

Question Paper

Quantitative Methods – II (132) : April 2003

Section A : Basic Concepts (40 Points)

- This section consists of questions with serial number 1 - 40.
- Answer all questions.
- Each question carries one point.

1. A continuous random variable is one which
 - a. Can assume only integer values
 - b. Can assume only even values
 - c. Can assume only odd values
 - d. Can assume any value within a given range
 - e. Can assume only a limited number of values.
2. Which of the following is **false** with regard to the expected value of a random variable?
 - a. It is a measure of central tendency for the random variable
 - b. It is the mean of the probability distribution of the random variable
 - c. It is calculated by weighting the possible values of the random variable by their respective probabilities and calculating the weighted mean of the values
 - d. It is a prediction for the value that the random variable will assume
 - e. All of the above.
3. Which of the following is **true** with regard to a Bernoulli process?
 - a. It is related with a continuous random variable
 - b. Each trial has two or more possible outcomes
 - c. The probability of the outcome of any trial remains constant over time
 - d. The outcome of one trial influences the outcome of another trial
 - e. None of the above.
4. The normal distribution
 - a. Is a discrete distribution
 - b. Is multimodal
 - c. Is a symmetrical distribution
 - d. Has mean, median and mode which are different from each other
 - e. Touches the horizontal axis at a finite distance from the mean.
5. Standardizing a normal variable means
 - a. Finding out the central tendency of the possible values of the variable
 - b. Finding out the dispersion of the possible values of the variable
 - c. Converting the possible values of the variable into percentages of their mean
 - d. Converting the variable into a standard normal variable
 - e. Finding out the coefficient of variation for the possible values of the variable.
6. When decisions are made under conditions of risk
 - a. The decision maker is completely certain as to the state of nature which is going to occur
 - b. The decision maker cannot define all possible decision alternatives
 - c. The decision maker can not define the various states of nature
 - d. The decision maker cannot estimate quantitatively the consequences of selecting any decision alternative under the various states of nature
 - e. The decision maker has sufficient knowledge to assign probabilities of occurrence to the various states of nature.

7. Which of the following criteria is/are used for making decision under uncertain conditions?
- Maximax criterion
 - Maximin criterion
 - Hurwicz criterion
 - Regret criterion
 - All of the above.
8. Which of the following criteria is used by an optimistic decision maker under uncertain conditions?
- Maximax criterion
 - Maximin criterion
 - Hurwicz criterion
 - Regret criterion
 - None of the above.
9. The expected value of perfect information
- Is the maximum expected profit associated with the decision alternatives, without perfect information
 - Is the minimum expected profit associated with the decision alternatives, without perfect information
 - Is the expected profit associated with any decision alternative with perfect information
 - Is the difference between the expected profit with perfect information and the maximum expected profit without perfect information
 - Is the difference between the expected profit with perfect information and the minimum expected profit without perfect information.
10. In marginal analysis the minimum required probability of selling an additional unit, that justifies stocking of that additional unit,
- Does not depend on the marginal loss that can be incurred by not selling that unit
 - Does not depend on the marginal profit that can be earned by selling that unit
 - Decreases if the marginal profit increases
 - Increases if the marginal profit increases
 - Does not change if the marginal profit increases or decreases.
11. In which method of sampling each possible sample has an equal chance of being selected and each item in the population has an equal chance of being included in the sample?
- Judgmental sampling
 - Simple random sampling
 - Stratified sampling
 - Systematic sampling
 - Cluster sampling.
12. Which method(s) of sampling is/are used when the population can be divided into groups according to certain characteristics?
- Cluster sampling
 - Stratified sampling
 - Simple random sampling
 - Systematic sampling
 - Both (a) and (b) above.
13. A Type II error occurs in hypothesis testing when
- The null hypothesis is false and accepted
 - The null hypothesis is false and rejected
 - The null hypothesis is true and accepted
 - The null hypothesis is true and rejected
 - The standard error of the sample statistic is incorrectly calculated.

