READ THE INSTRUCTIONS VERY CAREFULLY
1) Time duration is 2 hours
2) The total marks is 150.
3) This question paper consists of TWO sections.
4) **Section#1-Subjective**: 3 questions having multiple subparts each. There is step marking for all questions. You have to show all working and calculations to get the full marks. If your final answer is incorrect even though your approach is right, marks will be provided for working shown. There is no negative marking in this section.
5) **Section#2-Objective**: 15 questions. Correct answer: 4 marks. Incorrect answer: -1 marks. No marks for questions left unattended.
6) Write all answers in the answer sheets provided. Do not use separate answer sheets for objective questions. Please write the option number (A, B, C… etc.) very clearly in the same answer sheets provided and give explanation wherever it is asked.
7) Questions are self-explanatory. Make necessary assumptions wherever required.
8) Only non-Programmable calculators are allowed.

**PART#1 – Subjective**

**Question # 1: [Marks#30 (10*3)]**
1. Hospitality Hotels forecasts monthly labour needs.
   a) Given the following monthly labour figures, make a forecast for June using a three-period moving average and a five-period moving average.

<table>
<thead>
<tr>
<th>Month</th>
<th>Actual Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>32</td>
</tr>
<tr>
<td>February</td>
<td>41</td>
</tr>
<tr>
<td>March</td>
<td>38</td>
</tr>
<tr>
<td>April</td>
<td>39</td>
</tr>
<tr>
<td>May</td>
<td>43</td>
</tr>
</tbody>
</table>

   b) What would be the forecast for June using the naïve method?
   c) If the actual labour figure for June turns out to be 41, what would be the forecast for July using each of these models?
   d) Compare the accuracy of these models using the mean absolute deviation (MAD), mean squared error (MSE).
2. The manager of a small health clinic would like to use exponential smoothing to forecast demand for laboratory services in their facility. However, she is not sure whether to use a high or low value of $\alpha$. To make her decision, she would like to compare the forecast accuracy of a high and low $\alpha$ on historical data. She has decided to use $\alpha = 0.7$ for the high value and $\alpha = 0.1$ for the low value. Given the following historical data, which do you think would be better to use?

<table>
<thead>
<tr>
<th>Week</th>
<th>Demand (labour requirement)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>330</td>
</tr>
<tr>
<td>2</td>
<td>350</td>
</tr>
<tr>
<td>3</td>
<td>320</td>
</tr>
<tr>
<td>4</td>
<td>370</td>
</tr>
<tr>
<td>5</td>
<td>368</td>
</tr>
<tr>
<td>6</td>
<td>343</td>
</tr>
</tbody>
</table>

3. A company uses exponential smoothing with trend to forecast monthly sales of its products, which show a trend pattern. At the end of week 5, the company wants to forecast sales for week 6. The trend through week 4 has been 20 additional cases sold per week. Average sales have been 85 cases per week. The demand for week 5 was 90 cases. The company uses $\alpha = .20$ and $\beta = .10$. Make a forecast including trend for week 6.

**Question # 2: [Marks#30 (15+15)]**

a) Near market closing time on a given day, you lose access to stock prices, but some European call and put prices for a stock are available as follows:

<table>
<thead>
<tr>
<th>Strike Price</th>
<th>Call Price</th>
<th>Put Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>$40$</td>
<td>$11$</td>
<td>$3$</td>
</tr>
<tr>
<td>$50$</td>
<td>$6$</td>
<td>$8$</td>
</tr>
<tr>
<td>$55$</td>
<td>$3$</td>
<td>$11$</td>
</tr>
</tbody>
</table>

All options have the same expiration date. After reviewing the information above, John tells Mary and Peter that no arbitrage opportunities can arise from these prices. Mary disagrees with John. She argues that one could use the following portfolio to obtain arbitrage profit: Long one call option with strike price 40; short three call options with strike price 50; lend $1; and long some calls with strike price 55. Peter also disagrees with John. He claims that the following portfolio, which is different from Mary’s, can produce arbitrage profit: Long 2 calls and short 2 puts with strike price 55; long 1 call and short 1 put with strike price 40; lend $2; and short some calls and long the same number of puts with strike price 50.

