



**CIFA ADVANCED LEVEL**

**DERIVATIVES ANALYSIS**

**WEDNESDAY: 4 December 2024. Morning Paper.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings. Do NOT write anything on this paper.**

**QUESTION ONE**

- (a) Explain the use of the following exotic derivatives in your country:
- (i) Range forward contract. (2 marks)
  - (ii) Asian options. (2 marks)
  - (iii) Chooser options. (2 marks)

- (b) On 1 September 2024, Sandra Chepchumba entered into a Forward Rate Agreement (FRA) that expires on 1 December 2024 (90-days later) based on a 180-day Secured Overnight Financing Rate (SOFR). The rates on 1 September 2024 were as follows:

Lo (90) = 5.6%

Lo (270) = 6.0%

Chepchumba goes long the FRA on 1 September 2024 and 25 days later, the term structure was as follows:

L<sub>25</sub> (65) = 5.9%

L<sub>25</sub> (245) = 6.5%

**Required:**

- (i) Describe the notation of the FRA Sandra Chepchumba entered into on 1 September 2024. (2 marks)
  - (ii) Determine the appropriate price (FRA rate) as at 1 September 2024. (3 marks)
  - (iii) Determine the value of this FRA 25-days later. (3 marks)
- (c) Consider an asset priced at Sh.900. A futures contract on the asset expires in 75 days. There are 365 days in a year and the risk free interest rate is 7%.

**Required:**

Calculate the following:

- (i) The appropriate futures price assuming that the underlying asset has no storage costs, cash flows or convenience yield. (2 marks)
- (ii) The appropriate futures price assuming that the underlying asset's storage costs at the futures expiration is Sh.30. (2 marks)
- (iii) The appropriate futures price assuming that the underlying asset's storage costs at futures expiration is Sh.30 and the future value of positive cash flows is Sh.5. (2 marks)

**(Total: 20 marks)**

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## QUESTION TWO

- (a) With reference to Forward Rate Agreements (FRAs):
- (i) Explain the term “FRA contract”. (2 marks)
  - (ii) Highlight **TWO** ways in which a forward contract could be terminated. (2 marks)
  - (iii) Explain how a party to FRA can minimise credit risk that arises from the termination of a forward contract. (2 marks)
- (b) Hawksford Ltd., an investor in fixed income instruments decided to enter into a 182-day treasury bill futures contract expected to expire in 45 days. The 45-day treasury bill goes at 5.5% discount rate while 137-day treasury bill has a discount rate of 5.95%.

There are 360 days in a year.

### Required:

- (i) Determine the price of a futures contract that expires in 45 days. (4 marks)
  - (ii) Calculate the implied repo rate using spot rates. (3 marks)
- (c) An investor is considering a box spread consisting of options with exercise prices of Sh.75 and Sh.86. The call prices are Sh.17 and Sh.13 for exercise prices of Sh.75 and Sh.86 respectively. The put prices are Sh.10 and Sh.15 for exercise prices of Sh.75 and Sh.86 respectively. The options expire in nine months and the discrete risk free rate is 6%.

### Required:

- (i) Determine the value of the box spread and the profit for any value of the underlying at expiration. (3 marks)
- (ii) Show that this box spread is priced such that an attractive opportunity is available. (4 marks)

**(Total: 20 marks)**

## QUESTION THREE

- (a) Differentiate between “interest rate cap” and “interest rate collar”. (4 marks)
- (b) Discuss **THREE** demerits of derivatives. (6 marks)
- (c) An NSE 20 call option expiring in March 2025 with a strike price of 12,800 index points was listed on 29 September 2024 at a bid price of 385.30 index points and an ask price of 409 index points. The contract value per index point is Sh.5.

### Required:

- (i) Calculate the option value at expiration. (3 marks)
- (ii) The option premium for the holder of the long call. (3 marks)
- (iii) The exercise loss for the holder of a short call at a NSE 20 price of 13,300. (2 marks)
- (iv) The effect of option premium to the loss in (c) (iii) above. (2 marks)

**(Total: 20 marks)**

## QUESTION FOUR

- (a) Explain **TWO** reasons for trading interest rate swaps. (4 marks)
- (b) Mazao Bank Limited has issued floating rate notes with a maturity period of one year with interest rate of Secured Overnight Financing Rate (SOFR) plus 125 basis points with a face value of Sh.50 million. Mazao Bank Limited now believes that interest rates will rise and wishes to protect itself by entering into a swap.

A dealer provides a quote on a swap in which the company will pay a fixed rate of 6.5% and receive SOFR. Interest is paid quarterly and the current SOFR is 5%.

**Required:**

- (i) Describe how the company can use a swap to convert the debt to a fixed rate. (2 marks)
- (ii) Calculate the overall net payment including the loan by Mazao Bank Limited when all payments are made on the basis of 90/360. (4 marks)
- (c) Tanop Ltd. enters into an equity swap to receive a fixed rate and pay the return on NSE 25 total return index. The stock index is at 2,710.55. The equity swap has notional amount of Sh.25 million. The payment will be made quarterly for one year with interest calculated using the adjustment factor of 90/360. The term structure is as follows:

Term			Rate
90 days	Lo (90)	=	3%
180 days	Lo (180)	=	3.2%
270 days	Lo (270)	=	3.3%
360 days	Lo (360)	=	3.5%

60 days into the life of the Tanop Ltd. swap, the new term structure is as follows:

Term			Rate
30 days	L60 (30)	=	3.5%
120 days	L60 (120)	=	3.75%
210 days	L60 (210)	=	3.90%
300 days	L60 (300)	=	4.00%

The stock index is at 2,739.60.

**Required:**

- (i) Calculate the fixed rate on the swap at initiation. (4 marks)
- (ii) Calculate the value of the swap 60 days into its life from Tanop Ltd. perspective. (6 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

- (a) Evaluate **THREE** challenges faced by market participants in derivatives markets when leveraging Artificial Intelligence (AI) applications. (6 marks)
- (b) The price of beans in the month of November 2024 is Sh.25,000 per bag. The effective monthly interest rate is 1% and the storage cost per bag is Sh.500 per month. The beans will be stored from November 2024 to February 2025. A broker quotes the February 2025 forward price as Sh.26,500 per bag.

**Required:**

- (i) Calculate the February 2025 forward price. (3 marks)
- (ii) Determine the arbitrage profit. (1 mark)
- (c) Waekezaji Investments is a recognised pension fund management firm. The fund consists of Sh.800 million allocated 80% to equities and 20% to fixed income instruments. The equities portion has a beta of 1.2 and the fixed income portion has 6.7 as its modified duration. The firm's board of directors desires to temporarily change the asset allocation to 50% equities and 50% bonds. This follows the investment advisory received and the anticipated changes in capital market expectations.

**Additional information:**

- The equities index futures contract has a price of Sh.200,000 (after accounting for the multiplier) and a beta of 0.96.
- Fixed income futures contract has an implied modified duration of 7.2, priced at Sh.105,520 and a yield beta of 1.1.
- The investment horizon for the change is three months with appropriate duration of the money market instrument estimated at 0.25.
- After the investment horizon, the expected most likely scenario is that the equities portion of the portfolio returns a -3%, fixed income investments portion returns a +1.25%, equities index futures price goes from Sh.200,000 to Sh.193,600 and the fixed income futures price increases from Sh.105,250 and Sh.106,691.

**Required:**

- (i) Determine the number of equities futures contracts that Waekezaji Investments should trade in order to satisfy their desire. (2 marks)
- (ii) Determine the number of fixed income futures contracts that Waekezaji Investments should trade in to meet their purpose. (2 marks)
- (iii) Determine the total market value of Waekezaji Investment's portfolio after the anticipated market changes without the futures contract. (2 marks)
- (iv) Determine the total market value of Waekezaji Investment's portfolio after the anticipated market changes with the futures contracts. (2 marks)
- (v) Comment on your results in (c) (iii) and (c) (iv) above. (2 marks)

**(Total: 20 marks)**

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**CIFA ADVANCED LEVEL**

**DERIVATIVES ANALYSIS**

**WEDNESDAY: 21 August 2024. Morning Paper.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings. Do NOT write anything on this paper.**

**QUESTION ONE**

- (a) When a forward contract expires, there are two possible arrangements that can be used to settle the obligations of parties.

**Required:**

In relation to the above statement, distinguish between “cash settlement” and “delivery”. (4 marks)

- (b) With respect to swaptions:

(i) Outline **TWO** characteristics of swaptions. (2 marks)

(ii) Distinguish between a “payer swaption” and a “receiver swaption”. (4 marks)

- (c) Amani Ltd. has approached you to evaluate the following investment instruments that they intend to incorporate into their portfolios.

A Forward Rate Agreement (FRA) that expires in 90 days for which the underlying is the 180 - day London - Inter Bank Offered Rate (LIBOR). The dealer has provided a rate of 5.5% with Amani Ltd. taking the long position and the dealer goes short. At expiration, Amani Ltd. forecasts that the rate on 180 - day LIBOR will be 6%. Amani Ltd. agrees to a Sh.10 million notional principal for this instrument.

**Required:**

(i) Payoff amount from the FRA as forecasted by Amani Ltd. (3 marks)

(ii) Justify whether Amani Ltd. pays or receives the FRA payoff. (2 marks)

- (d) A forex dealer in international currencies domiciled in the United States (US) observes the spot exchange rate to be \$ 0.5987 to one Swiss Franc. The US interest rates are at 5.5% and Swiss interest rate is 4.75%. The dealer forecasts that interest rates will remain unchanged in the short-term investment period and that the rates are based on annual compounding and not quoted as LIBOR - type rates. The dealer enters into a forward contract with a maturity of 180 days. Assume 365 days in a year.

**Required:**

(i) The forward price that the dealer should commit to. (2 marks)

(ii) If the dealer enters into a long forward contract and that 40 days later, the spot rate is observed to be \$0.65 per Swiss Franc. Determine the value of the dealer’s long position with fixed interest rates as forecasted. (3 marks)

**(Total: 20 marks)**

**QUESTION TWO**

- (a) Describe **THREE** distinguishing features between “forwards” and “futures”. (6 marks)

- (b) A one-year swap with quarterly payments every 90, 180, 270 and 360 days with the underlying being 90-day LIBOR and the underlying spot rates at the beginning of the swap given as  $Lo(90) = 3.45%$ ,  $Lo(180) = 3.58%$ ,  $Lo(270) = 3.70%$  and  $Lo(360) = 3.75%$  respectively. Assume 360 days in a year.

**Required:**

Determine the annualised fixed rate.

(6 marks)

- (c) Alfred Abonyo, an investments analyst with Kendu Bay Capital, gathers the following information regarding put and call options on Mawingu Ltd. share:

- Call price (Co) = Sh.4.50
- Put price (Po) = Sh.6.80
- Exercise price (X) = Sh.70
- Term of the contracts (put and call) = 139 days
- Current market price per share, (So) = Sh.67.32
- Applicable risk free rate, (r) = 5%
- Assume 365 days in a year.

Alfred Abonyo desires to use the put-call parity condition to determine the fair market prices.

**Required:**

Determine the prices of the following:

- (i) Synthetic call option. (2 marks)
- (ii) Synthetic put option. (2 marks)
- (iii) Synthetic bond. (2 marks)
- (iv) Synthetic underlying security. (2 marks)

**(Total: 20 marks)**

**QUESTION THREE**

- (a) With respect to the applications of Artificial Intelligence (AI) and financial technology in derivatives markets:

- (i) Highlight **TWO** potential benefits of AI. (2 marks)
- (ii) Distinguish between “machine learning” and “deep learning”. (4 marks)

- (b) A portfolio manager holds 60,000 of Kiu Ltd. shares trading at a price per share of Sh.74.25 on 12 January 2024. To hedge the price risk of the equity position, he buys 600 European put options on the market expiring in March 2024 with a strike price of Sh.76 at a price per put of Sh.3.27.

**Required:**

- (i) Determine the profit or loss of the protective put strategy at expiration if the price of the Kiu Ltd. share is Sh.68. (4 marks)
  - (ii) In relation to a protective put strategy, determine the maximum profit, the maximum loss and the breakeven share price at expiration. (6 marks)
- (c) On 1 October 2023, the fixed income portfolio of Retirees Fund (RF) obtained forecasts that in one month’s time interest rates are expected to decline. RF would wish to raise the duration of Sh.75 million of bonds from its current level of 6.22 to 7.50 to take advantage of the expected interest rate decline. To do so, RF identifies an appropriate bond futures contract that is currently priced at Sh.82,500 with an implied modified duration of 8.12. The applicable yield beta is 1.05.

**Required:**

- (i) The number of futures contracts necessary to increase the duration of RF portfolio. (2 marks)
- (ii) One month later, 1 November 2023, the implied yield on the future has decreased by 35 basis points and futures price has now moved to Sh.85,000. Yield on the bond portfolio has decreased by 40 basis points and the portfolio has increased in value by Sh.1,933,500.

Determine the overall gain from the above transaction.

(2 marks)

**(Total: 20 marks)**

#### QUESTION FOUR

(a) In relation to options, explain the following:

- (i) Option's moneyness. (2 marks)
- (ii) In the money. (2 marks)
- (iii) At the money. (2 marks)

(b) A futures contract on a Sh.100 par treasury bond paying 8% semiannually exists. The underlying bond has 5 years to maturity and 9% yield. The futures contract expires in 1 year and 6 months time. Risk free rate is 6%, bond's price is Sh.95.94.

**Required:**

- (i) Calculate the accumulated value of coupons and interest. (2 marks)
- (ii) Determine the futures price assuming a conversion factor of 1.0505. (2 marks)

(c) A global airline management is proposing to the board to hedge an increase in fuel prices as well as currency fluctuation to 100% of expected demand over the next 12 months using heating oil futures and Euro (USD/Eur) currency futures. The board has reviewed this proposal and queried the use of longer dated contracts to hedge the expected exposure from Quarter 3 (Q3) and Quarter 4 (Q4) due to the lower levels of liquidity in these contracts. The following information relates to the company and the market:

Company information	Expected demand (millions of gallons)
Quarter 1 (Q1)	20
Quarter 2 (Q2)	32
Quarter 3 (Q3)	36
Quarter 4 (Q4)	28

**Additional information:**

1. The contract is specified on a quarterly basis and has a size of 42,000 gallons.
2. Exchange rate USD per Euro 125,000 (quarterly rate).
3. Minimum price fluctuations are USD 4.20 per contract (heating oil) and USD 6.25 per contract (Euro futures).
4. Settlement method is physical delivery.

**Market information**

Month	Heating oil Price	Euro Futures Price
March	1.67	1.11
June	1.58	1.13
September	1.52	1.16
December	1.50	1.20

**Required:**

- (i) Calculate the number of heating oil and Euro futures contracts that the airline would need to buy or sell to hedge 100% for the next 6 months using March (Q1) and June (Q2) contracts. (5 marks)
- (ii) Recommend with a reason an alternative trading strategy that could be used to address the board concerns. (2 marks)
- (iii) Highlight **THREE** reasons why the airline may choose not to hedge any of its fuel costs. (3 marks)

**(Total: 20 marks)**

#### QUESTION FIVE

(a) Discuss **THREE** functions of derivatives markets in financial markets. (6 marks)

(b) The price of an American call on a non-dividend paying security is Sh.4. The security price is Sh.31, the exercise price is Sh.30, and the expiration date is in three months. The risk free rate is 8%.

**Required:**

Derive the upper and the lower bounds for the price of an American put on the same security with the same exercise price and expiration date. (3 marks)

- (c) Faida Bank Limited has lent Sh.50 million loan to a borrower at a fixed rate of 9% for a remaining term of three years with quarterly payments. The bank had originally funded the loan at a fixed rate but because of changing interest rate expectations, it has now decided to finance it at a floating rate. Although it cannot change the terms and conditions of the loan to the borrower, the bank's investment analysts have advised the bank to convert the loan to a floating rate loan using a swap.

**Additional information:**

1. The fixed rate on 3-year swaps with quarterly payments is 10%.
2. There are 90 days in each quarter and 360 days in a year.
3. The floating rate payments are referenced to the London Inter-Bank Offered Rate (LIBOR).

**Required:**

- (i) Explain how the bank could convert the fixed rate loan to a floating rate loan using a swap. (2 marks)
- (ii) Determine the quarterly interest rate payment to be made by the borrower, the bank and the counter party to the swap. (3 marks)
- (iii) Determine the overall payoff from having converted the fixed rate loan to a floating rate loan on a quarterly basis. (2 marks)
- (iv) Discuss **TWO** reasons why the effective floating rate loan will be less than the LIBOR on quarterly basis. (4 marks)

**(Total: 20 marks)**

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**CIFA ADVANCED LEVEL**

**DERIVATIVES ANALYSIS**

**WEDNESDAY: 24 April 2024. Morning Paper.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings. Do NOT write anything on this paper.**

**QUESTION ONE**

- (a) In relation to elementary principles of derivative pricing:
- (i) Explain the term “the law of one price”. (2 marks)
  - (ii) Describe **THREE** principles underlying the law of one price. (6 marks)
- (b) Wakulima Limited shares are currently trading at a price of Sh.150 per share. The share price can go up by 33% or down by 15%. The applicable risk free rate for this share is 4.5%.

**Required:**

Use a one-period binomial model to advise an investor on the appropriate price of a put option with an exercise price of Sh.150 (6 marks)

- (c) Simon Lowasa anticipates the receipt of funds in 200 days which he will use to purchase a particular security. The security he has in mind is currently selling for Sh.62.50 and will pay a Sh.0.75 dividend in 50 days and another Sh.0.75 dividend in 140 days. The risk free rate is 4.2%. Simon decides to commit to a future purchase of the security by going long a forward contract on the security. Assume a year has 365 days.

**Required:**

- (i) The forward price at the end of 200 days. (2 marks)
- (ii) Suppose Simon Lowasa enters into the contract at the price in (c) (i) above. Now 75 days later, the security price is Sh.55.75. Calculate the value of the forward contract at this point. (2 marks)
- (iii) It is now the expiration day, and the security price is Sh.58.50. Compute the value of the forward contract at expiration. (2 marks)

**(Total: 20 marks)**

**QUESTION TWO**

- (a) Explain **THREE** ways in which a swap contract can be terminated. (6 marks)
- (b) A Kenyan trader is considering a three-month trade with Tanzania, a neighbouring country. She gathers the following information:
1. The applicable risk free rates are 6% and 4% for Kenya (domestic market) and Tanzania (foreign market) for the 3-month period stated on annual compounding.
  2. The spot exchange rate between the Kenyan shilling and Tanzanian shilling is KES.0.0667.
  3. Assume a year has 365 days.

**Required:**

- (i) The continuously compounded Kenyan and Tanzanian risk free rates. (2 marks)
- (ii) The price at which the Kenyan trader would enter into a forward contract that expires in 90 days. (2 marks)
- (iii) The value of a forward position 25 days into the contract given spot exchange rate 90 days later is KES.0.065. (2 marks)

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- (c) The discount rate on a 60-day treasury bill is 6% and the discount rate on a 150-day treasury bill is 6.5%.

**Required:**

- (i) Based on the 60-day and 150-day treasury bill discount rates, determine what should be the price of a 60-day futures contract for a Sh.1 par value. (3 marks)
- (ii) If the actual price of a 60-day futures contract is 0.9853, outline the transactions necessary to take advantage of the of the arbitrage opportunity. (3 marks)
- (iii) Calculate the implied repo-rate to determine the profitability of the arbitrage strategy. (2 marks)
- (Total: 20 marks)**

**QUESTION THREE**

- (a) Enumerate **FOUR** reasons why fixed income derivatives are more difficult to value than equity derivatives. (4 marks)
- (b) Describe **THREE** characteristics of credit default swaps (CDS). (6 marks)
- (c) Mazurui Investments Inc. is considering an equity swap that calls for semi-annual payments for one year. Mazurui Investments Inc. will receive the return on the Dow Jones Industrial Average (DJIA) that starts off at 10,033.27.

**Additional information:**

- Current Secured Overnight Financing Rate (SOFR)

Days	Rate
180	7.2%
360	8.0%
- 90 days later, the new term structure is

Days	Rate
90	7.1%
270	7.4%
- Dow Jones Transport Index (DJTI) starts off at 2,835.17 and 90 days later is at 2,842.44.
- The Dow Jones Industrial Average (DJIA) index is 9,955.14 90 days later.
- Notional principal of the swap is Sh.60 million.

**Required:**

- (i) Determine the fixed rate for a one-year interest rate swap given the above term structures. (4 marks)
- (ii) The market value of the swap 90 days later that calls for Mazurui Investments Inc. to pay a fixed rate and receive the return on the DJIA. (3 marks)
- (iii) The market value under the scenario that the counter party pays the return on the DJTI. (3 marks)
- (Total: 20 marks)**

**QUESTION FOUR**

- (a) Outline **THREE** reasons why basis risk may arise when a futures contract is used to hedge a position in the cash market. (3 marks)
- (b) Explain the following terms as used in the derivative markets:
- Forward contract. (2 marks)
  - Futures contract. (2 marks)
  - Swap contract. (2 marks)
- (c) An option trader holds 10 short European call contracts on shares of Omega Ltd. One contract refers to 100 shares. The calls have a strike price of Sh.67 and a time to expiration of 279 days. The Omega security is traded at a closing price per share of Sh.63.75 on March 2024. The annualised volatility of the security is 34.6%, while the dividend per share is Sh.5. The risk free interest rate is -0.45%. According to the Black Scholes model, the call price is Sh.4.14. The option has a delta of 0.387 and a gamma of 0.021.

**Required:**

Determine the number of shares of Omega Ltd. required to hedge the delta risk of the short call position. (3 marks)

(d) A diversified portfolio with a market value of Sh.800 million currently has the following allocation:

Equity	80%	Sh.640 million
Bonds	20%	Sh.160 million

The equity portion of the portfolio is allocated as follows:

Domestic securities	70%	Sh.448 million
International securities	30%	Sh.192 million

The bond portion of the portfolio is allocated as follows:

Government bonds	80%	Sh.128 million
Corporate bonds	20%	Sh.32 million

The portfolio manager wishes to change the overall allocation of the portfolio to 75% equity and 25% bonds within the equity category, the new allocation is to be 75% domestic securities and 25% international securities. In the bond category, the new allocation is to be 75% government bonds and 25% corporate bonds. The manager wants to use four year swaps to achieve the desired allocations, with settlements at the end of each year. Assume that the counter-party payment or receipts are tied to secured overnight financing rate (SOFR). Use generic securities or bond indexes where appropriate.

**Required:**

- (i) Indicate how the manager can use swaps to achieve the desired allocations. (6 marks)
- (ii) Construct the most efficient overall swap in which all equivalent but opposite SOFR payments are consolidated. (2 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

- (a) Summarise **FOUR** option greek measures that help traders and investors understand the sensitivity of option prices to changes in different variables. (4 marks)
- (b) Discuss **THREE** uses of covered calls in the derivative markets. (6 marks)
- (c) On 10 January 2024, Mila Ltd. determines that it will need to borrow Sh.5 million on 15 February 2024 at 90-day Secured Overnight Financial Rate (SOFR) plus 300 basis points. The loan will be an add-on interest loan in which Mila Ltd. will receive Sh.5 million and pay back plus interest on 16 May 2024. To manage the risk associated with the interest on 15 February 2024 and pays off on 16 May 2024. The exercise rate is 5 percent and the option premium is Sh.10,000. The current 90-day SOFR is 5.25 percent. Mila Ltd. takes this rate plus 300 basis points as free rate it would borrow for a period of up to 90 days.

**Additional information:**

- 1. Interest is computed on the exact number of days divided by 360.
- 2. 90-day SOFR on 15 February 2024 was 6 percent.

**Required:**

- (i) The effective cost of the call as of the time the loan is taken. (2 marks)
- (ii) Amount of loan proceeds. (1 mark)
- (iii) Interest amount on the loan. (2 marks)
- (iv) Option payoff. (2 marks)
- (v) The effective interest rate on the loan. (3 marks)

**(Total: 20 marks)**

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**CIFA ADVANCED LEVEL**

**DERIVATIVES ANALYSIS**

**WEDNESDAY: 6 December 2023. Morning Paper.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings. Do NOT write anything on this paper.**

**QUESTION ONE**

(a) Explain the following terms as used in derivatives markets:

(i) Forward commitments. (2 marks)

(ii) Contingent claims. (2 marks)

(iii) Exotic derivatives. (2 marks)

(b) Describe **THREE** market participants in derivatives markets. (6 marks)

(c) Peter Mwangangi owns Taifa Limited shares currently trading at Sh.150 at the securities exchange. Peter plans to sell the shares in 250 days from now. The risk free rate is 5.25%. Taifa Limited plans to pay dividends to its common shareholders according to the following schedule:

Days to payment from now	Dividends per share (Sh.)
30	1.25
120	1.25
210	1.25

There are 365 days in a year.

**Required:**

(i) State the position that Peter Mwangangi should take in the forward markets in order to hedge against a possible price decline. (1 mark)

(ii) Determine the no-arbitrage forward price of a contract established now expiring in 250 days. (3 marks)

(iii) At expiration, the price of Taifa Limited's share is at Sh.130. Determine the value of the forward contract. (2 marks)

(iv) Elaborate whether the value in (c) (iii) above was a gain or loss to Peter Mwangangi. (2 marks)

**(Total: 20 marks)**

**QUESTION TWO**

(a) Assess **THREE** ways of terminating a futures contract. (6 marks)

(b) The following information has been obtained from Zig trading exchange:

Day	Futures price (Sh.)
0	82
1	84
2	78
3	73
4	79
5	82
6	84

**Additional information:**

1. Initial margin requirement is Sh.5 per contract.
2. Maintenance margin requirement is Sh.2 per contract.
3. An investor establishes a long position of 20 contracts, meets all margin calls and does not withdraw any funds.

**Required:**

Determine the ending balance of the long position account from day 1 to day 6. (6 marks)

- (c) A Kenyan businessman deals with imports from United Kingdom (UK). Due to the recent exchange rate movement, he has been advised that the value of the Pound is likely to increase against the Kenyan Shilling over the next 30 days. The businessman is expected to make payment of imported goods in 30 days' time and wants to hedge the currency exposure. The applicable Kenyan risk free rate is 5.5% and the UK risk free rate is 4.5%. These rates are expected to remain unchanged over the next month.

The current spot rate is Sh.150/£.

**Required:**

- (i) Explain whether the businessman should use a long or short forward contract to hedge the currency risk. (2 marks)
  - (ii) Calculate the no-arbitrage price at which the businessman should enter into a forward contract that expires in 30 days. (3 marks)
  - (iii) Assume it is 10-days later into the life of the forward contract and the spot rate is Sh.153/£. Interest rates are unchanged. Calculate the value of the forward contract held by the businessman. (3 marks)
- (Total: 20 marks)**

**QUESTION THREE**

- (a) Explain **THREE** uses of a swaption. (6 marks)
- (b) Hildah Mwangeli is a financial analyst at Bottomline Bank, a commercial bank based in South Africa. One of the bank's investments is exposed to movements in the South African Rand and Hildah Mwangeli desires to hedge the currency exposure. He prices a one year fixed for fixed currency swap involving Rand and Kenya Shilling with a quarterly reset. Mwangeli uses the interest rate data presented below to price the currency swap.

