INSTRUCTIONS TO CANDIDATES:

1. This question paper consists of Ten numbered pages, including this page.
2. There are four questions in this paper. **ANSWER ALL FOUR QUESTIONS.** All questions carry equal marks.
3. Answer question one on the datasheet provided.
4. Answer each question on a **SEPARATE BOOKLET.**
5. Show all workings.
6. Appendix A on page 10 contains formulae you may find useful.
7. Cumulative distribution tables are attached for your use.
QUESTION 1 (50 MARKS: 45 MINUTES)

This is a Multiple Choice Question. Answer each question by clearly indicating your choice on the data sheet provided. Each question carries 2.5 marks. There will be no negative marking.

1. All other things equal, a bond’s duration is ________.
   A. higher when the yield to maturity is higher
   B. lower when the yield to maturity is higher
   C. the same at all yield rates
   D. indeterminable when the yield to maturity is high
   E. lower when yield to maturity is lower

2. A bank has an average duration of its liabilities equal to 2 years. The bank’s average duration of its assets is 3.5 years. The bank’s market value of equity is at risk if ________________.
   A. interest rates fall
   B. credit spreads fall
   C. interest rates rise
   D. the price of all fixed income securities rises
   E. All of the above

3. Pension fund managers can generally best bring about an effective reduction in their interest rate risk by holding ________________.
   A. long maturity bonds
   B. long duration bonds
   C. short maturity bonds
   D. short duration bonds
   E. interest-bearing assets

4. A bond with a 9-year duration is worth R1,080.00 and its yield to maturity is 8%. If the yield to maturity falls to 7.84%, you would predict that the new value of the bond will be ________.
   A. R1,035
   B. R 1,036
   C. R 1,094
   D. R 1,124
   E. R 1,064

5. Advantages of cash flow matching and dedicated strategies include ______.
   I. once the cash flows are matched there is no need for rebalancing
   II. cash flow matching typically earns a higher rate of return than active bond portfolio management
   III. financial institution’s liabilities often exceed the maturity of available bonds, making cash matching even more desirable


6. If economic conditions are such that very slow growth is expected in the foreseeable future, one would want to invest in industries with _________ sensitivity to economic conditions.
   A. below average
   B. average
   C. above average
   D. since growth is expected to be slow, sensitivity to economic conditions is not an issue
   E. None of the above

7. You write a put option on a stock. The profit at contract maturity of the option position is ________ where X equals the option’s strike price, $S_T$ is the stock price at contract expiration and $P_0$ is the original premium of the put option.
   A. $\text{Max}(P_0, X - S_T - P_0)$
   B. $\text{Min}(-P_0, X - S_T - P_0)$
   C. $\text{Min}(P_0, S_T - X + P_0)$
   D. $\text{Max}(0, S_T - X - P_0)$
   E. None of the above

8. The value of a listed put option on a stock is lower when ____________.
   I. the exercise price is higher
   II. the contract approaches maturity
   III. the stock decreases in value
   IV. a stock split occurs
   A. II only
   B. II and IV only
   C. I, II and III only
   D. III only
   E. None of the above

9. You are cautiously bullish on the common stock of the ABC Limited over the next several months. The current price of the stock is R50 per share. You want to establish a bullish money spread to help limit the cost of your option position. You find the following option quotes:
<table>
<thead>
<tr>
<th>Expiration</th>
<th>Strike</th>
<th>Call</th>
<th>Put</th>
</tr>
</thead>
<tbody>
<tr>
<td>June</td>
<td>45.00</td>
<td>8.50</td>
<td>2.00</td>
</tr>
<tr>
<td>June</td>
<td>50.00</td>
<td>4.50</td>
<td>3.00</td>
</tr>
<tr>
<td>June</td>
<td>55.00</td>
<td>2.00</td>
<td>7.50</td>
</tr>
</tbody>
</table>

To establish a bull money spread with calls you would ______________.