Which of the following statements is true?

(i) Only John is correct.
(ii) Only Mary is correct.
(iii) Only Peter is correct.
(iv) Both Mary and Peter are correct.
(v) None of them is correct.
b) An insurance company sells single premium deferred annuity contracts with return linked to a stock index, the time-\( t \) value of one unit of which is denoted by \( S(t) \). The contracts offer a minimum guarantee return rate of \( g \% \). At time 0, a single premium of amount \( \pi \) is paid by the policyholder, and \( (\pi \times g \%) \) % is deducted by the insurance company. Thus, at the contract maturity date, \( T \), the insurance company will pay the policyholder:

\[
\pi \times (1 - y\%) \times \max[S(T)/S(0), (1 + g\%)^T].
\]

You are given the following information:

(i) The contract will mature in one year.
(ii) The minimum guarantee rate of return, \( g \% \), is 3%.
(iii) Dividends are incorporated in the stock index. That is, the stock index is constructed with all stock dividends reinvested.
(iv) \( S(0) = 100 \).
(v) The price of a one-year European put option, with strike price of $103, on the stock index is $15.21.

Determine \( y\% \), so that the insurance company does not make or lose money on this contract.

**Question # 3: [Marks#30 (15+15)]**

a) For a two-period binomial model, you are given:

(i) Each period is one year.
(ii) The current price for a non-dividend-paying stock is 20.
(iii) \( u = 1.2840 \), where \( u \) is one plus the rate of capital gain on the stock per period if the stock price goes up.
(iv) \( d = 0.8607 \), where \( d \) is one plus the rate of capital loss on the stock per period if the stock price goes down.
(v) The continuously compounded risk-free interest rate is 5%.

Calculate the price of an American call option on the stock with a strike price of 22.

b) You are considering the purchase of 100 units of a 3-month 25-strike European call option on a stock. You are given:

(i) The Black-Scholes framework holds.
(ii) The stock is currently selling for 20.
(iii) The stock’s volatility is 24%.
(iv) The stock pays dividends continuously at a rate proportional to its price. The dividend yield is 3%.
(v) The continuously compounded risk-free interest rate is 5%.

Calculate the price of the block of 100 options.
PART#II - Objective

1) You have three (3) financial assets with the following set of information

<table>
<thead>
<tr>
<th>Asset (i)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>Average return</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.00</td>
<td>3.00</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td>B</td>
<td>3.00</td>
<td>9.00</td>
<td>6.00</td>
<td>6.00</td>
</tr>
<tr>
<td>C</td>
<td>4.00</td>
<td>6.00</td>
<td>16.00</td>
<td>8.00</td>
</tr>
</tbody>
</table>

If SS is allowed, then at MVP the weights of A, B and C are

(A) (6/12, 4/12, 3/12)  
(B) (3/12, 6/12, 4/12)  
(C) (4/12, 3/12, 6/12)  
(D) none of the above

2) For problem #1, given above, the return at MVP is

(A) 4.00  
(B) 6.67  
(C) 6.83  
(D) none of the above

3) For problem #1, given above, the variance, V(MVP), at MVP is

(A) V(MVP) < 4.00  
(B) 4.00 ≤ V(MVP) < 9.00  
(C) 9.00 ≤ V(MVP) < 16.00  
(D) V(MVP) ≥ 16.00

4) If we invest in equal proportion in n stocks and the single index model is true, then

(A) \( \sigma_P^2 = \beta_P^2 \sigma_p^2 + \frac{1}{n} \sum_{i=1}^{n} \sigma_x(i) \)  
(B) \( \sigma_P^2 = \beta_m^2 \sigma_p^2 + \frac{1}{n^2} \sum_{i=1}^{n} \sigma_x(i) \)  
(C) \( \sigma_P^2 = \beta_P^2 \sigma_p^2 + \frac{1}{n^2} \sum_{i=1}^{n} \sigma_x(i) \)  
(D) none of the above

