INV2601 DISCUSSION CLASS SEMESTER 1

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Examination

- Duration – 2 hours
- 40 multiple choice questions.
- Total marks = **40**
- Tested on study units 1 – 15 (Topic 5 study unit 16, excluded)
- Not provided: interest factor tables and formula sheet
- Examination includes both theory and calculations
- Mark composition:

	Questions	Percentage
Theory	14	35%
Calculations	26	65%
Total	**40**	**100%**

Examination

- The following questions will be tested from each topic:

		Questions
Topic 1	The Investment Background	14
Topic 2	Equity Analysis	4
Topic 3	The Analysis of Bonds	8
Topic 4	Portfolio Management	14
Total		**40**

TOPIC 1

THE INVESTMENT BACKGROUND

CHAPTER 1: INTRODUCTION

- An investment is:
  - a current commitment of money, based on fundamental research
  - to real and/or financial assets for a given period
  - in order to accumulate wealth over the long term
- Goal of investment management
  - Find investment returns that satisfy the investor's required rate of return
- Required rate of return – is the return that should compensate the investor for:
  - Time value of money during the period of investment
  - The expected rate of inflation during the period of investment
  - The risk involved

Required Rate of Return

- To determine the required rate of return:
  - The investor has to determine the nominal risk free rate of return
  - Then add risk premium to compensate for the risk associated with the investment
- NRFR =[(1 + RRFR)(1 + EI)]

  Where: RRFR = real rate of return (in decimal form)

  EI = expected inflation (in decimal form)
- $$RRFR = \left[\frac{(1 + NRFR)}{(1 + EI)}\right] - 1$$

Fundamental Principles of Investment

- Time value of money – an amount of money can increase in value because of the interest earned from an investment over time.
- Risk vs Return
- Risk is the uncertainty about whether an investment will earn its expected rate of return.
  - Measure of risk of a single asset:
    1. standard deviation(σ)
    2. coefficient of variation (CV)
- Return is the sum of the cash dividends, interest and any capital appreciation or loss resulting from the investment.
  - Historical return can be calculated using HPR and HPY
- The risk and return principle:
  - The greater the risk, the higher the investor's required rate of return

Example - HPR and HPY

- The beginning value of an investment is R1400. After 8 years the ending value is R1 900. Calculate the holding period yield (HPY) of the investment.

$$HPR = \frac{\text{Ending value of investment}}{\text{Beginning value of investment}}$$

$$= \frac{1\,900}{1\,400}$$

$$= 1.3571$$

$$\text{Annual HPR} = 1.3571^{1/8} = 1.3571^{0.125}$$

$$= 1.0389$$

$$\text{Annual HPY} = 1.0389 - 1 = 0.0389 \times 100$$

$$= 3.89\%$$

Example - HPR, HPY and Real Rate of Return

- On March 1, you bought 100 shares at R20 and a year later sold them for R28 a share. During the year, you received dividend of R2 per share. Assuming the rate of inflation is 6%. Calculate the real rate of return on this investment.
- $$HPR = \frac{\text{Ending value of investment(including cash flows)}}{\text{Beginning value of investment}}$$

  $$= \frac{28 + 2}{20} = 1.50$$
- $HPY = (HPR - 1) \times 100$

  $= (1.50 - 1) \times 100 = 50\%$

$$\text{Real rate of return} = \frac{HPR}{(1 + \text{rate of inflation})}$$

$$= \frac{1.50}{1.06} - 1 \times 100$$

$$= 41.51\%$$

Example – Coefficient of Variation

Calculate the Coefficient of Variation (CV) of Green Ltd given the following information.

Possible outcomes	Probability(%)	Return(%)
Pessimistic	20	5
Most Likely	30	8
Optimistic	50	10

CV= δ/ E(r)

E(r)= 0.2×5 + 0.3×8 + 0.5×10 = 8.40%

$\delta = \sqrt{0.2(5-8.4)^2 + 0.3(8-8.4)^2 + 0.5(10-8.4)^2}$

$= \sqrt{3.64}$

δ= 1.91%

CV= 1.91/3.64 = 0.2274

CHAPTER 2: CHARACTERISTICS OF A WELL FUNCTIONING MARKET

- Availability of information
- Liquidity and price continuity
- Transaction costs
- Informational efficiency
  - A large number of competing, profit-maximising, independent participants analyze and value securities
  - New information arrives randomly
  - Competing investors attempt to adjust prices rapidly to reflect new information

Primary and Secondary Markets

- Primary markets – sells newly issued securities of companies(‘new issues’) and is also involved in initial public offerings(IPOs).
- Secondary market – supports the primary market by:
  - i) giving investors liquidity, price continuity and depth
  - ii)providing information about current prices and yields
- Third market - Over the counter trading of listed shares (OTC) by a broker. This market may be used by investors to trade shares that are either suspended on the exchange or while the exchange is closed.
- Fourth market – direct trading of securities between two parties with no intermediary.