Days to maturity	Rand spot interest rates (%)	Kenyan Shilling spot interest rates (%)
90	0.05	0.20
180	0.10	0.40
270	0.15	0.55
360	0.25	0.70

**Required:**

Determine the annualised equilibrium fixed swap rate for South African Rand. (4 marks)

- (c) John Okenangwa manages an investment portfolio consisting of a futures contract on a Treasury bill that expires in 50 days. The treasury bill matures in 140 days. The discount rates on Treasury bill are as follows:
- 50 day treasury bill 5.0%
  - 140 day treasury bill 4.6%

**Required:**

- (i) The appropriate futures price by using the prices of the 50 day and 140 day Treasury bill. (1 mark)
- (ii) Determine the futures price in terms of the underlying spot price compounded at the appropriate risk free rate. (2 marks)
- (iii) Convert the futures price to the implied discount rate on the futures. (2 marks)

- (d) Washington Omondi gathers the following information from a financial service data terminal on 14 May 2023 relating to TMA Ltd. (option data):

Exercise price (Sh.)	Calls			Put		
	May (Sh.)	June (Sh.)	July (Sh.)	May (Sh.)	June (Sh.)	July (Sh.)
120	8.75	15.40	20.90	2.75	9.25	13.65
125	5.75	13.50	18.60	4.60	11.50	16.60
130	3.60	11.35	16.40	7.35	14.25	19.65

**Additional information:**

- The current stock price: Sh.125.94.
- Expirations: 21 May 2023, 18 June 2023, 16 July 2023.
- The applicable annualised risk free rate is 4.56%.
- An option contract is for 100 shares of the stock employed.
- Washington Omondi decides to examine the TMA Ltd. June box spread using the 125 and 130 options.

He undertakes the following transactions:

- Buy the 125 call at Sh.13.50, buy the 130 put at Sh.14.25, write the 130 call at 11.35 and write the 125 put at Sh.11.50. The premiums paid for the 125 call and 130 put minus the premium received for the 130 call and 125 put net out to Sh.4.90.

**Required:**

- Determine the payoff at expiration. (1 mark)
- Calculate the net present value (NPV) of the box spread. (4 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

- Highlight **FOUR** common characteristics among all forward commitments. (4 marks)
- The following information relates to put and call options on an asset:

Call price	Sh.3.5
Put price	Sh.9.0
Exercise price	Sh.50
Forward price	Sh.45
Days to option expiration	175
Risk free rate	4%

**Required:**

- The synthetic call option price. (2 marks)
  - Price of the synthetic put option. (2 marks)
  - Price of the synthetic forward contract. (2 marks)
- Hassan Korir manages the equity portion of the Bold Beverage Pension Fund which is converting its pension plan from defined benefit scheme to defined contribution scheme effective three months from now. Plan participants have three months to elect various investments for the new plan. The trustees inform Hassan that they wish to keep the value of the pension fund stable during these three months.

Accordingly, Hassan wants to eliminate systematic risk in the equity portion of the fund by using futures on the Securities Exchange (SE) 100 index which is the benchmark for the fund's equity portfolio. He collects the information shown below:

Value of Bold Beverage pension fund equity portfolio	Sh.235,400,000.
Level of SE 100 index	4,650
Level of three month SE 100 futures contract	4,667
Futures multiplier	Sh.10
Beta of Bold Beverage Pension Fund equity portfolio	1.04
Beta of SE 100 futures contract	0.98

**Additional information:**

1. Three months after Hassan implements the hedge, the SE 100 index is up 3.75%.
2. The equity portion of the Beta Beverage Pension Fund is up 3.5% and the level of the expiring three month SE 100 futures contract that Hassan sold is 4,824.
3. The trustees ask Hassan to assess the effectiveness of the hedge that has been in place.

**Required:**

- (i) State the target beta for Hassan's hedging strategy. (1 mark)
- (ii) Determine the number of futures contract that Hassan should sell to achieve the target. (4 marks)
- (iii) Determine the effective beta of the Bold Beverage Pension Fund equity portfolio, including the futures assuming that Hassan sold 5,200 futures contract. (5 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

- (a) Assess **THREE** trends that will shape the future of derivatives markets globally. (6 marks)
- (b) The following information relates to a call option on Bendera Limited's shares trading at a securities exchange:
  1. The exercise price is Sh.70.
  2. The risk free rate is 6%.
  3. The volatility is 0.4.
  4. The days to option expiration is 90 days.
  5. The current share price is Sh.60.

**Required:**

The price of a call option on Bendera Limited's shares using the Black-Scholes-Merton (BSM) pricing model. (5 marks)

The formula for BSM is given as follows:

$$C = N(d_1) S_t - N(d_2) K e^{-rt}$$

Where:  $d_1 = \frac{\ln \frac{S_t}{K} + \left( r + \frac{\delta^2}{2} \right) t}{\delta \sqrt{t}}$

$$d_2 = d_1 - \delta \sqrt{t}$$

$C$  = Call option price  
 $N$  = CDF of normal distribution  
 $S_t$  = Spot price of an asset  
 $K$  = Strike price  
 $r$  = Risk free rate  
 $t$  = Time to maturity  
 $\delta$  = Volatility of the asset

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- (c) A company issues an inverse floating rate note with a face value of Sh.30 million and a coupon rate of 14% minus SOFR (secured overnight financing rate). The company uses the proceeds to buy a bond with a coupon rate of 8%.

**Required:**

- (i) Explain how the company would manage the risk of this position using a swap with a fixed rate of 7%. (2 marks)
- (ii) Calculate the overall cash flow given that SOFR is less than 14%. (3 marks)
- (iii) Explain what would happen if SOFR exceeds 14%. (2 marks)
- (iv) Describe what the company would do to offset this problem if SOFR exceeds 14%. (2 marks)

**(Total: 20 marks)**

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**CIFA ADVANCED LEVEL**

**DERIVATIVES ANALYSIS**

**WEDNESDAY: 23 August 2023. Morning Paper.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings. Do NOT write anything on this paper.**

**QUESTION ONE**

- (a) Discuss **THREE** criticisms of derivative markets. (6 marks)
- (b) Distinguish between a “credit default swap (CDS)” and a “credit linked swap (CLS)”. (2 marks)
- (c) A 250-day futures contract is entered into using a 7% semi-annual pay coupon bond with a spot price of Sh.1,050 (accrued interest inclusive) and will make a coupon payment 182 days later. The annual risk free rate is 6%. Assume a year has 365 days.

**Required:**

Calculate the price of the 250-day futures contract. (4 marks)

- (d) An investor is considering a two-period binomial model in which the underlying is at Sh.50 and can go up 4.88% or down 2.53% each period. The risk free rate is 1.25%. The exercise price of the call is Sh.50.

**Required:**

- (i) Calculate the payoffs of the call option at expiration. (4 marks)
- (ii) Calculate the value of the call option expiring in two periods. (4 marks)

**(Total: 20 marks)**

**QUESTION TWO**

- (a) Explain the following option spread strategies:
- (i) Bull spread. (2 marks)
- (ii) Bear spread. (2 marks)
- (iii) Butterfly spread using calls. (2 marks)
- (b) Lesley Gikenye is an investments practitioner with Wanda Capital and is evaluating the following forward contract positions that affect the company:
1. A 180-day forward contract involving the Mexican Peso (MXN) and the United States Dollar (USD). The risk free rates are 6% in the United States and 8% in Mexico. The current spot exchange rate is \$0.0845.
  2. The company entered into a four-month forward contract to buy 10 million Euro (€) at a price of USD (\$) 1.112 per Euro. A month later, the three-month forward price is \$1.109 per Euro. The USD interest rate is 0.30% and the Euro interest rate is 0.40%.

**Required:**

- (i) Calculate the forward exchange rate for a 180-day forward contract that Wanda Capital should engage in. (3 marks)
- (ii) Calculate the value of Wanda Capital’s forward position in the four-month forward contract. (3 marks)



- (c) Wastaafu Pension Fund owns a Sh.100 million large-Cap position for which the fund manager expects a poor market performance over the next three months. Fund managers have decided to create synthetic cash equal to Sh.100 million exposure.

**Additional information:**

1. Three-month forward contracts are currently at 1,400 with a multiplier of Sh.250.
2. Three-month Treasury rates are estimated at 2.8%.

**Required:**

- (i) The appropriate number of forward contracts to meet the fund manager's desire to create the synthetic cash. (3 marks)
- (ii) Justify why the fund manager's decision to create synthetic cash equal to Sh.100 million exposure is appropriate. (3 marks)
- (iii) Explain to the fund managers of Wastaafu Pension Fund the relevance of pre-investing in risk management. (2 marks)

**(Total: 20 marks)**

**QUESTION THREE**

- (a) Describe **THREE** types of margin used in the futures market. (6 marks)
- (b) Samson Ole Kina manages a family investment portfolio which initially consist of Sh.46 million of equities and Sh.32 million of bonds. As a result of a change in family circumstances, the portfolio is rebalanced using the transactions shown below:

Types of futures contracts	Action	Number of futures contracts to Buy/Sell	Price per futures contract (Sh.)
Equity futures contract	Buy	42	160,000
Bond futures contract	Sell	35	190,000

Three months after these transactions, the market value of the portfolio's equities has increased by 3.00% and the market value of its bonds has decreased by 2.40%. The prices of the equity and bond futures are now quoted at Sh.165,000 and Sh.185,250 respectively.

**Required:**

Calculate the profit or loss on the portfolio over the past three months. (6 marks)

- (c) A portfolio manager expects to purchase a portfolio of stocks in 90 days. In order to hedge against a potential price increase over the next 90 days, he decides to take a long position on a 90 day forward contract on the NSE 20 share index. The index is currently at 1145. The continuously compounded dividend yield is 1.75%. The discrete risk free rate is 4.25%. Twenty eight (28) days after the portfolio has entered the forward contract, the index value is 1225 and at expiration, the index value is 1235. Assume a 365 day year.

**Required:**

Calculate the following:

- (i) The no-arbitrage forward price on this contract. (3 marks)
- (ii) The value of the forward contract 28 days into the contract. (3 marks)
- (iii) The value of the forward contract at expiration. (2 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

- (a) Highlight **FOUR** duties of a Derivatives Exchange in relation to derivative markets. (4 marks)
- (b) Jacob Imanyara, a derivatives trader has obtained the following information about a call option:

- Time to maturity 3 years
- Continuous risk-free rate 3%
- Continuous dividend yield 2%
- $N(d_1)$  0.7

**Required:**

The delta of the call option.

(3 marks)

- (c) The current price of a share is Sh.25. A call option is available with Sh.20 strike price that expires in three months. Assume that the underlying stock exhibits an annual standard deviation of 25 and that, the current risk free rate is 4.5%,  $N(d_1) = 0.9737$  and  $N(d_2) = 0.9652$ .

**Required:**

- (i) The value of the call option using the Black-Scholes-Merton model. (3 marks)
- (ii) Suggest three assumptions of the Black-Scholes-Merton model. (3 marks)
- (d) An Indian company needs to borrow 100 million Kenya Shillings (KES) for one year for its Kenyan subsidiary. The company decides to issue India-denominated bonds in an amount equivalent to KES 100 million. The company then enters into a one year currency swap with a quarterly reset (30/360 day count) and the exchange of notional amounts at initiation and at maturity. At the swaps initiation, the Indian company receives the notional amount in Kenya Shillings and pays the counterparty the notional amount in Indian Rupee. At the swaps expiration, the Indian company pays the notional amount in Kenya Shillings and receives from the counterparty the notional amount in Indian Rupee. Based on interbank rates, the following spot rates are available today, at time 0:

Days to maturity	Kenya Shilling (KES) spot interest rates (%)	Indian Rupee (INR) spot interest rates (%)
90	2.50	0.10
180	2.60	0.15
270	2.70	0.20
360	2.80	0.25

Assume that the counterparties in the currency swap agree to a KES/INR spot exchange rate of 1.140 (expressed as number of Kenya Shilling for 1 INR).

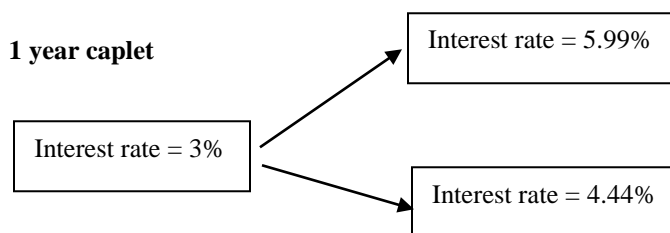
**Required:**

Calculate the fixed swap quarterly payments in the currency swaps in:

- (i) Kenya Shilling (KES). (5 marks)
- (ii) Indian Rupee (INR). (2 marks)
- (Total: 20 marks)**

**QUESTION FIVE**

- (a) Examine **THREE** applications of swaps in derivative markets. (6 marks)
- (b) Gem Holdings Limited purchases a 1 – year cap with annual reset and a strike rate of 5.0% on a notional principal of Sh.25 million. The binomial model below represents a bundle of 1-year option.



**Required:**

The value of a 1 – year caplet. (4 marks)

- (c) Mutemi Karuri is considering a three year receiver swaption with an exercise rate of 11.75% in which the underlying swap is a Sh.20 million notional principal four year swap. The underlying rate is secured overnight financing rate (SOFR). At expiration of the swaption, the SOFR rates are as follows:

Days	Rate (%)
360	10
720	10.5
1080	10.9
1440	11.2

Assume 360 days in a year.

**Required:**

- (i) Calculate the swap fixed rate. (4 marks)
- (ii) Calculate the payoff value of the swaption. (6 marks)

**(Total: 20 marks)**

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**CIFA ADVANCED LEVEL**

**DERIVATIVES ANALYSIS**

**WEDNESDAY: 26 April 2023. Morning Paper.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings. Do NOT write anything on this paper.**

**QUESTION ONE**

(a) Outline **THREE** distinctions between “contingent claims” and “forward commitments” as used in derivatives. (6 marks)

(b) On April 15, the spot price of a bushel of corn is Sh.366, the annual storage cost is Sh.35 per bushel, the risk free rate is 3% and the cost of transportation of corn from the destination point specified on the futures contract to a local grain elevator or vice versa is Sh.3.5 per bushel.

**Required:**

(i) Explain the steps to earn a riskless return on futures contract on the July corn given a futures price of Sh.385 per bushel. (4 marks)

(ii) Calculate the riskless return. (1 mark)

(c) A share index is at 1,521.75 currently and is the underlying of a futures contract expiring in 73 days. The risk-free rate is 6.1%. The value of the dividends reinvested over the life of the future is Sh.5.26.

Assume a 365-day year.

**Required:**

(i) Calculate the present value of the dividends. (2 marks)

(ii) Determine the appropriate futures price. (2 marks)

(iii) Assuming a continuously compounded yield of 1.75%, determine the futures price. (5 marks)

**(Total: 20 marks)**

**QUESTION TWO**

(a) Explain **THREE** changes that have taken place in the regulation of the over the counter market since the 2008 financial crisis. (6 marks)

(b) James Kamonya previously bought ABC Ltd. shares at Sh.12 and now buys the November 15 put for Sh.1.46 and simultaneously writes the November 17 covered call for Sh.1.44.

**Required:**

Calculate the following for a collar position created:

(i) The maximum gain. (2 marks)

(ii) The minimum gain. (2 marks)

(c) Explain the following terms as used in the option markets:

(i) Calendar spread. (2 marks)

(ii) Long straddle. (2 marks)

- (iii) The underlying stock sells for Sh.50 and an investor selects 30 day options with an exercise price of Sh.50. The call sells for Sh.2.29 and the put for Sh.2.28.

**Required:**

Calculate the breakeven points from the above investment strategy. (2 marks)

- (d) An investor takes a short position in 1,000 European call options on stock futures. The options mature in 8 months and the futures contract underlying the call options expires in 9 months. The current 9-month futures price is Sh.8 per stock. The exercise price of the options is Sh.8, the risk free rate is 12% per annum and the volatility is 18% per annum.

**Required:**

Calculate the delta of a short position in 1,000 futures options. (4 marks)

**(Total: 20 marks)**

**QUESTION THREE**

- (a) Explain the purpose of the following price movement limits in futures contract trading:

(i) Daily price limits. (2 marks)

(ii) Position limits. (2 marks)

- (b) An investor contracts his broker to buy two gold futures contracts. The current futures prices of gold is observed at Sh.1,450 per ounce. The investor contracts to buy 200 ounces and that each contract size is 100 ounces.

**Additional information:**

1. Initial margin requirement is Sh.6,000 per contract.
2. Maintenance margin is Sh.4,500 per contract.
3. The contract is entered into on Day 1 and closed out on Day 7.
4. Daily settlement prices were observed as follows:

Day	Settlement Price Sh.
1	1,441.00
2	1,438.30
3	1,444.60
4	1,441.30
5	1,440.10
6	1,436.20
7	1,429.90

**Required:**

- (i) Determine the end of the day account balance for a long position in two gold futures contracts for day 2 to day 7. (8 marks)

- (ii) Determine the variation margin balance amount by end of day 7. (2 marks)

- (c) A portfolio manager manages a portfolio of Sh.5,000,000 and desires to increase the beta of this portfolio from its current value of 0.8 to 1.1 using futures contracts. The beta of the chosen future contract is 1.05 with a price of Sh.240,000.

**Required:**

- (i) The number of futures contracts to achieve a beta of 1.1 for the portfolio. (2 marks)

- (ii) The unhedged portfolio value increased in value by 5.1% and the futures price increases in value by 5.1% with one month remaining to the futures contract expiration. The market had a return of 5.2 %.

**Required:**

The realised effective beta (ex-post beta) for the hedged portfolio. (4 marks)

**(Total: 20 marks)**

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**QUESTION FOUR**

- (a) With respect to swap markets and contracts, distinguish between a “plain vanilla interest rate swap” and a “basis swap”. (4 marks)
  
- (b) 300 days into a quarterly – pay swap currency contract after initiation, a derivatives analyst gathers the following data:
  - 1. 60-day Dollar (\$) interest rate is 5.4%.
  - 2. 60-day Pound (£) interest rate is 6.6%.
  - 3. The exchange rate is £ 0.52 per \$.
  - 4. The 90-day \$ and £ interest rates on the last settlement date were 5.6% and 6.4% respectively.
  - 5. The fixed £ rate is 6.8%.

**Required:**

- (i) The present value in Dollars (\$) of a \$5,000,000 swap of the \$ floating side. (3 marks)
  
  - (ii) The present value in Pounds (£) of a £ 2,500,000 counter party to the swap in (b) (i) above (£ fixed side). (3 marks)
  
  - (iii) The value of the receive \$ floating pay £ fixed side of the swap. (3 marks)
- (c) Jackline Mutua, an investment analyst with Cooperative capital is analysing the company’s forward rate agreement (FRA) the company is exposed to and has gathered the following information:
- 1. The contract is 5.32%, 1 × 4 FRA with a principal amount of Sh.1 million.
  - 2. 10 days have lapsed from initiation of the contract and the 110 days London Interbank Offered Rate (LIBOR) is 5.9% with 20-day LIBOR quoted at 5.7%.

Assume a 360-day year.

**Required:**

- (i) Price of the FRA 10 days into the contract. (3 marks)
  
  - (ii) Present value of the FRA discounted at the 110-day rate. (4 marks)
- (Total: 20 marks)**

**QUESTION FIVE**

- (a) Outline **SIX** functions of the financial futures market. (6 marks)
  
- (b) The price of a 1-year put on a stock of KM limited with an exercise price of Sh.70 is Sh.5 and the forward price of the contract expiring in one year is Sh.81. The annual risk free rate is 10%.

**Required:**

Calculate the price of call option on a stock of KM Ltd. with an exercise price of Sh.70 that expires in one year using the put-call forward parity. (3 marks)

- (c) A bond fund manager purchases a five-year credit default swap (CDS) on BBB rated bond at the 2% spread. One year later the economy becomes weaker, causing credit spreads on four year BBB rated bonds and new CDS spread to increase to 2.5%. The bond fund manager sold his 2% CDS to a swap bank who hedged the CDS by selling a new 2.5% CDS on the four year BBB rated bond. The discount rate is 6% and the national amount is Sh.100 million.

**Required:**

Determine the maximum amount that the swap bank would pay the bond manager for assuming the CDS swap. (4 marks)

- (d) A firm has entered into a swap agreement for a national principal of Sh.100 million with a bank where bank paid 9% fixed and received secured overnight financing rate (SOFR) semiannually. It has 3 more years to go and has just exchanged the cash flow. The 6 month SOFR for the next payment of interest was reset at 8%. Next day, the market exhibited a fall and the 6 month SOFR fell to 7% leading the firm to believe that it is overpaying. It wants to cancel the swap arrangement.

**Required:**

Determine how much the firm should ask the bank to pay to cancel the swap deal. (7 marks)

**(Total: 20 marks)**

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**CIFA ADVANCED LEVEL**

**DERIVATIVES ANALYSIS**

**WEDNESDAY: 7 December 2022. Morning Paper.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings. Do NOT write anything on this paper.**

**QUESTION ONE**

- (a) Outline **FOUR** differences between a cash market and a derivative market. (4 marks)
- (b) Explain **THREE** types of forward commitment contracts. (6 marks)
- (c) Joan Akoth believes she has identified an arbitrage opportunity for a commodity as indicated by the information provided below:

Spot price for commodity	Sh.120
Futures price for commodity expiring in 1 year	Sh.125
Interest rate for one year	8%

**Required:**

- (i) Describe **THREE** transactions necessary to take advantage of this specific arbitrage opportunity. (3 marks)
- (ii) Calculate the arbitrage profit. (3 marks)
- (iii) Describe **FOUR** market imperfections that could limit Joan's ability to implement this arbitrage strategy. (4 marks)

**(Total: 20 marks)**

**QUESTION TWO**

- (a) Describe **THREE** types of risks involved in forward contract. (6 marks)
- (b) Babito Fund manager is evaluating various investment holdings in their portfolio and they have gathered the following information:
1. They are exposed to a four month forward to buy a zero coupon bond that will mature in one year. The current price of the bond is Sh.930 and the continuously compounded risk free rate of return is 6% per annum.
  2. A three month all share index (currently at 400) futures contract with a continuously compounded dividend yield of 1% per annum and 6% interest rate (risk free rate).
  3. A one year futures contract on gold costs Sh.20 per 10 gm to store it with payment made at the end of the year. Spot rate is observed at Sh.900 with a risk free rate of 7% per annum compounded continuously.

**Required:**

Using the cost-of-carry model, calculate:

- (i) The appropriate forward price on the zero coupon bond. (2 marks)
- (ii) The arbitrage free future price of the index. (2 marks)
- (iii) The theoretical price of the futures price on gold. (2 marks)

- (c) Zipro Limited is considering a swap in which they will pay the floating rate and receive the return on equity. The equity swap is for one year involving floating quarterly payments on 90 day, 180 day, 270 day and 360 day whose underlying is a 90-day London interbank offered rate (LIBOR) and receiving return on equity.

Annualised LIBOR rates are as follows:

Lo(90)	=	3.45%	Lo(270)	=	3.7%
Lo(180)	=	3.58%	Lo(360)	=	3.75%

**Required:**

- (i) Calculate the swap fixed rate. (4 marks)
- (ii) 60 days into the swap, the stock index is at 1436.59 while at the swap initiation the index was at 1405.72. The present value factors are 0.9965, 0.9858, 0.9751 and 0.9643 respectively, 60 days into the swap.

Calculate the swap market value with a Sh.1 notional principal.

(4 marks)

**(Total: 20 marks)**

**QUESTION THREE**

- (a) Assess **THREE** functions of a clearing house in relation to contract. (6 marks)

- (b) A British company intends to issue a five-year bond with £100 million at 4.5% but actually needs an equivalent amount in dollars, \$1.50 million (current \$/£ exchange rate is \$1.50/£) to finance operations in the United States (US). A US company intends to issue \$150 million bonds at 6% maturing in 5 years and needs £100 million to invest in London. To meet each other's needs, both parties enter into a swap.

**Required:**

- (i) Explain the structure of the swap agreement. (2 marks)
- (ii) Determine the amount that the British and US companies would spend on interest. (2 marks)
- (iii) Evaluate the transactions that would take place at maturity of the swap. (2 marks)
- (c) Fanaka Investments are considering a share worth Sh.49 at the securities exchange. They establish that a call option with an exercise price of Sh.50 costs Sh.6.25 and a put with an exercise price of Sh.50 cost Sh.5.875. Suppose Fanaka Investments goes ahead and buys a straddle.

**Required:**

- (i) Differentiate between a "straddle" and a "strangle" as used in option derivative. (2 marks)
- (ii) Determine the value and profit at expiration from the straddle if price of the share at expiration is Sh.61. (2 marks)
- (iii) The maximum loss from the straddle. (2 marks)
- (iv) The breakeven price at expiration from the straddle. (2 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

- (a) Describe **TWO** ways of settling a forward contract. (4 marks)
- (b) Discuss **THREE** challenges of artificial intelligence (AI) in derivatives market. (6 marks)
- (c) European put and call options with an exercise price of Sh.90 expire in 115 days. The underlying is priced at Sh.96 and makes no cash payments during the life of the options. The applicable risk free rate for these instruments is 4.5%. The put recently has sold for Sh.7.50 and the call Sh.16.00.

Assume a 365-day year.

**Required:**

Determine whether there is any mispricing present in the option markets by comparing the price of the actual call with the price of the synthetic call. (4 marks)



(d) Salim Karisa is a derivatives analyst and is interested in the valuation of a call option on Beta Company using a one period binomial option pricing model. The underlying stock is a non dividend paying stock. Salim gathers the following data:

1. The current share price is Sh.50 and the call option exercise price is Sh.50.
2. In one period, the share price will either rise to Sh.56 or decline to Sh.46.
3. The risk free rate of return is 5%.

**Required:**

Calculate the following:

- (i) The optimal hedge ratio for the call option. (2 marks)
- (ii) The risk-neutral probability of the up move for the Beta stock. (2 marks)
- (iii) The value of the call option using the binomial model. (2 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

- (a) Discuss **THREE** weaknesses of delta hedging as a risk management strategy in derivatives contracts. (6 marks)
- (b) Eliud Dande is a portfolio manager and oversees a balanced fund. The balanced fund has a current market value of Sh.700 million and a current allocation of 65% equity with an equity beta of 1.12 and 35% fixed income with a modified duration of 6.55.

Eliud Dande believes that reported earnings will be better than those anticipated by the market and based on this short-term market view, he decides to use futures contract to adjust the allocation of the balanced fund to 80% equity and 20% fixed income for the next three months. Dande wants to maintain the balanced fund's current equity beta and modified duration.

