Week 1 Assignment Artificial Intelligence (AI) for Investments

Q1: A company is expected to pay $5 dividend by the end of the year, after which the stock price is expected to be at $110. If the market capitalization rate is 8%, what is the appropriate interval for the stock price today.

    a) 90-95

    b) 95-100

    c) 100-105

    d) 105-110

    e) 110-120

Hint: P= (5+110)/1.08= 106.5

Q2: A company does not plow back any earnings and pays all in the form of dividends at $5, which is expected to continue infinitely in future. If the current price is $40, what is the appropriate interval for the market capitalization rate.

    a) 9%-10%

    b) 10%-11%

    c) 11%-12%

    d) 12%-13%

    e) 13%-14%

Hint 40=5/r, r= 12.5%

Q3: If a company does not offer any dividends and plows back all the money, then it should have zero (0) price.

    a) No

    b) Yes

    c) Cannot say/more information is required

Hint: Even if a company is not paying dividends and plows back all the money in positive projects, the share price is not zero. Since, the investors can get their hands on money by selling the stock. The value of this stock represents the positive (or negative) NPV projects taken by this company.

Q4: Identify the correct Investment decision

    a) Raising funds through equity issuance.

    b) Raising funds through Bank loan.

    c) Repayment of interest on the bank loan.

    d) Using cash flow to prepay the debt.

e) Purchasing plant and machinery for the upcoming project.

Hint: Raising funds through equity issuance, bank loans, repaying interest on bank loan, and prepayment of debt are all financing decisions. Purchasing plant machinery and equipment are all investment related decisions.

Q5: Which of the following is the most important goal of a firm and its managers.

    a) Minimizing expenses for the current year

    b) Minimizing expenses for the next three years

    c) Maximizing cash inflows for the next three years

    d) Maximizing the firm value (or the share price)

    e) Maximizing the profit for the current year

    f) Maximizing the profit for the next three years

Hint: Maximizing firm value (or share price) is the most important goal and incorporates all the other dimensions (profit, costs, cash inflows, outflows, etc.).

Q6: The following cash flows are projected on a new firm-venture: $432, $137, $797, by the end of the years 1, 2 and 3 respectively. The opportunity cost of capital is 15%. The present value of these cash flows lie in the following interval.

    a) 1000-1010

    b) 1010-1020

    c) 1020-1030

    d) 1030-1040

    e) 1040-1050

Hint: $432/1.15+137/1.15^2+797/1.15^3=1003.28$

Q7: If the opportunity cost of capital is 9%, what is the appropriate interval for the present value of $374 paid at the end of 9th year

    a) 160-180

    b) 180-200

    c) 200-220

    d) 220-240

    e) None of the above

Hint: $374/1.09^9= 172.2$

Q8: If the firm chooses a simple payback period as the decision rule, which of the following is not true.

    a) The firm may choose many short-lived projects, which may also have negative NPVs

b) The firm may miss out on many long-lived but positive NPV projects

c) The firm may not account for the time-value of money

d) The firm may not appropriately account for the risk of these projects

e) The firm will select only long-lived projects with negative NPV

Hint: If a firm chooses simple payback method, it may choose many short-lived project with negative NPVs. Also, it may miss out many long term project with positive NPVs. The method does not account for the time-value of money. Since, the time value is not considered appropriately, and therefore, the risk of the project is not considered.

Q9: Compute the IRR of the project with the following cash flows.

Project	C_0	C_1	C_2
A	-6,750	+4,500	+18,000

a) 85%-95%

b) 95%-105%

c) 105%-110%

d) 110%-115%

e) 115%-120%

NPV=0 =-6750+4500/(1+IRR)+18000/(1+IRR)^2; solving the equation IRR= 100%

Q10: Compute the present value of $1 received after 6-years, if your opportunity cost of capital is 12%. The value lies in the following interval

a) $0.1-$0.2

b) $0.2-$0.3

c) $0.4-$0.5

d) $0.5-$0.6

e) $0.6-$0.7

Present value = 1/1.12^6=0.507

Week 2 Probability Modelling

AI for Investment

Q1-8 You are the owner of a grocery delivery firm. You are interested in formulating a policy to offer gifts to delayed deliveries and looking at the data. Historically the delivery time data has followed normal distribution with a mean (μ) = 8-min average delivery time and standard deviation (SD or σ) = 2-min. Answer the questions below, using this information. (Hint: Use the following property of normal distribution, z = -2 to +2 for 95%; z = -1 to +1 for 68% and z = -3 to +3 for 99% area. That is, 68% area will lie within ± 1 SD, 95% area will lie within ± 2 SD, 99% area will lie within ± 3 SD.

Q1 What is the probability of delivery time of 4-12 mins

  a) 80%-90%
  b) 90%-100%
  c) 70%-80%
  d) 30%-40%

Hint: The delivery time lies between ± 2 S.D around the mean (8-2*2=4 mins and 8+2*2=12 mins). Therefore, around 95% of the area is covered. In other words, 95% probability of observing a delivery time between 4-12 mins.

Q2 What is the probability of delivery time of 6-10 mins

  a) 80%-90%
  b) 90%-100%
  c) 70%-80%
  d) 60%-70%

Hint: The delivery time lies between ± 1 S.D around the mean (8-1*2=6 mins and 8+2*1=10 mins). Therefore, around 68% of the area is covered. In other words, 68% probability of observing a delivery time between 6-10 mins.

Q3 What is the probability of delivery time of 2-14 mins

  a) 80%-90%
  b) 90%-100%
  c) 70%-80%
  d) 60%-70%

Hint: The delivery time lies between ± 3 S.D around the mean (8-2*3=2 mins and 8+2*3=14 mins). Therefore, around 99% of the area is covered. In other words, 99% probability of observing a delivery time between 2-14 mins

Q4 What is the probability of delivery time of 6-8 mins

    a) 80%-90%
    b) 90%-100%
    c) 70%-80%
    d) 30%-40%

Hint: Recall that between 6-10 mins, covers ± 1 S.D around the mean (i.e., 8-1*2=6 mins and 8+2*1=10 mins). This comprises approximately 68% of the area. Therefore, by symmetry (since 8-mins is the mean and normal distribution is symmetric around the mean), half, that is 34%, area will lie.

Q5 What is the probability of delivery time of 8-12-mins

    a) 60%-70%
    b) 50%-60%
    c) 40%-50%
    d) 30%-40%

Hint: Recall that between 4-12 mins, covers ± 2 S.D around the mean (i.e., 8-2*2=4 mins and 8+2*2=12 mins). This comprises approximately 95% of the area. Therefore, by symmetry (since 8-mins is the mean and normal distribution is symmetric around the mean), half, that is 47.5%, area will lie.

Q6 What is the probability of delivery time of more than 8-mins

    a) 85%-95%
    b) 45%-55%
    c) 75%-85%
    d) 65%-75%

Hint: We are given the mean delivery time is 8-mins. Assuming normal distribution, 50% of observations lie above and 50% lie below this point. In other words, 50% probability of observing a delivery of more than 8-mins.

Q7 What is the probability of delivery time of less than 8-mins

    a) 15%-25%
    b) 45%-55%
    c) 25%-35%
    d) 35%-45%

Hint: We are given the mean delivery time is 8-mins. Assuming normal distribution, 50% of observations lie above and 50% lie below this point. In other words, 50% probability of observing a delivery of less than 8-mins

Q8 What is the probability of delivery time of 2-8 mins

    a) 60%-70%
    b) 50%-60%
    c) 40%-50%
    d) 30%-40%

Hint: Recall that between 2-14 mins, covers $\pm$ 3 S.D around the mean (i.e., 8-2*3=2 mins and 8+2*3=14 mins). This comprises approximately 99% of the area. Therefore, by symmetry (since 8-mins is the mean and normal distribution is symmetric around the mean), half, that is 49.5%, area will lie.