Type of Transactions

- Market orders – orders to buy or sell securities at the best prevailing price. ‘sell at best’ or ‘buy at best’. Provide liquidity
- Limit orders - specify the buy or sell price
- Short sales - the sale of shares the investor does not own with the intention of buying them back at a lower price at a later stage.
  - He would have to borrow them from another investor, sell them in the market and subsequently replace them at (hopefully) a price lower than the price at which he sold them.
  - The investor who lends the shares receives the proceeds as collateral and can invest this in short-term, risk-free securities.
- Stop loss – conditional market order that directs the trade should the share price decline to a predetermined level
- Stop buy order – used by short seller who want to minimise any loss if the share increases in value

CHAPTER 3: INTRODUCTION

- Investment theory – explains the way in which investors specify and measure risk and return in the valuation process
- The efficient market theory is an important component of the investment theory
- Investors are faced with systematic and unsystematic risk
- Two important theories about risk and return
  - Capital asset pricing model (CAPM)
  - Arbitrage pricing model (APT)

Efficient Market Theory

- An efficient market – is one in which:
  - Prices of securities adjust rapidly to the arrival of new information. Current prices of securities reflect all information about a security.
  - Investments with higher expected returns have higher expected risk
- Forms of the efficient market hypothesis
  - Weak form – current security prices reflect all security market information
  - Semi-strong form – security prices adjust rapidly to all public information
  - Strong form – security prices fully reflect all information (public and private sources)

Investment Theory

- THE SECURITY MARKET LINE (SML)
  - Reflects the best combination of risk and return on alternative investments
  - A portfolio consists of a risk-free asset and combinations of alternative risky assets can be constructed
  - δ_P = linear proportion of the standard deviation of the risky asset portfolio.
  - SML risk is measured by means of beta (systematic risk)

Markowitz Efficient Frontier

- Represent that set of portfolios that have the **maximum return** for every given level of risk or the **minimum risk** for every level of return. Also known as efficient portfolios.
  - Contains only portfolios
  - Individual assets cannot have their risk reduced by diversification.
  - No portfolio dominates any other portfolio
  - Adding a risk free asset leads to creation of the capital market line(CML)
    - It is a risk-return for efficient portfolios
    - NB: CML risk is measured by means of the standard deviation (total risk)
    - Total risk = systematic risk + unsystematic risk

Standard deviation of the portfolio

An investor wishes to construct a portfolio consisting of a 30% allocation to a share index and a 70% allocation to a risk free asset. The return on the risk-free asset is 4.5% and the expected return on the share index is 12%. The standard deviation of returns on the share index is 6%. Calculate the expected standard deviation of the portfolio.

There are two versions of the formula, portfolio standard deviation (δ_P):

1. Portfolio standard deviation (δ_P)

$$= \sqrt{[w_{SI}{}^2 \times \delta_{SI}{}^2] + [w_{RFA}{}^2 \times \delta_{RFA}{}^2] + [2 \times w_{SI} \times w_{RFA} \times COV_{SI,RFA}]}$$

or

2. Portfolio standard deviation (δ_P)

$$= \sqrt{[w_{SI}{}^2 \times \delta_{SI}{}^2] + [w_{RFA}{}^2 \times \delta_{RFA}{}^2] + [2 \times w_{SI} \times w_{RFA} \times r_{SI,RFA} \times \delta_{SI} \times \delta_{RFA}]}$$

NB: $COV_{SI,RFA} = r_{SI,RFA} \times \delta_{SI} \times \delta_{RFA}$

A risk free asset has no risk therefore its standard deviation [δ_{RFA}] is 0. If you insert 0 to replace δ_{RFA} in the above formula, the only remaining part of the formula will be $= \sqrt{[w_{SI}{}^2 \times \delta_{SI}{}^2]}$. This is because the other two parts of the formula will be cancelled off to 0.

Portfolio standard deviation (δ_P) $= \sqrt{[w_{SI}{}^2 \times \delta_{SI}{}^2]}$

$\delta_P = \sqrt{[0.3^2 \times 6^2]}$

$= \sqrt{[0.09 \times 36]}$

$= \sqrt{3.24}$

$= 1.80\%$

[Refer to Marx (2010:36,274)]
[Refer to Study guide (2007:18)]

Asset Pricing Models

- Two most common theories are CAPM and APT
  - If you can measure risk, you should be able to determine the required rate of return
  - Investors are risk averse; thus for any increase in risk they require an increase in the required rate of return
- CAPM – the return an investor should require from a risky asset assuming that he is exposed only to the asset's systematic risk as measured by beta.
  - Rationale – for any level of risk, the SML indicates the return that should be earned by using the market portfolio and the risk-free asset

Example - CAPM

- The required rate of return for a company is 14.6%. The risk free rate of return is 11% per annum, and the estimated return of the market is 15%. The beta of this company is:
- Required return= $r_f + \beta(r_m - r_f)$

$$14.6 = 11 + \beta(15 - 11)$$

$$= \frac{14.6 - 11}{4}$$

$$\beta = 0.90$$

Example – beta coefficient

- The beta coefficient of unit trusts A and B respectively, is:

Unit trust	Average rate of return (%)	Variance (%)	Correlation coefficient with the market index
A	27	6.00	0.85
B	15	2.00	0.55
Market Index	25	4.00	-