A. buy the 55 call and sell the 45 call
B. buy the 45 call and buy the 55 call
C. buy the 45 call and sell the 55 call
D. sell the 45 call and sell the 55 call
E. None of the above

10. Given the ABC Limited information in question 9 and ignoring commissions, the cost to establish the bull money spread with calls would be ________.
   A. R1,050
   B. R650
   C. R400
   D. R400 income rather than cost
   E. R1,500

11. The Black-Scholes option pricing formula was developed for ________.
   A. American options
   B. European options
   C. Tokyo options
   D. out-of-the-money options
   E. Asian options

12. What combination of puts and calls can simulate a long stock investment?
   A. Long call and short put
   B. Long call and long put
   C. Short call and short put
   D. Short call and long put
   E. None of the above
13. You own a stock portfolio worth R50,000. You are worried that stock prices may take a dip before you are ready to sell so you are considering purchasing either at the money or out of the money puts. If you decide to purchase the out of the money puts your maximum loss is __________ than if you buy at the money puts and your maximum gain is __________.
A. greater; lower
B. greater; greater
C. lower; greater
D. lower; lower
E. positive; negative

14. A hedge ratio of 0.70 implies that a hedged portfolio should consist of __________.
A. long .70 calls for each short stock
B. long .70 shares for each long call
C. long .70 shares for each short call
D. short .70 calls for each long stock
E. None of the above

15. According to the put-call parity theorem, the payoffs associated with ownership of a call option can be replicated by __________.
A. shorting the underlying stock, borrowing the present value of the exercise price, and writing a put on the same underlying stock and with the same exercise price
B. buying the underlying stock, borrowing the present value of the exercise price, and buying a put on the same underlying stock and with the same exercise price
C. buying the underlying stock, borrowing the present value of the exercise price, and writing a put on the same underlying stock and with the same exercise price
D. shorting the underlying stock, lending the present value of the exercise price and buying a put on the same underlying stock and with the same exercise price
E. shorting the underlying stock, borrowing the present value of the exercise price, and writing a put on the same underlying stock and with a different exercise price

16. You are considering purchasing a put option on a stock with a current price of R33. The exercise price is R35, and the price of the corresponding call option is R2.25. According to the put-call parity theorem, if the risk-free rate of interest is 4%, and there are 90 days until expiration, the value of the put should be __________.
A. R2.25
B. R3.91
C. R4.05
D. R5.52
E. R2.05
17. Suppose you purchase a call and write a put on the same stock with the same exercise price and expiration. If prices are at equilibrium the value of this portfolio is ________.
   A. $S_0 - X e^{-rt}$
   B. $S_0 - X$
   C. $S_0 + X e^{-rt}$
   D. $S_0 + X$
   E. None of the above

18. Futures contracts have many advantages over forward contracts except that ________.
   A. futures positions are easier to trade
   B. futures contracts are tailored to the specific needs of the investor
   C. futures trading preserves the anonymity of the participants
   D. counterparty credit risk is not a concern on futures
   E. counterparty market risk is not a concern on futures

19. Interest rate swaps involve the exchange of ____________.
   A. fixed rate bonds for floating rate bonds
   B. floating rate bonds for fixed rate bonds
   C. net interest payments and an actual principal swap
   D. net interest payments based on notional principal, but no exchange of principal
   E. None of the above

20. Sahali Trading Company has issued R100 million worth of long-term bonds at a fixed rate of 9%. Sahali Trading Company then enters into an interest rate swap where they will pay LIBOR and receive a fixed 8.00% on a notional principal of R100 million. After all these transactions are considered, Sahali’s cost of funds is ________.
   A. 17%
   B. LIBOR
   C. LIBOR + 1%
   D. LIBOR - 1%
   E. None of the above
QUESTION 2 (50 MARKS: 45 MINUTES)

PART A (30 MARKS: 27 MINUTES)

(a) Describe the key factors that led to and the lessons learnt from the following risk management case studies:
   (i) Barings (1995);
   (ii) Swiss Bank UBS (2011).

(20 marks: 18 minutes)

(b) Discuss the three key considerations for a portfolio manager when implementing a contingent immunization strategy and describe whether such a strategy is an active, passive, or combination of both.

(10 marks: 9 minutes)

PART B (20 MARKS: 18 MINUTES)

(a) Assume the following spot rates for various times from today.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>SPOT RATE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.0</td>
</tr>
<tr>
<td>2</td>
<td>7.0</td>
</tr>
<tr>
<td>3</td>
<td>8.0</td>
</tr>
<tr>
<td>4</td>
<td>9.0</td>
</tr>
</tbody>
</table>

Calculate the forward rates from years one to two, one to three, and two to four.