Q9 Which of the following is correct if the two events are mutually exclusive?

    a) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
    b) $P(A \cup B) = P(A) + P(B) + P(A \cap B)$
    c) $P(A \cup B) = P(A) + P(B)$
    d) $P(A \cup B) = P(A) - P(B)$

Hint: If event A and B are mutually exclusive then P (A intersection B) = 0. Hence P(A U B) = P(A) + P(B)

Q10 Which of the following distributions has a bell-shaped curve?

    a) Normal Distribution
    b) Poison Distribution
    c) Binomial distribution
    d) Uniform Distribution
    e) None of the above

Hint: Normal Distribution has a bell-shaped curve, is symmetric about the mean, and is widely used in statistics and probability theory. The peak of the curve represents the mean, median, and mode, and it tapers off symmetrically on both sides.

Q1: Consider the situation of a manufacturer of soft drink products. The label on a soft drink bottle states that it contains 67.6 fluid ounces. You, as a customer, want to check the manufacturer's claim. What would be the null and alternate hypothesis in this case?

    i.   H0: $\mu = 67.6$ *ounces* and Ha: $\mu \neq 67.6$ *ounces*

    ii.   **H0: $\mu \geq 67.6$ *ounces* and Ha: $\mu < 67.6$ *ounces***

    iii.   H0: $\mu < 67.6$ *ounces* and Ha: $\mu \geq 67.6$ *ounces*

    iv.   H0: $\mu \neq 67.6$ *ounces* and Ha: $\mu = 67.6$ *ounces*

Explanation: The label on a soft drink bottle states that it contains 67.6 fluid ounces. Thus, in a hypothesis test about the population mean fluid weight per bottle, we would begin with the assumption that the label is correct and state the null hypothesis as $\mu \geq 67.6$ *ounces*. The challenge to this assumption would imply that the label is incorrect and the bottles are being underfilled. This challenge would be stated as the alternative hypothesis as $\mu < 67.6$ *ounces*. Thus, the null and alternative hypotheses are: H0: $\mu \geq 67.6$ *ounces* and Ha: $\mu < 67.6$ *ounces*.

Q2: Which of the following correctly identifies the Type 1 error?

    i.   Accepting H0 when H0 is true

    ii.   Accepting H0 when Ha is true

    iii.   **Rejecting H0 when H0 is true**

    iv.   Rejecting H0 when Ha is true

Explanation: If H0 is accepted and H0 is true, this conclusion is correct. Similarly, if H0 is rejected when Ha is true, this conclusion is correct. However, if we reject H0 when H0 is true,

we make a Type I error. And if H0 is accepted when Ha is true, we make a Type II error; that is, we accept H0 when it is false.

Questions 3-4: Given the below information, compute Questions 3-4.

Each week, Lloyd's department store selects a simple random sample of 100 customers to learn about the amount spent per shopping trip. Based on the historical data, Lloyd's assumes a known value of $\sigma = \$20$ for the population standard deviation. The historical data also indicate that the population follows a normal distribution. During the most recent week, Lloyd's surveyed 100 customers (n = 100) and obtained a sample mean of $\bar{x} = \$82$. Assume z= ± 1.645 for a 90% confidence interval and z= ± 2.576 for a 99% confidence interval.

Q3: Given the above information, construct a 90% confidence interval for the population mean.

   i.   (68.56, 85.51)

   ii.   (69.20, 85.70)

   iii.   **(78.71, 85.29)**

   iv.   (77.24, 89.86)

Explanation: The 90% confidence interval for population mean can be estimated using:

population mean = sample mean ± margin of error, i.e., $\mu = \bar{x} \pm Z * SE$

Here, SE is the standard error of the sample mean, which is equal to $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{20}{\sqrt{100}} = 2$

$\mu = \bar{x} \pm Z * SE = 82 \pm 1.645 * 2 = 78.71 \ to \ 85.29$

Q4: Using the above information, construct a 99% confidence interval for the population mean.

    i.   **(76.85, 87.15)**

    ii.   (78.56, 86.78)

    iii.   (77.89, 86.12)

    iv.   (81.23, 83.45)

Explanation: The 99% confidence interval for population mean can be estimated using:

population mean = sample mean ± margin of error, i.e., $\mu = \bar{x} \pm Z * SE$

Here, SE is the standard error of the sample mean, which is equal to $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{20}{\sqrt{100}} = 2$

$\mu = \bar{x} \pm Z * SE = 82 \pm 2.576 * 2 = 76.85 \ to \ 87.15$

Questions 5 to 8

Consider the following hypothesis test:

$$H_0: \mu = 50$$

$$H_a: \mu \neq 50$$

A sample of 60 is used, and the population standard deviation is 8. Using the above information, answer the following questions.

Q5: What type of hypothesis test is being conducted in this scenario?

  i. One-tailed (right-tailed)

  ii. One-tailed (left-tailed)

  iii. **Two-tailed**

  iv. None of the above

Explanation: The alternative hypothesis $\mu \neq 50$ suggests testing for inequality in both directions.

Q6: What is the correct interval of standard error (SE) of the sample mean, given that the population standard deviation is 8 and the sample size is 60?

    i. 0.5-0.8

    ii. 1.2-1.5

    iii. **1-1.2**

    iv. 2-2.5

Explanation: SE $= \frac{\sigma}{\sqrt{n}} = \frac{8}{\sqrt{60}} = 1.033$

Q7: For a sample mean ($\bar{x}$) of 52.5, what is the correct interval of z-score if the population mean is 50, the sample size is 60, and the population standard deviation is 8?

    i.   2.5-3

    ii.   1.5-2

    iii.   1-1.5

    iv.   **2-2.5**

Explanation: Using the Z-score formula:

$$z = \frac{\bar{x} - \mu}{SE} = \frac{52.5 - 50}{8/\sqrt{60}} = 2.5/1.033 = 2.42$$

Q8: What is the conclusion about the null hypothesis if the sample mean ($\bar{x}$) = 51.8, at $\alpha = 0.05$ significance level? Assume z = 1.96 for a 95% confidence interval.

    i.   Reject H_0

    ii.   Accept H_0

    iii.   **Fail to reject H_0**

    iv.   None of the above

Explanation: For $\bar{x}$ = 51.8, the Z score is: $Z = \frac{51.8 - 50}{8/\sqrt{60}} = 1.74$

Since 1.74 lies within the range of −1.96 to 1. 96, there is insufficient evidence to reject the null hypothesis. This means the sample mean is not significantly different from the hypothesized mean.

Questions 9-10: Given the below information, answer Questions 9-10.

A national survey of 900 women golfers was conducted to learn how women golfers view their treatment at golf courses in the United States. The survey found that 396 of the women golfers were satisfied with the availability of tee times. Thus, the point estimate of the proportion of the population of women golfers who are satisfied with the availability of tee times is 396/900 = 0.44.

Q9: Given the above information, construct a 95% confidence interval for the population proportion.

  a)   **(40.76%, 47.24%)**

  b)   (50.23%, 60.10%)

  c)   (11.01%, 16.05%)

  d)   None of the above

Explanation: 95% confidence interval: Proportion ± Margin of Error (MOE) = $\bar{p} \pm Z *$

$\sqrt{\frac{\bar{p}(1-\bar{p})}{n}} = 0.44 \pm 1.96 * 0.0165 = 0.44 \pm 0.0324 = 40.76\%$ to 47.24%

Q10: Using the above information, assume that the company is interested in conducting a new survey to estimate the current proportion of the population of women golfers who are satisfied with the availability of tee times. How large should the sample be if the survey director wants to estimate the population proportion with a margin of error of .025 at 95% confidence?

  a)   1356

b)   1324

c)   **1515**

d)   1490

Explanation: With MOE = .025 and z = 1.96, we need a planning value $\bar{p}$ to calculate the sample size. Using the previous survey result of p = .44 as the planning value $\bar{p}$, sample size

$$(n) = \frac{(z^2)\bar{p}(1-\bar{p})}{E^2} = \frac{(1.96)^2(0.44)(1-0.44)}{(0.025)^2} = 1514.5 \text{ or } 1515.$$

1) What is the output of the following code?

x <- c(1, 4, 2, 3)
x[2]

    a) 1
    b) 2
    c) 3
    d) 4
    e) NA

Explanation: The above code is an example of indexing. x[2] accesses the second element of the vector x, which is 4.