- $$\beta = \frac{\text{corr} \times \delta\,\text{asset} \times \delta\ \text{market}}{\text{variance of the market}}$$

$$\beta\,(A) = \frac{0.85 \times \sqrt{6} \times \sqrt{4}}{4} = 1.04$$

$$\beta\,(B) = \frac{0.55 \times \sqrt{2} \times \sqrt{4}}{4} = 0.39$$

Example – beta of a portfolio

- Portfolio (V) consists of the following assets:

PORTFOLIO V			
Asset	Proportion	Beta	Standard deviation
1	0.1	1.65	0.2
2	0.3	1	0.18
3	0.2	1.3	0.12
4	0.2	1.1	0.15
5	0.2	1.25	0.1
Total	1.0		

Calculate the beta of the portfolio.

$\beta = (0.1 \times 1.65) + (0.3 \times 1) + (0.2 \times 1.3) + (0.2 \times 1.1) + (0.2 \times 1.25)$

$= 0.165 + 0.3 + 0.26 + 0.22 + 0.25$

$= 1.195$

Using CAPM to assess an asset

- An investment in an asset can be assessed by means of CAPM to determine whether an asset is over or undervalued
- Estimated rate of return – is the actual holding period rate of return that the investor anticipates
  - Estimated rate of return > required rate of return
    - The share is undervalued
  - Estimated rate of return < required rate of return
    - The share is overvalued
- Highly efficient market – all assets should plot on the SML
- Less efficient market – assets may at times be mispriced due to investors being unaware of all the relevant information

Example – Using CAPM to assess an asset

- The estimated rate of return of Company C is 22.60%. The beta is 1.6 and the standard deviation is 13%. The expected rate of return of the market is 19%. The risk free rate of return is 11%, Company C is:

Estimated rate of return = 22.60%

Required return (k) $= rf + \beta\ (rm - rf)$
$= 11\% + 1.6(19 – 11)$
$= 11\% + 12.80\%$
$= 23.80\ \%$

Estimated rate of return < Required rate of return
22.60% < 23.80%

Therefore, the share is overvalued
22.60% - 23.80% = -1.20%

The share is overvalued by 1.20%

CHAPTER 4: TIME VALUE OF MONEY

- The equal annual beginning of year deposits required to accumulate R20 000 at the end of six years given an interest rate of 5%, are:

HP 10BII	
Input	Function
Begin mode	BEG/END
20 000	FV
6	N
5	I/YR
	PMT
	R2 800.33

CHAPTER 4: TIME VALUE OF MONEY

- Gareth will receive an annuity of R4 000 a year for ten years. The first payment is to be received five years from today. At a 9% discount rate, the value of the annuity today is:

HP 10BII	
INPUT	FUNCTION
BEG	BEG/END
4 000	PMT
10	N
9	I/YR
	PV
	R27 980.99

HP 10BII	
INPUT	FUNCTION
END	BEG/END
-R27 980.99	FV
5	N
9	I/YR
	PV
	R18 186

CHAPTER 4: TIME VALUE OF MONEY

- Yellow Ltd has a required rate of return of 5%. They invest R40 000 with Red Capital and can earn the following annual cash flows over the next 5 years.

Years	Cash inflow
1	R 8 000
2	R12 000
3	R14 000
4	R16 000
5	R18 000

- Calculate the **NPV** of the investment and determine the **investment decision** that should be taken as a result.

CHAPTER 4: TIME VALUE OF MONEY

HP 10B11	
INPUT	FUNCTION
-R40 000	CF 0
R8 000	CF 1
R12 000	CF 2
R14 000	CF 3
R16 000	CF 4
R18 000	CF 5
5%	I/YR
	NPV
	R17 863.84
The investment is acceptable as it is greater than R0	

CHAPTER 5: VALUATION PRINCIPLES AND PRACTICES

- Valuation – process of finding the intrinsic value of an asset.
  - Also called fair value or estimated value of an asset
  - It plays an important role in investment decision making
  - Buy : intrinsic value > market value
    - Earning positive returns
  - Don't buy : intrinsic value < market value
- Valuation concepts
  - Par value, market value, book value and intrinsic value
- Required inputs
  - Cash flows, timing and discount rate

Value of a preference share

- A company issued 8.5% preference shares at R80 each. Determine the intrinsic value of a preference share assuming a 6.5% required rate of return.

$$Vp = \frac{Dp}{Kp}$$

$$Dp = 0.085 \times R80$$

$$= R6.80$$

$$Vp = \frac{6.80}{0.065}$$

$$= R104.62$$

Constant growth model

- Assume Tabe Ltd is expected to pay a dividend of R3,20 next year. The growth rate of the firm is 17,2% and the investor's required rate of return is 20%. What would the value of the share be?

  Value of the share = $\dfrac{D1}{k - g}$

  $$= \frac{3.20}{0.20 - 0.172}$$

  $$= R114.28$$

Two-stage dividend model

- An investor in Fun Ltd's ordinary share expects it to pay annual cash dividends of R2,00 and R2,30 per share during the next two years. This investor plans to sell the share for R33 at the end of the second year, after collecting the two dividends. Fun Ltd's required rate of return is 10%. Calculate the present value of this share.

