers and cause short-termism in decision making i.e. short term recovery instead of valuable long-term investment..

Whistle-blowing

- Voluntary release of non-public information as a moral protest, by a member or former member of an organisation to an appropriate audience outside of the normal channels of communication regarding illegal/immoral conduct that is opposed to public interest.

Compliance?

› No for their employers: Employee – legal & contractual agent of employer
  - Duty of loyalty is breached: protect confidential information & act in principal's best interest.
› Yes for laws/accounting rules: whistle-blowers think their companies should follow regulations and not be engaged with illegal activities

Contribution?

› Yes for quality of works: whistle-blowers expressed concerns about the quality about their company's financial reports as employees

Consequences?

› Internal: damage to Enron shareholders after they revealed the scandal
› External: regulators and the market can subsequently correct wrongdoings after they learned about accounting frauds

Conflicts of Interest

Sell Recommendations

- For sell-side financial analysts e.g. brokerage firms, there are often very FEW sell recommendations.
  - Buy-side clients: may have significant holdings of securities under review and would be adversely affected by downgrades.
  - Investment banking relationships: sell-side firms may encourage favourable research on current/potential clients of IB division.
  - Public companies: targets of unfavourable reports may deny analysts access to managers and conference calls.
  - Issuer paid research: analysts are often hired by companies to issue recommendations.

Ethical Walls

- Investment banks face significant conflicts of interest when they operate both investment banking and brokerage services.
  - Staff within IB may have private information about sensitive negoitations, takeovers etc. This is valuable for brokerage division clients.
  - Strict separation of divisions must be ensured.

Appendix

WACC and Tax

Tax and the WACC – Classical

› The WACC needs to be adjusted to reflect differences in tax systems:

1. The **classical** tax system
   a. CF are discounted **before** tax:

$$WACC = (r_d \times w_d) + \left[\left(\frac{r_e}{1 - t_c}\right) \times w_e\right]$$

   b. CF are discounted **after** tax:

$$WACC\ (A/T) = [(1 - t_c)(r_d \times w_d)] + (r_e \times w_e)$$

Tax and the WACC – Imputation

› The WACC needs to be adjusted to reflect differences in tax systems:

2. The **imputation** tax system
   a. CF are discounted **before** tax:

$$WACC = (r_d \times w_d) + \left[\left(\frac{r_e}{1 - t_c(1 - \gamma)}\right) \times w_e\right]$$

   b. CF are discounted **after** tax:

$$WACC\ (A/T) = [(1 - T)(r_d \times w_d)] + \left[\left(\frac{r_e(1 - T)}{1 - T(1 - \gamma)}\right) \times w_e\right]$$

where:

γ = proportion of franking credits utilised by shareholder

T = effective corporate tax rate

Code of Ethics

› Members of CFA Institute, including CFA charterholders and candidates, must:

- Act with integrity, competence, diligence, respect, and in an ethical manner with the public, clients, prospective clients, employers, employees, colleagues in the investment profession, and other participants in the global capital markets.
- Place the integrity of the investment profession and the interests of clients above their own personal interests.
- Use reasonable care and exercise independent professional judgment when conducting investment analysis, making investment recommendations, taking investment actions, and engaging in other professional activities.
- Practice and encourage others to practice in a professional and ethical manner that will reflect credit on themselves and the profession.
- Promote the integrity of and uphold the rules governing capital markets.
- Maintain and improve their professional competence and strive to maintain and improve the competence of other investment professionals.

CFA Institute

Professional ethics – CPA Code of Ethics

› The fundamental ethics principles of professional accountants qualified by CPA Australia are:

- Integrity – to be straightforward and honest in all professional and business relationships.
- Objectivity – to not allow bias, conflict of interest or undue influence of others to override professional or business judgements.
- Professional competence and due care – to maintain professional knowledge and skill at the level required to ensure that a client or employer receives competent professional services based on current developments in practice, legislation and techniques and act diligently and in accordance with applicable technical and professional standards.
- Confidentiality – to respect the confidentiality of information acquired as a result of professional and business relationships and, therefore, not disclose any such information to third parties without proper and specific authority, unless there is a legal or professional right or duty to disclose, nor use the information for the personal advantage of the Member or third parties.
- Professional behaviour – to comply with relevant laws and regulations and avoid any action that discredits the profession.