(10 marks: 9 minutes)

(b) Assume an institutional investor, XYZ, is in a short bond portfolio investment with a nominal value of R100 million paying a floating rate of 10 percent. The bond matures in five years. Interest rates are expected to rise in the near future. Assume a counterparty is willing to enter into a Forward Rate Agreement (FRA) that benefits both parties. With the aid of a diagram and a table, illustrate how XYZ can use a FRA to hedge against interest rate increases.

(10 marks: 9 minutes)
QUESTION 3 (50 MARKS: 45 MINUTES)

PART A (30 MARKS: 27 MINUTES)

Assume the following two bonds with different years to maturity.

<table>
<thead>
<tr>
<th>Bond</th>
<th>Annual coupon rate</th>
<th>Years to maturity</th>
<th>YTM (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10%</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>10%</td>
<td>20</td>
<td>10</td>
</tr>
</tbody>
</table>

Further assume interest rates are expected to change by 100 basis points in either direction in the near future.

**Required:**

(a) Assuming interest rates change as predicted, prove

(i) that bond price volatility is directly related to maturity; and

(ii) that bond price movements resulting from equal absolute increases or decreases in yield are not symmetrical.

(12 marks: 11 minutes)

(b) Calculate the duration of bond A and demonstrate how duration violates the bond price volatility characteristic which states that price movements resulting from equal absolute increases or decreases in yield are not symmetrical.

(12 marks: 11 minutes)

(c) Briefly discuss trading strategies available to a bond investor using (modified) duration.

(6 marks: 5 minutes)

PART B (20 MARKS: 18 MINUTES)

For bear or short straddle strategy one has to sell both put and call with the same T and X. With the aid of a table and diagram, demonstrate a profit to a bear straddle.
QUESTION 4 (50 MARKS: 45 MINUTES)

Part A (40 marks: 36 minutes)

Assume a call option on stock XYZ with the following characteristics: standard deviation 30 percent, dividend yield 3 percent, stock price R60; exercise price R50; and expiration 2 months. The firm expects to pay its next dividend in 2 month’s time. The risk free rate of return is 6 percent.

Required:

(a) Use the Black-Scholes formula to determine the value of XYZ call option.  
(18 marks: 16 minutes)

(b) Calculate the time value of the option.  
(3 marks: 3 minutes)

(c) Use the Put-Call Parity to determine the value of a Put option with similar terms as the call option described above.  
(5 marks: 4 minutes)

(d) If the value of the put described above is R1.64 and the actual put is currently trading at R2 (overvalued), show the steps that you would take to make riskless profits. Tabulate your answer).  
(10 marks: 9 minutes)

(e) Describe how the N(d1) value calculated in (a) above can be used in hedging.  
(4 marks: 4 minutes)

PART B (10 MARKS: 9 MINUTES)

Samu believes she has identified an arbitrage opportunity for a commodity as indicated by the information given below in the following table:

<table>
<thead>
<tr>
<th>Commodity Price and interest rate information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot price for commodity</td>
</tr>
<tr>
<td>Futures price for commodity expiring in one year</td>
</tr>
<tr>
<td>Interest rate for one year</td>
</tr>
</tbody>
</table>

Describe the transactions necessary to take advantage of this specific arbitrage opportunity and calculate the arbitrage profit.
Appendix: Useful formulae

\[(1 + s_t)^t = (1 + s_{t-1})^{t-1} \times (1 + f_{t-1,t})\]

\[\text{Duration} = \frac{V_- - V_+}{2(V_0)(\Delta y)}\]

\[\text{Convexity} = \frac{V_+ + V_- - 2V_0}{2V_0(\Delta y)^2}\]

\[V_0 = C \times \frac{1 - \frac{1}{(1+r)^t}}{r} + \frac{FV}{(1+r)^t}\]

Convexity adjustment = \(C \times (\Delta y)^2 \times 100\)

\[F_0 = S_0(1+r)^T\]

\[C_0 = S_0e^{-\delta T}N(d_1) - X(e^{-rT})N(d_2)\]

\[d_1 = \frac{\ln\left(\frac{S_0}{X}\right) + \left(r - \delta + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}\]

\[d_2 = d_1 - \sigma\sqrt{T}\]

\[P_0 = C_0 - S_0 + X(e^{-rT})\]

\[P_0 = C_0 - S_0 + \text{PV(Div)} + \text{PV(X)}\]

\[H = \frac{Cu-Cd}{Su-Sd}\]