D1= R2.00

D2= R2.30

D3= R33

Required rate of return (k) = 10%

$$\text{Value of the share} = \frac{D1}{(1+k)^1} + \frac{D2}{(1+k)^2} + \frac{P2}{(1+k)^2}$$

$$= \frac{2.00}{(1.10)^1} + \frac{2.30}{(1.10)^2} + \frac{33}{(1.10)^2}$$

= 1.8182 + 1.9008 + 27.2727

= R30.99

Three stage dividend model

- Micro Corporation just paid dividends of R2 per share. Assume that over the next three years dividends will grow as follows; 5% next year, 15% in year two and 25% in year 3. After that growth is expected to level off to a constant growth rate of 10% per year. The required rate of return is 15%. Calculate the intrinsic value using the multistage model.

$D_0 = 2.00$

$D_1 = 2.00(1.05) = 2.10$

$D_2 = 2.00(1.05)\ (1.15) = 2.415$

$D_3 = 2.00(1.05)\ (1.15)\ (1.25) = 3.0188$

$D_4 = 2.00(1.05)\ (1.15)\ (1.25)\ (1.10) = 3.3206$

Required rate of return = k = 15%

Growth rate = g = 10%

Three stage dividend model

Value of the share:

$$= \frac{D1}{(1+k)^{1}} + \frac{D2}{(1+k)^{2}} + \frac{D3}{(1+k)^{3}} + \frac{\frac{D4}{(k-g)}}{(1+k)^{3}}$$

$$= \frac{2.10}{(1.15)^{1}} + \frac{2.415}{1.15)^{2}} + \frac{3.0188}{(1.15)^{3}} + \frac{\frac{3.3206}{(0.15-0.10)}}{(1.15)^{3}}$$

$$= \frac{2.10}{1.15} + \frac{2.415}{1.3225} + \frac{3.0188}{1.5209} + \frac{66.4120}{1.5209}$$

$$= 1.8261 + 1.8261 + 1.9849 + 43.6663$$

$$= R49.30$$

No growth model

- A company has a beta of 1.3, while the market return equals 18% and the risk-free rate of return equals 12%. The company is expected to pay a dividend of R10.89 next year, with no further growth anticipated. Determine the value of the firm's ordinary shares.

$$V = \frac{E}{k}$$

Where E = perpetual stream of earnings

Required return (k) = rf + β (rm - rf)

= 12 + 1.3 (18 – 12)

= 12 + 7.80

= 19.80%

$$V = \frac{10.89}{0.198}$$

= R55

CHAPTER 6: FUNDAMENTAL ANALYSIS

Analysis of macroeconomic factors

Asset allocation based on economic prospects

Industry analysis

Which industries will gain from economic prospects?

Company Valuation

Companies that will benefit most from the economic prospects

Which ones are undervalued?

Tools used to effect monetary policy

Tool	Expansionary monetary policy	Restrictive monetary policy
Reserve requirements	Reduce reserve requirements	Raise reserve requirements
Open market operations	Purchase addition government securities, which releases funds into the economy and expands the money supply	Sell previously bought government securities, which will reduce the money supply
Repo rate	Lower the repo rate, which will encourage more borrowing from the central bank	Increase the repo rate, which will discourage borrowing from the central bank

TOPIC 2

EQUITY ANALYSIS

CHAPTER 8: COMPANY ANALYSIS

- Ratio analysis
  - Liquidity ratios
  - Financial leverage ratios
  - Asset management ratios
  - Profitability ratios
  - Market value ratios

Liquidity ratios

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}}$$

$$\text{Quick ratio} = \frac{\text{Current assets} - \text{inventory}}{\text{Current liabilities}}$$

$$\text{Cash ratio} = \frac{\text{Cash} + \text{marketable securities}}{\text{Current liabilities}}$$

Financial leverage ratios

$$\text{Long term debt ratio} = \frac{\text{Long term debt}}{\text{Owners' equity + long term debt}}$$

$$\text{Debt to equity ratio} = \frac{\text{Long-term debt + short term debt}}{\text{Total owners' equity}}$$

$$\text{Debt ratio} = \frac{\text{Total liabilities}}{\text{Total assets}}$$

$$\text{Interest coverage ratio} = \frac{\text{EBIT}}{\text{Interest charges}}$$

Asset management ratios

$$\text{Inventory turnover} = \frac{\text{Cost of sales}}{\text{Inventory}}$$

$$\text{Days' sales of inventory} = \frac{365}{\text{Inventory turnover}}$$

$$\text{Accounts receivable turnover} = \frac{\text{Annual credit sales}}{\text{Average accounts receivable}}$$

$$\text{Collection period} = \frac{365}{\text{Accounts receivable turnover ratio}}$$

$$\text{Asset turnover} = \frac{\text{Sales}}{\text{Total assets}}$$

Profitability ratios

$$\text{Gross profit margin} = \frac{\text{Gross profit}}{\text{Sales}}$$

$$\text{Net profit margin} = \frac{\text{Net income}}{\text{Sales}}$$

$$\text{ROA} = \frac{\text{Net income}}{\text{Total assets}}$$

$$\text{ROE} = \frac{\text{Net income}}{\text{Common equity}}$$

CHAPTER 9 – COMPANY VALUATION

- Midlands Ltd currently retains 60% of its earnings which are R4 a share this year. It earns a ROE of 30%. Assuming a required rate of return of 22%, how much would you pay for Midlands Ltd on the basis of the earning multiplier model?