2) What will be the output of the following code?

x <- c(TRUE, FALSE, TRUE, TRUE)
sum(x)

    a) 0
    b) 1
    c) 2
    d) 3
    e) 4

Explanation: In R, TRUE is treated as 1 and FALSE as 0 in numerical operations. The sum of the vector c(TRUE, FALSE, TRUE, TRUE) is $1 + 0 + 1 + 1 = 3$.

3) What is the output of the following code?

sum(c(1, 2, NA, 4), na.rm = TRUE)

    a) 7
    b) 8
    c) NA
    d) 9
    e) 4

Explanation: The sum() function calculates the sum of the vector. The argument na.rm = TRUE tells R to remove NA values before performing the calculation. Thus, the result is $1 + 2 + 4 = 7$.

4) What is the output of the following code?

x <- c(1, 2, 3)
y <- c(4, 5)
z <- x + y

    a) 5 7 3
    b) **5 7 7**
    c) NA
    d) 5 7

Explanation: When vectors of different lengths are operated on, R recycles the shorter vector. Here, y is recycled, and z becomes 1+4, 2+5, 3+4. A warning is issued about the length mismatch.

5) What is the correct syntax to create a vector in R?

a) vector(c(1, 2, 3))
b) c(1, 2, 3)
c) c[1, 2, 3]
d) vector[1, 2, 3]

Explanation: The c() function in R combines values into a vector. This syntax is used to create a simple, one-dimensional array of elements. Other syntax is incorrect.

6) Which data structure in R is used to store multiple elements of different data types?

a) Vector

b) Matrix

c) List

d) Data Frame

Explanation: In R, a list is a data structure that can store multiple elements of different data types (e.g., numeric, character, logical, and data frames).Whereas Vector can store elements of only one data type, Matrix can store only one data type (usually numeric or character) in a two-

dimensional structure, and Data Frame can store different data types, but it is more structured and column-oriented.

7) What does the summary() function provide for a data frame in R?

a) Descriptive statistics

b) Data visualization

c) Structural information

d) Code execution time

Explanation: The summary() function provides a quick overview of the data in a data frame, including minimum, maximum, mean, and quartiles for numeric variables, and frequency counts for factor variables.

8) Which function is used to generate a sequence of numbers in R?

a) seq()

b) range()

c) dim()

d) None of the above

Explanation: The seq() function is used to generate sequences of numbers with a specified starting point, ending point, and increment. range() syntax results in highest and lowest values in a vector. dim() shows the number of rows and columns in the dataframe.

9) Which function is used to check the structure of a data frame in R?

a) summary()
b) str()
c) head()
d) None of the above

Explanation: summary() provides a summary of each column in a data frame, including measures like mean, median, and counts for categorical variables. str() displays the structure of an object, showing data types and a preview of the elements..head() displays the first six rows of a data frame.

10) Which function in R is used to fit a linear regression model?

a) lm()
b) reg()
c) rq()
d) None of the above

Explanation: lm() fits a linear regression model in R, allowing users to analyze the relationship between dependent and independent variables. reg () is not a standard function in R. We can perform quantile regression using the rq function.

Artificial Intelligence for Investments

Assignment 5 Solution

The correct answers are in bold fonts.

Q1. Which of the following statements is correct in the context of security prices in the financial markets?

(a) The observed price is inefficient. [Hint: Observed price includes noise and hence is inefficient]

(b) Efficient (true) price is unobserved. [Hint: Observed prices include noise and are inefficient. True prices are not observed]

(c) Observed price is more volatile than true efficient price. [Hint: Observed prices include noise and hence are more volatile (and inefficient also).]

(d) **All of the statements are correct. [Hint: The observed prices are noisy and inefficient. True efficient prices are not observed and only theoretical in nature. They are less volatile as fundamental information is expected to arrive less frequently as compared to noise.]**

Q2. Which of the following statement is correct in the context of market participants?

(a) Noise traders' trading activity instills noise in prices. [Hint: Noise traders are uninformed or carry stale information. Their trading activity incorporates noise in prices.]

(b) Informed traders' trading activity instills information in prices. [Hint: Informed traders are generally large institutional investors. They spend considerable resources on information acquisition. Their trading activity incorporates true and fundamental information in prices.]

(c) Market makers offer both buy and sell-side quotes. [Hint: Market makers have the responsibility of ensuring the continuous and smooth functioning of the market. So, they offer both-sided quotes continuously.]

(d) **All of the statements are correct. [Hint: Noise and liquidity traders incorporate noise in prices, while informed traders incorporate their information in prices and make markets more efficient. Market makers provide liquidity to market by offering both buy and sell sided quotes.]**

Q3. Which of the following statement is correct in the context of efficient markets?

(a) One cannot make money using public information in a semi-strong efficient market. [Hint: If a market is a semi-strong form efficient, then public information is already incorporated.]

(b) If a market is a semi-strong form efficient (and trading on private information is unethical and illegal) then the best course of action is to stay invested in the market. [Hint: If one cannot beat the market then one should keep investing in the market.]

(c) If a market is weak-form efficient, then one can make money using public information. [Hint: A weak form efficient market incorporates all the information available in past prices. However, all the public information may not be incorporated.]

(d) **All of the statements are correct. [Hint: If a market is semi-strong efficient, one cannot make money using historical prices and public information. If a market is weak form efficient, then one cannot make money using historical information, but can make money using public information.]**

Q4. Which of the following statement is correct in the context of Risk preferences?

(a) A risk-neutral person is equally happy with getting USD 50 with certainty or making a gamble that has USD 50 as an expected outcome. [Hint: A risk-neutral person is not concerned with the increase or decrease in the risk of the proposition but with the expected outcome.]

(b) The utility(Y)/Wealth(X) function of a risk-neutral person is linear. [Hint: For the risk-neutral person, the incremental utility for each unit of incremental is the same irrespective of the change in risk profile.]

(c) A risk-preferring person would take less reward if the risk of the gamble is increased. [Hint: Since the risk-preferring person derives additional utility from the gamble with higher risk, she would be willing to take the gamble even with a lower reward, if it entails higher risk.]

(d) **All of the statements are correct. [Hint: A risk neutral person does not care about risk and only about expectations of the outcome; her utility wealth function is linear in nature. In contrast, a risk preferring person derives positive utility from the risk itself.]**

Q5. In pure limit order book markets, liquidity is consumed by

(a) Designated Market Makers. [Hint**:** There are no designated market makers in pure limit order book markets.]

(b) **Market orders. [Hint: Market orders consume liquidity.]**

(c) Limit orders. [Hint: Limit orders patiently waiting in the order book and provide liquidity to incoming market orders.]

(d) Brokers. [Hint**:** Brokers do not directly trade in financial markets; they route their client's orders.]

Q6. Compute the relative spread for the best Ask: Rs 460 and the best Bid Rs 450.

(a) 0%-2% [Hint: $Relative\ Spread = \frac{AbsoluteSpread}{Mid\_Price}$]

(b) **2%-4% [Hint: $Relative\ Spread = \frac{AbsoluteSpread}{Mid\_Price} = \frac{10}{\frac{460+450}{2}} = 2.20\%$]**

(c) 4%-6% [Hint: $Relative\ Spread = \frac{AbsoluteSpread}{Mid\_Price}$]

(d) 6%-8% [Hint: $Relative\ Spread = \frac{AbsoluteSpread}{Mid\_Price}$]

Q7. For a rational individual the following is a correct statement.

    (a) USD 1 today is preferred to USD 1 tomorrow. [Hint: Due to the time value of money, rational individuals always prefer a dollar today to a dollar tomorrow.]

    (b) A rational individual is a risk-averse person. [Hint: A rational individual does not like risk, and would want an extra premium to bear that risk.]

    (c) A rational individual would prefer less risk for a given level of return and a higher return for a given level of risk. [Hint: Risk-averse individuals require a certain extra premium to bear additional risk.]