Dande plans to use the stock equity index futures and Treasury bond futures to execute his transaction. He gathers the data for the two contracts as shown below:

**Selected futures contract data:**

Contract underlying index price (Sh.)	Futures Beta	Implied modified duration
Broad equity index 94,505	0.97	—
Broad government bond index 99,100	—	7.15

**Additional information:**

1. Both contracts expire three months from today.
2. The risk free rate is 1.85%.
3. Yield beta for the Treasury bond contract is 1.00.

**Required:**

Compute:

- (i) The number of stock index futures contract that Eliud Dande should buy in order to achieve the adjusted allocation. (3 marks)
  - (ii) The number of Treasury bond contracts that Eliud Dande should sell in order to achieve the adjusted allocation. (3 marks)
- (c) An investor has a short position in put options on 5000 shares of stock. Call option delta is given as 0.532 while put option delta is given as -0.419. Assume that each option has one share of stock as the underlying.

**Required:**

- (i) The pre-existing portfolio given that the hedging instrument is stock. (3 marks)
- (ii) The pre-existing portfolio given that the hedging instrument is call options. (3 marks)
- (iii) Outline **TWO** assumptions of the Black model used in the valuation of European options on futures. (2 marks)

**(Total: 20 marks)**

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**CIFA ADVANCED LEVEL**

**PILOT PAPER**

**DERIVATIVES ANALYSIS**

**DECEMBER 2021**

**Time Allowed: 3 hours**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

- (a) With respect to the requirement for posting margin accounts by option holders and writers, explain the distinction of options from forwards and futures. (5 marks)
- (b) Explain some of the reasons why investors may find options useful. (5 marks)
- (c) Consider a stock index option that expires in 75 days. The stock index is currently at 1240.89 and makes no cash payments during the life of the option. Assuming that the stock index has a multiplier of 1 and the risk free rate is 3%, Calculate the lowest and highest possible prices for European style put options on the above stock index with exercise prices of:
- (i) 1225 (3 marks)
- (ii) 1255 (3 marks)
- (d) A stock currently trades at a price of Sh.100. The stock price can go up to 10% or down 15%. The risk free rate is 6.5%. Use a one period binomial model to calculate the price of a call option with an exercise price of Sh. 90. (4 marks)
- (Total: 20 marks)**

**QUESTION TWO**

- (a) With respect to option trading strategies, discuss the notion that strangles and straddles are strategies for those who feel the asset is going to be more volatile without a clear upwards or downwards tendency. (5 marks)
- (b) Distinguish between a “long strangle” strategy from a “short strangle” strategy while trading options. (5 marks)
- (c) A 45-day T-bill has a discount rate of 5.50 percent. A 135-day T-bill has a discount rate of 5.95 percent.
- (i) What should be the price of a futures contract that expires in 45 days? Assume Sh. 1 par value. (5 marks)
- (ii) Show that the purchase of a 135-day T-bill, with its price in 45 days hedged by the sale of a 45-day futures contract that calls for the delivery of a 90-day T-bill, is equivalent to purchasing a 45-day T-bill and holding it to maturity. (5 marks)
- (Total: 20 marks)**

**QUESTION THREE**

- (a) Each futures exchange has its own clearing house. Describe the role that is played by the clearing house. (5 marks)
- (b) Describe how the futures exchange clearing houses limit their own counter party risk as they guarantee the financial integrity of the futures exchanges. (5 marks)

- (c) Consider an asset priced at Sh. 90. A futures contract on the asset expires in 75 days. The risk free interest rate is 7%.
- (i) Find the appropriate futures price if the underlying asset has no storage costs, cash flows or convenience yield. (5 marks)
  - (ii) Find the appropriate futures price if the underlying assets storage costs at the futures expiration equal Sh.3. (5 marks)
- (Total: 20 marks)**

**QUESTION FOUR**

- (a) Explain two reasons why use of a market maker is advantageous to counter parties in the swap market. (5 marks)
  - (b) Describe the three major types of participants in the swap market. (5 marks)
  - (c) A Kenyan company enters into a currency swap in which it pays a fixed rate of 6% in dollars and the counter party pays a fixed rate of 5% in Kenya shillings. The notional principals are Kshs. 75 million and \$10.5 million. Payments are made semiannually and on the basis of 30 days per month and 360 days per year.
    - (i) Calculate the initial exchange of payments that take place at the beginning of the swap. (3 marks)
    - (ii) Calculate the semi-annual payments. (3 marks)
    - (iii) Calculate the final exchange of payments that takes place at the end of the swap. (4 marks)
- (Total: 20 marks)**

**QUESTION FIVE**

Consider a fund manager who expects to receive a cash inflow of Shs. 30 Million in two months. The manager wishes to use futures contracts to take a Shs. 21 Million synthetic position in stocks and Shs. 9 Million in bonds today. The stock would have a Beta of 1.25 and the bonds a modified duration of 6.56. A stock index futures contract with a Beta of 0.96 is priced at Shs. 225,130. A bond futures contract with a modified duration of 7.25 is priced at Shs. 105,120.

- (a) Calculate the number of stock and bond futures contracts the fund manager would have to trade in order to synthetically take the desired position in stock and bonds today. Indicate whether the futures positions are long or short. (10 marks)
- (b) When the futures contract expires in two months, stocks have risen by 3.75% and bonds have declined by 2.3%. Stock index futures are priced at Shs. 231,614 and bond futures are priced at Shs. 102,453.

Illustrate how the profits on the futures positions are essentially the same as the change in the value of stocks and bonds during the two-month period. (10 marks)

**(Total: 20 Marks)**

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**CIFA ADVANCED LEVEL**

**DERIVATIVES ANALYSIS**

**WEDNESDAY: 3 August 2022. Morning paper.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings. Do NOT write anything on this paper.**

**QUESTION ONE**

- (a) Discuss three features of derivatives. (6 marks)
- (b) Cite four reasons why exotic derivative products have become popular in the recent past. (4 marks)
- (c) Describe two reasons for hedging an equity portfolio. (4 marks)
- (d) Good Life Investment Consultants are managing bond investments portfolio for their clients worth Sh.100 million with a duration of 1.5 years. They are considering increasing the duration of their bond portfolio to 3.5 years through the use of a swap. They estimate that the duration of a fixed-rate bond is 75% of its maturity.

**Required:**

- (i) Advise Good Life Investments Consultants on whether to enter into a swap paying fixed and receiving floating or paying floating and receiving fixed. Justify your answer. (2 marks)
- (ii) Using suitable computations, advise whether Good Life Investments Consultants on whether it should choose a four year swap with quarterly payments or a three-year swap with semi-annual payments. (2 marks)
- (iii) Determine the most appropriate notional principal of the swap to be employed. (2 marks)

**(Total: 20 marks)**

**QUESTION TWO**

- (a) Explain the following terms as used in futures exchanges:

- (i) Floor trader. (1 mark)
- (ii) Scalper. (1 mark)
- (iii) Day trader. (1 mark)
- (iv) Position trader. (1 mark)

- (b) Daniel Kioko is analysing a recently purchased call option on Nebo Ltd.'s share with an exercise price of Sh.35 and a premium of Sh.3.20.

**Required:**

- (i) The payoffs and profits for the call option at expiration assuming the prices of Nebo Ltd.'s share are estimated at Sh.30, Sh.35 and Sh.40 respectively. (2 marks)
- (ii) The break-even price assuming that there are no transaction costs. (2 marks)

- (c) An investor is considering a one year currency swap with semiannual payments. The two currencies are the Kenya Shilling (KES) and the United States Dollar (USD). The current exchange rate is 110 KES per USD.

The current Kenya term structure is as follows:

$$L_0(180) = 0.0623$$

$$L_0(360) = 0.0665$$

The secured overnight financing rate (SOFR) term structure is

$$L_0(180) = 0.0563$$

$$L_0(360) = 0.0580$$

60 days later, the new exchange rate is 115 KES per USD

The new Kenya term structure is:

$$L_{60}(120) = 0.0585$$

$$L_{60}(300) = 0.0605$$

The new SOFR term structure is:

$$L_{60}(120) = 0.0493$$

$$L_{60}(300) = 0.0505$$

The notional amount is Sh.1.

**Required:**

- (i) The annualised fixed rates for shilling and dollar. (4 marks)
- (ii) The market value (in shillings) of pay shilling fixed and receive dollar fixed swap. (2 marks)
- (iii) The market value (in shillings) of pay floating and receive dollar fixed swap. (2 marks)
- (iv) The market value (in shillings) of pay floating and receive dollar floating swap. (2 marks)
- (v) The market value (in shillings) of pay fixed and receive dollar floating swap. (2 marks)

(Total: 20 marks)

**QUESTION THREE**

- (a) With reference to risk management using forward contracts and futures contracts, examine three instances where a short hedge and a long hedge are appropriate. (3 marks)
- (b) Pepino Limited is a company incorporated in Kenya and has a South African subsidiary that generates 10 million South African Rands (ZAR) a year. Pepino Limited would like to lock in the rate at which it converts ZAR to Kenya Shillings using a currency swap. The fixed rate on a currency swap in South Africa Rands is 4% and the fixed rate on a currency swap in Kenya Shillings is 5%.

The current exchange rate is 1 KES = 0.825 ZAR.

**Required:**

- (i) The notional principal in South Africa Rands and Kenya Shilling for a swap with annual payments that will achieve Pepino Limited's objective. (2 marks)
- (ii) The overall periodic cash flow from the subsidiary operations and the swap. (3 marks)
- (c) An asset manager enters into an equity swap in which he receives the return of MSE share index in return for paying the return on BJIA index. At the start of the swap, the MSE share index is at 4781.9 and the BJIA is at 9867.33.

**Required:**

The market value of the swap three months later when the MSE share index is at 5242.9 and BJIA is at 10016. Assume that notional principal of the swap is Sh.15 million. (3 marks)

- (d) Raki Limited is a Kenyan Company that occasionally undertakes short-term loans denominated in US dollars. Raki Limited uses forward rate agreement (FRA) to lock in the rate of such loans as soon as it determines that it will need the money. The underlying being the 180-day London interbank offered rate (LIBOR) at a FRA rate of 5.25%.

On 15 April 2022, Raki Limited determines that it will borrow Sh.40 million on 20 August 2022. The loan is to be repaid 180 days later (16 February 2023) and the rate will be at LIBOR plus 200 basis points. Raki Limited decides to go long on FRA thereby enabling it to receive the difference between LIBOR on 20 August 2022 and the FRA rate quoted by the dealer on 15 April 2022 of 5.25%.

Raki Limited locks in a 7.25% rate that is 5.25% plus 200 basis points. At contract expiration, that is, 20 August 2022, 180 day LIBOR is at 6%.

**Required:**

- (i) Describe how the FRA will be executed. (1 mark)
- (ii) Compute the FRA payoff. (2 marks)
- (e) In 60 days, a bank plans to lend Sh.10 million for 180 days. The lending rate is secured overnight financing rate (SOFR) plus 200 basis points. The current SOFR is 4.5%. The bank buys an interest rate put that matures in 60 days with a notional principal of Sh.10 million and a strike rate of 4.3%. The put premium is Sh.4,000.

At expiration, SOFR is at 4.1%.

**Required:**

Calculate the effective annual rate of the loan.

(6 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

- (a) Kennedy Mwangi owns a dividend paying stock currently worth Sh.150. He plans to sell the stock in 250 days. In order to hedge against a possible price decline, he takes a short position in a forward contract that expired in 250 days. The risk free rate is 5.25%. Over the next 250 days, the stock will pay dividends according to the following schedule:

Days to next dividend	Dividend per share (Sh.)
30	1.25
120	1.25
210	1.25

**Additional information:**

- 100 days after the forward contract is entered, the stock price declines to Sh.115.
- At expiration, the stock price is at Sh.130.  
There are 365 days in a year.

**Required:**

- (i) The forward price of a contract established today and expiring in 250 days. (3 marks)
- (ii) The value of a forward contract after 100 days of entering the forward contract. (3 marks)
- (iii) The value of the forward contract at its expiration. (2 marks)
- (b) A futures contract on a Treasury bill expires in 50 days. The treasury bill matures in 140 days. The discount rates on treasury bills are as follows:
- |                       |      |
|-----------------------|------|
| 50 day Treasury bill  | 5.0% |
| 140 day Treasury bill | 4.6% |

**Required:**

- (i) Determine the appropriate futures price by using the prices of the 50 and 140 day Treasury bill. (3 marks)
- (ii) Find the futures price in terms of the underlying spot price compounded at the appropriate risk free rate. (3 marks)
- (iii) Convert the futures price to the implied discount rate on the futures. (2 marks)
- (c) An investor holds a futures contract whose underlying is the MSE share index. Assume the following:
- The maturity of the futures contract is close to the maturity hedge.
  - Ignore the daily settlement of futures contract.

**Additional information:**

- The value of the MSE share index is 2000 and the portfolio value is Sh.5,000,000.
- The risk free rate is 10% per annum and dividend yield is 4% per annum.
- The Beta of the portfolio is 1.5.
- A futures contract on the MSE share index with four months to maturity is used to hedge the portfolio value over the next three months where one futures contract is for delivery of 250 times the index.

**Required:**

- (i) The current futures price. (2 marks)
  - (ii) The number of futures contracts needed to be shorted to hedge the portfolio. (2 marks)
- (Total: 20 marks)**

**QUESTION FIVE**

- (a) With reference to credit derivatives:
  - (i) Explain three applications of index credit default swap (CDS) deals. (3 marks)
  - (ii) Highlight four terms and conditions that a protection buyer and seller need to agree in a Credit Default Swap (CDS). (4 marks)
- (b) Discuss the following concepts of option moneyness:
  - (i) In-the-money options. (2 marks)
  - (ii) At-the-money options. (2 marks)
  - (iii) Out-of-the-money options. (2 marks)
- (c) Wembe Ltd.'s shares are currently trading at Sh.6.10 per share. The dividend paid was Sh.0.50 per share. Assume that dividends are only paid annually. A European option exists on shares with an exercise price of Sh.5 with one year to maturity. The risk-free rate is 8% and the variance of the rate of return on the share is 12%.

**Required:**

The value of the call option using the Black-Scholes option pricing model.

(7 marks)  
**(Total: 20 marks)**

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CIFA ADVANCED LEVEL

DERIVATIVES ANALYSIS

WEDNESDAY: 6 April 2022. Morning paper.

Time Allowed: 3 hours.

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings. Do NOT write anything on this paper.

QUESTION ONE

- (a) Explain three advantages of options compared to futures contracts in derivatives market. (6 marks)
- (b) Describe the role of each of the four participants in the derivatives market. (4 marks)
- (c) John Mutwiri owns a Sh.100 face value bond that pays 8% semi-annual coupon. The bond has 10 years to maturity and has 6% as its yield. John is considering entering into a futures contract that calls for the delivery of this bond whose current price is Sh.114.88. The futures contract is for 1½ years.

**Required:**

The price of the futures contract assuming a risk free rate of 5%. (4 marks)

- (d) Prestige Investment Limited anticipates that it will require Sh.15 million for an upcoming project that is supposed to start 60 days from now. The company intends to borrow the Sh.15 million in 60 days time at 90-day London Interbank Offered Rate (LIBOR) plus 100 Basis Points using a forward rate agreement (FRA) expiring in 60 days. The FRA that will lock the interest rate at 6% per annum based on a Eurodollar that matures 150 days from today. 60 days later, the LIBOR is at 7.5% per annum.

**Required:**

The effective borrowing rate that the company will pay assuming the LIBOR in 60 days is 7.5%.

Assume a 360 day year.

(6 marks)

(Total: 20 marks)

QUESTION TWO

- (a) Evaluate four roles of derivatives market in the finance industry. (4 marks)
- (b) An equity portfolio manager currently has Sh.95 million equity position in the financial sector. He wants to convert this equity position to cash for a period of six months, without liquidating his holdings.

**Additional information:**

1. An equity futures contract that expires in six months is priced at Sh.1,564 and has a multiplier of 100.
2. The dividend yield on the underlying index is 0.45%.
3. The risk free rate is 5.75%.

**Required:**

- (i) The number of futures contract required to create synthetic cash. (2 marks)
- (ii) The effective amount of money committed to the risk free asset and the effective number of units of the stock index that are converted to cash. (4 marks)
- (iii) Describe how this strategy produces an outcome equivalent to investing in cash at the beginning of the six month period given that the stock index is at 1,735 when the futures contract expires. (2 marks)
- (c) Monica Chebet is the corporate treasurer of BPR Investment Bank Ltd. which has a 4-year Sh.200 million floating rate Note (FRN) outstanding at London Interbank Offered Rate (LIBOR). Monica Chebet is concerned about rising interest rates in the short term and she would like to refinance the loan at a fixed rate for the next two years. A swap dealer arranges a 2-year plain vanilla interest rate swap with annual payments of 8.1% and receives LIBOR. The counterparty receives 7.9% and pays LIBOR. The counterparty has a Sh.200 million fixed rate debt outstanding at 8%.



One year LIBOR is currently quoted at 7%.

**Required:**

- (i) The net borrowing costs to BPR Investment Bank Ltd. and counterparty's net borrowing costs. (2 marks)
- (ii) The swap dealer's spread and BPR Investment Bank Ltd. fixed rate payment at the end of first year LIBOR being 7%. (2 marks)
- (iii) Total interest costs borne by BPR Investment Bank Ltd. and the counterparty's fixed rate receipt under the swaps. (2 marks)
- (iv) Cash flows to the swap dealer. (2 marks)

**(Total: 20 marks)**

**QUESTION THREE**

(a) Differentiate between the following types of margins used in the futures market:

- (i) Initial margin. (1 mark)
- (ii) Maintenance margin. (1 mark)
- (iii) Variation margin. (1 mark)

(b) Describe five differences between "futures contract" and "forward contracts" (5 marks)

(c) A derivatives trader is considering a two period binomial model in which a share currently trades at a price of Sh.65. The share price can either go up 20% or down 17% each period. The risk free rate is 5%. The exercise price is Sh.70.

**Required:**

The price of the put option expiring in two periods. (7 marks)

(d) A portfolio manager has a portfolio with a total market value of Sh.1,000,000. The portfolio is allocated 60% to MSE all share index and 40% to Matunda Limited shares which are currently trading for Sh.30 per share. The portfolio manager wishes to reduce exposure to Matunda Limited to not more than 25% of the overall portfolio. He plans to achieve this by entering into a 2-year equity swap which will use the MSE 20 share index. The settlement will be made at the end of each year. The return on the Matunda Limited shares is projected at 5% and the return on the MSE 20 share index at 6%.

**Required:**

(i) Explain the structure of the swap by calculating the amount involved. (3 marks)

(ii) Evaluate the net cash flow for the swap at the end of year one. (2 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

(a) Assess three applications of swaptions in derivatives markets. (6 marks)

(b) Propose two application of artificial intelligence (AI) and financial technology in derivatives market. (4 marks)

(c) Bureti Ltd. is a floating rate borrower. It takes out a Sh.20 million one year loan on 1 March. The loan is an interest-only loan, requiring quarterly interest payments on the first day of each corresponding month. 1 June, 1 September, 1 December and 1 March of the following year and the full principal payment at the end. The interest rate is a 90 day Secured Overnight Financing Rate (SOFR) plus 1.5%. Current 90 day SOFR is 6%, which sets the rate for the first three month period at 7.5%. The rates are reset every three months. The firm manages the risks of rising interest rates over the life of the loan by purchasing an interest rate cap and offsetting the cost of the cap by selling an interest rate floor. It chooses an interest rate cap with an exercise rate of 6.25%. The component caplets expire on the rate reset dates. To generate a floor premium sufficient to offset the cap premium, Bureti Ltd. sells a floor with an exercise rate of 5.25%. Assume there are 360 days in a year.

The SOFR on the following dates is given as follows:

1 June	: 6.50%
1 September	: 5.50%
1 December	: 5.00%

**Required:**

Determine the effective interest payments.

(6 marks)

- (d) ABW Ltd. shares currently sells for Sh.36. In the next 6 months, the share price will either increase to Sh.42 or decrease to Sh.31. The risk free rate of return is 4% per year.

**Required:**

The current market price on a call option on the ABC Ltd.'s shares assuming its term to expiration is 6 months and its strike price is Sh.35. (4 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

- (a) In relation to the Black-Scholes-Merton Model (BSM) used in options valuation:

(i) Describe three inputs of the BSM. (3 marks)

(ii) Outline three criticisms of the BSM. (3 marks)

- (b) A derivative analyst is considering a European receiver swaption that expires in two years and is on a one year swap that will make quarterly payments. The swaption has an exercise rate of 6.5%. The notional principal is Sh.100 million. At expiration, the term structure of interest rates is as follows:

Lo (90) = 0.0373

Lo (180) = 0.0429

Lo (270) = 0.0477

Lo (360) = 0.0538

**Required:**

(i) The market value of the swaption at expiration. (6 marks)

(ii) Show that the payoff is equivalent to that of a call option on a bond with an exercise price of Sh.1. (2 marks)

- (c) Country A has a risk free rate of 6% while country B has a risk free rate of 4% and the spot exchange rate (direct quote) between Country A and Country B is Sh.0.6667.

**Required:**

(i) The continuously compounded country A and country B risk free rates. (1 mark)

(ii) The price at which an investor could enter into a forward contract that expires in 90 days. (2 marks)

(iii) The value of the forward position 25 days into the contract assuming that the spot rate is Sh.0.65. (3 marks)

**(Total: 20 marks)**

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Present Value Interest factor of 1 Received at the End of  $n$  Periods at  $r$  Percent:

$$PVIF_{r,n} = 1 / (1+r)^n = (1+r)^{-n}$$

Period	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	18%	20%	25%	30%
1	0.9901	0.9804	0.9708	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850	0.8772	0.8696	0.8621	0.8333	0.8065	0.7808	0.7562
2	0.9803	0.9612	0.9426	0.9246	0.9070	0.8900	0.8734	0.8573	0.8417	0.8264	0.8116	0.7972	0.7831	0.7695	0.7561	0.7432	0.6844	0.6584	0.6340	0.6107
3	0.9706	0.9423	0.9151	0.8890	0.8638	0.8396	0.8163	0.7938	0.7722	0.7513	0.7312	0.7118	0.6931	0.6750	0.6575	0.6407	0.5718	0.5452	0.5206	0.4974
4	0.9610	0.9238	0.8885	0.8548	0.8227	0.7921	0.7629	0.7350	0.7084	0.6830	0.6587	0.6355	0.6133	0.5921	0.5718	0.5523	0.4823	0.4552	0.4306	0.4074
5	0.9515	0.9057	0.8626	0.8219	0.7835	0.7473	0.7130	0.6806	0.6499	0.6209	0.5935	0.5674	0.5426	0.5194	0.4972	0.4761	0.4061	0.3785	0.3549	0.3321
6	0.9420	0.8880	0.8375	0.7903	0.7462	0.7050	0.6663	0.6302	0.5963	0.5645	0.5346	0.5066	0.4803	0.4556	0.4325	0.4104	0.3404	0.3128	0.2892	0.2674
7	0.9327	0.8708	0.8131	0.7599	0.7107	0.6651	0.6227	0.5825	0.5440	0.5081	0.4738	0.4411	0.4099	0.3799	0.3511	0.3236	0.2536	0.2260	0.2024	0.1816
8	0.9235	0.8536	0.7894	0.7307	0.6761	0.6254	0.5782	0.5343	0.4934	0.4552	0.4195	0.3861	0.3547	0.3244	0.2961	0.2698	0.1998	0.1722	0.1486	0.1278
9	0.9143	0.8388	0.7684	0.7046	0.6495	0.5984	0.5511	0.5079	0.4684	0.4319	0.3978	0.3658	0.3357	0.3075	0.2811	0.2558	0.1858	0.1582	0.1346	0.1138
10	0.9053	0.8263	0.7504	0.6819	0.6264	0.5749	0.5272	0.4839	0.4447	0.4091	0.3757	0.3442	0.3144	0.2861	0.2597	0.2344	0.1644	0.1368	0.1132	0.0924
11	0.8963	0.8143	0.7334	0.6607	0.5988	0.5458	0.4977	0.4541	0.4146	0.3795	0.3466	0.3156	0.2863	0.2587	0.2329	0.2076	0.1376	0.1100	0.0864	0.0656
12	0.8874	0.7995	0.7146	0.6387	0.5764	0.5231	0.4746	0.4306	0.3907	0.3553	0.3221	0.2907	0.2611	0.2331	0.2066	0.1813	0.1113	0.0837	0.0601	0.0403
13	0.8787	0.7778	0.6894	0.6095	0.5468	0.4931	0.4442	0.4000	0.3597	0.3239	0.2903	0.2586	0.2285	0.2002	0.1737	0.1484	0.0784	0.0508	0.0272	0.0074
14	0.8700	0.7579	0.6651	0.5819	0.5188	0.4647	0.4154	0.3709	0.3302	0.2941	0.2601	0.2279	0.1973	0.1690	0.1425	0.1172	0.0472	0.0196	0.0060	0.0042
15	0.8613	0.7370	0.6410	0.5553	0.4910	0.4363	0.3866	0.3417	0.3006	0.2641	0.2307	0.1990	0.1687	0.1397	0.1122	0.0869	0.0169	0.0093	0.0057	0.0039
16	0.8528	0.7264	0.6272	0.5390	0.4744	0.4193	0.3692	0.3239	0.2824	0.2455	0.2118	0.1806	0.1505	0.1215	0.0938	0.0685	0.0085	0.0049	0.0033	0.0025
17	0.8444	0.7142	0.6120	0.5214	0.4564	0.4010	0.3506	0.3049	0.2631	0.2258	0.1918	0.1602	0.1297	0.1011	0.0734	0.0481	0.0081	0.0045	0.0029	0.0021
18	0.8360	0.7022	0.5974	0.5036	0.4382	0.3825	0.3318	0.2858	0.2437	0.2059	0.1725	0.1405	0.1095	0.0805	0.0528	0.0275	0.0075	0.0039	0.0023	0.0015
19	0.8277	0.6904	0.5826	0.4856	0.4198	0.3638	0.3128	0.2665	0.2241	0.1858	0.1521	0.1198	0.0885	0.0591	0.0314	0.0061	0.0025	0.0009	0.0003	0.0001
20	0.8195	0.6770	0.5657	0.4654	0.3993	0.3430	0.2917	0.2451	0.2024	0.1637	0.1296	0.0968	0.0651	0.0361	0.0081	0.0025	0.0009	0.0003	0.0001	0.0001
21	0.8114	0.6658	0.5515	0.4488	0.3824	0.3258	0.2741	0.2271	0.1841	0.1449	0.1105	0.0773	0.0451	0.0161	0.0005	0.0001	0.0001	0.0001	0.0001	0.0001
22	0.8034	0.6568	0.5391	0.4338	0.3671	0.3102	0.2581	0.2107	0.1674	0.1268	0.0921	0.0589	0.0261	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
23	0.7954	0.6482	0.5274	0.4196	0.3525	0.2953	0.2428	0.1949	0.1512	0.1099	0.0758	0.0423	0.0091	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
24	0.7876	0.6377	0.5138	0.4036	0.3362	0.2787	0.2258	0.1774	0.1333	0.0916	0.0571	0.0234	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
25	0.7799	0.6285	0.4999	0.3874	0.3197	0.2619	0.2086	0.1598	0.1153	0.0733	0.0385	0.0046	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
26	0.7723	0.6200	0.4878	0.3738	0.3058	0.2477	0.1941	0.1449	0.1001	0.0577	0.0226	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
27	0.7648	0.6124	0.4816	0.3653	0.2969	0.2385	0.1845	0.1349	0.0900	0.0473	0.0120	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
28	0.7574	0.6050	0.4759	0.3574	0.2887	0.2300	0.1757	0.1257	0.0806	0.0376	0.0017	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
29	0.7500	0.5977	0.4705	0.3507	0.2817	0.2227	0.1682	0.1178	0.0724	0.0292	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
30	0.7427	0.5904	0.4642	0.3431	0.2738	0.2145	0.1600	0.1092	0.0636	0.0200	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
35	0.7059	0.5608	0.4354	0.3124	0.2424	0.1824	0.1274	0.0764	0.0300	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
40	0.6717	0.5229	0.3986	0.2743	0.1942	0.1342	0.0792	0.0280	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
50	0.6080	0.3715	0.2281	0.1487	0.0872	0.0543	0.0330	0.0213	0.0134	0.0085	0.0054	0.0035	0.0022	0.0014	0.0009	0.0006	*	*	*	*