Required rate of return(k)	22%
ROE	30%
Retention rate (RR)	60%
Earnings per share(EPS)	R4.00

Growth rate(g) = ROE × RR

= 30% × 0.60

= 18%

Example – Company Valuation

$$P/E = \frac{D/E}{K - g}$$

where: D/E (dividend payout) = 1 – RR (retention rate)

$$= \frac{(1 - 0.60)}{0.22 - 0.18}$$

$$= 10.00 \times$$

$E1 = Eo(1 + g) = 4.00(1.18) = R4.72$

$Po = P/E \times E1$

$= 10.00 \times 4.72$

$= R47.20$

TOPIC 3

THE ANALYSIS OF BONDS

CHAPTER 11: BOND FUNDAMENTALS

- Bonds are issued in the capital market (financial market for long term debt obligations and equity securities)
- Bonds provide an alternative to direct lending as a source of funding
- Basics of bonds
  - Principal value
  - Coupon rate
  - Term to maturity
  - Market value
  - Yield to maturity

Bond Risk Exposures

- Interest rate risk – effect of changes in the prevailing market rate on the return on a bond (price risk and reinvestment risk)
- Price risk – arises when a bond is sold before maturity
- Reinvestment risk – arises from the market rate being different from the yield to maturity
- Credit risk – risk that creditworthiness of a bond issuer will deteriorate. It is sub-divided into the following:
  - Default risk – possibility that issuer will fail to meet its obligations regarding timely payment of coupons and principal
  - Credit spread risk – risk that the credit spread will increase
  - Downgrade risk – risk that a rating agency assigns a lower rating to a bond causing a rise in yield and drop in price

Bond Risk Exposures

- Yield curve risk – arises from a non parallel shift in the yield curve
- Liquidity risk – risk of having to sell a bond at a price below fair value due to lack of liquidity
- Call risk
  - Applies to callable bonds
  - It is the risk that the bond is eventually called from the holder by the issuer when the market rate falls
  - Call protection reduces call risk
  - Non-callable bonds have no call risk

Alternative Bond Structures

- Coupon bonds
- Zero-coupon bonds
- Bonds with embedded options
    - Call provision
    - Put provision
    - Sinking fund provision
- Floating rate notes

CHAPTER 12: VALUATION OF BONDS

Relation	Effect	Issue
Coupon rate < Discount rate	Bond price < Principal value	Discount bond
Coupon rate > Discount rate	Bond price > Principal value	Premium bond
Coupon rate = Discount rate	Bond price = Principal value	Par value bond

Yield measures

- Nominal yield – coupon rate of bond
- Current yield – only considers a bond’s annual interest income ignoring any capital gains/losses, or reinvestment income
- Yield to maturity – annualised rate of return based on bond’s price, coupon payments and par value
- Yield to call
  - A provision that gives the bond issuer the right to call the bond at a predetermined price that is at/above par
  - Has a higher return than an identical non-callable bond
  - Advantageous to the issuer
  - Bond is called when interest rates have dropped significantly

Yield measures

- Yield to put
  - Advantageous to the holder forcing the issuer to repurchase the bond prior to maturity at a predetermined price
  - Arises when prevailing interest rate have risen significantly
  - Holder reinvest(new issue) at a higher rate(lower price)
- Realised yield – takes into account of the expected rate of rate during the investment
- Spot and forward rates – the appropriate discount rates for cash flows at different points in time

Example – current yield

- A bond is a 10% semi-annual paying bond priced a R1200 with 6 years to maturity. The bond can be called in 4 years at R1080.

  Calculate the:

- Current yield = $\frac{\text{annual coupon pmt}}{\text{bond price}}$

  $= \frac{100}{1\,200}$

  $= 8.33\%$

Example – yield to maturity

- Yield to maturity

HP 10BII	
Input	Function
-R1 200	PV
R1 000	FV
50	PMT
12	N
2.9917 × 2	I/YR
	5.98%

Example – realised yield

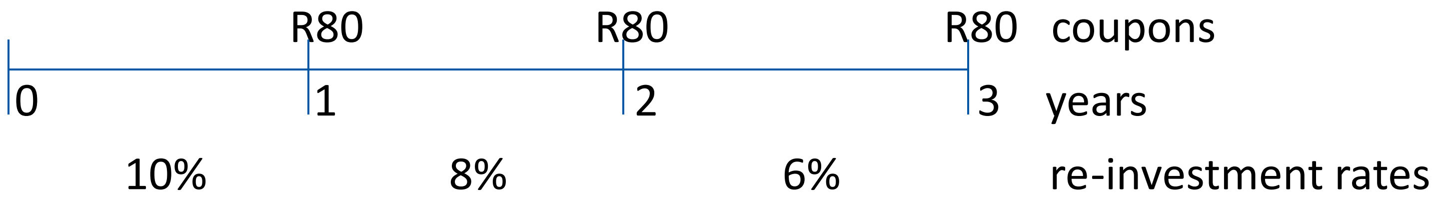
- Assume that you purchase a 3-year R1 000 par value bond, with an 8% coupon, and a yield of 10%. After you purchase the bond, one year interest rates are as follows (these are the reinvestment rates)

Year 1	10%
Year 2	8%
Year 3	6%

- Calculate the realised compound or horizon yield, if you hold the bond to maturity. Interest is paid annually.