    (d) **All of the statements are correct. [Hint: Rational investors prefer a safe dollar than a risky dollar, a dollar today than a dollar tomorrow, and they are risk averse.]**

Q8. An individual is likely to be a (A) a saver or (B) a consumer if

    (a) (A) If he is a borrower (B) If he is a lender. [Hint: A consumer spends more in consumption and less in investment/lending and also may need to borrow to maintain that consumption; a saver is more of an investor/lender]

    (b) (A) If he is a borrower (B) If he is an investor. [Hint: A consumer spends more in consumption and less in investment/lending and also may need to borrow to maintain that consumption; an investor can also be a lender]

    (c) (A) If he is a lender (B) if he is an investor. [Hint: A saver or investor can invest/lend]

    (d) **(A) If he is an Investor (B) if he is a borrower. [Hint: An investor can lend; a consumer may need to borrow to maintain the consumption levels [**

Q9. For a rational individual, consuming normal goods with positive utility, the following statement is incorrect with respect to the marginal utility of consumption.

    (a) The marginal utility is constant. [Hint: If one consumes more and more of a certain good, the marginal utility of the consumption is not the same.]

    (b) The marginal utility of wealth becomes negative. [Hint: While the marginal utility of normal goods such as food or clothing can become negative after excessive consumption, the marginal utility of wealth never becomes negative.]

    (c) Marginal utility increases with more consumption. [Hint: As one consumes something in excess, the utility and satisfaction of the consumers do not increase.]

(d) **All of the statements are incorrect. [Hint: Marginal utility decreases after a certain level of consumption. As one consumes something in excess, the utility and satisfaction of that consumption start to decrease after a certain limit.]**

Q10. The existence of financial instruments with different interest rates cannot be explained by

(a) The difference in taste and preferences. [Hint: Unlike goods like food and clothing, tastes and preferences are not a factor in financial instruments (assuming that investors are rational)].

(b) Presence of different opportunity sets (e.g., time pattern of consumption). [Hint: While, there are different opportunity sets available to individuals, financial markets facilitate the optimization of the time pattern of consumption and also across different opportunity sets. Thus, in the presence of efficient markets, different opportunity sets may not result in different interest rates]

(c) Indicates the certainty in the economic and financial environment. [Hint: Economic and financial environment is not certain.]

(d) **All the three statements cannot explain difference in interest rates. [Hint: Indicates the uncertainty in the economic and financial environment. Economic and financial uncertainty affects the risk of different financial instruments differently. Riskier instruments are expected to offer a higher rate of interest.]**

Artificial Intelligence (AI) for Investments

Assignment 6 Solution

Question (1-10): The following information is given for the two securities. Assume that these are the only two securities available, and also that short-selling is not available.

	Expected Return	Standard Deviation
Security A	6%	3%
Security B	8%	4%

1. Theoretically, what should be the level of correlation between two securities to minimize the risk (standard deviation) of a portfolio?
   - **A. -1**
   - B. 0
   - C. +1
   - D. More information is required
   - E. None of the above

Hint: Theoretically minimum risk is observed when the correlation is minimum (ρ_{12}= -1).

2. Given that the correlation between two securities is +1, how should the investment be proportioned between the two securities to minimize risk (standard deviation)?

   a. Security A= 50%, Security B= 50%
   b. Security A= 25%, Security B= 75%
   c. Security A= 100%, Security B= 0%
   d. More information is required
   e. None of the above

Hint Since correlation is 1, no diversification will be achieved, hence the minimum risk portfolio will be the one with all 100% invested in the lowest risk security that is A.

3. If the correlation between these two securities is +1, what should be the proportionate amounts invested in the two securities to achieve maximum risk (standard deviation) portfolio.

   A. Security A= 50%, Security B= 50%
   B. Security A= 100%, Security B= 0%
   C. Security A= 25%, Security B= 75%
   D. More information is required

    E. None of the above

4. If the correlation between these two securities is -1, what should be the correct interval for the proportionate amounts invested in the two securities to achieve the minimum risk (standard deviation)

    A. Security A= (0%-20%), Security B= (80%-100%)
    B. Security A= (30%-50%), Security B= (50%-70%)
    C. Security A= (70%-90%), Security B= (30%-10%)
    D. Security A= (40%-60%), Security B= (30%-50%)
    E. None of the above

5. In the previous question, what is the correct range for the portfolio's expected return?

    A. 0%-2%
    B. 2%-4%
    C. 4%-6%
    D. 6%-8%
    E. 8%-10%
    F. None of the above

6. If the correlation is 0, what are the proportions to be invested in the two securities to achieve the minimum risk portfolio?

    A. Security A= (0%-20%), Security B= (60%-100%)
    B. Security A= (20%-40%), Security B= (40%-60%)
    C. Security A= (40%-60%), Security B= (0%-20%)
    D. Security A= (60%-80%), Security B= (20%-40%)
    E. None of the above

Hint: $Xa = \frac{\sigma_b^2 - \sigma_a\sigma_b\rho_{ab}}{\sigma_a^2 + \sigma_b^2 - 2\sigma_a\sigma_b\rho_{ab}} = \frac{4^2}{3^2 + 4^2} = \frac{16}{25} = 64\%; \ Xb = \frac{9}{25} = 36\%$

7. In the previous question, calculate the risk (standard deviation) of minimum risk portfolio.

    A. 0%-1%
    B. 1%-2%
    C. 2%-3%
    D. 3%-4%
    E. 4%-5%
    F. None of the above

Hint: $\sigma^2 = (X_a * \sigma_a)^2 + (X_b * \sigma_b)^2 + 2 * \rho_{ab} * (X_a * \sigma_a)(X_b * \sigma_b)$

$\sigma^2 = (64\% * 3\%)^2 + (36\% * 4\%)^2 + 2 * (-1) * (64\% * 3\%) * (36\% * 4\%)$

$\sigma = 0.48\%$

8. Find the correct interval for the risk (standard deviation) of the portfolio, if the correlation is 0, and the following proportionate amounts are invested in Security A= 30% and Security B= 70%.

    A. 0%-1%
    B. 1%-2%
    C. 2%-3%
    D. 3%-4%
    E. 4%-5%
    F. None of the above

Hint: $\sigma^2 = (X_a * \sigma_a)^2 + (X_b * \sigma_b)^2 + 2 * \rho_{ab} * (X_a * \sigma_a)(X_b * \sigma_b)$

$\sigma^2 = (30\% * 3\%)^2 + (70\% * 4\%)^2$

$\sigma = 2.94\%$

9. In previous question, what is the correct interval for the expected return of the portfolio

    A. 0%-2%
    B. 2%-4%
    C. 4%-6%
    D. 6%-8%
    E. 8%-10%
    F. None of the above

Hint: $E(R)= X_a*R_a+X_b*R_b= 30\%*6+70\%*8= 7.4\%$

10. If a risk-free asset is also available that offers a return of 20% along with Securities A and B, then what would be the optimum investment strategy.

    A. Investment in risk-free asset and a portfolio of securities A and B
    B. Investment in only risky assets (A and B)
    C. Investment in risk-free asset and investment in A
    D. Investment in risk-free asset and investment in B
    E. Investment in only risk-free asset

Hint: The risk-free asset offers even higher returns (20%) than both A and B, hence no further improvement is possible and the entire amount should be invested in the risk-free asset only.

Artificial Intelligence (AI) for Investments

Assignment 7 Solution

1) Suppose the market portfolio has a standard deviation of 12% and the expected market return of 15%. Compute the market Sharpe ratio if the risk-free rate is 5%

A) 0.00-0.25

B) 0.25-0.50

C) 0.50-0.75

D) 0.75-1.00

Hint: The Sharpe ratio is calculated as:

Sharpe Ratio= (Expected Return−Risk-free rate)/ standard deviation

Sharpe Ratio= (15%−5%)/12%=10%/12%=0.833. The Sharpe ratio measures risk-adjusted returns, using total risk (standard deviation) in the denominator.

2) Given that a stock has a beta of 0.80, a risk-free rate of 3%, and an expected return of 8%, what is the implied market risk premium?