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Present Value Interest factors for Annuity of 1 Discounted at  $r$  Percent for  $n$  Periods:

$$PVIFA_{r,n} = [1 - 1/(1+r)^n] / r$$

Period	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	18%	20%	25%	30%
1	0.9901	0.9804	0.9708	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850	0.8772	0.8696	0.8621	0.8333	0.8065	0.7808	0.7562
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334	1.8080	1.7833	1.7591	1.7355	1.7125	1.6901	1.6681	1.6467	1.6257	1.6052	1.5278	1.4598	1.4000	1.3480
3	2.9410	2.8830	2.8286	2.7751	2.7233	2.6730	2.6243	2.5771	2.5313	2.4869	2.4437	2.4018	2.3612	2.3216	2.2832	2.2459	2.1085	1.9813	1.8528	1.7418
4	3.9020	3.8077	3.7171	3.6299	3.5468	3.4651	3.3857	3.3121	3.2397	3.1699	3.1024	3.0373	2.9745	2.9137	2.8550	2.7982	2.5887	2.4843	2.3816	2.2862
5	4.8534	4.7135	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927	3.8897	3.7908	3.6959	3.6048	3.5172	3.4331	3.3522	3.2743	2.9806	2.7454	2.6083	2.4556
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229	4.4859	4.3553	4.2305	4.1114	3.9975	3.8887	3.7845	3.6847	3.3255	3.0205	2.8514	2.6427
7	6.7262	6.4720	6.2383	6.0211	5.8184	5.6284	5.4493	5.2804	5.1213	4.9724	4.8334	4.7042	4.5848	4.4751	4.3751	4.2848	3.8648	3.4948	3.3111	3.0921
8	7.6457	7.3255	7.0197	6.7337	6.4653	6.2138	5.9773	5.7456	5.5284	5.3254	5.1361	4.9597	4.7968	4.6473	4.5021	4.3711	3.8948	3.4648	3.2511	3.0021
9	8.5500	8.1622	7.7881	7.4333	7.0967	6.7761	6.4703	6.1784	5.8999	5.6347	5.3824	5.1429	4.9161	4.7021	4.4997	4.3077	3.7748	3.2848	3.0311	2.7421
10	9.4413	8.9626	8.5082	8.1108	7.7217	7.3491	7.0238	6.7151	6.4127	6.1264	5.8559	5.6012	5.3621	5.1381	4.9291	4.7351	4.1448	3.5948	3.2911	2.9521
11	10.308	9.7898	9.2926	8.7985	8.3664	7.9467	7.5391	7.1434	6.7587	6.3849	6.0219	5.6696	5.3279	5.0961	4.8741	4.6611	4.0148	3.4048	3.0511	2.6721
12	11.155	10.575	9.9546	9.3851	8.8333	8.3338	7.8427	7.3601	6.8857	6.4284	6.0801	5.7409	5.4091	5.1851	4.9701	4.7641	4.0448	3.3748	2.9611	2.5521
13	12.134	11.348	10.635	9.9556	9.3938	8.8527	8.3577	7.8838	7.4199	7.0134	6.6649	6.3241	6.0011	5.7861	5.5791	5.3801	4.6148	3.8848	3.4111	2.9521
14	13.004	12.106	11.296	10.563	9.8996	9.2958	8.7455	8.2442	7.7627	7.3467	6.9419	6.5482	6.1651	5.8921	5.7241	5.5641	4.7448	3.9548	3.4211	2.9221
15	13.865	12.849	11.938	11.118	10.388	9.7122	9.1679	8.6595	8.1697	7.7461	7.3409	6.9464	6.5624	6.1891	5.9341	5.7841	4.9148	4.0648	3.4611	2.9121
16	14.718	13.578	12.581	11.652	10.838	10.168	9.4468	8.8514	8.3126	7.8337	7.3792	6.9390	6.5041	6.0841	5.8741	5.6841	4.7648	3.8848	3.2911	2.7821
17	15.562	14.292	13.196	12.166	11.274	10.477	9.7832	9.1216	8.5436	8.0216	7.5488	7.1196	6.7091	6.3091	6.0441	5.8941	4.9148	4.0148	3.3411	2.7821
18	16.398	14.992	13.754	12.639	11.699	10.828	10.058	9.3719												



**kasneb**

**CIFA ADVANCED LEVEL**

**DERIVATIVES ANALYSIS**

**FRIDAY: 17 December 2021.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

- (a) Argue three cases against the existence of derivatives market in your country. (6 marks)
- (b) Explain the following terms used in derivatives market and contracts:
- (i) Exchange traded derivative. (2 marks)
  - (ii) Over the counter contract. (2 marks)
  - (iii) Contingent claims. (2 marks)
- (c) An investor anticipates that in the next month, interest rates are likely to decline significantly, and he would like to increase the bond portfolio's duration to take advantage of interest rates decline.

The investor would like to raise the duration on Sh.75 million of bonds from its current level of 6.22 to 7.5 (These are the modified durations). The investor has identified appropriate Treasury bond futures contract currently priced at Sh.82,500 with an implied modified duration of 8.12.

Yield on the bond portfolio is 5% more volatile than implied yield on futures. (Beta is 1.05).

**Required:**

- (i) State whether the investor should buy or sell futures contract. (1 mark)
- (ii) Calculate the number of futures contract involved in raising bond portfolio's duration. (3 marks)
- (iii) Calculate the profit on futures contract if one month later the future's price moves to Sh.85,000. (2 marks)
- (iv) Assuming the investor wanted to reduce the duration to zero, explain whether he should buy or sell futures contract. (1 mark)
- (v) Determine the number of futures contract required to achieve the investors objective in (c) (iv) above. (1 mark)

**(Total: 20 marks)**

**QUESTION TWO**

- (a) A futures contract is mostly constructed with the idea that the participants will hold their positions until the contract expires. However, there may be need to terminate a futures contract before maturity.

In relation to the above statement, discuss three ways in which a derivatives market participant could terminate a futures contract. (6 marks)

- (b) An investor would like to hedge himself against stock market index volatility. He enters into a forward contract on the NSE share index currently valued at 1140. The continuously compounded risk-free rate is 4.6% and the continuous dividend yield is 2.1%. The forward contract is for 140 days.

Assume a year has 365 days.

**Required:**

- (i) The forward price. (2 marks)
- (ii) The value of the forward contract after 95 days assuming the value of the NSE index is at 1025. (3 marks)

- (c) Makao Limited decided to venture into the bond market by buying a newly issued bond 200 days ago. The bond is a 10 year, 8% bond paying interest semi-annually and has a face value of Sh.1,000. Currently, the bond is selling at Sh.1,146.92.

The first four coupons are paid in 181 days, followed by the coupons paid in 365 days, 547 days and 730 days.

Makao Limited would like to sell the bond 365 days from today. The company is concerned about locking in the price at which they can sell the bond.

**Required:**

- (i) Advise Makao Limited whether it should enter into a long or short forward contract to lock in the price. (1 mark)
- (ii) Calculate the non-arbitrage value of contract 180 days after forward contract was entered into.

Assume risk free rate is 6% at the start of contract and 4% 180 days into the forward contract. Price of the bond 180 days into forward contract is Sh.1,302.26.

(8 marks)

**(Total: 20 marks)**

**QUESTION THREE**

- (a) Explain the following terms as used in options markets:

- (i) Bull spreads. (2 marks)
- (ii) Bear spreads. (2 marks)

- (b) An investor simultaneously purchases an underlying having a price of Sh.77 and writes a call option on it with an exercise price of Sh.80 and selling at Sh.6.

**Required:**

- (i) Justify why the investor should take this position. (2 marks)
- (ii) Calculate the value at expiration for the above strategy if the underlying at expiration is:
- Sh.75. (1 mark)
  - Sh.85. (1 mark)
- (iii) Determine the maximum profit. (1 mark)
- (iv) Determine the break-even point. (1 mark)

- (c) The following information relates to call and put options on a stock:

Call price  $C_0 = \text{Sh.4.50}$   
 Put price  $P_0 = \text{Sh.6.80}$   
 Exercise price  $X_0 = \text{Sh.70}$   
 Current stock price,  $S_0 = \text{Sh.67.32}$   
 Days to option expiration = 139 days.  
 Risk-free rate,  $r_f = 5\%$   
 Number of days in a year is 365.

**Required:**

Using the put-call parity, evaluate the prices of the following:

- (i) Synthetic call option. (2 marks)
- (ii) Synthetic put option. (2 marks)
- (iii) Synthetic underlying stock. (2 marks)
- (iv) Synthetic bond. (2 marks)
- (v) Identify any mispricing of each of the synthetic instruments in (b) (i) - (b) (iv) above. (2 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

- (a) Summarise four differences between futures and options. (8 marks)
- (b) Juhudi Ltd. is planning to acquire a competing firm in 109 days. The acquisition will initially be financed by Sh.80 million bridge loan with a term of 180 days and at a rate of 180 day LIBOR plus 300 basis points. Principal and interest will be paid at the end of the loan term. Juhudi Ltd. is concerned about a potential increase in interest rates before the initiation of the loan and seeks your guidance on fully hedging this interest rate risk. The year has 365 days.

You advise Juhudi Ltd. to buy an interest rate call option on 180 day LIBOR with an exercise interest rate of 2.0% for a premium of Sh.86,000. The call expires in 109 days and any payoff occurs at the end of the loan term. Current 180 day LIBOR is 2.2%. Juhudi Ltd. can finance the call option premium at current 180 day LIBOR plus 300 basis points. At initiation of the loan 109 days later, 180 days LIBOR is 3.5%.

**Required:**

The effective annual rate in basis points on the loan. (8 marks)

- (c) Consider a one-period binomial model in which the price of underlying is at Sh.65 and can go up 30% or down 22%. The risk-free rate is 8%.

**Required:**

Determine the price of a European call option with an exercise price of Sh.70. (4 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

- (a) Explain the following terms in relation to the option Greeks:

(i) Rho. (2 marks)

(ii) Vega. (2 marks)

(iii) Gamma. (2 marks)

- (b) A European option on a futures contract priced at Sh.139.19 has an exercise price of Sh.125. The futures option expires in 215 days. The continuously compounded risk-free rate is 4.25% while the volatility is given as 0.15.

**Required:**

The futures call option price using the Black model. (5 marks)

Note:

$$C = e^{-rt} [f_0(T) N(d_1) - XN(d_2)]$$

$$d_1 = \frac{\ln \frac{f_0(T)}{X} + (\sigma^2/2)T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

Where:

- $f_0(T)$  = Futures price
- $X$  = Exercise price
- $T$  = Time to expiration
- $r$  = Risk-free rate

- (c) An investor owns bonds issued by Marafiki Ltd. and buys a default protection from a credit default swaps (CDS) dealer. The bonds mature in one year and have a par value of Sh.10 million.

**Required:**

(i) Analyse the need for the use of this CDS to the investor. (2 marks)

(ii) If the dealer reckons that the probability of default is 2% and the recovery rate in the event of default to be 40%. Determine the fair premium for the CDS deal. (4 marks)

- (d) NEXTE is the Nairobi Securities Exchange (NSE) derivatives market that facilitates futures trading in the Kenyan market.

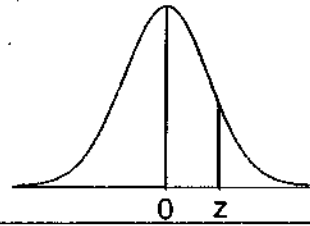
**Required:**

(i) Name the two futures products that one can trade in NEXTE. (2 marks)

(ii) Identify the equity index that constitute the equity index futures contracts of NEXTE. (1 mark)

**(Total: 20 marks)**

.....



Normal Probabilities:

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990



**CIFA PART III SECTION 6**

**DERIVATIVES ANALYSIS**

**FRIDAY: 3 September 2021.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

- (a) Summarise six lessons that financial institutions could learn from recent derivatives mishaps. (6 marks)
- (b) Distinguish between “hedgers” and “arbitrageurs” as used in derivatives markets. (4 marks)
- (c) A financial manager is considering hedging against possible decrease in short term interest rates in the country. He decides to hedge his risk exposure by going short on a forward rate agreement (FRA) that expires in 90 days based on the 90-day London interbank offered rate [LIBOR].

The current term structure for the LIBOR is as follows:

Term (days)	Interest rate (%)
30	5.83
90	6.00
180	6.14
360	6.51

**Required:**

- (i) Identify the type of FRA used by the financial manager. (2 marks)
- (ii) The interest rate that the financial manager would receive on the FRA identified in (c) (i) above. (3 marks)
- (iii) It is now 30 days since the financial manager took a short position in the FRA. Interest rates have shifted down and the new term structure for the LIBOR is as follows:

Term (days)	Interest rate (%)
60	5.50
150	5.62

**Required:**

- Calculate the market value of the FRA using a notional principal of Sh.15,000,000. (5 marks)
- (Total: 20 marks)**

**QUESTION TWO**

- (a) Explain four reasons for regulation of the derivatives market. (4 marks)
- (b) Explain the following types of hedging:
- (i) Carrying charge hedging. (2 marks)
- (ii) Operational hedging. (2 marks)
- (iii) Selective hedging. (2 marks)



- (c) The gold futures contract on the Globex Trading System covers 100 ounces of gold. An investor decides to enter into two contracts. The initial futures price per ounce is Sh.1,000. The initial margin requirement is Sh.6,000 per contract and the maintenance margin is Sh.4,000. The price of gold in the following 6 days is as follows:

Day	Price per ounce of gold (Sh.)
1	990
2	980
3	970
4	960
5	970
6	980

**Required:**

The margin account balance at the end of day 6.

(6 marks)

- (d) Brian Masaku works for an investment firm which is exposed to movement in the Uganda shilling. Brian desires to hedge the currency exposure. He prices one year fixed cash for fixed currency swap involving the Uganda shilling and Kenya shilling with a quarterly reset. He uses the interest rate data below to price the currency swap:

Days to maturity	Uganda shilling	Kenya shilling
	Spot interest rates (%)	Spot interest rates (%)
90	0.05	0.20
180	0.10	0.40
270	0.15	0.55
360	0.25	0.70

**Required:**

The annualised equilibrium fixed swap rate for Uganda shilling.

(4 marks)

(Total: 20 marks)

**QUESTION THREE**

- (a) Discuss four applications of swaps.

(8 marks)

- (b) The following information relates to the shares of XYZ Ltd.:

- The current price of each share is Sh.35.
- The expected continuously compounded rate of return is 8%.
- XYZ Ltd. pays semi-annual dividends of Sh.0.32 per share, with the next dividend expected to be paid two months from now.
- The continuously compounded risk-free interest rate is 4%.

**Required:**

The current one-year forward price of XYZ Ltd.'s share.

(4 marks)

- (c) Martin Orwa, a client of a derivative consulting firm, is planning to acquire a competing firm in 109 days. The acquisition will initially be financed by a Sh.80 million bridge loan with a term of 180 days at an interest rate of 180 day LIBOR plus 300 basis points. Principal and interest will be paid at the end of the loan term. Martin is concerned about a potential increase in interest rates before the initiation of the loan and asks for advice on fully hedging this interest rate risk.

A derivative analyst at the consulting firm advises Martin to buy an interest rate call option on 180 day LIBOR with an exercise rate of 2.0% for a premium of Sh.86,000. The call expires in 109 days and any payoff occurs at the end of the loan term. Current 180 day LIBOR is 2.2%. The client can finance the call option premium at a current 180 day LIBOR plus 300 basis point. At initiation of the loan 109 days later, 180 LIBOR is 3.5%.

**Required:**

The effective annual rate in basis point on the loan.

(8 marks)

(Total: 20 marks)

**QUESTION FOUR**

- (a) Explain the following terms as used in option trading:

(i) Calendar spread.

(2 marks)

(ii) Implied volatility.

(2 marks)

(b) Describe two uses of implied volatility in option trading. (4 marks)

(c) The price of an asset will either rise by 25% or fall by 40% in 1 year, with equal probability.

A European put option on this asset matures after 1 year.

**Additional information:**

1. The price of the asset today is Sh.100.
2. The strike price of the put option is Sh.130.
3. Put option premium is Sh.7.
4. Annual effective risk free rate is 3%.

**Required:**

The expected profit of the put option. (4 marks)

(d) Samla Investment Ltd. uses different strategies in investment. One of its popular strategies is to invest when it does not have money but expects to receive it later. The company expects to receive Sh.6 million at a later date, but would like to proceed and take a position of Sh.3 million in equity and 3 million in bonds. The desired equity Beta is 1.0 and the desired bond duration is 6.2. A stock index futures contract is priced at Sh.195,000 with a Beta of 0.97. Bond futures contract goes for Sh.110,000 and it has an implied modified duration of 6.0.

At expiration, share prices goes down by 5% and the stock index futures is down to Sh.185,737.50. Bonds are up 2% and bonds futures price is up to Sh.112,090.

**Required:**

(i) The profit (loss) using futures contract. (3 marks)

(ii) The profit (loss) using direct investment in the actual securities. (2 marks)

(iii) Compare your results in (d) (i) and (d) (ii) above. (1 mark)

(iv) Explain the term "pre-investing" investment approach. (2 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

(a) In relation to options markets:

(i) Explain the term "market makers". (2 marks)

(ii) Highlight two roles played by market makers in options markets. (2 marks)

(b) The current market price per share of Flamingo Ltd. is Sh.55. A one year call option with an exercise price of Sh.55 is trading at Sh.4.92. The share price can increase by 20% or decrease by 15% over the next year.

The risk free rate is 5%.

**Required:**

(i) Using suitable computations, determine whether any arbitrage profit exists in trading the company's shares. (4 marks)

(ii) Describe the transaction necessary to earn the arbitrage profit (if any) in (b) (i) above. (2 marks)

(c) A pension fund has accumulated Sh.10 million worth of Ndovu Limited's shares. The market price per share is Sh.50. The following information on options on both Ndovu Limited shares and NSE index is provided below:

	<b>Ndovu Limited</b>	<b>NSE index</b>
	<b>Sh.</b>	<b>Sh.</b>
European call	6.31	6.31
European put	4.83	4.83
American call	6.28	6.28
American put	4.96	4.96

Ndovu Limited share option sensitivities:

	<b>Delta</b>
European call	0.5977
European put	-0.4023
American call	0.5973
American put	-0.4258

The pension fund would like to consider neutralising its Ndovu Limited's equity position from changes in the share price of Ndovu Limited.

As a consultant, the fund has approached you to assist in creating a delta-neutral portfolio.

**Required:**

(i) The number of standard Ndovu Limited's European call option to be sold or bought. (3 marks)

(ii) The number of standard Ndovu Limited's European put options to be bought or sold. (3 marks)

(d) A derivatives specialist uses a strategy that involves creating a synthetic call from other instruments at a cost less than the market value of the call itself and then selling the call. During the course of his research, he observes that ABC Limited's share is currently priced at Sh.56 while a European style put option with a strike price of Sh.55 is trading at Sh.0.40 and a European-style call option with the same strike price is trading at Sh.2.50. Both options have 6 months remaining until expiration. The risk free rate is currently 4%.

**Required:**

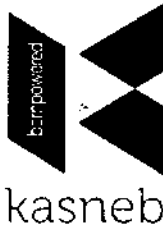
The arbitrage profit he would earn if he were to establish a long protective put position. (4 marks)

(Total: 20 marks)

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**CIFA PART III SECTION 6  
DERIVATIVES ANALYSIS**

**FRIDAY: 21 May 2021.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

- (a) Modern financial markets employ a wide range of derivative instruments that could suit different needs of their clients.

In light of the above statement, describe four types of swaps available to market participants in your country. (4 marks)

- (b) Examine five types of risks associated with trading derivatives. (5 marks)
- (c) Describe two uses of index futures. (4 marks)
- (d) The current price of a futures contract is Sh.212. The initial margin requirement is Sh.10 and the maintenance margin required is Sh.8. An investor can go long 20 contracts, meet all margin calls but does not withdraw any excess margin. The contract is purchased at the settlement price of that day, so there is no mark to market profit or loss on the day of purchase.

The investor has provided the table below:

Day	Beginning Balance Sh.	Funds Deposited Sh.	Futures Price Sh.	Price Charge Sh.	Gain/ Loss Sh.	Ending Balance Sh.
0			212			
1			211			
2			214			
3			209			
4			210			
5			204			
6			202			

**Required:**

- (i) Complete the table above. (6 marks)
- (ii) Determine the total gains or losses by the end of day 6. (1 mark)
- (Total: 20 marks)**

**QUESTION TWO**

- (a) Highlight four features of a forward contract. (4 marks)
- (b) A 1 year semi-annual equity swap which is based on an index is at 985 and has a fixed interest rate of 4.4%.

90 days after the initiation of the swap, the index is at 982 and the London Interbank Offered Rate (LIBOR) is at 4.6% for 90 days and 4.8% for 270 days. The notional value of the equity swap is Sh.2 million.

**Required:**

The value of the swap to the equity payer. (4 marks)

- (c) An investor has an equity portfolio with a 60% allocation to small-cap stocks and a 40% allocation to large cap stocks. The portfolio is currently valued at Sh.150 million. The investor wishes to reduce the small cap allocation to 45% and increase the large cap allocation to 55% for a period of nine months. The large cap beta is 1.15 and the small cap beta is 1.25. A small cap futures contract that expires in nine months is priced at Sh.195,750 and has a beta of 1.12. A large cap futures contract that expires in nine months is priced at Sh.215,750 and has a beta of 0.92. Both contracts have multipliers of 1. After nine months, the large cap stocks are up 4.75% and small cap stocks are up 6.25%. The large cap futures price is Sh.223,762 and the small cap futures price is Sh.206,712.

**Required:**

- (i) The market value of the portfolio using futures to adjust the allocation. (8 marks)
- (ii) Citing two reasons, explain why the returns on the futures overlay strategy is not the same as that of a cash market strategy. (2 marks)

- (d) A spot price of an asset is Sh.50, the interest rate is 6.25%, the futures value of the storage cost is Sh.1.35 and the futures expires in 15 months.

**Required:**

Determine the futures price. (2 marks)

**(Total: 20 marks)**

**QUESTION THREE**

- (a) Distinguish between "over the counter (OTC)" and "Exchange market" as used in derivatives trading. (4 marks)

- (b) Wazembo Limited's share is trading for Sh.70 and pays a Sh.2.20 dividend in one month. The one-month risk free rate is 10% quoted on an annual compounding basis. The share trades ex-dividend the same day the single share forward contract expires.

**Required:**

The one-month forward price for Wazembo Limited's ordinary share. (3 marks)

- (c) A firm has entered into a receive-floating 6x9 FRA - forward rate agreement at a rate of 0.86%, with a notional amount of Sh.10 million LIBOR. The six-month spot Shilling London interbank offered rate (LIBOR) was 0.628% and the nine-month Shilling LIBOR was 0.712%. The 6x9 FRA rate is quoted in the market at 0.86%. After 90 days have passed, the three-month Shilling LIBOR is 1.25% and the six-month Shilling LIBOR is 1.35%.

**Required:**

Calculate the value of the original receive-floating 6x9 FRA after 90 days. (4 marks)

- (d) Top-Tech Limited arranged a floating rate loan on 15 June 2019 to finance the construction of one of its factories. The company's Chief Executive Officer (CEO) has approached you to help reduce the firm's exposure to the risk of rising interest rates. You respond by purchasing caplets and selling floorlets to establish a zero-cost position. Details concerning the loan transaction and hedging transaction are summarised below. The LIBOR rates and the number of days falling within each settlement period are also provided.

**Details concerning loan and hedging transaction is provided as follows:**

Loan amount	Sh.50 million
Frequency of interest payments	Semi-annually (June 15 and December 15)
Term of loan	2 years
Cap rate	10.20%
Floor rate	9.40%
Interest rate on loan	LIBOR + 100 basis points

**Loan settlement Dates and LIBOR rates**

Settlement Date	Number of Days in Period	LIBOR (%)
15 June 2019	-	8.50
15 December 2019	183	9.00
15 June 2020	182	9.20
15 December 2020	183	9.95
15 June 2021	182	11.30

**Required:**

- (i) Calculate the effective interest due on 15 June 2020. (7 marks)
- (ii) Determine the caplet payoff on 15 June 2021. (2 marks)

**(Total: 20 marks)**

#### QUESTION FOUR

- (a) (i) Outline three advantages and three limitations of the Black-Scholes-Merton (BSM) model. (6 marks)
- (ii) The underlying is priced at Sh.225 and the continuously compounded dividend yield is 2.7%. The exercise price is Sh.200. The continuously compounded risk free rate is 5.25%. The time to expiration is three years and the volatility is 0.15.

**Required:**

The price of a call option using the Black-Schole-Merton (BSM) model adjusted for cash flows on the underlying. (4 marks)

- (b) Tyson Mkubwa is a financial analyst and would like to obtain the value of a European call option with two years to expiration and an exercise price of Sh.100. The underlying bond is Sh.100 par value, 7% annual coupon bond with three years to maturity.

The interest rate at the start of the call option contract is 3% and it is expected to either go up to 5.99% or down to 4.44% in year 1. Interests rates are expected to change into 3 levels in years 2, that is, 8.56%, 6.34% or 4.7% respectively.

The bond price at the end of year 2 is expected to be Sh.98.56 at 8.56%, Sh.100.62 at 6.34% and 102.20 at 4.7% interest rates respectively.