Example – realised yield

HP 10BII	
Input	Function
1000	FV
80	PMT
3	N
10	I/YR
	PV (Market price)
	R950.263



Step 1: Calculate the future value of the coupon payments reinvested.

= 80(1.08)(1.06) + 80(1.06) + 80

= 91.584 + 84.80 + 80

= R256.384

Example – realised yield

Step 2: Add the face value of the bond to the future value of the coupon payments.

= R1 000 + R256.384

= R1 256.384

Step 3: Calculate the actual yield received.

HP 10BII	
Input	Function
R1 256.384	FV
-R950.263	PV
3	N
	I/YR
	9.76%

Measurement of Interest Rate Risk

- Interest rate risk is the risk that changing market rates will impact negatively on the return of a bond
- Duration-convexity approach to measuring interest rate risk or price sensitivity provides an approximation of the actual interest rate sensitivity
- Duration allows for managing the price sensitivity of a bond portfolio
  - Declining interest rate environment – lengthen duration to take full advantage of the increase in the value through an increased interest rate sensitivity
  - Increasing interest rate environment – shorten duration so as to limit the decline in bond value

Duration

- Properties of duration
  - Duration of a zero coupon bond will equal its term to maturity
  - Duration of a coupon bond will always be less than its term to maturity
  - Positive relationship between term to maturity and duration
  - Inverse relationship between coupon and duration
  - Inverse relationship between yield to maturity and duration
- Calculation of duration
  - Macaulay duration – sums the weighted discounted cash flows to arrive at a basic duration value
  - Modified duration – discount the Macaulay duration at the yield to maturity
  - Effective duration – straight forward way to calculate duration. It is equal to modified duration

Example – effective duration

- A 5-year, 6 % coupon bond pays interest semi-annually and sells for R958.42. The effective duration of this bond is closest to:

	V-	Vo	V+
FV	1 000	1 000	1 000
PMT	30	30	30
N	10	10	10
I/YR	3	3.5	4
PV	1000	958.42	918.89

$$\text{Effective duration} = \frac{(V-) - (V+)}{2V_0\,(\Delta y/100)}$$

$$= \frac{1000 - 918.89}{2 \times 958.42 \times 0.01} = 4.23$$

Example – duration

- A 6 % coupon bond pays interest semi-annually, has a modified duration of 10, sells for R800, and is priced at a yield to maturity (YTM) of 8%. If the market rate increases to 9%, the estimated change in price, using the duration concept, is:

Modified duration = effective duration (D) = 10

Change in yield(Δy) = 9-8 =1% = 0.01

Duration effect: $\%\Delta P_D = -D\,(\Delta y)$

$= -10(0.01) = -0.10$

Estimating prices with duration: $P_{D(+1)} = V_0 \times (1 - \%\,\Delta P_D)$

$P_{D(+1)} = R800\,(1 - 0.10)$

$P_{D(+1)} = R720$

Estimated change in price = R720 – R800

=-R80

Convexity

- Duration ignores the curvature of the price-yield relationship
  - It is a poor approximation of price sensitivity to larger yield changes
  - Increases in price are underestimated
  - Decreases in price are overestimated
- Convexity adjustment accounting for the convex shape of the price-yield curve improves the accuracy of the duration measure
- If you have two bonds which equal duration but bond A had a higher convexity than bond B. You will prefer bond A because :
  - It has a better price performance when yields fall (greater price increase) and also when yields rise (smaller decrease in price)

Example – convexity

- A 12-year, 10% semi-annual coupon bond (R1 000 par value) is priced at a yield to maturity (YTM) of 8%. The convexity adjustment with a 150 basis point decrease in yield is closest to:

$$\text{Effective convexity} = \frac{(V-) + (V+) - 2\,V_0}{2\,V_0\,(\Delta y/100)^2}$$