A) 0%-2%

B) 2%-4%

C) 4%-6%

D) 6%-8%

Hint: Rearrange the CAPM formula to solve for the market risk premium

Expected return=Risk-free rate+β×Market risk premium

8%=3%+0.80×Market risk premium

5%=0.80×Market risk premium

Market risk premium=6.25%

The market risk premium is the excess return that investors expect from investing in the market rather than the risk-free asset.

3) **Given two portfolios, A and B, where Portfolio A has a beta of 0.2 and a standard deviation of 40%, and Portfolio B has a beta of 1.8 and a standard deviation of 20%, which of the following is true about their expected returns under CAPM?**

A) **Portfolio A will have a lower return than Portfolio B.**

B) Portfolio A will have a higher return than Portfolio B

C) Both portfolios will have the same return.

D) None of the above

Hint:

According to CAPM and portfolio theory, markets do not reward idiosyncratic risk. So as per the CAPM model, the only risk factor relevant in determining returns is market risk as measured by beta. Under CAPM, portfolios with higher betas are expected to provide higher returns because they carry more systematic risk. Portfolio A's beta of 0.2 implies lower exposure to market risk compared to Portfolio B's beta of 1.8.

4) **If you are tracking 200 securities, and do not assume any index model or simplifying correlation structure. How many estimates are needed?**
   a) 1000-3000
   b) 3000-5000
   c) 5000-7000
   d) 7000-10000
   e) **None of the all**

Hint: 200 Estimates of expected Returns, 200 Estimates of Variances, and 200*199/2 estimates of covariances. That is a total of 20300 estimates

5) **If you are tracking 200 securities and assume one market and three industries (a total of four indices). Expected returns on each security are affected by one market and one industry. Then how many estimates are needed.**

   a) 700-800

   b) 800-900

   c) 900-1000

   d) 1000-1100

   e) None of the all

Hint: Ri= ai+βi1*Im+βi2*I1+ei. For each security i, 200 estimates of ai's 200 estimates of βim (Sensitivity to market), 200 estimates of βij (Sensitivity to its industry), and 200 estimates of idiosyncratic risk (σi). 3 estimates of industry return and variances, i.e., total 6. One estimate of market return and variance each, i.e., total 2. Overall 200*4+3*2+2=808 estimates are needed.

Questions 6-8

Assume that stock market returns have the market index as a common factor, and all the stocks have a beta of 1 on the market index. All firm-specific returns have a standard deviation of 20%. Suppose that an analyst studies 10 stocks and finds that half of them have an alpha of 2%, and the other half have an alpha of -2%. He buys INR 2 Lakh of positive alpha stocks and shorts INR 2 lakh of negative alpha stocks (all stocks are given equal weight in the portfolio). Also, the following form of single index model holds. Hint: Market is the only factor. First equation is the return generating process and second is the equilibrium model.

$$R_i = \alpha_i + \beta_i R_M + e_{it}$$

$$\overline{R}_i = \alpha_i + \beta_i \overline{R}_M$$

6) **Calculate the expected profit (in Rs) for this trader.**

a) 1500-3500

b) 3500-5500

c) 5500-7500

d) 7500-9500

Hint: $E(R_{pos}) = \alpha_{pos} + \beta * E(R_m) = 2\% + 1 * E(R_m)$

$E(R_{neg}) = \alpha_{neg} + \beta * E(R_m) = -2\% + 1 * E(R_m)$

Portfolio profit $= E(R_{net}) * 2lakh = [E(R_{pos}) - E(R_{neg})] * 2lakh = 4\% * 2lakh =$ INR 8000

7) Calculate the systematic risk (beta) of this portfolio

a) (-0.4) – (-0.2)

b) (-0.2) – (0.2)

c) 0.2 - 0.4

d) 0.4 - 0.6

Hint: $\beta_p = 0.5 * \beta_{pos} + 0.5 * \beta_{neg}$

$\beta_p = 0.5 * 1 + (-0.5 * 1) = 0$

8) Estimate the overall risk (standard deviation) of this portfolio (in %)

a) 0%-5%

b) 5%-10%

c) 10%-20%

d) 20%-30%

Hint: $\sigma_p^2 = \beta_p^2 * \sigma_m^2 + \Sigma_{i=1}^{N} X_i^2 * \sigma_{ei}^2$; since $\beta_p = 0$, therefore $\beta_p^2 = 0$. Also, $X_1 = X_2 = \cdots = X_n = \frac{1}{N}$

$$\sigma_p^2 = 0 * \sigma_m^2 + \left(\frac{1}{10}\right)^2 * (0.2)^2 * 10 = 0.004$$

$\sigma_p = 0.06324$ or 6.324%

9) How many estimates are required if we are tracking 200 securities using the single index model?

    a) 100-300
    b) 300-600
    c) 600-900
    d) 900-1200
    e) None of the all

Hint: Ri= ai+βi*Rm+ei. A total of 200 estimates of ai's, 200 estimates of beta's, 200 estimates of security idiosyncratic variances, 1 estimate of market return and 1 estimate of market standard deviation (σM). That is a total of 3*200+2=602 inputs.

10) How many estimates are required if we are tracking 200 securities by assuming multi-index model with 4 indices?

    a) 100-500
    b) 500-1000
    c) 1000-1500
    d) 1500-2000
    e) None of the all

Hint: Ri= ai+βi1*I1+βi2*I2+βi3*I3+βi4*I4+ei. 200 estimates of ai's and 200 estimates of standard deviations (σi's) for security i, 4*200=800 estimates of βij's for each security i and index j, 4 estimates of index returns (Ij) and 4 estimates of index standard deviations (σj's). A total of 1208 estimates.

Artificial Intelligence (AI) for Investments

Assignment 8 Solution

Question 1-6: Consider the data provided on mutual funds below

Fund	Return (%)	Standard Deviation (%)	Beta
1	12.0	8.0	3.0
2	14.0	6.0	2.0
3	15.0	8.0	1.5
4	10.0	6.0	2.0
5	20.0	10.0	2.5

In addition, the risk-free rate is given as 5%, expected return on market is 10%, standard deviation of market is 6%.

Question 1: Compute the Sharpe Ratio for Fund 1.

(a) **0.5-1.0. Hint. *Sharpe Ratio*:** $\frac{R_P - R_F}{\sigma_P} = \frac{12\% - 5\%}{8\%} = \mathbf{0.875}$

(b) 1.0-1.50. Hint. *Sharpe Ratio*: $\frac{R_P - R_F}{\sigma_P}$

(c) 1.5-2.0. Hint. *Sharpe Ratio*: $\frac{R_P - R_F}{\sigma_P}$

(d) 2.0-2.5. Hint. *Sharpe Ratio*: $\frac{R_P - R_F}{\sigma_P}$

Question 2: Compute the Treynor's measure (%) for Fund 3.

(a) 0-2. Hint. $Treynor's\ Measure\ (TM) = \frac{R_P - R_f}{\beta_P}$

(b) 2-4. Hint. $Treynor's\ Measure\ (TM) = \frac{R_P - R_f}{\beta_P}$

(c) 4-6. Hint. $Treynor's\ Measure\ (TM) = \frac{R_P - R_f}{\beta_P}$

(d) **6-8. Hint. $Treynor's\ Measure\ (TM) = \frac{R_P - R_f}{\beta_P} = \frac{15-5}{1.5} = 6.67$**

Question 3: Compute the Jensen's alpha measure (also called differential measure) for Fund 5 if beta is the appropriate risk measure.

(a) **1% to 4%. Hint. $\alpha_{Jen} = \bar{R}_P - R_f - \beta_P * (\bar{R}_m - R_f) = 20 - 5 - 2.5 *$** **$(10 - 5) = 2.5\%$**

(b) 4% to 8%. Hint. $\alpha_{Jen} = \bar{R}_P - R_f - \beta_P * (\bar{R}_m - R_f)$

(c) 8% to 12%. Hint. $\alpha_{Jen} = \bar{R}_P - R_f - \beta_P * (\bar{R}_m - R_f)$

(d) 12% to 16%. Hint. $\alpha_{Jen} = \bar{R}_P - R_f - \beta_P * (\bar{R}_m - R_f)$

Question 4: For Fund 4, compute the Jensen's alpha measure (also called differential measure) if SD is the appropriate risk measure.