**Required:**

- (i) Construct a two-period binomial tree for option price. (8 marks)
- (ii) Determine the option value today. (2 marks)

(Total: 20 marks)

#### QUESTION FIVE

- (a) Derivative contracts are largely classified into either forward commitments or contingent claims. Citing relevant examples, distinguish between "forward commitments" and "contingent claims". (6 marks)

- (b) Proton Ltd. is a Kenyan company that issues a bond with a face value of Sh.1.2 billion and a coupon rate of 5.25%. Proton Ltd. decides to use a swap so as to convert this bond into a dollar-denominated bond.

The current exchange rate is Sh.120/\$. The fixed interest rate on the dollar-denominated swaps is 6% and the fixed interest rate of the shilling-denominated swaps is 5%. All payments to be made annually.

**Required:**

- (i) Assess how swap will be executed. (3 marks)
- (ii) Identify the cash flows at start. (2 marks)
- (iii) Generate all interest cash flows of each interest payment date. (2 marks)
- (iv) Identify the cash flows at the expiration of the bond. (2 marks)

- (c) The following information is available on put and call options on an asset:

Call price	Sh.3.50
Put price	Sh.9
Exercise price	Sh.50
Forward price	Sh.45
Days to option expiration	175 days
Risk-free rate	4%

**Required:**

Using put-call forward parity, calculate prices of the following:

- (i) Synthetic call option. (1 mark)
- (ii) Synthetic put option. (1 mark)
- (iii) Synthetic forward contract. (1 mark)
- (iv) For each of the 3 synthetic instruments in (c) (i), (c) (ii) and (c) (iii) above, identify any mispricing by comparing the actual price with the synthetic price. (2 marks)

(Total: 20 marks)







**CIFA PART III SECTION 6**

**DERIVATIVES ANALYSIS**

**MONDAY: 30 November 2020**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

- (a) (i) Explain the meaning of the term “no-arbitrage principle” as used in derivatives markets. (2 marks)
- (ii) Highlight three assumptions of no-arbitrage principle. (3 marks)
- (b) Explain four main purpose of derivatives market in your country. (4 marks)
- (c) A company has an outstanding loan of Sh.50 million that mature's in three years. The interest rate on the loan is London Interbank Offered Rate (LIBOR) payable at the end of each year. In order to hedge against an increase in interest rate, the company enters into a swap to pay a fixed rate of 8% and receive LIBOR. In order to gain added flexibility in case the interest rate falls, the company plans to purchase a swaption with an exercise interest rate of 8.5%. The company is considering unwinding the swap at the first settlement date and that the swaption is European style. It is assumed that if the company exercises the swaption, it will do so by actually entering into the swap.

**Required:**

The net cash flows on the first settlement date assuming LIBOR if the fixed rate on the underlying swap is 7.5%. (7 marks)

- (d) The value of a stock index is 3000. The value of an investor's portfolio is Sh.608,000. The risk-free interest rate is 10% per annum, the dividend yield on index is 6% per annum. The beta of the portfolio is 1.5. A futures contract on the stock index with four months to maturity is used to hedge the value of the portfolio over the next three months. The futures contract is for delivery of 50 times the index. The index changes to 2700 at the end of three months.

**Required:**

Calculate the gain on short futures position. (4 marks)

**(Total: 20 marks)**

**QUESTION TWO**

- (a) Examine five benefits of swaps as a form of derivative. (5 marks)
- (b) A Kenyan firm (KF) enters into a 3-year annual currency swap with a foreign firm (FF) with foreign currency units while the Kenyan firm has the Kenya shillings (KES) units.

The foreign currency are known as (FC). KF is the fixed rate payer and FF is the floating rate payer. The fixed interest rate at the swap initiation is 7% and 8% at the end of the swap. The variable interest rate is 5% currently, 6% at the end of year 1, 8% at the end of year 2 and 7% at the end of year 3.

At the beginning of the swap, KES 1 million is exchanged at an exchange rate of 2 FC = 1 KES. At the end of the swap period the exchange rate is 1.5 FC = 1 KES.

**Required:**

- (i) Show the payments and the party at the swap initiation. (2 marks)
- (ii) Calculate the second net swap payment at the end of year 1. (3 marks)
- (iii) At the end of the swap, determine what FF will give to KF in terms of notional principal. (2 marks)
- (iv) Demonstrate that at the end of 3 years FF pays KES 1,080,000. (2 marks)

- (c) Kassim Mohamed is a derivatives manager who is considering using option strategies to profit from his views on share prices. He collects the information given below for the listed options on the shares of Mavuno Limited which are currently trading at a price of Sh.25 per share.

	Calls	June	Expiry August	November
Strike	30	0.77	1.38	1.85
	25	1.09	3.50	4.25
	20	5.71	7.84	8.36

	Puts	June	Expiry August	November
Strike	30	5.45	5.93	6.21
	25	0.73	2.89	3.26
	20	0.53	0.93	1.23

**Required:**

Calculate the following:

- (i) Maximum loss from a bull spread using August puts with strike prices of Sh.30 and Sh.25. (4 marks)
- (ii) The net cost to enter a box spread using August options with strike prices of Sh.20 and Sh.25. (2 marks)
- (Total: 20 marks)**

**QUESTION THREE**

- (a) (i) Evaluate four factors that could determine the value of option prices. (4 marks)
- (ii) The risk or volatility of an individual asset could be reduced either by writing a covered call option against the asset or by purchasing a put option on the asset.

**Required:**

Explain the difference in the extent to which each of these two option strategies modify an individual asset's risk. (4 marks)

- (b) Juliet Nambuye, a derivatives analyst has been asked to value the 1-year put and call options for PKQ Limited, exercisable at Sh.49 with the underlying asset trading at Sh.49.25. Based on current estimates, in one year, the share price of PKQ Limited is expected to either move up by 15% or move down by 20%. The current risk free rate for 30 days is 3.30% per annum.

**Required:**

The value of PKQ's options using a one period binomial model. (4 marks)

- (c) An investor owns 60,000 shares of Pelfex Limited that are currently trading at Sh.50 per share at the Securities Exchange. A call option on the company's shares with an exercise price of Sh.50 is selling at Sh.4.

Ten minutes ago, the call price was Sh.3.6 while the share price has increased by Sh.0.672 in the last 10 minutes to settle at the current price of Sh.50.

**Required:**

Determine the number of call options required to create a delta-neutral hedge for Pelfex Limited's shares. (4 marks)

- (d) The following information relates to a long forward contract on a non-dividend paying stock entered into a few months ago:

1. The forward contract expires in six months.
2. The risk free rate is 10% per annum that is compounded continuously.
3. The stock has a price of Sh.25 per share.
4. The delivery price is Sh.24.

**Required:**

The value of the forward contract.

(4 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

(a) Assess four salient differences between a futures contract and a forward contract. (4 marks)

(b) Craft Brewers Ltd. intends to carry out the following transactions in the coming months:

1. Issue a loan note of 30 million U.S dollars (USD) in three months (90 days) time. The note will have a six month (180 days) term. These proceeds will be used to meet the working capital requirements of the company.
2. Receive new capital injection of 90 million British pounds (GBP). This will occur in eight months (244 days time).

The company reports in euros (EUR).

Hassan Ndegwa, the treasury manager decides to hedge the interest rate exposure on the U.S borrowing with a forward rate agreement (FRA) and also hedge the conversion of pounds to euros.

Using the information below and a 30/360 day count, Hassan Ndegwa calculates the FRA rates implicit in the term structure. A large investment bank offers Craft Brewers Ltd. a FRA rate of 4.68% for the USD 30 million note in three months time.

**Current term structure of USD LIBOR rates (annualised)**

Term (Days)	Rate (%)
30	3.10
60	3.40
90	3.71
180	3.99
270	4.12
360	4.22

Hassan analyses the GBP per Euro (EUR) exchange rate using the data below:

**Interest rate and exchange rate data:**

United Kingdom interest rate*	4.17%
Euro interest rate*	3.28%
Spot exchange rate (GBP per EUR)	0.6892

\* 244 days interest rate, discrete and annualised

A year has 365 days

**Required:**

- (i) Calculate the six month FRA rate three months from now, implicit in the current term structure of USD LIBOR rates. (4 marks)
- (ii) Using a 180 day spot rate of 4.48% at expiration of the FRA, calculate the payoff to Craft Brewers Ltd. from the FRA offered by the investment bank. (4 marks)
- (iii) Calculate the arbitrage free 244 day forward exchange rate (GBP per EUR). (4 marks)

(c) The Treasury bond futures price is Sh.101.375. An investor is considering the following four bonds:

Bond	Price (Sh.)	Conversion factor
1	125.15625	1.2131
2	142.46875	1.3792
3	115.96875	1.1149
4	144.06250	1.4026

**Required:**

Determine the cheapest to deliver bond.

(4 marks)

(Total: 20 marks)

**QUESTION FIVE**

(a) Distinguish between the following derivatives market terms:

- (i) "Maintenance margin requirement" and "variation margin requirement". (2 marks)
- (ii) "Position trader" and "scalper". (2 marks)
- (iii) "Contango" and "normal backwardation". (2 marks)

(b) The standard deviation of monthly changes in the spot price of gold is 1.2. The standard deviation of monthly changes in the futures price of gold for the closest contract is 1.4. The correlation between the futures price changes and the spot price changes is 0.7. It is now November 15. An ornament maker is committed to buying 200,000 units of gold on December 15. The ornament maker wants to use the January gold futures contract to hedge its risk.

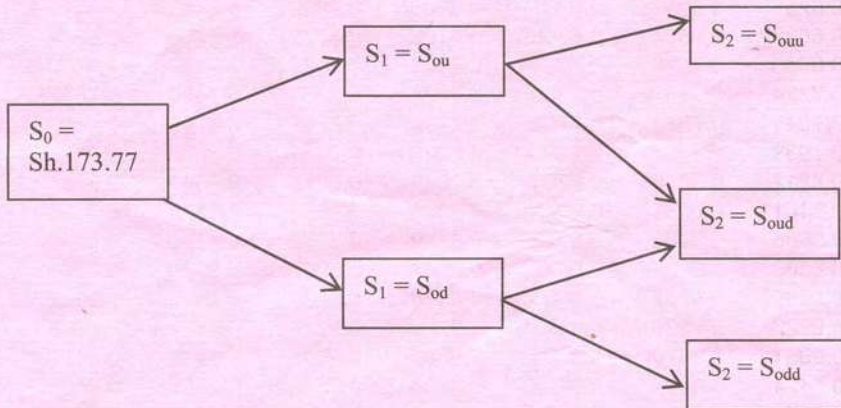
**Required:**

Describe the strategy that the ornament maker should follow.

(3 marks)

(c) An analyst would like to price an option for Kimbo Ltd. which does not currently pay any dividend. Kimbo Ltd's shares currently trade at Sh.173.77 at the Securities Exchange.

The price is expected to move as shown in the following diagram over the next 2 years:



$u = 130\%, d = 80\%$

The analyst is looking at valuing a 2 year American put option with a strike price of Sh.180 using a two period binomial calculation. The risk free rate is currently 4.2% per annum.

**Required:**

Calculate the value of Kimbo Ltd's put option using the two period binomial model.

(7 marks)

(d) An asset manager has short equity forward exposure over the Nairobi Securities Exchange (NSE) index. The forward contract was entered during the past quarter at a forward price of Sh.2,240.28 and it matures in 127 days.

The following rates and prices are current at the end of the quarter:

- NSE index is at 2,231.72.
- Continuously compounded risk free rate is 4.87% per annum.
- Continuously compounded dividend yield on the index is 3.08% per annum.

**Required:**

Calculate the end of quarter value of the NSE Index equity forward to the asset manager.

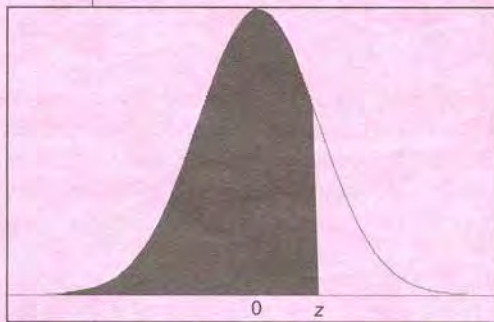
Assume the year has 365 days.

(4 marks)

**(Total: 20 marks)**

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## Cumulative Probabilities for the Standard Normal (Z) Distribution



Values in the table correspond to the area under the curve of a standard normal random variable for a value at or below  $z$ .

<b>z</b>	<b>0.00</b>	<b>0.01</b>	<b>0.02</b>	<b>0.03</b>	<b>0.04</b>	<b>0.05</b>	<b>0.06</b>	<b>0.07</b>	<b>0.08</b>	<b>0.09</b>
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998									
4.0	0.99997									
4.5	0.999997									
5.0	0.9999997									

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**CIFA PART III SECTION 6**

**DERIVATIVES ANALYSIS**

**THURSDAY: 28 November 2019.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

- (a) Your country's Securities Exchange recently introduced derivatives trading as a new strategy of expanding its product offerings:

In light of the above statement:

- (i) Describe three types of traders common in the derivatives markets. (3 marks)
- (ii) Propose three factors that could have hindered the growth of derivatives markets in developing countries. (3 marks)

- (b) Hezbon Otieno owns a dividend paying stock which is currently worth Sh.150. He plans to sell the stock in 250 days. In order to hedge against possible price decline, Hezbon decides to take a short position in a forward contract that expires in 250 days.

**Additional information:**

- The risk-free rate is 5%.
- Over the next 250 days the stock will pay dividends as follows:

Days to next dividend	Dividend per share (DPS) Sh.
30	1.25
120	1.25
210	1.25

- Assume a 365-day year.

**Required:**

- (i) The forward price of a contract established today which expires in 250 days. (4 marks)
- (ii) The value of the forward contract after 100 days assuming that the stock price is Sh.115 on that day. (4 marks)
- (iii) The value of the contract at expiration assuming that the stock price is Sh.130 at expiration. (2 marks)
- (c) A bank has committed to lend Sh.25 million to a corporate borrower in 30 days. The loan will mature in 180 days and carries an interest rate of London-Interbank Offered Rate (LIBOR) plus 150 basis points.

The bank is concerned that interest rates will fall and in order to lock the lending rate, it decides to short a forward rate agreement (FRA) with an interest rate of 5.5%

**Required:**

The effective rate on the loan assuming 180 day LIBOR in 30 days is 3.25%.

(4 marks)

**(Total: 20 marks)**

## QUESTION TWO

- (a) Suggest four reasons why futures options are popular in the derivatives market. (4 marks)
- (b) Mercury Investment Limited holds an asset worth Sh.500,000. The firm intends to enter into a futures contract to sell the asset in 45 days.

### Additional information:

1. The risk-free interest rate is 8%.
2. Storage cost is Sh.22,500.
3. The future value of positive cash flow is Sh.7,500.
4. A year has 365 days.

### Required:

The appropriate futures price of the asset:

- (i) Assuming there is neither storage cost nor cash flows. (2 marks)
- (ii) Considering storage cost only. (2 marks)
- (iii) Considering the cash flows only. (2 marks)
- (iv) The future price of the asset is currently trading at Sh.600,000. Show how Mercury Investment Limited could execute an arbitrage transaction assuming that the cost of carry is Sh.35,500. (4 marks)
- (c) An investment manager uses various hedging strategies. One of them is the box spread. The options have exercise prices of Sh.75 and Sh.85.

The call prices are Sh.16.02 and Sh.12.28 for exercise prices of Sh.75 and Sh.85 respectively.

The put prices are Sh.9.72 and Sh.15.18 for exercise prices of Sh.75 and Sh.85 respectively.

The options expire in 6 months. The discrete risk-free rate is 5.13%.

### Required:

- (i) Evaluate the value of the box spread and the profit at expiration. (3 marks)
- (ii) Show that the box spread is mispriced thereby giving rise to an arbitrage opportunity. (3 marks)
- (Total: 20 marks)**

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## QUESTION THREE

- (a) Explain the following terms in the context of options strategies for managing equity portfolios:

- (i) Protective put. (2 marks)
- (ii) Money spread. (2 marks)
- (iii) Zero cost collar. (2 marks)

- (b) A portfolio manager believes that the market will be volatile in the near future, but does not feel particularly strongly about the direction of the movement. With this expectation, he decides to buy both a call and a put option with the same exercise price and the same expiration date on the same underlying stock trading at Sh.49. He buys one call option and one put option on this stock, both with an exercise price of Sh.50.

The premium on the call is Sh.6.25 and the premium on the put is Sh.5.875.

### Required:

- (i) The profit that the manager realises when the price of the stock at expiration is Sh.37. (3 marks)
- (ii) The maximum loss from the strategy above. (2 marks)
- (iii) The break-even stock price at expiration of the option. (2 marks)

- (c) Fanishi Limited issues a leveraged floating rate note (FRN) with a face value of Sh.5 billion that pays a coupon of 2.5 times 91 days Treasury bill rate. The company plans to generate a profit by selling the notes, using the proceeds to purchase a bond with a fixed coupon rate of 7% a year and hedging the risk by entering into an appropriate swap. A swap dealer provides a quote with a fixed rate of 6% and a floating rate of 91 days Treasury bill rate.

**Required:**

- (i) Determine the net cash flow from entering the swap. (5 marks)
- (ii) Explain two additional risks that the company might be exposed to by entering into the above swap arrangement. (2 marks)

**(Total: 20 marks)**

**QUESTION FOUR**

- (a) Assess four interest rate hedging strategies that could be used by a borrower of a variable interest rate loan. (4 marks)
- (b) The discount rates on a 60-day Treasury bill and 150-day Treasury bill are 6% and 6.25% respectively.

Assume that the Treasury bill has a Sh.1 par value and that a year has 360 days.

**Required:**

- (i) The price of a 60-day futures contract. (4 marks)
- (ii) Using suitable computations, outline the transaction that could be used to take advantage of any arbitrage opportunity assuming that the actual price of a 60-day futures contract is 0.9853. (2 marks)
- (iii) Determine the repo rate. (2 marks)

- (c) Sarah Kizito is a portfolio manager at TrueColours Asset Management firm. One of Sarah's clients has a portfolio valued at Sh.150 million that is allocated 75% to equities and 25% to bonds. Sarah wants to reduce the portfolio's equity allocation to 50% and raise its bond allocation to 50%. She intends to simultaneously lower the modified duration of the bond portfolio from 6.05 to 5.50 but leave the beta of the equity portfolio unchanged at 1.08. She will use equity index and bond futures to achieve these objectives.

Information on the relevant futures contract is as follows:

- Beta of equity index futures contract	0.95
- Price of equity index futures contract	Sh.125,000
- Modified duration of bond futures contract	7.50
- Price of bond futures contract	Sh.105,000
- The yield beta of the bond futures contract	1.00

The risk-free rate is 2.15%.

**Required:**

To achieve Sarah's portfolio objective, determine:

- (i) The number of equity index futures contract that she should sell. (3 marks)
- (ii) The number of bond futures contract that she should buy. (5 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

- (a) Explain the effect of the following factors on the value of a European put option and call option price:

- (i) The underlying price. (1 mark)
- (ii) The exercise price. (1 mark)
- (iii) Time to expiration. (1 mark)
- (iv) Risk-free rate. (1 mark)
- (v) Volatility of the underlying. (1 mark)



- (b) A local pension fund has a 450,000 basis point value (BPV) duration gap with BPV of assets being less than that of liabilities. The fund uses a swap with a BPV per 100 notional of 0.2571 to construct a 50% hedge ratio. After setting up the 50% hedge, the manager forms the opinion that rates will increase and would like to benefit if his view is correct but unaffected if he is wrong.

The manager would be willing to adjust the hedge position by 15% to a 35% or 65% hedge. He checks and finds that both payer and receiver swaptions are available with a strike of 2.7%. The premiums for the payer and receiver swaptions are 55 and 75 basis points, respectively.

**Required:**

- (i) The notional principal of the 50% hedge ratio swap the manager could use. (2 marks)
- (ii) The initial cost of the swaption the manager could buy or sell to adjust his hedge to a 35% hedge. (3 marks)
- (iii) The rate on new swaps and indicate whether new rates will have to be higher or lower than the rate to make exercising the swaption profitable. (2 marks)
- (c) A one year swap with quarterly payments pays a fixed rate and receives a floating rate. The term structure at the beginning of the swap was as follows:

Lo(90)	=	0.0252
Lo(180)	=	0.0305
Lo(270)	=	0.0373
Lo(360)	=	0.0406

In order to mitigate the credit risk of the parties engaged in the swap, the swap was marked to market in 90 days. After 90 days, the swap was marked to market. The new term structure of the swap was as follows:

L90(90)	=	0.0539
L90(180)	=	0.0608
L90(270)	=	0.0653

**Required:**

- (i) The market value of the swap per Sh.1 notional principal at the beginning of the swap. (6 marks)
- (ii) The new fixed rate on the swap at which the swap would proceed after marking to market. (2 marks)
- (Total: 20 marks)
- .....



**CIFA PART III SECTION 6**  
**DERIVATIVES ANALYSIS**

**FRIDAY: 24 May 2019.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

- (a) Highlight five differences between “currency exchange futures” and “forward contracts”. (5 marks)
- (b) A local company has an outstanding loan of Sh.250 million that carries a 5.15% fixed interest rate. The company anticipates that the interest rates are going to decline and enters into a one-year pay floating London Inter-bank Offered Rate (LIBOR) to receive fixed interest rate swap with quarterly payments.

The notional principal on the swap is Sh.250 million.

The current term structure of interest rates is as provided below:

Days	LIBOR (%)
90	1.42
180	1.84
270	2.12
360	3.42

45 days later, the global market experiences a financial crisis which causes interest rates to rise dramatically and the term structure of interest rates changes as shown below:

**Term structure of interest rates 45 days later**

Days	LIBOR (%)
90	2.21
180	2.62
270	3.73
360	4.92

**Required:**

- (i) The annualised fixed rate of swap entered by the local company. (4 marks)
- (ii) The market value of the swap after 45 days. (4 marks)
- (c) An investor decides to hedge a Sh.200,000 portfolio by writing index call options. The index stands at 550 and an out of the money index stock with a strike price of Sh.560 sells for Sh.800. The stock index call option hedge ratio is 0.4. The market declines by 2% which causes the price of the index option to decline to Sh.350.

**Required:**

The net gain or loss to the investor after the market decline. (5 marks)

- (d) A derivatives trader has a holding period of 2 months. The standard deviation of spot prices over the two months period is 0.18 and the volatility of the futures contract over the same period is 0.29. The correlation of the two changes in price is 0.85.

**Required:**

The optimal hedge ratio.

(2 marks)

**(Total: 20 marks)**

## QUESTION TWO

(a) Explain the impact of the following risk management strategies on a European call option:

- (i) Delta. (1 mark)
- (ii) Gamma. (1 mark)
- (iii) Vega. (1 mark)
- (iv) Rho. (1 mark)
- (v) Theta. (1 mark)

(b) Crypto Investments Limited is an oil producing company that has just negotiated a contract to sell 1 million barrels of crude oil on 15 August 2019 (assuming today is 15 May 2019).

The company is concerned about price fluctuations and is contemplating locking a favourable price by using futures contract as a hedging strategy.

The spot price on 15 May 2019 is Sh.19 per barrel and the 15 August 2019 oil futures price is expected to be Sh.18.75 per barrel. Each futures contract consists of 1,000 barrels.

### Required:

- (i) The monetary value of loss to be suffered by Crypto Investments Limited assuming prices on 15 August 2019 fall by Sh.0.01 and assuming that there is no hedging strategy. (1 mark)
  - (ii) State whether the oil producer will short or long the futures so as to hedge its position. (1 mark)
  - (iii) Determine the number of crude oil futures contract that Crypto Investments Limited would require to engage in so as to hedge its position. (2 marks)
  - (iv) Compute the total amount to be realised by Crypto Investments Limited on 15 August 2019 assuming a spot price of Sh.17.50 and assuming that the company shorts the futures position. (2 marks)
  - (v) Determine the total amount that the oil producer will realise assuming that the company decides to sell the futures contract and the spot price of crude oil turns out to be Sh.19.50 on 15 August 2019. (2 marks)
  - (vi) Comment on the results obtained in (b) (iv) and (b) (v) above. (2 marks)
- (c) John Mativo, a derivatives trader, is considering European put and call options with exercise price of Sh.45 and expiration of 115 days. The underlying price is Sh.48 and does not make any cash payment in the life of the options. The risk-free rate is 4.5%. The put is selling at Sh.3.75 while the call is selling at Sh.8.00.

### Required:

- (i) The value of the call option. (3 marks)
  - (ii) Advise the investor on whether to buy the call option based on your answer in (c) (i) above. (2 marks)
- (Total: 20 marks)**

## QUESTION THREE

(a) Prices are set to eliminate the opportunity to profit at no risk with no commitment of one's own funds.

Discuss the above statement in relation to derivatives principles referred to as the "law of one price". (6 marks)

(b) Summarise four ways of terminating a swap contract. (4 marks)

(c) John Sang is a financial and investments analyst in Telco Traders Ltd. He is concerned about the price changes of a stock that Telco Traders owns. He would also like to lock in a price at which they can sell the stock in the next 100 days.

The stock currently cost Sh.3,000 and is expected to pay dividends of Sh.40 in 15 days, Sh.40 in 85 days and Sh.50 in 175 days. The annual risk-free rate is 5% and the yield curve is flat.

Assume a 365 - day year.

**Required:**

- (i) The appropriate price that John Sang could receive in 100 days using forward contract. (2 marks)
- (ii) Assume that John Sang enters into a forward contract on the stock to sell it after 100 days, and after 60 days, the stock value is Sh.3,600.  
Determine the value of the short position in such a forward contract assuming that the risk-free rate remains unchanged. (3 marks)
- (iii) Determine the value of the forward contract assuming that the holder holds a long position and the stock price is Sh.3,800. (2 marks)

- (c) An asset is priced at Sh.50, the risk-free interests rate is 8% and a futures contract on this asset expires in 45 days. The net overall cost of carry for the underlying asset is Sh.3.55. Assume a 365-day year.

**Required:**

- Advise an investor whether an arbitrage transaction exists, assuming such futures contract is trading at Sh.60. (3 marks)
- (Total: 20 marks)**

**QUESTION FOUR**

- (a) A financial analyst gathered the following information relating to a stock:

Stock price	Sh.52
Strike price	Sh.50
Time to expiration	3 months
Standard deviation	20%
Interest rate (annual)	10%

**Required:**

The value of the call option using the Black-Scholes-Merton model. (4 marks)

- (b) A financial analyst reviews an equity swap with an annual reset that a local bank entered into six months ago as the receive-fixed, pay-equity party. At the time of initiation, the underlying equity index was trading at Sh.100. Selected data regarding the equity swap which is linked to an equity index are presented below:

Swap notional amount	:	Sh.20 million
Original swap term	:	5 years with annual resets
Fixed swap rate	:	2%

The equity index is currently trading at Sh.103 and the relevant spot rate along with their associated present value factors are presented below:

Maturity (years)	Spot rate (%)	Present value factors
0.5	0.40	0.998004
1.5	1.00	0.985222
2.5	1.20	0.970874
3.5	2.00	0.934579
4.5	2.60	0.895255

**Required:**

The fair value of the equity swap from the bank's perspective. (4 marks)

- (c) An interest rate put option based on a 90-day underlying rate has an exercise rate of 7.5% and expires in 180 days. The forward rate is 7.25% and volatility is 0.04. The continuously compounded risk-free rate is 5%.