	V-	Vo	V+
FV	1 000	1 000	1 000
PMT	50	50	50
N	24	24	24
I/YR	3.25	4	4.75
PV	1288.546	1152.47	1035.35

Example – convexity

$$\text{Effective convexity} = \frac{(V-) + (V+) - 2V_0}{2V_0(\Delta y/100)^2}$$

$$= \frac{1288.546 + 1035.35 - (2 \times 1152.47)}{2 \times 1152.47 \times 0.015^2}$$

$$= \frac{18.956}{0.51859}$$

$$= 36.553$$

$$\Delta P = V_0 \times \text{convexity} \times (\Delta y/100)^2$$

$$= 1152.47 \times 36.553 \times (0.015)^2$$

$$= R9.47$$

TOPIC 4

PORTFOLIO MANAGEMENT

CHAPTER 13: DERIVATIVE INSTRUMENTS

- Major categories of derivatives
  - Forwards
    - Agreement between two parties in which one party the buyer agrees to buy from the other party, the seller, an underlying asset at a future date at a price established today
    - The contract is customized (privately traded on an over the counter (OTC) market
    - Risk of default by either party is high
  - Futures
    - Agreement between two parties in which the buyer agrees to buy from the seller, an underlying asset at a future date at a price established today
    - Public traded on a futures stock exchange
    - Standardized transaction

Derivative Instruments

- Options
  - Call option: the right to buy a specific amount of a given share at a specified price (strike price) during a specified period of time
    - Provided the market price (S) exceeds the call strike(X) before or at expiration. NB: **S > X**
  - Put option: the right to sell a specific amount of a given share at a specified price (strike price) during a specified period of time
    - Provided the put strike price (X) exceeds the market price (S) before or at expiration. NB: **X > S**
- Swaps
  - An agreement between two parties to exchange a series of future cash flows
  - A variation of a forward contract; equivalent to a series of forward contracts

Example - Arbitrage opportunity

- Jake Gray, CFA, believes he has identified an arbitrage opportunity for a commodity as indicated by the information given in the following table:
- Commodity price and Interest Rate Information

Spot price for commodity	R120
Futures price for commodity expiring in 1 year	R125
One-year interest rate	8%

1. Calculate the theoretical futures price (F)
2. The following actions will realise an arbitrage profit.

   1 short spot; borrow money; buy futures

   2 sell spot; borrow money; buy futures

   3 long spot; invest proceeds; buy futures

   4 short spot; invest proceeds; long futures

Example – Arbitrage opportunity

1 $F = 120\,(1.08)^1$

$= R129.60$

2 The theoretical or fair value (R129.60) exceeds the actual market price (R125). **F > P**

The futures contract is available at a cheap price, therefore:

Buy futures contract, sell spot and invest proceeds (reverse cash and carry arbitrage)

Arbitrage profit = fair value – actual price

Realised profit = 129.60 - 125 =R4.60

Buying or selling a call option

- Call holder(buyer) can exercise his right to purchase the underlying should the spot price exceed the strike price (**S > X**)
- When S>X, the call option has an intrinsic value (in-the-money).
  - [c = max(0; S – X)]
- Profit potential:
  - Call holder is unlimited
  - Call writer is limited to the premium received
- Potential loss:
  - Call holder is the premium paid
  - Call writer is unlimited

Buying or selling a put option

- The put holder can exercise his right to sell the underlying should the strike price exceed the spot price (**X>S**)
- When X>S, the put option has an intrinsic value(in-the-money)
  - [p = max (0; X – S)]
- Potential profit:
  - Put holder is limited to the breakeven value (X-p)
  - Put writer is limited to the premium received
- Potential loss:
  - Put holder is premium paid
  - Put writer is the breakeven value(X-p)

Put – Call Parity

A 3 month European call option with a strike price of R70 sells at a premium of R6.00. It has a risk free rate of 8% and a current share price of R73. Using the put call parity, what is the equivalent value of the European put option.

Put-call parity

$$S + p = \frac{X}{(1 + r)^{T-t}} + c$$

$$73 + p = \frac{70...}{(1.08)^{0.25}} + 6$$

$$p = \frac{70}{1.0194} + 6 - 73$$

p = 68.6678 + 6 – 73

p = R1.67

Trading strategies

- Covered call strategy
  - Own the underlying share and you short a call
  - Pay off similar to a short put
  - Calls can be sold to generate income(premiums) with the expectation that the calls will lapse unexercised
  - The short call is covered because the underlying share is owned and available for delivery should the call be exercised
  - Viable if the underlying share price is expected to remain unchanged over the short term (stable market)
  - Max profit = $(X – So + C)$
  - Max loss = breakeven $(S\text{-}p)$
  - Exercise if $S > X$

Trading strategies

- Protective put strategy
  - Buying a put when owning the underlying so as to protect the value of the share
  - Paying a premium and buying insurance against adverse (downward) price movements in the underlying
  - Payoff is similar to a long put
  - Establishing a minimum portfolio value (strike level) while retaining any upside or increase in portfolio value less the premium paid (cost of insurance)
  - Put holder will exercise when S declines below X
  - Max profit = $(S_T – S_o – p)$

    Where: S_T = higher current spot price

    S_o = initial spot price
  - Max loss = $(S_o – X + P)$
  - Breakeven = $S_o + p$

Trading strategies

- Straddle
  - Combination of a long call and a long put with the same strike and expiration
  - Relatively large movement in price is anticipated though the direction is uncertain
  - Max loss= cost of the call(c) and put(p) premiums paid = (c + p)
  - Breakeven: A = [X - (c +p)] and B = [X + (c +p)]
  - Potential gain to the straddle holder = Unlimited with an increasing spot price(call exercised) but limited to the lower breakeven value(A) in the event of the underlying price decreasing to zero(put exercised)