(a) **0% to 5%. Hint.** $\alpha_{Jen} = \bar{R}_P - R_f - (\sigma_P/\sigma_m) * (\bar{R}_m - R_f) = 10 - 5 - \left(\frac{6}{6}\right) * (10 - 5) = 0\%$

(b) 5% to 10%. Hint. $\alpha_{Jen} = \bar{R}_P - R_f - (\sigma_P/\sigma_m) * (\bar{R}_m - R_f)$

(c) 10% to 15%. Hint. $\alpha_{Jen} = \bar{R}_P - R_f - (\sigma_P/\sigma_m) * (\bar{R}_m - R_f)$

(d) 15% to 20%. Hint. $\alpha_{Jen} = \bar{R}_P - R_f - (\sigma_P/\sigma_m) * (\bar{R}_m - R_f)$

Question 5: Which of the following is incorrect in value-vs-growth investing.

(a) Value stocks are cheap stocks. Hint: Value stocks have lower price to earnings ratios as compared to their peers.

(b) Growth stocks are sold at premium. Hint: Growth stocks P/E ratios are high (e.g., technology stocks). The high prices are justified by considerable growth prospects in future.

(c) Value minus growth offers on average positive returns. Hint: Value stocks are underpriced and may offer higher returns as compared to growth stocks that are sold at premium.

(d) **Growth minus value offers on average positive returns. Hint: Growth stocks are sold at premium and on average may offer lower returns than value stocks.**

Question 6. In the context of timing and selection of securities, identify the incorrect statement.

(a) A timing strategy would involve increasing the beta of the portfolio in anticipation of market rise. Hint: Timing involves taking changing portfolio composition in anticipation of market movements.

(b) Increasing bonds composition vis-à-vis equity is part of timing strategy. Hint: If you anticipate the market to go down, one can decrease the portfolio beta by increasing the proportion of bonds in the portfolio.

(c) **Stock selection would involve picking securities with negative alphas. Hint: A positive alpha would offer excess risk-adjusted returns.**

(d) To find securities with positive alphas one needs asset pricing models to estimate expected returns commensurate with the risk of the security. Hint: Models like 3-factor Fama-French, CAPM, etc., are required to examine whether the returns from the portfolio are higher, lower, or commensurate with respect to the risk of the portfolio.

Questions 7-10

Question 7. A portfolio consists of two stocks. The expected return of stock A is 14%, and its standard deviation is 8%, while the expected return of stock B is 10%, and its standard deviation is 4%. There is a correlation of 0 between the two stocks. Find the amount invested in the minimum variance portfolio.

(a) $X_A = 0.25, X_B = 0.75$ Hint: $X_A = [\sigma_B^2 - \rho_{AB}\sigma_A\sigma_B] / [\sigma_A^2 + \sigma_B^2 - 2\rho_{AB}\sigma_A\sigma_B]$

(b) $X_A = 0.20, X_B = 0.80$ Hint: $X_A = [\sigma_B^2 - \rho_{AB}\sigma_A\sigma_B] / [\sigma_A^2 + \sigma_B^2 - 2\rho_{AB}\sigma_A\sigma_B] =$

$\frac{\sigma_B^2}{\sigma_A^2 + \sigma_B^2} = \frac{0.04^2}{0.04^2 + 0.08^2} = \mathbf{0.20}$

(c)$X_A = 0.35, X_B = 0.65$ Hint: $X_A = [\sigma_B^2 - \rho_{AB}\sigma_A\sigma_B] / [\sigma_A^2 + \sigma_B^2 - 2\rho_{AB}\sigma_A\sigma_B]$

(d) $X_A = 0.30, X_B = 0.70$ Hint: $X_A = [\sigma_B^2 - \rho_{AB}\sigma_A\sigma_B] / [\sigma_A^2 + \sigma_B^2 - 2\rho_{AB}\sigma_A\sigma_B]$

Question 8. In the previous question (7), determine the standard deviation of the portfolio

    (a) 2%-3% $Hint: \sqrt{(w_A^2 * \sigma_A^2 + w_B^2 * \sigma_B^2)}$

    (b) 3%-4% $Hint:$ $\sqrt{(w_A^2 * \sigma_A^2 + w_B^2 * \sigma_B^2)} = \sqrt{(0.2 * 0.08)^2 + (0.8 * 0.04)^2} =$

    3.58%

    (c) 4%-5% $Hint: \sqrt{(w_A^2 * \sigma_A^2 + w_B^2 * \sigma_B^2)}$

    (d) 5%-6% $Hint: \sqrt{(w_A^2 * \sigma_A^2 + w_B^2 * \sigma_B^2)}$

Question 9. In the previous question (7), if the correlation $\rho_{AB} = -1$, find the approximate amount invested in the minimum variance portfolio

(a)$X_A = 0.33, X_B = 0.67$ Hint: $X_A = [\sigma_B^2 - \rho_{AB}\sigma_A\sigma_B] / [\sigma_A^2 + \sigma_B^2 - 2\rho_{AB}\sigma_A\sigma_B] =$
$[0.04^2 - (-1) * 0.08 * 0.04)] / [0.08^2 + 0.04^2 - 2 * (-1) * 0.08 * 0.04] =$
0.33

(b)$X_A = 0.30, X_B = 0.70$ Hint: $X_A = [\sigma_B^2 - \rho_{AB}\sigma_A\sigma_B] / [\sigma_A^2 + \sigma_B^2 - 2\rho_{AB}\sigma_A\sigma_B]$

(c)$X_A = 0.25, X_B = 0.75$ Hint: $X_A = [\sigma_B^2 - \rho_{AB}\sigma_A\sigma_B] / [\sigma_A^2 + \sigma_B^2 - 2\rho_{AB}\sigma_A\sigma_B]$

(d)$X_A = 0.20, X_B = 0.80$ Hint: $X_A = [\sigma_B^2 - \rho_{AB}\sigma_A\sigma_B] / [\sigma_A^2 + \sigma_B^2 - 2\rho_{AB}\sigma_A\sigma_B]$

Question 10. In the previous question (7), determine the standard deviation of the portfolio if the correlation $\rho_{AB} = -1$

    (a) **0-2% $Hint: w_A\sigma_A - w_B\sigma_B = \frac{1}{3} * 0.08 - \frac{2}{3} * 0.04 = 0$**

    (b) 2%-4% $Hint: w_A\sigma_A - w_B\sigma_B$

    (c) 6%-8% $Hint: w_A\sigma_A - w_B\sigma_B$

    (d) 4%-6% $Hint: w_A\sigma_A - w_B\sigma_B$

Artificial Intelligence (AI) for Investments

Assignment 9 Solution

1. Simply adding more securities to the portfolio leads to diversification.

   a) By reducing the systematic risk
   b) By reducing the market risk
   c) **By reducing the stock specific/idiosyncratic risk**
   d) None of the all

Hint: Addition of more securities, if they are not perfectly correlated, leads to reduction of stock specific idiosyncratic risk. This is also referred to as diversification.

2. Which of the following is incorrect

   a) Bearing more market risk offers higher expected return
   b) Adding securities with low correlation among each other may offer reduction in risk
   c) **Gold security is risky and therefore a portfolio with a high-proportion of this stock should offer a higher expected return**
   d) Idiosyncratic stock specific risk is not rewarded in efficient capital markets

Hint: Market offers reward - expected return - only for bearing systematic risk, not idiosyncratic risk. Because the idiosyncratic risk diversifies. For example, if a gold security is added to a portfolio, a lot of risk comprises idiosyncratic risk of finding gold while a very small component that is market risk. However, in a well-diversified portfolio that idiosyncratic stock specific risk diversifies and only a small market risk remains. Thus, the contribution of this security to portfolio risk is very less and markets accordingly reward a small premia to bear that risk.