**Required:**

The price of the interest rate put option using the Black model. (4 marks)

- (d) A box spread consists of options on a stock trading at Sh.27.95. The options have exercise prices of Sh.25 and Sh.30 and they mature in six months. The call options for the exercise prices of Sh.25 and Sh.30 have a premium of Sh.5.30 and Sh.2.75 respectively. The put options for these exercise prices have a premium of Sh.2.00 and Sh.4.30 respectively.

**Required:**

The discrete risk-free rate assuming that the options are correctly priced. (5 marks)

- (e) Examine three sources of gains and losses from delta hedging for a market-maker. (3 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

- (a) Discuss three users of futures contracts. (3 marks)
- (b) Explain the following terms as used in derivatives markets:
- (i) Initial margin. (2 marks)
  - (ii) Maintenance margin. (2 marks)
  - (iii) Price limits. (2 marks)
- (c) Nachu PLC, a Japanese company issued a bond with a face value of ¥1,200,000,000 with a coupon rate of 5.25%. The company would like to convert this bond into a Euro-denominated bond using a swap contract. Currently, the exchange rate is ¥120/€. The fixed rate on Euro-denominated swaps is 6% and the fixed rate on Yen ¥ denominated swaps is 5%. Interest payments are done annually.

**Required:**

- (i) Describe how the swap will be executed, clearly identifying the cash flows at start. (4 marks)
  - (ii) Calculate all interest cash flows at each interest payment date. (2 marks)
  - (iii) Determine the notional principal cash flows at maturity. (2 marks)
- (d) An investor has gathered the following information on put and call options on stock:

Call price	Sh.6.64
Put price	Sh.2.75
Exercise price	Sh.30
Days to option expiration	2.9 days
Current stock price	Sh33.19

**Required:**

Put-call parity given that the stock price at expiration is Sh.20 and risk-free rate is 4%.

(4 marks)  
**(Total: 20 marks)**

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**CIFA PART III SECTION 6**  
**DERIVATIVES ANALYSIS**

**FRIDAY: 30 November 2018.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

- (a) In relation to derivatives trading, distinguish between “forward commitments” and “contingent claims”. (2 marks)
- (b) (i) Explain the term “cross-hedging”. (2 marks)
- (ii) Argue three cases against hedging. (3 marks)
- (c) Using illustrative examples, examine two ways of writing a call option. (4 marks)
- (d) Jeremy Cheposin is an equity analyst at ABC Ltd. He believes that call options are an alternative approach to establish a long position on Triple M stock. The current market price of a six-month put option with a strike price of Sh.100 is Sh.5.35.

The risk-free interest rates are provided below:

<b>Maturity</b>	<b>Risk-free interest rate (%)</b>
3 months	0.50
6 months	0.50
1 year	1.00

**Required:**

The price of a six-month call option using the put-call parity. (3 marks)

- (e) A stock currently trades at a price of Sh.65 and has an exercise price of Sh.60. The stock price can go up by 20% or down by 17% each period. The risk-free rate is 5%.

**Required:**

The price of a call option expiring in two periods using a two-period binomial model. (6 marks)

**(Total: 20 marks)**

**QUESTION TWO**

- (a) Three months ago, Zuhura Ltd. purchased a European receiver swaption that is exercisable into a two-year swap with semi-annual payments. The swaption has a semi-annual exercise rate of 2.75% and a notional principal of Sh.25,000,000. The swaption has just expired.

The relevant term structure of interest rate is presented below:

<b>Days</b>	<b>London Interbank Offered Rate (LIBOR)</b>
	<b>(%)</b>
180	1.95
360	3.68
540	4.11
720	4.65

**Required:**

The market value of the receiver swaption.

(4 marks)

- (b) SM Bank entered into a Sh.5 million, 1 year equity swap with quarterly payments 300 days ago. The bank agreed to pay an annual fixed rate of 4% and receive the return on an international equity index. The index was trading at 3000 at the end of the third quarter, 30 days ago. The current 60-day London Interbank Offered Rate (LIBOR) rate is 3.6%. The discount factor is 0.9940 and the index is now at 3150.

**Required:**

The value of the swap to the bank. (4 marks)

- (c) After examining its long-term liabilities, Lake Bank Limited has decided that it needs to borrow Sh.100 million over the next two years to finance its operations. For this type of funding, Lake Bank Limited issues quarterly coupon short-term Floating Rate Notes (FRN) based on 90-day London Interbank Offered Rate (LIBOR). The bank is concerned that interest rates may shift upwards and is considering using interest rate derivatives. The managers at the bank have collected quotes on the over-the-counter (OTC) interest rate caps and floors from the markets based on a notional principal of Sh.100 million.

**Interest rate caps and floors**

Term (Years)	LIBOR	Settlement	Interest rate caps		Interest rate floors	
			Rate (%)	Price (Sh.)	Rate (%)	Price (Sh.)
1	90-day	Quarterly	3.50	2,000,000	2.55	1,900,000
1	180-day	Semi-annual	3.50	2,000,000	2.55	1,900,000
2	90-day	Quarterly	3.65	2,200,000	2.70	2,090,000
2	180-day	Semi-annual	3.65	2,200,000	2.70	2,090,000

**Required:**

- (i) Explain the term "interest rate collar". (1 mark)
- (ii) The payoff from this derivative 360-days after the contract initiation assuming that the LIBOR at expiration is expected to be 3.75%. (3 marks)
- (iii) The expected payoff after 720-days from a short position in the 2-year semi-annual interest rate floor assuming that the LIBOR at expiration is expected to be 2.40% (3 marks)
- (d) On 1 March 2018, the one-month London Interbank Offered Rate (LIBOR) was 5.50% and the two-month LIBOR rate was 6.00%. The April treasury futures were quoted at 93.75. The contract size was Sh.5,000,000. The one-month LIBOR rate observed on 1 April 2018 was 7.25%.

(Assume that there is no basis risk and that one year has 360 days).

**Required:**

Determine whether an arbitrage opportunity exists. (5 marks)

(Total: 20 marks)

**QUESTION THREE**

- (a) Assess four objectives of global regulation of derivatives market. (8 marks)
- (b) John Njoroge is a derivative consultant in New York and is working on four assignments relating to different clients.

**Client 1:**

The client manages equity portfolio for a pension fund. One month (30 days) ago, the pension fund expected a large inflow of cash in 60 days. In order to hedge against a potential rise in equity value, Njoroge advised the client to enter into a long forward contract on the S & P 500 index expiring in 60 days. The information relating to the transaction is provided below:

Price of a 60-day S & P 500 forward contract 30 days ago	1,403.22
S & P 500 index level today	1,450.82
Annualised continuously compounded risk-free rate	3.92%
Annualised continuously compounded dividend yield for S & P 500	2.50%

**Client 2:**

Three months ago (90 days), the client purchased a bond with a 5% annual coupon rate and a maturity of 7 years from the date of purchase. The bond has a face value of Sh.1,000 and pays interest every 180 days from the date of issue. As the client is concerned about the potential increase in interest rate, Njoroge advised the client to enter into a short forward contract expiring in 360 days. The annualised risk-free rate now is 4% per year and the price of the bond with accrued interest is Sh.1,071.33.



**Client 3:**

A corporate treasurer has gathered the following information:

Annualised 90 day LIBOR rate	3.2%
Annualised 450 day LIBOR rate	4.5%
Annualised risk-free rate in the United States	4.0%
Annualised risk-free rate in the Euro zone	6.0%
Spot exchange rate, USD per EUR	1.39

Three months (90 days) from now, the treasurer expects to borrow USD 5 million at LIBOR for a period of twelve months (360 days). He is concerned that interest rates may rise significantly over the next few months and wishes to hedge this risk. Njoroge advises him to enter into a forward rate agreement (FRA) expiring in 90 days on a 360 day LIBOR.

**Client 4:**

The client expects an inflow of EUR 3,000,000 that needs to be converted to United States Dollars (USD) in 270 days and is concerned that the Euro will decline in value over this period. Njoroge advises the client to enter into an agreement to sell the Euro forward in 270 days.

**Required:**

- (i) The value of the equity forward contract. (3 marks)
  - (ii) The price of the forward contract on the bond purchased. (3 marks)
  - (iii) The rate on the forward rate agreement (FRA) expiring in 90 days on 360 day LIBOR. (3 marks)
  - (iv) The forward price that the client should sell the Euros. (3 marks)
- (Total: 20 marks)**

**QUESTION FOUR**

- (a) Highlight three similarities between "forward contracts" and "futures contracts". (3 marks)
- (b) Explain the term "marking to market" as used in futures market. (2 marks)
- (c) Agva Asset Management Group (AAMG) is a pension fund management firm. One of its funds consists of Sh.300 million allocated 80% to equities and 20% to bonds. The equity portion has a beta of 1.10 and the bond portion has a duration of 6.5. AAMG would like to temporarily adjust the asset allocation to 50% equities and 50% bonds. The firm will use stock index futures and bond futures to achieve this objective. The stock index futures contract has a price of Sh.200,000 and a beta of 0.96. The bond futures contract has an implied modified duration of 7.2 and a price of Sh.105,250. The yield beta is 1.0. The transaction will be put in place on 15 November 2018, and the horizon date for termination is 10 January 2019.

**Required:**

- (i) The number of stock index futures contracts that AAMG should sell to achieve the set objective. (3 marks)
- (ii) The number of bond futures contracts that AAMG should buy to achieve the set objective. (3 marks)
- (d) Martin Opondo believes that the stock price of XYZ Ltd. will have little volatility over the next three months. He wants to construct a butterfly spread option strategy to take advantage of the opportunity he believes exists.

The following data show 3-month options which are available on XYZ Ltd.'s stock:

Option	Strike price (Sh.)	Option price (Sh.)
Put	35	1.25
Put	40	3.50
Put	45	5.50
Call	40	5.90

Martin can use any number of contracts of the above options to construct his strategy.

**Required:**

The total profit (loss) on a properly constructed butterfly spread, assuming that the price of the underlying stock at expiration is Sh.41. (4 marks)

- (e) Evans Nyongesa has recently opened a margin account in which he trades wheat futures. In July 2018, Nyongesa entered a long position of five wheat contracts, each of which covered 5,000 bushel.
- The contract price was Sh.2 and each contract required an initial margin deposit of Sh.150 and maintenance of Sh.100.
- On day 1, the price of wheat declined by Sh.0.02.
- On day 2, the price of wheat increased by Sh.0.01.
- On day 3, the price of wheat declined by Sh.0.03.

**Required:**

Determine the margin balance for this position at the end of day 3. (5 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

- (a) James Kivuva sells a September 2018 call on Delta Ltd.'s shares with an exercise price of Sh.45 for a Sh.3 premium. He also buys a September 2018 call on the same Delta Ltd.'s shares with an exercise price of Sh.40 for a Sh.5 premium.

**Required:**

- (i) Identify with a reason, the type of option strategy employed by James Kivuva. (1 mark)
- (ii) Determine the maximum profit and loss for James Kivuva. (2 marks)

- (b) An investor wishes to purchase a European put option which has the following characteristics:

Current market price of a share	Sh. 25
Strike price for a six months put option	Sh. 20
Annual standard deviation of the underlying stock	25%
Current continuously compounded risk-free rate	4.25%
N (d <sub>1</sub> )	0.9737
N (d <sub>2</sub> )	0.9651

**Required:**

The value of the put option using the Black-Scholes-Merton (BSM) model. (5 marks)

- (c) Josovina Investment Bank has Sh.400 million portfolio available for investment. The cost of funds is 5.5%. The bank lends 50% of the assets to domestic customers for an average annual interest rate of 7.35%. The balance of the portfolio is lent to some Ugandan clients at an annual interest rate of 8%. The spot exchange rate is KES 0.0266/UGX.

At the same time, the bank sells a forward contract to eliminate exchange rate risk equal to the expected receipts one year from now.

The forward exchange rate is KES 0.0250/UGX.

**Required:**

The net interest margin on the balance sheet of Josovina Investment Bank. (4 marks)

- (d) (i) Explain the term "swaption" in the context of derivatives. (1 mark)
- (ii) Examine three primary uses of swaptions. (3 marks)

- (e) Jedi Limited, a Japanese company issues a bond with a face value of 1.2 billion Japanese Yen (¥) and a coupon rate of 5.25%. The company is contemplating to use a swap to convert this bond into a Euro (€) denominated bond.

**Additional information:**

1. The current exchange rate is ¥ 120/€.
2. The fixed rate on Euro-denominated swaps is 6%.
3. The fixed rate on Yen-denominated swaps is 5%.
4. All payments will be made annually, so there is no adjustment such as Days/360.

**Required:**

- (i) Describe the terms of the swap between the two counter parties. (1 mark)
- (ii) Determine the cash flow at the start of the contract. (1 mark)
- (iii) Calculate all interest cash flows at each interest payment date. (2 marks)
- (iv) Calculate all principal cash flows at the maturity of the bond. (2 marks)

**(Total: 20 marks)**

Present Value of 1 Received at the End of n Periods:

$$PVIF_{r,n} = 1/(1+r)^n = (1+r)^{-n}$$

Period	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	14%	15%	16%	18%	20%	24%	28%	32%	36%
1	.9901	.9804	.9709	.9615	.9524	.9434	.9346	.9259	.9174	.9091	.8929	.8772	.8696	.8621	.8475	.8333	.8065	.7813	.7576	.7353
2	.9803	.9612	.9426	.9246	.9070	.8900	.8734	.8573	.8417	.8264	.7972	.7695	.7561	.7432	.7182	.6944	.6504	.6104	.5739	.5407
3	.9706	.9423	.9151	.8890	.8638	.8396	.8163	.7938	.7722	.7513	.7118	.6750	.6575	.6407	.6086	.5787	.5245	.4768	.4348	.3975
4	.9610	.9238	.8865	.8548	.8227	.7921	.7629	.7350	.7084	.6830	.6355	.5921	.5718	.5523	.5158	.4823	.4230	.3725	.3294	.2923
5	.9515	.9057	.8626	.8219	.7835	.7473	.7130	.6806	.6499	.6209	.5674	.5194	.4972	.4761	.4371	.4019	.3411	.2910	.2495	.2149
6	.9420	.8880	.8375	.7903	.7452	.7050	.6663	.6302	.5963	.5645	.5066	.4556	.4323	.4104	.3704	.3349	.2751	.2274	.1890	.1580
7	.9327	.8706	.8131	.7599	.7107	.6651	.6227	.5835	.5470	.5132	.4523	.3996	.3759	.3538	.3133	.2791	.2218	.1776	.1432	.1162
8	.9235	.8535	.7894	.7307	.6768	.6274	.5820	.5403	.5019	.4665	.4039	.3506	.3269	.3050	.2650	.2326	.1789	.1388	.1085	.0854
9	.9143	.8368	.7664	.7026	.6446	.5919	.5439	.5002	.4604	.4241	.3606	.3075	.2843	.2630	.2255	.1938	.1443	.1084	.0822	.0628
10	.9053	.8203	.7441	.6755	.6139	.5584	.5083	.4632	.4224	.3855	.3220	.2697	.2472	.2267	.1911	.1615	.1164	.0847	.0623	.0462
11	.8963	.8043	.7224	.6496	.5847	.5268	.4751	.4289	.3875	.3505	.2875	.2365	.2149	.1954	.1619	.1346	.0938	.0662	.0472	.0340
12	.8874	.7895	.7014	.6246	.5568	.4970	.4440	.3971	.3555	.3186	.2567	.2076	.1869	.1685	.1372	.1122	.0757	.0517	.0357	.0250
13	.8787	.7730	.6810	.6006	.5303	.4688	.4150	.3677	.3262	.2897	.2292	.1821	.1625	.1452	.1163	.0935	.0610	.0404	.0271	.0184
14	.8700	.7579	.6611	.5775	.5051	.4423	.3878	.3405	.2992	.2633	.2046	.1597	.1413	.1252	.0985	.0779	.0492	.0316	.0205	.0135
15	.8613	.7430	.6419	.5553	.4810	.4173	.3624	.3152	.2745	.2394	.1827	.1401	.1229	.1079	.0835	.0649	.0397	.0247	.0155	.0099
16	.8528	.7284	.6232	.5339	.4581	.3936	.3387	.2919	.2519	.2176	.1631	.1229	.1069	.0930	.0708	.0541	.0320	.0193	.0118	.0073
17	.8444	.7142	.6050	.5134	.4363	.3714	.3166	.2703	.2311	.1978	.1456	.1078	.0929	.0802	.0600	.0451	.0258	.0150	.0089	.0054
18	.8360	.7002	.5874	.4936	.4155	.3503	.2959	.2502	.2120	.1799	.1300	.0946	.0808	.0691	.0508	.0376	.0209	.0118	.0068	.0039
19	.8277	.6864	.5703	.4746	.3957	.3305	.2765	.2317	.1945	.1635	.1161	.0829	.0703	.0596	.0431	.0313	.0169	.0092	.0051	.0029
20	.8195	.6730	.5537	.4564	.3769	.3118	.2584	.2145	.1784	.1486	.1037	.0728	.0611	.0514	.0365	.0261	.0135	.0072	.0039	.0021
25	.7798	.6095	.4776	.3751	.2953	.2330	.1842	.1460	.1160	.0923	.0588	.0378	.0304	.0245	.0160	.0105	.0046	.0021	.0010	.0005
30	.7419	.5521	.4120	.3083	.2314	.1741	.1314	.0994	.0754	.0573	.0334	.0196	.0151	.0116	.0070	.0042	.0016	.0006	.0002	.0001
40	.6717	.4529	.3066	.2083	.1420	.0972	.0668	.0460	.0318	.0221	.0107	.0053	.0037	.0026	.0013	.0007	.0002	.0001		
50	.6080	.3715	.2281	.1407	.0872	.0543	.0339	.0213	.0134	.0085	.0035	.0014	.0009	.0006	.0003	.0001				
60	.5504	.3048	.1697	.0951	.0535	.0303	.0173	.0099	.0057	.0033	.0011	.0004	.0002	.0001						

\* The factor is zero to four decimal places

Present Value of an Annuity of 1 Per Period for n Periods:

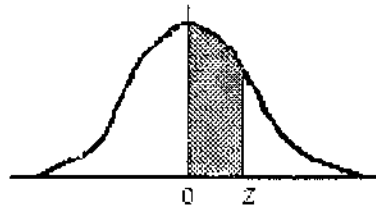
$$PVIFA_{r,n} = \sum_{t=1}^n \frac{1}{(1+r)^t} = \frac{1 - \frac{1}{(1+r)^n}}{r}$$

Number of payments	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	14%	15%	16%	18%	20%	24%	28%	32%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.8929	0.8772	0.8696	0.8621	0.8475	0.8333	0.8065	0.7813	0.7576
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334	1.8080	1.7833	1.7591	1.7355	1.6901	1.6467	1.6257	1.6052	1.5656	1.5278	1.4560	1.3916	1.3315
3	2.9410	2.8839	2.8286	2.7751	2.7232	2.6730	2.6243	2.5771	2.5313	2.4869	2.4018	2.3216	2.2832	2.2459	2.1743	2.1065	1.9813	1.8664	1.7653
4	3.9020	3.8077	3.7171	3.6299	3.5460	3.4651	3.3872	3.3121	3.2397	3.1699	3.0373	2.9137	2.8550	2.7982	2.6901	2.5887	2.4043	2.2410	2.0957
5	4.8534	4.7135	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927	3.8897	3.7908	3.6048	3.4331	3.3522	3.2743	3.1172	2.9706	2.7454	2.5320	2.3452
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229	4.4859	4.3553	4.1114	3.8887	3.7845	3.6847	3.4976	3.3255	3.0205	2.7594	2.5342
7	6.7282	6.4720	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064	5.0330	4.8684	4.5638	4.2883	4.1604	4.0386	3.8115	3.6046	3.2423	2.9370	2.6775
8	7.6517	7.3255	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466	5.5348	5.3349	4.9676	4.6389	4.4873	4.3436	4.0776	3.8372	3.4212	3.0758	2.7860
9	8.5660	8.1622	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469	5.9952	5.7590	5.3282	4.9464	4.7716	4.6065	4.3030	4.0310	3.5655	3.1842	2.8681
10	9.4713	8.9826	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101	6.4177	6.1446	5.6502	5.2161	5.0189	4.8332	4.4941	4.1925	3.6819	3.2689	2.9304
11	10.3676	9.7868	9.2526	8.7605	8.3064	7.8869	7.4987	7.1390	6.8052	6.4951	5.9377	5.4527	5.2337	5.0286	4.6560	4.3271	3.7757	3.3351	2.9776
12	11.2551	10.5753	9.9540	9.3851	8.8633	8.3838	7.9427	7.5361	7.1607	6.8137	6.1944	5.6603	5.4206	5.1971	4.7932	4.4392	3.8514	3.3868	3.0133
13	12.1337	11.3484	10.6350	9.9856	9.3936	8.8527	8.3577	7.9038	7.4869	7.1034	6.4235	5.8424	5.5831	5.3423	4.9095	4.5327	3.9124	3.4272	3.0404
14	13.0037	12.1062	11.2961	10.5631	9.8986	9.2950	8.7455	8.2442	7.7862	7.3667	6.6282	6.0021	5.7245	5.4675	5.0081	4.6106	3.9516	3.4587	3.0609
15	13.8651	12.8493	11.9379	11.1184	10.3797	9.7122	9.1079	8.5595	8.0607	7.6061	6.8109	6.1422	5.8474	5.5755	5.0916	4.6755	4.0013	3.4834	3.0764
16	14.7179	13.5777	12.5611	11.6523	10.8378	10.1059	9.4456	8.8514	8.3126	7.8237	6.9740	6.2651	5.9542	5.6685	5.1524	4.7296	4.0333	3.5026	3.0892
17	15.5623	14.2919	13.1661	12.1657	11.2741	10.4773	9.7632	9.1216	8.5436	8.0216	7.1196	6.3729	6.0472	5.7487	5.2223	4.7746	4.0591	3.5177	3.0971
18	16.3983	14.9920	13.7535	12.6593	11.6896	10.8276	10.0591	9.3719	8.7556	8.2014	7.2497	6.4674	6.1280	5.8178	5.2732	4.8122	4.0799	3.5294	3.1039
19	17.2260	15.6785	14.3238	13.1339	12.0853	11.1581	10.3356	9.6036	8.9501	8.3649	7.3658	6.5504	6.1982	5.8775	5.3162	4.8435	4.0967	3.5386	3.1090
20	18.0456	16.3514	14.8775	13.5903	12.4622	11.4699	10.5940	9.8181	9.1285	8.5136	7.4694	6.6231	6.2593	5.9288	5.3527	4.8696	4.1103	3.5458	3.1129
25	22.0232	19.5235	17.4131	15.6221	14.0939	12.7834	11.6536	10.6748	9.8226	9.0770	7.8431	6.8729	6.4641	6.0971	5.4669	4.9476	4.1474	3.5640	3.1220
30	25.6077	22.3965	19.6004	17.2920	15.3725	13.7648	12.4090	11.2578	10.2737	9.4269	8.0552	7.0027	6.5660	6.1772	5.5168	4.9789	4.1601	3.5693	3.1242
40	32.8347	27.3555	23.1148	19.7928	17.1591	15.0463	13.3317	11.9246	10.7574	9.7791	8.2438	7.1050	6.6418	6.2335	5.5482	4.9966	4.1659	3.5712	3.1250
50	39.1961	31.4236	25.7298	21.4822	18.2559	15.7619	13.8007	12.2335	10.9617	9.9148	8.3045	7.1327	6.6605	6.2463	5.5541	4.9395	4.1666	3.5714	3.1250
60	44.9550	34.7609	27.6756	22.6235	18.9293	16.1614	14.0392	12.3766	11.0480	9.9672	8.3240	7.1401	6.6651	6.2402	5.5553	4.9999	4.1667	3.5714	3.1250

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STANDARD  
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from 0 to z



z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.201	.2051	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000



**CIFA PART III SECTION 6**  
**DERIVATIVES ANALYSIS**

**FRIDAY: 1 December 2017.**

**Time Allowed: 3 hours.**

**Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.**

**QUESTION ONE**

- (a) Highlight three advantages of exchange-traded options compared to options traded in the over-the counter (OTC) market. (3 marks)
- (b) (i) Define the term “futures option”. (2 marks)
- (ii) Argue three cases why futures options have replaced options on fixed income securities as the options vehicles of choice for institutional investors who want to use exchange-traded options. (6 marks)
- (c) A four-month put futures position has a strike price of Sh.50. The risk-free rate of interest is 10% per annum. The current futures price is Sh.47.

**Required:**

The lower bound for the value of the futures option if it is:

- (i) European futures option. (2 marks)
- (ii) American futures option. (1 mark)
- (d) European put and call options with an exercise price of Sh.45 is expected to expire in 115 days. The underlying asset is priced at Sh.48 and is expected to make no cash payments during the life of the options. The risk-free rate is 4.5%. The put option is selling at Sh.3.75 and the call option is selling for Sh.8.00. Assume a 365-day year.

**Required:**

- (i) Identify the mispricing by comparing the price of the actual call with the price of the synthetic call. (2 marks)
- (ii) Based on your answer in (d)(i) above, illustrate how an arbitrage transaction is executed. (4 marks)
- (Total: 20 marks)**

**QUESTION TWO**

- (a) Summarise four similarities common to both options and forward contracts. (4 marks)
- (b) Argue three cases for the existence of swaptions in the financial markets. (3 marks)
- (c) Firm A plans to issue a Sh.100 million floating rate note today that has a 180-day term and coupon payments after every 90-days equal to the 90-day LIBOR. It plans to use a plain vanilla interest rate swap to convert this floating rate debt to a fixed rate obligation.

Firm B plans to use a swaption to hedge its future interest rate exposure and it plans to issue a Sh.100 million floating rate note in 90-days time that has a 180-day term and coupon payments every 90-days equal to the 90-day LIBOR. The firm intends to buy a European swaption with a notional principal amount of Sh.100 million and a 90-day expiry period at the time of floating rate note issuance. The firm intends to exercise the swaption if yields increase. The fixed rate on the swaption is 3.90% and, if in 90-days time the fixed rate on the underlying equivalent swap was 4.32%, the swaption will be exercised.