Trading strategies

- Bull and bear spreads
  - Can be constructed with either two calls or puts with the same underlying and expiration but with a difference in strike are bought and sold respectively to either benefit from a risk(bull spread) or fall(bear spread) in the market
  - Bull call spread = short out-of-the-money call (X_H) - long-in-the money call (X_L)
  - If both are exercised by the respective holders following an increase in the spot price as anticipated(bull market)
    - Max profit = [$X_L - X_H - c_L + c_H$]
    - Max loss = [$c_L + c_H$]
  - Bull put spread = short put in-the-money (X_H) - long put out-of-the money (X_L)

CHAPTER 14:PORTFOLIO MANAGEMENT

- Life cycle phase of an individual investor
  - Accumulation phase
  - Consolidation phase
  - Spending phase
- Objectives of the investor
  - Capital preservation
  - Capital appreciation
  - Current income
- Constraints
  - Liquidity and time horizon
  - Tax concerns
  - Legal and regulatory factors
  - Unique needs and personal preferences

General Portfolio Construction

Question 6 (3)

Probability of occurrence	**Rate of Return – Security A**	**Rate of Return – Security B**
50%	12%	10%
25%	10%	11%
25%	8%	9%

Calculate the standard deviation of both securities.

1. A 0.71 B 1.66
2. A 0.85 B 1.66
3. **A 1.66 B 0.71**
4. A 1.71 B 1.66

E_A = 0.5 (12) + 0.25 (10) + 0.25 (8)
= 10.50%

E_B = 0.5 (10) + 0.25 (11) + 0.25 (9)
= 10.00%

δ_A = $\sqrt{0.5 (12 - 10.5)^2 + 0.25 (10 - 10.5)^2 + 0.25 (8 - 10.5)^2}$
= $\sqrt{1.125 + 0.0625 + 1.5625}$
= $\sqrt{2.75}$
= 1.66

δ_B = $\sqrt{0.5 (10 - 10)^2 + 0.25 (11 - 10)^2 + 0.25 (9 - 10)^2}$
= $\sqrt{0 + 0.25 + 0.25}$
= $\sqrt{0.50}$
= 0.71

[Refer to Marx (2010:271)]

General Portfolio Construction

Question 7 (1)

Calculate the correlation coefficient between the two assets.

1. **0.42**
2. 0.77
3. 0.87
4. 0.91

Correlation ($r_{A,B}$) $= \text{Covariance}_{A,B} \div (\delta_A \times \delta_B)$

$\text{Covariance}_{A,B} = \sum \text{probability} \times (\text{return}_A - k_A) \times (\text{return}_B - k_B)$)

= 0.5(12-10.5)(10-10) × 0.25(10-10.5)(11-10) × 0.25(8-10.5)(9-10)

= 0 + - 0.125 + 0.625

= 0.50

$r_{A,B}$ = 0.50 ÷ (1.66 × 0.71)

= 0.50 ÷ 1.1786

= 0.42

[Refer to Marx (2010: 272)]

General Portfolio Construction

Question 8 (4)

Calculate the portfolio risk if 50% of the portfolio is invested in A and 50% in B.

1. 0.770%
2. 0.087%
3. 0.910%
4. **1.030%**

Portfolio standard deviation (δ_p)

$= \sqrt{} [w_A{}^2 \times \delta_A{}^2] + [w_B{}^2 \times \delta_B{}^2] + [2 \times w_A \times w_B \times r_{AB} \times \delta_A \times \delta_B]$

$w_A = 0.5$ $w_B = 0.5$ $r = 0.42$ $\delta_A = 1.66$ $\delta_B = 0.71$

$= \sqrt{} [0.5^2 \times 1.66^2] + [0.5^2 \times 0.71^2] + [2 \times 0.5 \times 0.5 \times 0.42 \times 1.66 \times 0.71]$

$= \sqrt{} [0.6889 + 0.126 + 0.2475]$

$= \sqrt{} 1.0624$

$= 1.030\%$

[Refer to Marx (2010: 274)]

CHAPTER 15: EVALUATION OF PORTFOLIO MANAGEMENT

Unit trust	Average rate of return	Variance	Beta
SBIF	26	4.84	0.94
RDPF	18	1.00	0.22
RMBF	22	3.24	0.65
Total Market Index	24	4.00	

1. Evaluate the performance of unit trust RMBF according to the method of Treynor
2. Evaluate the performance of unit trust SBIF according to the method of Sharpe
3. the performance of unit trust RDPF according to the method of Jensen

Performance measurement

1. Treynor (TPI) = $(r_p - r_f) / \beta$

   = (22 – 15) / 0.65

   = 7 / 0.65

   TPI = 10.77

2. Sharpe (SPI) = $(r_p - r_f) / \delta$

   = (26 – 15) / √4.84

   = 11 / 2.2

   SPI = 5.00

3. Jensen's alpha (α) = $r_p - [r_f + \beta (r_m - r_f)]$

   α = 18 – [15 + 0.22 (24 – 15)]

   α = 18 – 16.98

   α = 1.02%

Good luck in your exam!!