3. If I am holding a security individually (not in a portfolio), what is the most appropriate risk measure for me

   a) Market risk
   b) **Standard deviation**
   c) Systematic risk
   d) Non-diversifiable risk

Hint: If you are holding a security individually, you are not diversified. So you would look at the overall risk of the security that is standard deviation.

4. A security's contribution to the risk of a well-diversified portfolio is
a) Company specific risk
b) Standard deviation of the security
c) Diversifiable risk
d) **Systematic risk**
e) Unique risk

Hint: For a well-diversified portfolio, only systematic (or market risk matters), as the idiosyncratic risk is eliminated due to diversification.

5. If an individual owns a well diversified portfolio, the most appropriate measure of risk is

a) Standard deviation
b) Correlation between the two securities
c) **Market risk**
d) Stock specific risk

Hint: For a well diversified portfolio, market risk (or beta) is the most appropriate measure of risk.

6. In which of the following situations would you get the largest reduction in risk by spreading your investment across two stocks?

a) The two shares are perfectly correlated
b) There is no correlation
c) There is a modest negative correlation
d) **There is a perfect negative correlation**

Hint: The theoretically largest possible reduction in risk takes place when the stocks are perfectly negatively correlated.

7. A positive covariance between two securities indicates that

a) the two securities move in different directions
b) **the two securities move in the same direction**
c) the two securities are low risk
d) the two securities are high risk

Hint: The two securities move perfectly in the same direction a lock-step manner.

8. The betas for the market portfolio and risk-free security are:

   1) Market   2) Riskfree

   a) 0   1
   b) **1**   **0**
   c) -1   1
   d) 1   -1
   e) 2   1

Hint: For a market portfolio like Nifty 50 beta is one, while for govt. securities beta is close to zero.

9. Beta is a measure of

   a) Company specific risk
   b) Diversifiable risk
   c) **Systematic risk**
   d) Unique risk

Hint: Beta is a measure of systematic, non-diversifiable, market risk.

10. As the compounding frequency increases, the effective returns

   a) **Increase**
   b) Decrease
   c) None of the above
   d) Can not say

Hint: As the compounding frequency increases, the money is returned (or paid back) more frequently, and can be put to use more frequently. That is higher effective returns.

Artificial Intelligence (AI) for Investments

Assignment 10 Solution

Question 1: Which of the following statement is incorrect in the context of Volume.

(a) Volume contributes to the weight of evidence.
(b) **When price and volume patterns do not agree the current price action is strong**.
(c) Rising volume along with rising price would suggest that price has momentum and the trend may continue.
(d) Rising volume with falling price may suggest that sellers dominate.

Hint: Volume is one important piece of evidence. When price and volume do not agree, the current trend is weak. When price and volume agree that indicates the strength of the current trend. When sellers dominate, prices fall despite increase in volume.

Question 2: Which of the following statements is incorrect in the context of technical analysis?

(a) **Technical analysis focuses on examining the fundamentals of a security.**
(b) Fundamental analysis examines factors impacting a company's cash flow and long-term value.
(c) According to Dow theory, the market has three key trends.
(d) None of the above

Hint: Technical analysis does not take into account the long-term fundamentals of a security. Fundamental analysis is concerned with the long-term factors affecting a security, not temporary supply-demand imbalances. The three trends are (a) Primary or major trend, (b) Secondary market reactions, and (c) Minor movements.

Q3: What is the correct interval for the divisor for 10-week weighted moving average (WMA)?

(i) **50-100**
(ii) 5-15
(iii) 100-150
(iv) 15-25

Hint: For the weighted average, the divisor is the sum of the weights, i.e.,
1+2+3+4+5+6+7+8+9+10=55

Q4: Consider the following six prices in time-series, oldest to latest: 101, 100, 103, 99, 96, 99. Compute the weighted moving average (WMA) for the series.

(a) 80-90
(b) **90-100**
(c) 100-110
(d) 110-120

Hint: $\frac{\sum_{i=1}^{6} P_i * i}{\sum_{i=1}^{6} i} = \frac{101*1+100*2+103*3+99*4+96*5+99*6}{(1+2+3+4+5+6)} = \textbf{99.04}$

Q5: What is the correct interval for the divisor for 10-week simple moving average (SMA)?

    (i)   50-100
    (ii)   **5-15**
    (iii)   100-150
    (iv)   15-25

Hint: For simple moving average, the divisor is the number of periods=10

Q6: Consider the following six prices in time-series, oldest to latest: 101, 100, 103, 99, 96, 99. Compute the simple moving average (SMA) for the series.

    (i)   **90-100**
    (ii)   80-90
    (iii)   110-120
    (iv)   120-130

Hint: $\frac{\sum_{i=1}^{6} P_i}{6} = \frac{101+100+103+99+96+99}{(6)} = \textbf{99.6}$

Q7: For a 20-week frequency, the following information is given. Current price P_t=100, $EWMA_{t-1}$ = 120. Compute the exponent (α).

    (a) **0.00-0.15**
    (b) 0.15-0.25
    (c) 0.25-0.35
    (d) 0.35-0.45

Hint. A=2/Time-span=2/20=0.10

Q8: For a 20-week frequency, the following information is given. Current price P_t=100, $EWMA_{t-1}$ = 120. Compute $EWMA_t$.

    (a) 100-105.
    (b) 105-110.
    (c) **110-120.**
    (d) 120-125.
    (e) 125-130.

Hint. $\alpha * (P_t - EWMA_{t-1}) + EWMA_{t-1} = 0.1 * (100 - 120) + 120 = 118$

Q 9: Consider the following information about weekly closing prices below. Currently, we have just finished week 9. Compute ROC for a 3-week time span.

Week	1	2	3	4	5	6	7	8	9
Price	100	101	102	104	100	99	98	97	96

    (a) 92-95

(b) 95-97

(c) 97-99

(d) 99-101

Hint: 3- Week ROC $= \dfrac{Price_{w9}}{Price_{w6}} = \dfrac{96}{99} = 96.97$

Q 10: Consider the following information about weekly closing prices below. Currently, we have just finished week 9. Compute 8-Week RSI.

Week	1	2	3	4	5	6	7	8	9
Price	100	105	108	110	100	98	96	94	92

(a) 40-45

(b) 45-50

(c) 50-55

(d) 55-60

(e) 60-65

Hint: 8-Week RSI.

RS = average of 8-week up closes/ average of 8-week down closes

   = [(105+108+110)/3]/ [(100+98+96+94+92)/5=1.121

$RSI = 100 - \dfrac{100}{1+RS}$ =100-100/ (1+1.121) =52.85

Week	1	2	3	4	5	6	7	8	9
Price	100	105	108	110	100	98	96	94	92
		UP	UP	UP	Down	Down	Down	Down	Down

Artificial Intelligence (AI) for Investments

Assignment 11 Solution

Q1: Which of the following best describes the difference between cross-sectional and time-series data?

(i) Cross-sectional data tracks the same individual over time, while time-series data observes multiple individuals at a single point in time.
(ii) Cross-sectional data observes multiple individuals at a single point in time, while time-series data tracks the same individual over multiple periods.
(iii) Cross-sectional data and time-series data are identical concepts used interchangeably.
(iv) None of the above.

Explanation: Cross-sectional data captures multiple units (e.g., individuals, firms) at a single time, while time-series data follows one unit over multiple time periods. Panel data, on the other hand, combines both.

Q2: Which of the following statements about the error term in a regression model is correct?

(i) The error term captures the impact of all explanatory variables included in the model.
(ii) **The error term represents unobserved factors that affect the dependent variable but are not included in the model.**
(iii) The error term is irrelevant in Ordinary Least Squares (OLS) estimation.
(iv) None of the above

Explanation: The error term accounts for factors affecting the dependent variable that are not explicitly included in the model, which is why it is crucial in regression analysis.

Q3: Which of the following is incorrect as an essential assumption of a multiple linear regression model?

(i)   The error term should have a zero conditional mean.
(ii) The error term should be serially correlated.
(iii) The variance of the error term should be constant (homoscedasticity).
(iv) No correlation between the error term and the independent variable.
(v)   The model should be correctly specified.