The following information is also provided:

<b>LIBOR, Swap and Swaption (Rates are annualised)</b>	<b>Today</b>	<b>In 90-days</b>
90-day LIBOR	3.50%	4.00%
180-day LIBOR	3.85%	4.35%
Fixed rate on swaption	3.90%	Not Applicable
Fixed rate on swap	Not Applicable	4.32%
90-day discount factor	0.9913	0.9901
180-day discount factor	0.9811	0.9787

**Required:**

- (i) Determine the annualised fixed rate on the plain vanilla interest rate swap. (3 marks)
  - (ii) Calculate the market value of the swap at expiration. (4 marks)
- (d) Susan Cheptoo is an investor who seeks to arbitrage pricing discrepancies in the market over the next six months. She has observed the following data in the market:

<b>Instrument</b>	<b>Spot Price (Sh.)</b>	<b>Futures price for contract expiring in six months (Sh.)</b>	<b>Income from Treasury Note for six months (Sh.)</b>	<b>Finance charge for six months (Sh.)</b>
Treasury note deliverable on the futures contract	101	100 (invoice price)	4.50	2.50

**Required:**

- (i) Describe the process that Cheptoo would follow to carry out the arbitrage transaction. (3 marks)
  - (ii) Calculate the arbitrage profit, if any, that is available to exploit a possible pricing discrepancy. (3 marks)
- (Total: 20 marks)**

**QUESTION THREE**

- (a) (i) Explain the term "derivative mishaps". (2 marks)
- (ii) Assess five lessons that financial institutions could learn from derivative mishaps. (5 marks)

(b) A US based company that exports goods to Switzerland expects to receive payment on shipment of goods in three months time. Since the payment will be in Swiss Francs, the US company intends to hedge against a decline in the value of the Swiss Francs over the next three months.

The US risk-free rate is 2% and the Swiss risk-free rate is 5%. Assume that interest rates are expected to remain fixed over the next six months. The current spot rate is 0.5974.

Assume a 365-day year.

**Required:**

- (i) Advise the US company whether it should use a long forward contract or a short forward contract to hedge against the currency risk. (2 marks)
  - (ii) Calculate the no-arbitrage price at which the US company could enter into a forward contract that expires in three months. (2 marks)
  - (iii) It is now 30 days since the US company entered into a forward contract. The spot rate is 0.55. Interest rates are the same as before.  
Calculate the value of US company forward position. (3 marks)
- (c) Peterson Mwanzia, a portfolio manager at Riora Investment Bank holds a portfolio with a total market value of Sh.105 million. Sh.65 million of this portfolio is invested in a broadly diversified portfolio of domestic equities while the remaining Sh.40 million is invested in the shares of EOBL Corporation. Mwanzia intends to reduce exposure to EOBL Corporation's shares by Sh.30 million and plans to achieve this objective by entering into a three-year equity swap using the standard and poor (S & P) 500 index.

Assume that the settlement is made at the end of each year and that one year later, EOBL share is 4% and the return on the S & P 500 market index is -3%.

**Required:**

- (i) Explain the structure of the equity swap. (2 marks)
  - (ii) Calculate the net cash flow for the swap at the end of one year. (4 marks)
- (Total: 20 marks)**

**QUESTION FOUR**

(a) Discuss the following options strategies:

- (i) Box spread. (2 marks)
- (ii) Straddle. (2 marks)
- (iii) Collar. (2 marks)
- (iv) Bull spread. (2 marks)

(b) Omega Ltd. provides risk management consulting with regard to options and swaps for institutional and individual clients. Ann Melinda is an investment advisor for Omega Ltd. tasked to work with the firm's High Networth (HNW) client's accounts. She is considering derivative strategies for several Omega Ltd.'s clients.

**Additional information:**

1. SCM foundation owns 30,000 shares of Nasdaq 100 index tracking stock which has a current market price of Sh.30 per share. Ann Melinda believes that there is substantial risk of downside price movement in the index over the next six months. She has recommended that SCM foundation use a six-month collar for the entire position of 30,000 shares as a protection against the share price falling below Sh.27. The table below gives exercise prices and option premiums (per share) for the tracking stock puts and calls expiring in six months:

Option type	Exercise price (Sh.)	Option premium (Sh.)
Call	35	0.80
Put	27	0.95

The tracking stock index option is for 100 shares of the index tracking stock. SCM foundation plans to hold the collar strategy until expiration of the puts and call options.

2. Michael Kirwa believes that the price of large capitalisation stocks will rise slightly and he intends to profit from this movement using a bull spread strategy. Melinda recommends that Kirwa uses Dow Jones Industrial Average (DJIA) options that expire in two months. The current market price of DJIA is Sh.91. The table below gives the exercise prices and call options premium (per share) for two DJIA call options:

Exercise price (Sh.)	Option premium (Sh.)
88	4.40
94	1.00

The total cost of one contract is the quoted premium times the contract multiplier, which is 100 shares per contract. Kirwa decides to use 100 contracts per position.

3. James Simbili expects the tracking stock on the DJIA to trade within a narrow range around its current price. Based on his expectation, he believes that a profitable trading opportunity is to initiate a butterfly spread strategy using call options on DJIA. Melinda suggests the need to use three one-month call options on DJIA. Each option contract is for 100 shares. The table below gives exercise prices and option premiums for three DJIA call options expiring in one month.

Exercise price (Sh.)	Option premium (Sh.)
88	4.20
92	2.00
96	0.50

James intends to use a butterfly spread with a total of 200 long contracts and 200 short contracts.

**Required:**

- (i) Calculate the profit from SCM foundation's collar given that the market value of index tracking is Sh.33 at expiration. (3 marks)
  - (ii) Calculate the maximum potential profit from SCM foundation's collar at expiration. (3 marks)
  - (iii) Calculate the maximum potential profit from Michael Kirwa's bull spread strategy at expiration of the DJIA call options. (3 marks)
  - (iv) Calculate the maximum potential loss at expiration for James Simbili's butterfly spread strategy.(3 marks)
- (Total: 20 marks)**

**QUESTION FIVE**

- (a) Evaluate three assumptions underlying the Black-Scholes-Merton (BSM) model of options valuation. (6 marks)
- (b) Using the relevant options Greeks, assess how an option price, as represented by the Black-Scholes-Merton (BSM) model, is affected by a change in the value of each of the following inputs:
  - (i) Underlying asset price. (2 marks)
  - (ii) Underlying asset volatility. (2 marks)
  - (iii) Time-to-maturity. (2 marks)
- (c) The value of a portfolio is Sh.608,000. The risk-free interest rate is 10% per annum. The value of BSE Index is 3000. The beta of the portfolio is 1.5 and the dividend yield on the index is 6% per annum. A futures contract on the BSE index with four months to maturity is used to hedge the value of the portfolio over the next three months. The futures contract is for delivery of 50 times the index. After three months, the value of the index is 2700.

**Required:**

- (i) The minimum-variance hedge ratio. (5 marks)
  - (ii) The gain on short futures position at the end of three months. (3 marks)
- (Total: 20 marks)**
- .....



# KASNEB

## CIFA PART III SECTION 6

### DERIVATIVES ANALYSIS

FRIDAY: 26 May 2017.

Time Allowed: 3 hours.

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

#### QUESTION ONE

- (a) Argue three cases for the existence of derivatives markets in your country. (6 marks)
- (b) Justify why a portfolio manager would prefer to create a put option synthetically instead of buying it in the market. (2 marks)
- (c) Differentiate between "strip hedge" and "stack hedge" as used in derivatives trading. (2 marks)
- (d) A non-dividend paying stock has a call option. The price of the stock is Sh.49. The strike price is Sh.50. The risk free-rate is 5%. The time-to-maturity is 0.3846 years and the volatility is 20%. There are 365 days in a year.

#### Required:

- (i) The option's theta. (4 marks)
- (ii) The change in the option's delta when price increases by 10%. (2 marks)
- (iii) The change in the option's value when volatility increases to 21% from 20%. (2 marks)
- (iv) The change in the option's value when risk-free rate increases to 6% from 5%. (2 marks)

#### Hint:

$$\text{Option theta} = -\frac{S_0 N'(d_1) \sigma}{2\sqrt{T}} - rKe^{-rT} N(d_2)$$

$$\text{Option gamma} = \frac{N'(d_1)}{S_0 \sigma \sqrt{T}}$$

$$\text{Option vega} = S_0 \sqrt{T} N(d_1)$$

$$\text{Option rho} = KTe^{-rT} N(d_2)$$

$$\text{Where: } N'(d_1) = 0.40112$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

(Total: 20 marks)

#### QUESTION TWO

- (a) Discuss three factors that could affect an option's time value. (3 marks)
- (b) (i) Explain the term "interest rate cap" in relation to derivatives markets. (1 mark)
- (ii) An institution has issued a floating rate note for which the interest rate is reset after every 90 days, using the prevailing 90-day spot interest rate. The next reset date is due in 42 days' time. The institution has purchased an interest rate cap with a maturity of 42 days and cap rate of 5.50%. The amount involved is Sh.10 million. The 90-day spot interest rate at 42 days is 5.80%.

#### Required:

The pay-off to the cap. (2 marks)

- (c) Andrew Makori is a global equity manager who manages a Sh.95 million large capitalisation United States (US) equity portfolio and he is currently forecasting that equity markets will decline soon. Andrew prefers to avoid the transactions cost of making sales but intends to hedge Sh.15 million of the portfolio's current value using Standard and Poor (S & P) 500 index futures. Andrew realises that his portfolio will not track the S & P 500 index exactly. He decides to perform a regression analysis on his actual portfolio returns versus the S & P futures returns over the past year. This regression analysis will indicate a risk minimising beta of 0.88 with a coefficient of determination ( $R^2$ ) of 0.92.

**Futures Contract Data**

S & P 500 futures price	Sh.1,000
S & P 500 Index	999
S & P 500 Index multiplier	250

**Required:**

- (i) The number of futures contracts required to hedge Sh.15 million of the equity manager's portfolio. (3 marks)
- (ii) Advise Andrew Makori on three alternative methods that he should use to replicate the futures strategy. (6 marks)
- (d) A box spread consists of options with exercise prices of Sh.75 and Sh.85. The call prices are Sh.16.02 and Sh.12.28 for exercise prices of Sh.75 and Sh.85 respectively. The put prices are Sh.9.72 and Sh.15.18 for exercise prices of Sh.75 and Sh.85 respectively. The options expire in six months and the discrete risk free-rate is 5.13%.

**Required:**

- (i) The profit of the box spread at expiration. (2 marks)
- (ii) Show that this box spread is priced such that an attractive opportunity is available. (3 marks)
- (Total: 20 marks)

**QUESTION THREE**

- (a) Explain two uses of index futures. (2 marks)
- (b) Evaluate three advantages of interest rate collar. (3 marks)
- (c) Diamond Financial Services (DFS) offers fixed income portfolio management services to institutional investors. DFS would like to execute a duration changing strategy for a Sh.150 million bond portfolio of a particular client. This portfolio has a modified duration of 8. DFS plans to change the modified duration to 6 by using a futures contract priced at Sh.150,000 which has an implied modified duration of 7. The yield beta is 1.5. After one year, the yield on the bond has decreased by 30 basis points. The bond portfolio increases in value by 1.5% and the futures price increases to Sh.152,000.

**Required:**

The overall gain on the portfolio. (3 marks)

- (d) Kemeloi Capital is a money management firm that specialises in turning the idle cash of its clients into equity index positions at very low cost. The firm has a new client with Sh.500 million of cash that it would like to invest in the small cap equity sector. Kemeloi Capital would like to construct the position using a futures contract on a small cap index.

**Additional information:**

- The futures price is 1,500.
- The multiplier is 100.
- The contract expires in six months.
- The underlying small cap index has a dividend yield of 1%.
- The risk free rate is 3% per annum.

**Required:**

Determine how the cash could be equitised using a futures contract. (3 marks)

- (e) Melly Odhiambo, a corporate treasurer at Suneka Ltd. needs to hedge the risk of the interest rate on a future transaction. The risk is associated with the rate on the 180-day London Inter-bank Offer Rate (LIBOR) in 30 days. The relevant term structure of LIBOR is given as follows:

30 day LIBOR	5.75%
210 day LIBOR	6.15%

20 days later, interest rates are expected to move significantly downward to the following:

10 day LIBOR	5.45%
190 day LIBOR	5.95%

On the expiration day, 180 day LIBOR is expected to be 5.72%. Melly Odhiambo decides to long this forward rate agreement (FRA) for a notional principal of Sh.20 million.

**Required:**

- (i) Compute the market value of the FRA, 20 days later. (2 marks)
- (ii) Calculate the payment to be made to or by the company so as to settle the FRA contract on its expiration. (2 marks)
- (f) John Omulundo, an investment manager, holds an asset portfolio with a total market value of Sh.105 million. The allocation of the portfolio is as follows:
1. Sh.65 million is invested in a broadly diversified portfolio of domestic stocks.
  2. Sh.40 million is invested in the stocks of Jimbo Corporation.

The investment manager wishes to reduce exposure to Jimbo Corporation stocks by Sh.30 million. The manager plans to achieve this objective by entering into a three-year equity swap using the Standard and Poor (S & P) 500 market index.

Assume that settlement is made at the end of each year and the return on S & P 500 market index is -3 percent.

**Required:**

- (i) Explain the structure of the equity swap. (2 marks)
- (ii) Calculate the net cash flow for the swap at the end of the year. (3 marks)
- (Total: 20 marks)**

**QUESTION FOUR**

- (a) Although there is a clear similarity between forward contracts and futures contracts, critical distinctions nonetheless exist between the two.

**Required:**

In relation to the above statement, explain five differences between forward contracts and futures contracts. (5 marks)

- (b) A long forward contract on a non-dividend paying stock was entered some time ago. It has 6 months to maturity. The risk-free rate of interest with continuous compounding is 10% per annum. The stock price is Sh.25 and the delivery price is Sh.24.

**Required:**

The value of the forward contract. (3 marks)

- (c) A six-month European call option on the spot price of gold exists. The strike price is Sh.1,200. The six-month futures price of gold is Sh.1,240. The risk free-rate of interest is 5% per annum and the volatility of the futures price is 20%.

The option is the same as a six-month European option on the six-month futures price.

**Required:**

The value of the option. (4 marks)

- (d) A portfolio manager is entering into a two-year swap in which his firm will receive the rate of return on the Russell 2,000 index and will pay a fixed interest rate. The swap has annual payments. The fixed rate of the swap to be initiated is 4.99%. The Russell 2,000 index is at 757.09 at the beginning of the swap and the notional principal of the swap is Sh.100 million. One hundred days later, the Russell 2,000 index is at 723.86 and the term structure is presented below:

**Term structure of LIBOR interest rates 100 days later**

Days (T)	Lo (T)	Bo (T)
260	0.0442	0.9691
620	0.0499	0.9209

Note: Calculations are on a 360-day year basis.

Where: T = Time to expiration  
 L<sub>0</sub>(T) = LIBOR rate to time T  
 B<sub>0</sub>(T) = Discount factor of Sh.1 from time T to the present

**Required:**

The market value of the firm's position in the swap 100 days after the initiation of the swap. (4 marks)

- (e) Silvia Makena is concerned about the risk level of a client's equity portfolio. The client has 60% of this portfolio invested in two equity positions: Hope Industries and Hummer Securities.

Stock	Shares	Stock price (Sh.)
Hope Industries	375,000	26.20
Hummer Securities	300,000	34.00

Silvia investigates whether a privately negotiated equity swap could be used to reduce the risk of the Hope Industries and Hummer Securities holding. A swap dealer offers Silvia the following two options:

- The dealer will receive the return on 250,000 shares of Hope Industries and 200,000 shares of Hummer Securities from client.
- The dealer will pay the client the return on an equivalent amount on the Russell 3,000 index.

The dealer demonstrates the quarterly cash flows of this transaction under the assumptions that Hope Industries is up 2%, Hummer Securities is up 4% and the Russell 3,000 index is up 5% for the quarter.

**Required:**

The payoff to the client in the equity swap. (4 marks)

**(Total: 20 marks)**

**QUESTION FIVE**

- (a) Kansanga Ltd., a Ugandan company exports products to Kenya. Kansanga Ltd. has just closed a sale worth Kenya shillings (KES) 200,000,000. The amount will be received in two months. Since it will be paid in KES, the Ugandan company bears the exchange rate risk. In order to hedge this risk, Kansanga Ltd. intends to use a forward contract that is priced at Uganda shillings (UGX).

$$1 \text{ KES} = 28,544 \text{ UGX}$$

**Required:**

- (i) Illustrate how the company would go about constructing the hedge. (3 marks)
- (ii) Explain what happens when the forward contract expires in two months. (1 mark)
- (b) Emase Omanyala, a Certified Investment and Financial Analyst (CIFA), is a risk manager at Baraka Asset Managers (BAM). Emase works with individual clients to manage their investment portfolios. One client, John Mwajuma, is worried about how short-term market fluctuations over the next three months might impact his equity position in Mnazi Moja Corporation. While John is concerned about short-term downside price movements, he wants to remain with investments in Mnazi Moja Corporation shares as he remains positive about its long-term performance. John has asked Emase to recommend an option strategy that would keep him with investments in Mnazi Moja Corporation shares while protecting against a short-term price decline.

Emase gathers the following information to explore various strategies to address John's concerns:

**Table 1:**

<b>Mnazi Moja Corporation European Options</b>				
<b>Exercise price (Sh.)</b>	<b>Market call price (Sh.)</b>	<b>Call delta</b>	<b>Market put price (Sh.)</b>	<b>Put delta</b>
55.00	12.83	4.7	0.24	-16.7
65.00	3.65	12.0	1.34	-16.9
67.50	1.99	16.5	2.26	-15.3
70.00	0.91	22.2	3.70	-12.9
80.00	0.03	35.8	12.95	-5.0

**Additional information:**

1. Mnazi Moja Corporation's current share price is Sh.67.79.
2. Each option has 106 days remaining until expiration.

Another client, Samuel Momanyi, is a trader who does not currently own shares of Mnazi Moja Corporation. Samuel has told Emase that he believes that Mnazi Moja Corporation shares will experience a large move in price after the upcoming quarterly earnings release in two weeks. However, Samuel tells Emase that he is unsure of the direction that the stock will move. Samuel asks Emase to recommend an option strategy that would allow him to profit should the share price move in either direction.

A third client, Anthony Murungi does not currently own Mnazi Moja shares and has asked Emase to explain the profit potential of three strategies using options in Mnazi Moja Corporation: a bull call spread, a strangle and a butterfly spread. In addition, Anthony asks Emase to explain the gamma of a call option. In response, Emase prepares a memo to be shared with Anthony that provides analysis on three option strategies:

- Strategy 1: A strangle position at the Sh.67.50 strike option.  
 Strategy 2: A bull call spread using the Sh.65 and Sh.70 strike options.  
 Strategy 3: A butterfly spread using the Sh.65, Sh.67 and Sh.70 strike call options.

**Required:**

- (i) Citing appropriate reason(s), explain the option strategy that Emase should recommend to John Mwajuma. (2 marks)
- (ii) Citing appropriate reason(s), explain the option strategy that Emase should recommend to Samuel Momanyi. (2 marks)
- (iii) Based on the information given above on Mnazi Moja Corporation's European options, estimate the share price at expiration at which strategy 1 would be profitable. (3 marks)
- (iv) In relation to the data given in Table 1 above, estimate the maximum profit, on a per share basis, from investing in strategy 2. (3 marks)
- (v) Using the information given in Table 1 above, and assuming that the market price of Mnazi Moja Corporation's shares at expiration is Sh.66, estimate the profit or loss, on a per share basis, from investing in strategy 3. (3 marks)
- (vi) In the context of the data given in Table 1 above, determine the strike price of the call option with the largest gamma. (3 marks)

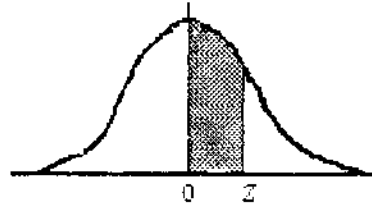
**(Total: 20 marks)**

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# NORMAL CURVE

AREAS  
under the  
STANDARD  
NORMAL CURVE  
from 0 to z



z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.201	.2051	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000

# KASNEB

## CIFA PART III SECTION 6

### DERIVATIVES ANALYSIS

FRIDAY: 25 November 2016.

Time Allowed: 3 hours.

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

#### QUESTION ONE

- (a) Derivatives trade in markets around the world, which include organised exchanges where highly standardised and regulated versions exist, and Over-the-Counter (OTC) markets, where customised and more highly regulated versions trade.

In relation to the above statement, discuss the following types of derivatives contracts:

- (i) Forward contract. (2 marks)
  - (ii) Futures contract. (2 marks)
  - (iii) Swap contract. (2 marks)
  - (iv) Option. (2 marks)
- (b) Consider a two-period binomial model in which a share currently trades at a price of Sh.97.50. The share price can increase by 30% or reduce by 25.50% in each period. The risk-free rate is 7.50%.

**Required:**

- (i) The price of a put option today that is expiring in two periods with an exercise price of Sh.90. (6 marks)
  - (ii) Based on the results in (b)(i) above, calculate the number of units of the underlying stock that would be required at each point in the binomial tree in order to construct a risk-free hedge. Use 15,000 puts. (6 marks)
- (Total: 20 marks)**

#### QUESTION TWO

- (a) Explain three factors that could affect the price of an option. (3 marks)
- (b) Citing three reasons, justify why futures options are increasingly becoming popular in the derivatives markets. (6 marks)
- (c) The following information relates to a European put futures option on crude oil:
- 1. The time to the option's expiration is 4 months.
  - 2. The current futures price is Sh.20.
  - 3. The futures exercise price is Sh.20.
  - 4. The risk-free interest rate is 9% per annum.
  - 5. The volatility on the futures price is 25% per annum.

**Required:**

The put price on a European put futures option. (3 marks)

- (d) A European receiver swaption expires in one year and is on a two-year swap that will make semi-annual payments. The swaption has an exercise rate of 7.2%. The notional principal is Sh.49 million. At the time of expiration, the term structure of interest rates is as follows:

$$\begin{aligned}L_0(180) &= 0.0412 \\L_0(360) &= 0.0465 \\L_0(540) &= 0.0533 \\L_0(720) &= 0.0648\end{aligned}$$

**Required:**

Illustrate four possible ways in which this swaption could be exercised, evaluating the relevant cash flows in each case. (8 marks)

**(Total: 20 marks)**

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Out of 3

### QUESTION THREE

- (a) (i) Distinguish between "price limit" and a "position limit" as applied in derivatives markets. (2 marks)
- (ii) Explain the purpose of price limit and position limit in derivatives markets. (2 marks)
- (b) Argue three cases against hedging in the derivatives markets. (3 marks)
- (c) The board of directors of Palex Ltd. is concerned about the downside risk of a Sh.100 million equity portfolio in its pension plan. The board's consultant has proposed hedging the equity portfolio with either futures or options in a temporary period of one month.

**Required:**

Using the following factors, describe how the use of futures differ from the use of options when hedging a portfolio's equity exposure:

- (i) Initial cost. (2 marks)
- (ii) Effect of implied volatility in pricing. (2 marks)
- (iii) Sensitivity to movement in the value of the underlying. (2 marks)
- (iv) Risk exposure. (2 marks)
- (d) The following information relates to a currency forward contract involving two currencies, the Kenya Shilling (KES) and the United States Dollar (USD):

Forward price (KES/USD)	0.01
Risk-free rate (Kenya)	6%
Risk-free rate (United States)	8%
Current spot rate (KES/USD)	0.009
Time to expiration	165 days

**Required:**

The value of the currency forward contract. (2 marks)

- (e) A portfolio manager expects to purchase a portfolio of stocks in 90 days from the Nairobi Securities Exchange (NSE). The manager decides to take a long position on a 90-day forward contract on the NSE 20 share index. The index is currently at 4580. The continuously compounded dividend yield is 1.75% while the discrete risk-free rate is 4.25%.

**Required:**

The value of the forward contract 28 days into the life of the forward contract; if the NSE 20 share index is at 4,900. Assume a 365-day year.

(3 marks)

(Total: 20 marks)

### QUESTION FOUR

- (a) Johnson Mwakasi is a derivatives consultant handling three clients; A, B and C who have the following investment positions:
- Client A has invested in stocks with a strong European exposure and he says that his portfolio has a positive delta.
  - Client B has invested in stocks of financial firms and she says that her portfolio has a negative rho.
  - Client C has recently retired and has managed to establish large option positions as a stock investor. He says that his portfolio has a positive theta

**Required:**

Explain the meaning of each claim made by each client. (6 marks)

- (b) In a Treasury bond futures contract, it is known that the cheapest bond to deliver will be a 12% coupon bond with a conversion factor of 1.6000. It is also known that the delivery will take place in 270 days. Coupons are payable semi-annually on the bond. The last coupon date was 60 days ago. The next coupon date is in 122 days and the coupon thereafter is in 305 days. The term structure is flat and the rate of interest with continuous compounding is 10% per annum. The current quoted bond price is Sh.115.

**Required:**

The quoted futures price.

(5 marks)

CF63 Page 2  
Out of 3



- (c) The following information relates to a European call option on the S&P 500 market index with two months to maturity:
1. The current value of the index is Sh.930.
  2. The exercise price is Sh.900.
  3. The risk-free interest rate is 8% per annum.
  4. The volatility of the index is 20% per annum.
  5. Dividend yields of 0.2% and 0.3% are expected in the first and second month.

**Required:**

The call price using Black-Scholes-Merton (BSM) model. (4 marks)

- (d) The spot price of corn is Sh.3.50 and it costs Sh.0.017 to store a bushel of corn for 1 month while the relevant cost of financing is 1% per month. The corn futures contract matures in 6 months and the current futures price for this contract is Sh.3.95 per bushel. The storage cost is paid at the onset of the transaction. There are 5,000 bushels per contract.

**Required:**

The arbitrage profit from the transaction. (5 marks)

(Total: 20 marks)

**QUESTION FIVE**

- (a) Assess three types of margins that an investor participating in a futures exchange could access. (6 marks)

- (b) Boaz Miriti manages the family investment portfolio which initially consisted of Sh.46 million of equities and Sh.32 million of bonds. As a result of a change in family circumstances, the portfolio is rebalanced using the transaction shown below:

Type of futures contract	Action	Number of futures contract to buy or sell	Price per futures contract (Sh.)
Equity futures contract	Buy	42	160,000
Bond futures contract	Sell	35	190,000

Three months after the above transactions, the market value of the family portfolio's equities has increased by 300% and the market value of its bonds has decreased by 240%. The prices of the equity futures contract and bond futures contract are now Sh.165,000 and Sh.185,250 respectively.

**Required:**

The profit or loss of the family investment portfolio over the past three months. (4 marks)

- (c) John Mukungi is a portfolio manager with Raimulo Financial Services. He manages a portfolio consisting 65% allocation to equities and 35% allocation to bonds. The portfolio has a market value of Sh.200 million. The beta of the equity position is 1.15, and the modified duration of the bond position is 6.75. The portfolio manager wishes to increase the equity allocation to 85% and reduce the bond allocation to 15% for a period of 6 months.