5) (This question has Multiple Answers) Identify the first two steps in a profitable arbitrage, given the following:
   - Yield on U.K. government one-year note: 8%
   - Yield on U.S. government one-year note: 5%
   - Exchange rate (spot): 1.60 USD/Pound
   - Exchange rate (one year forward): 1.70 USD/Pound

(A) Sell short US securities  
(B) Sell USD in spot foreign exchange market for pounds  
(C) Sell short UK securities  
(D) Sell pounds in spot foreign exchange market for USD  
(E) There is no arbitrage

6) Alan has just entered into a derivative position with a dealer. The dealer makes a positive payoff when the price of underlying asset is less than $35 and higher than $45 at expiration. Which of the followings describes the option strategy that the dealer has entered into?

I. 35-45 purchased strangle  
II. 35-45 written strangle  
III. 35-40-45 butterfly-spread
IV. 35-45 Bull call spread

(A) I, III  (B) II, III  (C) II, IV  (D) III, IV  (E) None of these

7) The current (spot) rate for corn is 1.60 per bushel. The 6 month forward price is $1.50 per bushel. The continuously compounded annual rate is \( r = 0.035 \). Farmer Brown, has total fixed and variable costs of 1.44 per bushel, and plans to produce 100,000 bushels for $144,000. A six month (\( T = 0.5 \)) put with a strike price of 1.52 per bushel is available at a price of 0.12. What are the minimum and maximum profits for Farmer Brown in six months if he is hedged with a purchase of this put?

A) Minimum = −4,212, Maximum = 19,678  
B) Minimum = −6,222, Maximum = 19,678  
C) Minimum = −4,212, no maximum  
D) Minimum = −6,242, no Maximum  
E) none of the above

8) The president of State University wants to forecast student enrollments for this academic year based on the following historical data: 5 years ago; 15,000, 4 years ago; 16,000, 3 years ago; 18,000, 2 years ago; 20,000, Last year; 21,000. What is the forecast for this year using exponential smoothing with \( \alpha = 0.4 \), if the forecast for two years ago was 16,000?

A) 17600  
B) 17850  
C) 19420  
D) 18960  
E) 19240

Questions 9 to 12 are based on the data given below:

Suppose Mr. X is in a world where there are only two assets – Gold and Stocks. He is interested in investing his money in one of the two assets or both. Consequently he collects the following data on returns on the two assets over the last six years.

<table>
<thead>
<tr>
<th></th>
<th>Gold</th>
<th>Stock Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Return</td>
<td>8%</td>
<td>20%</td>
</tr>
<tr>
<td>SD</td>
<td>25%</td>
<td>22%</td>
</tr>
<tr>
<td>Correlation</td>
<td>-</td>
<td>0.4</td>
</tr>
</tbody>
</table>

9) Mr. X is constrained to pick one, which one he would choose and why?

10) Mr. Y, a friend of Mr. X argues that he is wrong. He says that Mr. X is ignoring the big payoffs that he can get on gold. How would Mr. X go about alleviating his concern?

11) How would a portfolio composed of equal proportions in gold and stocks do in terms of mean and variance?

12) Mr. X came to know that GPEC (a cartel of gold-producing countries) is going to vary the amount of gold it produces with stock prices in the country. (GPEC will produce less gold when stock markets are up and more when it is down). What effect will this have on his portfolios? Explain
13) Non-diversifiable risk means it has the following property
(A) Can be made zero (0)  (B) cannot be made zero (0)
(C) Can be made a minimum of fifteen (15)  (D) can be made a maximum of ten (10)

14) Which is not a valid assumption for CAPM
(A) Presence of transaction cost  (B) Unlimited SS
(C) Personal tax not present  (D) \( r_{FL} \) same as \( r_{FB} \)

15) If we first subtract the trend value (T) for each quarter from the original value (Y), then average the values for a given quarter over successive years, then for short-term data we get:
A) Unseasonal data
B) Seasonal component
C) Cyclical component
D) De-seasonalised data