Explanation: In multiple linear regression, the error term should **not** be serially correlated. The other assumptions—zero conditional mean, homoscedasticity, no correlation between the error term and independent variables, and correct model specifications are essential for valid and reliable regression results.

Q4: In a multiple regression model, the Variance Inflation Factor (VIF) is used to detect:

(a) Heteroscedasticity
(b) **Multicollinearity**
(c) Autocorrelation
(d) Model misspecification

Explanation: A high VIF indicates that a predictor is highly correlated with other independent variables, leading to unstable coefficient estimates.

Q5-Q10: Using the information provided in the table below [X= Income, and Y= Weekly Consumption Expenditure], answer the following questions.

X-> Income	100	120	140	160	180	200	220	240	260	280
	55	65	79	80	102	110	120	135	137	150
	60	70	84	93	107	115	136	137	145	152
Y Weekly Cons Exp	65	74	90	95	112	130	140	140	155	175
	70	80	94	103	116	140	144	152	165	178
	77	87	101	109	121	145	146	159	180	181
		88		113	125	150		160	189	185
				115				162		191

Q5: What is the unconditional mean of Y?

  (a) 100-120
  (b) **120-140**
  (c) 140-160
  (d) 160-180

Explanation: Unconditional mean is the average of all the observations: 7334/60 = 122.23

Q6: What is the conditional mean of Y, given X=200, that is, E[Y|X=200]?

  (a) 100-120
  (b) **120-140**
  (c) 140-160
  (d) 160-180

Explanation: Conditional mean of Y is the average of Y given X=200. E[Y|X=200] =790/6 = 131.67

Q7: Calculate the conditional mean of Y, given X=280, that is, E[Y|X=280]?

    (a) 100-120
    (b) 120-140
    (c) 140-160
    (d) **160-180**

Explanation: Conditional mean of Y is the average of Y given X=280. E[Y|X=280] = 1212/7 = 173.14

Q8: Calculate the standard deviation of X, i.e., σx.

    (a) 20-40
    (b) **40-60**
    (c) 60-80
    (d) 80-100

Explanation: $\sigma x^2 = \frac{\Sigma(X_i - \bar{X})^2}{n}$, $\sigma x = 57.33$

Q9: Compute the Covariance between X and Y, i.e., σxY

    (a) 1800-1850
    (b) 1850-1900
    (c) 1900-1950
    (d) **1950-2000**

Explanation: $\sigma xy = \frac{\Sigma(X_i - \bar{X})(Y_i - \bar{Y})}{n}$, $\sigma xy = 1975.144$

Q10: If the following regression model is run, Y=β0+β1X+error. Estimate the value of β1 here?

    (a) 0.00-0.25
    (b) 0.25-0.50
    (c) **0.50-0.75**
    (d) 0.75-1.00

Explanation: $\beta 1 = \sigma xy / \sigma x^2 = 1975.144/(57.33)^2 = 0.601$

Assignment 12 Solution

Question 1-5: Consider the following linear probability model (LPM) estimated using OLS.

$$Y = -0.88 + 12.50X$$

Here Y = 1 if the family owns the house and 0 otherwise. X represents family income (measured in '000 of dollars). The dataset consists of 50 families.

The 't' value of the intercept term is -7.698 and for the income coefficient it is 12.515. The model has R-squared value of 80.48%.

Question 1: According to this model, what is the estimated probability that a family with '0' income owning a house?

 a) **0.0-0.1**
 b) 0.1-0.2
 c) 0.2-0.3
 d) 0.3-0.4
 e) 0.4-0.5

Hint: At X=0, Y=-0.88. However, probabilities can not be negative, so for a zero income, probability of owning the house as per this model is zero.

Question 2: According to this model, determine the increase in the probability of owning the house when family income rises by USD 4000.

 a) 0%-10%
 b) 10%-20%
 c) 20%-30%
 d) 30%-40%
 e) **40%-50%**

Hint: For each USD 1000, the increase in probability of owning the house is 12.50%, and therefore, for USD 4000 increase, the increase in probability will be 50%.

Question 3-6: Consider the following logit function: $Z_i = \beta_1 + \beta_2 x_{2i} + \beta_3 x_{3i} + \beta_4 x_{4i}$. Given $\beta_1 = 0.1$, $\beta_2 = 0.3$, $\beta_3 = -0.6$, $\beta_4 = 0.7$, and $\bar{x}_2 = 1.6$, $\bar{x}_3 = 0.20$, $\bar{x}_4 = 0.10$. Using the information provided here, Compute $F(z_i)$?

a) 0.40 to 0.50
b) 0.50 to 0.60
c) **0.60 to 0.70**
d) 0.70 to 0.80

Explanation: $F(z_i) = \hat{P}_i = \dfrac{1}{(1+e^{-(0.1+0.3x_{2i}-0.6x_{3i}+0.7x_{4i})})} = \dfrac{1}{1+e^{-0.53}} = 0.629$

Question 4: In the logistic regression, how is the marginal effect of a variable x_{2i} typically calculated?

a) $\beta_2 * (1 - F)$
b) **$\beta_2 * F * (1 - F)$**
c) $\beta_2 * F$
d) $\beta_2 * Log(F)$

Explanation: The correct formula for marginal effects in logistic regression is $\boldsymbol{\beta_2 * F * (1 - F)}$

Question 5: Given $F(z_i) = 0.629$, calculate average marginal effects for x_{2i}.

a) 0.03 to 0.05
b) **0.07 to 0.09**
c) 0.09 to 0.11
d) 0.11 to 0.13

Explanation: $Marginal\ effects = \beta_2 * F * (1 - F) = 0.3 * 0.629 * (1 - 0.629) = 0.07$

Question 6: Given $F(z_i) = 0.629$, calculate average marginal effects for x_{4i}.

a) 0.05-0.10
b) 0.10-0.15
c) **0.15-0.20**
d) 0.20-0.25

Marginal Effects for x_{4i} are $\beta_4 * F * (1 - F) = 0.7 * 0.629 * (1 - 0.629) = 0.163$

Question 7-8: Use the information provided below and compute the following. A regression model is trained to predict defaulter applications with 5 lakh data points. The model is tested on out-of-sample 200 data points. The following classification matrix is obtained at Thresholding level of 0.6. Here, 0's are considered as non-defaulters and 1's are defaulters. The model is evaluated on its ability to accurately predict (i.e., classify) the observations from the test dataset.

Actual/Predicted	Predicted =0	Predicted =1
Actual =0	60	20
Actual =1	40	80

What is the sensitivity – ability to correctly classify defaulters (1's) as 1's – of the model?

a) 40-50%
b) 50-60%
c) 60-70%
d) 70-80%

Hint: Sensitivity = True Positives/ (True Positives + False Negatives) = 80/ (80+40)*100 = 66.67%

Question 8: What is the specificity – ability to correctly classify non-defaulters (0's) as 0's – of the model?

a) 40-50%
b) 50-60%
c) 60-70%
d) 70-80%

Hint: Specificity = True Negatives/(False Positives + True Negatives) = 60/(60+20)*100 = 75.0%

Question 9: Which method is typically used to estimate Logit and Probit models?

a) **Maximum Likelihood Estimation (MLE)**
b) Ordinary Least Squares (OLS)
c) Generalized Least Squares (GLS)
d) All of the above
e) None of the above

Explanation: Logit and Probit models are non-linear, making them unsuitable for estimation using standard OLS or GLS techniques. Instead, they are commonly estimated using the Maximum Likelihood Estimation (MLE) method.

Question 10: **Which of the following statements is incorrect regarding a Logit or Probit model?**

a) The dependent variable is not binary.
b) The dependent variable can be continuous.
c) The model can be estimated using OLS.
d) All of the above.

Explanation: In Logit and Probit models, the dependent variable is binary and is not continuous, meaning it has only two possible outcomes, typically represented as 0 and 1.

Therefore, statement (a) and (b) are incorrect. Additionally, due to the non-linear nature of these models, they cannot be estimated using Ordinary Least Squares (OLS), making statement (c) invalid. As all three statements are incorrect, the correct choice is d).