In addition to altering asset allocations, John Mukungi would also like to increase the beta on the equity position to 1.20 and increase the modified duration of the bonds to 8.25.

A stock index futures contract that expires in six months is priced at Sh.157,500 and has a beta of 0.95. A bond futures contract that expires in six months is priced at Sh.109,000 and has implied modified duration of 5.25. The stock futures contract has a multiplier of 1.

**Required:**

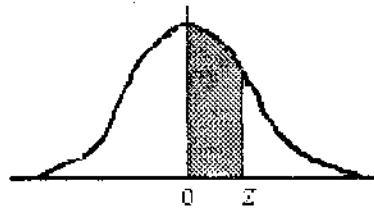
- (i) Demonstrate how John Mukungi could achieve his goals by using stock index and bond futures. (5 marks)
- (ii) The number of futures contracts. (4 marks)
- (iii) Indicate whether the portfolio manager should go long or short. (1 mark)

(Total: 20 marks)

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# NORMAL CURVE

AREAS  
under the  
STANDARD  
NORMAL CURVE  
from 0 to z



z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.201	.2051	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000

# KASNEB

## CIFA PART III SECTION 6

### DERIVATIVES ANALYSIS

FRIDAY: 27 May 2016.

Time Allowed: 3 hours.

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

#### QUESTION ONE

- (a) Discuss the following terms as used in the swaps market:
- (i) Index amortising swap. (2 marks)
  - (ii) Arrears swap. (1 mark)
  - (iii) Index differential swap. (2 marks)
  - (iv) Overnight index swap. (1 mark)
- (b) A two year swap with semiannual payments pays a floating rate and receives a fixed rate. The term structure at the beginning of the swap is as follows:

$$L_0(180) = 0.0583$$

$$L_0(360) = 0.0616$$

$$L_0(540) = 0.0680$$

$$L_0(720) = 0.0705$$

Where:  $L_i(m)$  is the m-day LIBOR on day i.

In order to mitigate credit risk of the parties engaged in the swap, the swap will be marked to market in 180 days. Suppose it is now 180 days later and the swap is being marked to market. The new term structure is as follows:

$$L_{180}(180) = 0.0429$$

$$L_{180}(360) = 0.0538$$

$$L_{180}(540) = 0.0618$$

#### Required:

- (i) The market value of the swap per Sh.1 notional principal. Indicate the amount paid by each party. (6 marks)
  - (ii) The new fixed rate on the swap at which the swap would proceed after marking to market. (2 marks)
- (c) Fredrick Aloo offers fixed income portfolio management services to institutional investors. He would like to execute a duration changing strategy for a Sh.100 million bond portfolio for a particular client. This portfolio has a modified duration of 7.2. Fredrick plans to change the modified duration of the portfolio to 5.0 by using a futures contract priced at Sh.120,000 which has an implied modified duration of 6.25 and a yield beta of 1.15.

#### Required:

- (i) Determine the number of futures contracts that Fredrick Aloo should sell. (2 marks)
- (ii) Suppose that the yield on the bond has decreased by 20 basis points at the horizon date, the bond portfolio has increased in value by 1.5% and the futures price has increased to Sh.121,200.

Determine the overall gain on the portfolio and the ex-post modified duration as a result of the futures transaction. (4 marks)

(Total: 20 marks)

## QUESTION TWO

- (a) Describe five ways that could be used to manage credit risk in derivatives markets. (5 marks)
- (b) European put and call options with an exercise price of Sh.45 will expire in 115 days. The underlying asset is priced at Sh.48 and makes no cash payments during the life of the options. The risk free rate is 4.5%. The put is selling for Sh.3.75 and the call is selling for Sh.8.

**Required:**

- (i) Using suitable computations, identify the mispricing in the call. (2 marks)
- (ii) Execute an arbitrage transaction. (4 marks)
- (c) On 10 January 2016, SCM Ltd. determined that it would need to borrow Sh.5 million on 15 February 2016 at 90 day LIBOR plus 300 basis points. The loan would be an add on interest loan in which SCM Ltd. would receive Sh.5 million and pay it back plus interest on 16 May 2016.

To manage the risk associated with the interest rate on 15 February 2016, SCM Ltd. buys an interest rate call that expires on 15 February 2016 and pays off on 16 May 2016. The exercise rate is 5% and the option premium is Sh.10,000. The current 90 days LIBOR is 5.25%. Assume that this rate, plus 300 basis points is the rate at which SCM Ltd. would borrow at for any period of up to 90 days if the loan were taken out today.

Interest is computed on the exact number of days divided by 360.

**Required:**

Determine the effective annual rate on the loan when the 90 day LIBOR on 15 February 2016 is at 6%. (5 marks)

- (d) A futures contract has a current price of Sh.212. The initial margin requirement is Sh.10 and the maintenance margin requirement is Sh.8. An investor goes long 20 contracts and meets all margin calls and does not withdraw any excess margin.

The futures price in the days following are shown below:

Day	Futures price (Sh.)
0	212
1	211
2	214
3	209
4	210
5	204
6	202

**Required:**

The investor's total gain or loss by the end of day 6.

(4 marks)

**(Total: 20 marks)**

## QUESTION THREE

- (a) Differentiate between a "payer swaption" and a "receiver swaption". (2 marks)
- (b) Discuss the following terms as used in the options markets:
- (i) Naked position. (2 marks)
- (ii) Covered position. (2 marks)
- (iii) Stop loss strategy. (2 marks)
- (c) A Kenyan corporation with a Tanzanian subsidiary generates cash flows of Tsh.10 million in a year. The subsidiary is considering using a currency swap to lock in the rate at which it converts to Kenyan shillings. The current exchange rate is Ksh.0.825/Tsh. The fixed rate on a currency swap in Tanzania shillings is 5%.

**Required:**

Determine the overall periodic cash flow from the subsidiary operations and the swap.

(4 marks)

- (d) An airline expects to purchase 2 million barrels of jet fuel in 1 month and decides to use heating oil futures for hedging.

The table below gives the data on the change in jet fuel prices per barrel and the corresponding change in the futures price for the contract on heating oil that would be used for hedging price changes during the month:

Month	Change in futures price per barrel ( $x_i$ )	Change in fuel price per barrel ( $y_i$ )
1	0.021	0.029
2	0.035	0.020
3	-0.046	-0.044
4	0.001	0.008
5	0.044	0.026
6	-0.029	-0.019
7	-0.026	-0.010
8	-0.029	-0.07
9	0.048	0.043
10	-0.06	0.011
11	-0.036	-0.036
12	-0.011	-0.018
13	0.019	0.009
14	-0.027	0.032
15	0.029	0.032

The summarised calculations are as follows:

$$\begin{aligned} \sum x_i &= -0.013 \\ \sum y_i &= 0.003 \\ \sum x_i^2 &= 0.0138 \\ \sum y_i^2 &= 0.097 \end{aligned}$$

Each heating oil contract traded has 42,000 barrels of heating oil.

**Required:**

The optimal number of contracts required for hedging.

(8 marks)

(Total: 20 marks)

#### QUESTION FOUR

- (a) Assess the effect of the following factors on option prices:

(i) Interest rates.

(1 mark)

(ii) Volatility.

(1 mark)

- (b) Jonathan Atwori is doing some scenario analysis on forward contracts. The process involves pricing the forward contracts and then estimating their values based on likely scenarios provided by the firm's forecasting and strategy department. The forward contracts with which Jonathan is most concerned are those on fixed income securities, interest rates and currencies.

#### Fixed income securities forward contract

The first contract he needs to price is a 270 day forward on a Sh.1 million Treasury bond with 10 years to maturity. The bond has a 5% coupon rate, has just made a coupon payment, and will make its next two coupon payments in 182 days and 365 days respectively. It is currently selling for Sh.98.25. The effective annual risk free rate is 4%.

#### Interest rates forward contract

Jonathan analyses forward rate agreements (FRA) using the LIBOR spot rate curve as follows:

30 day: 3.12%	60 day: 3.32%	90 day: 3.52%
120 day: 3.72%	150 day: 3.92%	180 day: 4.12%

After 30 days, Jonathan wants to value a Sh.10 million short position in the FRA. The 90 day forward rate in 30 days is now 4.14% and the original price of the FRA which was 4.30% for 120 day LIBOR has changed to 3.92%.

#### Currency forward contract

Jonathan also wants to price and value a currency forward on euros. The euro spot rate is 1.1854 USD. The dollar risk free rate is 3% and the euro risk free rate is 4%.

#### Required:

- (i) Determine the no arbitrage price for the forward contract on the Treasury bond. (2 marks)
  - (ii) Assume that the Treasury bond price decreases to Sh.98.11 (including accrued interest) over the next 60 days. Calculate the value of the short position in the 270 day forward contract on a Sh.10 million bond. (2 marks)
  - (iii) Calculate the price of a 2 x 5 forward rate agreement (FRA). (2 marks)
  - (iv) Determine the current value of the Sh.10 million FRA to the short position under the second scenario mentioned above. (2 marks)
  - (v) Calculate the no arbitrage price for a 1- year forward contract on the euros. (2 marks)
- (c) A stock index is at 755.42. A futures contract on the index expires in 57 days. The risk free rate is 6.25%. At expiration, the value of the dividends on the index is 3.94.

Assume one year has 365 days.

#### Required:

- (i) The appropriate futures price, using both the future value of the dividends and the present value of the dividends. (3 marks)
- (ii) The appropriate futures price in terms of the two specifications of the dividend yield. (3 marks)
- (iii) The futures price under the assumption of continuous compounding of interest and dividends based on the solution obtained in (c)(i) above. (2 marks)

(Total: 20 marks)

#### QUESTION FIVE

- (a) Evaluate two applications of index futures. (2 marks)
- (b) Your country is in the process of establishing a derivatives market. After an advertisement in the local dailies for an expert consultant to offer advisory services on derivatives markets, you are recruited and the first task you are given is to advise the relevant committee on the challenges they expect to face while trading derivatives instruments.

#### Required:

Highlight three challenges that the prospective derivatives market is likely to face. (3 marks)

- (c) TSST Ltd. plans to borrow Sh.10 million in 30 days at 90 day LIBOR plus 100 basis points. To lock in a borrowing rate of 7%, TSST Ltd. purchases a forward rate agreement (FRA) at a rate of 6%. Thirty days later, LIBOR is 7.5%.

#### Required:

Demonstrate that TSST Ltd.'s effective borrowing rate is 7% if LIBOR in 30 days is 7.5%. (4 marks)

- (d) Fusions derivatives services (FDS) is an options trading company that trades in a variety of derivatives instruments. FDS has just sold 500 call options on a stock currently priced at Sh.125.75. The trading date is 18 May 2016. The call has an exercise price of Sh.125, 60 days to expiration, a price of Sh.10.89, and a delta of 0.5649. FDS contemplates delta-hedging this transaction by purchasing an appropriate number of shares. Any additional transactions required to adjust the delta hedge will be executed by borrowing or lending at the risk free rate of 4%.

FDS has began delta-hedging the option. Two days later, on 20 May 2016, the following information is provided:

Stock price	Sh.122.75
Option price	Sh.9.09
Delta	Sh.0.5176
Number of options	500
Number of shares	328
Bond balance	-Sh.6,072
Market value	Sh.29,645

**Required:**

- (i) Assuming that at the end of 19 May 2016, the delta was 0.6564, show how 328 shares could be used to delta-hedge 500 call option. (2 marks)
  - (ii) Show the allocation of the Sh.29,645 market value of FDS's total position among stock, options and bonds on 20 May 2016. (2 marks)
  - (iii) Demonstrate the transactions that must be done to adjust the portfolio to be delta-hedged the following day (21 May 2016). (4 marks)
  - (iv) On 21 May 2016, the stock is worth Sh.120.50 and the call is worth Sh.7.88. Compute the market value of the delta-hedged portfolio and compare it with a benchmark, based on the market value on 20 May 2016. (3 marks)
- (Total: 20 marks)**
- .....

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# KASNEB

## CIFA PART III SECTION 6

### DERIVATIVES ANALYSIS

#### PILOT PAPER

September 2015.

Time Allowed: 3 hours.

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

#### QUESTION ONE

- (a) Consider a bond portfolio value of Sh.1,036,300 (duration 1.793), a futures value of Sh.102,510 (duration 1.62) and a yield Beta of 1.2.

**Required:**

- (i) Calculate the required number of contracts to reduce the portfolio duration to zero. (2 marks)
- (ii) Calculate the required number of contracts to achieve a target duration of 1.0. (2 marks)
- (b) Briefly discuss the meaning and importance of the terms "delta", "theta" and "vega" as applied in option pricing. (6 marks)
- (c) Assume that your company has invested in 100,000 shares of Unglow Ltd., a manufacturer of light bulbs. You are concerned about recent volatility in Unglow Ltd.'s share price due to unpredictable weather. You wish to protect your company's investment from a possible fall in Unglow Ltd.'s share price until change of weather in three months time, but do not wish to sell the shares at present.

No dividends are due to be paid by Unglow Ltd. during the next three months.

**Market data:**

Unglow Ltd.'s current share price:	Sh.20
Call option exercise price:	Sh.22
Time to expiry:	3 months
Interest rates (annual):	6%
Volatility of Unglow Ltd.'s shares:	50% (standard deviation per year)

Assume that option contracts are for the purchase or sale of units of 1,000 shares.

**Required:**

- (i) Devise a delta hedge that is expected to protect the investment against changes in share price until the change of weather. Delta may be estimated using  $N(d_1)$ . (8 marks)
- (ii) Comment on whether such a hedge is likely to be totally successful. (2 marks)
- (Total: 20 marks)**

#### QUESTION TWO

- (a) A stock price currently sells for Sh.36. In the next six months, the stock price will either increase to Sh.42 or decrease to Sh.31. The risk free rate is 4% per year.

**Required:**

Calculate the current price of a call option on the above stock if it's term to expiration is six months and it's strike price is Sh.35. (6 marks)

- (b) Explain the following terms:

- (i) Vocational arbitrage. (2 marks)
- (ii) Triangular arbitrage. (2 marks)



- (c) The following information is provided about the current spot rate between the United States (US) dollar (\$) and British pound (£), inflation rates in Britain and United States and real interest rates:

Current spot rate	=	\$1.4500/£
US inflation rate	=	1.5% per year
British inflation rate	=	2.0% per year
Real rate of interest	=	2.5%

**Required:**

Using the parity condition:

- (i) Compute the expected spot rate in one year's time. (2 marks)
- (ii) Assuming that you could borrow \$1,000,000 or £689,700 at the risk free interest rate, demonstrate how you could make an arbitrage profit if you were offered the chance to sell or buy British pound (£) forward for delivery one year from now at the current spot rate of \$1.4500/£. (8 marks)
- (Total: 20 marks)**

**QUESTION THREE**

- (a) State and briefly explain the relationship between a call option price and the following determinants:

- (i) The underlying stock's price. (2 marks)
- (ii) The exercise price. (2 marks)
- (iii) The time to maturity. (2 marks)
- (iv) The risk-free rate. (2 marks)

- (b) Zawadi Ltd. is considering introducing an executive share option scheme. The scheme would be offered to all middle level managers of the company. It would replace the existing scheme of performance bonuses linked to the post tax earnings per share of the company. Such bonuses in the last year ranged between Sh.500,000 and Sh.700,000. If the option scheme is introduced new options are expected to be offered to the managers each year.

It is proposed that for the first year, all middle level managers be offered options to purchase 500,000 shares at a price of Sh.500 per share, after the options have been held for one year. If the options are not exercised at that time, they will lapse. Assume that the tax authorities allow the exercise of such options after they have been held for one year.

The company's shares have a current market price of Sh.6.10 per share. The dividend paid was Sh.0.25 per share, a level that has remained constant for the last three years.

Assume that dividends are only paid annually.

The company's share has experienced a standard deviation of 38% during the last year. The short term risk free interest rate is 6% per annum.

**Required:**

Evaluate whether or not the proposed share option scheme is likely to be attractive to middle level managers of Zawadi Ltd. (8 marks)

- (c) When informed of the scheme in (b) above, one middle level manager of Zawadi Ltd. stated that he would rather receive put options than call option, as they would be more valuable to him:
- (i) Explain whether or not Zawadi Ltd. should agree to offer him put options. (2 marks)
- (ii) Is the manager correct in his statement that put options would be more valuable to him? Explain. (2 marks)
- (Total: 20 marks)**

**NB**

$$C = S N(d_1) - E(e^{-rt}) \cdot N(d_2)$$

$$\text{Where: } d_1 = \frac{\ln\left(\frac{S}{E}\right) + (rt + 0.5\sigma^2)t}{\sigma\sqrt{t}}$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

#### QUESTION FOUR

(a) The Dennevax Company Ltd. is an import-export company based in Kenya.

On 1 May 2015, the company exported coffee to South Africa on two months credit amounting to South African Rands (SAR) 14,000,000.

##### Additional information:

1. The rates in the forex and money markets were as follows:

	Ksh/1 SAR
1 May 2015	8.45
1 July 2015	8.40

	Interest rates
Kenya	21% per annum
South Africa	9% per annum

2. In the forex market, the SAR was quoted forward at an annual premium of 27%.

3. The customer settled the amount due on 1 July 2015.

##### Required:

- (i) Expected two-month forward exchange rate as at 1 July 2015. (2 marks)
- (ii) Advise the Dennevax Company Ltd. on the better hedging strategy between forward contract and money market hedges. (6 marks)
- (b) (i) Explain the advantages of using interest rate swap techniques. (4 marks)
- (ii) Explain the risk involved in using interest rate swap techniques. (2 marks)
- (c) In relation to options markets, distinguish between the following terms:
- (i) Bull spread and bear spread. (2 marks)
- (ii) Box spread and butterfly spread. (2 marks)
- (iii) Straddle and strangles. (2 marks)
- (Total: 20 marks)**

#### QUESTION FIVE

(a) Consider a stock price at Sh.60 which pays dividend of Sh.5 per share in one month. The risk free rate is 10%. A forward contract expiring in a month was priced at Sh.59.37. One month later the spot price is Sh.62.

##### Required:

The forward price and the value of the contract at this stage. (6 marks)

(b) A medium sized manufacturing company in South Africa is tendering for an order in Kuwait. The tender conditions state that payment will be made in Kuwait dinars 18 months from now. The company is unsure as to what price to tender.

The company's marginal cost of production at the time of tendering is estimated to be SA rand 1 million and a 25% mark up is normal for the company.

**Exchange rates**

Dinars/ 1 SAR

Spot 5.467 – 5.503

No forward rate exists for 18 months period

	<b>South Africa</b>	<b>Kuwait</b>
Annual inflation rates	9%	3%
Annual interest rates available to the manufacturing company:		
Borrowing	14%	9%
Lending	9%	3.5%

**Required:**

(a) Explain how the manufacturing company might protect itself against foreign exchange rate changes. (8 marks)

(b) Recommend the tender price that should be used. (6 marks)

**(Total: 20 marks)**

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# KASNEB

## CIFA PART III SECTION 6

### DERIVATIVES ANALYSIS

FRIDAY: 27 November 2015.

Time Allowed: 3 hours.

Answer ALL questions. Marks allocated to each question are shown at the end of the question. Show ALL your workings.

#### QUESTION ONE

- (a) (i) Describe how an arbitrage opportunity might exist in relation to derivatives markets. (2 marks)
- (ii) Explain the law of one price as applied in derivatives markets. (2 marks)

(b) The table below illustrates three European call options with the same underlying asset:

	Time to expiration (months)	Exercise price (Sh.)
Option A	6	2,000
Option B	9	2,000
Option C	9	2,500

**Required:**

Giving appropriate reasons, determine the option with the highest value. (3 marks)

(c) Explain the following terms with respect to derivative instruments:

- (i) Fiduciary call. (1 mark)
- (ii) Protective put. (1 mark)

(d) Samuel Mukungi simultaneously purchases an underlying asset priced at Sh.154 and writes a call option on it with an exercise price of Sh.160 and selling at Sh.12.

**Required:**

- (i) State the term commonly used to describe the position taken by Samuel Mukungi. (1 mark)
- (ii) Determine the value of the position at expiration and the profit (loss) for Samuel Mukungi if the price of the underlying asset at expiration is Sh.140, Sh.150, Sh.160 and Sh.170. (5 marks)
- (iii) The maximum profit and the maximum loss. (2 marks)
- (iv) The expiration price of the underlying which Samuel Mukungi would realise the maximum profit and incur the maximum loss. (2 marks)
- (v) The break-even price at expiration. (1 mark)

(Total: 20 marks)

#### QUESTION TWO

- (a) Explain two arrangements that could be used to settle the obligations of the parties to a forward contract when it expires. (4 marks)
- (b) (i) Explain the term "credit derivative". (2 marks)
- (ii) Examine two types of credit derivatives. (4 marks)
- (c) Baimunge Mugenda is a Kenyan-based importer of machinery from Britain. He expects the value of the Sterling Pound to appreciate against the Kenyan Shilling (Ksh.) over the next 30 days. He will be making payment on a shipment of imported machinery in 30 days and intends to hedge the currency exposure. The Kenyan risk-free rate is 16.5 per cent and the United Kingdom risk-free rate is 5.0 per cent. These rates are expected to remain constant in the next 30 days.

The current spot rate is Ksh.150 per Sterling Pound.

**Required:**

- (i) Justify whether Baimunge Mugenda should use a long or a short forward contract to hedge against the currency risk. (2 marks)
- (ii) The no-arbitrage price at which Baimunge Mugenda should enter into for a forward contract that expires in 30 days.  
Assume a 365-day year. (4 marks)
- (iii) Compute the value of Baimunge Mugenda's forward position if he moves forward 10 days and the spot rate changes to Ksh.153 per Sterling Pound while the interest rates remain constant. (4 marks)
- (Total: 20 marks)**

**QUESTION THREE**

- (a) Kimanzi Mutua is the chief trader at the Federal Futures Exchange (FFE), the only futures exchange in his country. One of his duties is to determine the prices of different types of futures contracts traded at FFE.

**Required:**

Assess how Kimanzi Mutua could determine the price of the following types of futures contracts traded at FFE:

- (i) Treasury bond futures contracts. (2 marks)
- (ii) Stock index futures contracts. (2 marks)
- (iii) Currency futures contracts. (2 marks)
- (b) A futures contract on a treasury bill expires in 91 days. The treasury bill matures in 182 days. The interest rates on treasury bills are as follows:

91-day treasury bill: 22.13%

182-day treasury bill: 21.84%

Assume a year has 360 days.

**Required:**

- (i) The appropriate futures price using the prices of the 91-day treasury bill and 182-day treasury bill. (4 marks)
- (ii) The futures price in terms of the underlying asset spot price compounded at the appropriate risk-free rate. (3 marks)
- (iii) Convert the futures price computed in (b) (i) above to the implied discount rate on the futures. (3 marks)
- (iv) Assume that the futures contract is trading in the market at an implied discount rate of 20 basis points lower than is appropriate, given the pricing model and the rule of no arbitrage.  
Illustrate how an arbitrage transaction could be executed. Show the outcome. (4 marks)
- (Total: 20 marks)**

**QUESTION FOUR**

- (a) Discuss three uses of swaptions. (6 marks)
- (b) Assume that you have just been employed by Fiduciary Investment Bank after completing the CIFA qualification. Your main responsibility is to trade and offer advisory services on derivatives. You are provided with the following information:

Current market price of the share	Sh.92
Exercise price of the call option	Sh.90
Call premium	Sh.10
Delta	0.584
Number of calls sold	2,000
Delta at the end of the previous day	0.68
Continuously compounded risk-free rate	9.0%

**Required:**

- (i) The number of shares needed to delta-hedge the call position at the end of the previous day. (2 marks)

- (ii) The market value of the portfolio today given that the loan balance at the end of the previous day was Sh.6,000. (3 marks)
- (iii) Illustrate the transactions that would need to be made to adjust the portfolio to be delta-hedged for the following day. (5 marks)
- (c) Omingo Ogot is an equity swap trader. He considers an equity swap in which he would receive the return on Index A in return for paying the return on Index B. At the inception of the equity swap, Index A is at 956.38 and Index B is at 19,734.66. The notional principal of the swap is Sh.30 million.

**Required:**

The market value of the swap, three months later, when Index A is at 1,048.58 and Index B is at 20,032. (4 marks)  
(Total: 20 marks)

**QUESTION FIVE**

- (a) In derivatives markets, numerous opportunities and strategies exist for managing risk using futures and forwards. Some types of hedges are almost always executed using futures while others are almost always executed using forwards. The choice or preference for one of the above derivative instruments over the other to hedge risk is prompted by their distinct characteristics.

**Required:**

Evaluate five primary differences between forward contracts and futures contracts that would make a derivatives analyst to prefer one of these derivatives instruments over the other when managing risk. (5 marks)

- (b) The following information relates to a put and a call option on a stock:

Call price, $C_0$	=	Sh.9.0
Put price, $P_0$	=	Sh.13.60
Exercise price, $X$	=	Sh.140
Time to option expiration, $T$	=	142 days
Current stock price, $S_0$	=	Sh.134.64
Risk-free rate, $r_f$	=	6%

One year is assumed to have 365 days.

**Required:**

Compute the prices of the following using put-call parity:

- (i) Synthetic call option. (2 marks)
- (ii) Synthetic put option. (2 marks)
- (iii) Synthetic bond. (2 marks)
- (iv) Synthetic underlying stock. (2 marks)
- (c) The price of a futures contract is Sh.278.38 and a European call option on this futures contract has an exercise price of Sh.250.00 with a time to expiration of 220 days. The continuously compounded risk-free rate is 21.25 per cent and the volatility is 0.19.

A year is assumed to have 365 days.

**Required:**

The price of the call using the Black Model. (7 marks)

Hint: The formula for the Black Model is given by:

$$C = e^{-r_f T} [f_0(T) N(d_1) - XN(d_2)]$$

$$P = e^{-r_f T} (X[1 - N(d_2)] - f_0(T) [1 - N(d_1)])$$

Where

$$d_1 = \frac{\ln(f_0(T)/X) + (\sigma^2/2)T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

$f_0(T)$  = The futures price

C = Price of the European call on a futures contract

X = Exercise price

P = Price of European put

$r^c$  = Continuously compounded risk-free rate

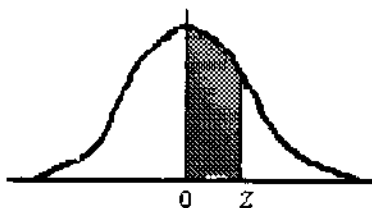
$\sigma$  = Annualised standard deviation of the continuously compounded return on the stock

(Total: 20 marks)

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# NORMAL CURVE

AREAS  
under the  
STANDARD  
NORMAL CURVE  
from 0 to z



z	0	1	2	3	4	5	6	7	8	9
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0754
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.201	.2051	.2088	.2123	.2157	.2190	.2224
0.6	.2258	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2518	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2996	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.5	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.7	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.8	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000	.5000