14. The standard normal distribution
- Has a mean equal to 1
 - Has a mean equal to zero
 - Has a mean less than zero
 - Has a mean equal to 5
 - Has a mean equal to 10.
15. The t distribution
- Is not a symmetrical distribution
 - Is a discrete probability distribution
 - Is a multimodal distribution
 - Is different for different sample sizes
 - Is positively skewed.
16. Which of the following is **true**?
- The standard error of mean increases as the sample size increases
 - The standard error of mean decreases as the sample size increases
 - The standard error of mean for sample sizes of 2 and above, is more than the standard deviation of population
 - The standard error of mean for sample sizes of 2 and above, is equal to the standard deviation of population
 - None of the above.
17. The sampling distribution of mean is
- A distribution of all possible sample means for samples of a given size taken from the same population
 - A distribution of all possible sample means for samples of a given size taken from different populations
 - A distribution of all possible sample means for samples of different sizes taken from the same population
 - A distribution of all possible sample means for samples of different sizes taken from different populations
 - A distribution of the observations in a sample.
18. The finite population correction factor is used for calculating the
- Mean of an infinite population
 - Standard deviation of an infinite population
 - Standard error of mean when the population is infinite
 - Standard error of mean when the population is finite and sampling is done with replacement
 - Standard error of mean when the population is finite and sampling is done without replacement.
19. The finite population correction factor
- Increases as the sample size increases
 - Decreases as the sample size increases
 - Remains constant for all possible sample sizes
 - Is equal to 1 for sample sizes of 2 and above
 - Is more than 1 for sample sizes of 2 and above.
20. The means of two populations are represented by μ_1 and μ_2 . It has to be tested whether population mean, μ_2 , is less than population mean, μ_1 . Which of the following is a correct representation of the alternative hypothesis for such a test?
- $H_0: \mu_1 - \mu_2 \neq 0$
 - $H_0: \mu_1 - \mu_2 = 0$
 - $H_1: \mu_1 - \mu_2 \neq 0$
 - $H_1: \mu_1 - \mu_2 < 0$
 - $H_1: \mu_1 - \mu_2 > 0$.

21. In a right tailed test of hypothesis the
- Acceptance region lies under the right tail
 - Rejection region lies under the right tail
 - Acceptance region lies under the right and left tails
 - Rejection region lies at the center of the distribution
 - Entire region lying on the right of the mean of the distribution is the rejection region.
22. The standard error of estimate is developed from the variations of the
- Observed values of the dependent variable around a fixed quantity
 - Observed values of the dependent variable around the mean of the observed values of the independent variable
 - Observed values of the dependent variable around the fitted regression line
 - Observed values of the independent variable around their mean
 - Observed values of the independent variable around the mean of the observed values of the dependent variable.
23. If the dependent variable decreases as the independent variable increases in an estimating equation then, the coefficient of correlation will be in the range of
- 0 to -2.00
 - 0 to -1.00
 - 0 to 0.50
 - 0 to 0.25
 - 0 to 1.00.
24. Which of the following represents the proportion of variation in the dependent variable that is explained by the regression line?
- Coefficient of determination
 - Coefficient of correlation
 - Coefficient of variation
 - Standard error of estimate
 - None of the above.
25. Which of the following is **true**?
- The coefficient of determination is positive always
 - The coefficient of determination is negative if the coefficient of correlation is negative
 - The coefficient of determination is negative if the coefficient of correlation is positive
 - The coefficient of determination is the square root of the coefficient of correlation
 - None of the above.
26. If the regression equation is a perfect estimator of the dependent variable then which of the following is **false**?
- The standard error of estimate is zero
 - The coefficient of correlation is zero
 - The coefficient of determination is 1.00
 - All the data points fall on the regression line
 - None of the above.
27. The extent to which the observed values of the dependent variable differ from the predicted values according to the regression line is measured by
- The slope of the regression line
 - The intercept of the regression line
 - The standard error of estimate
 - The coefficient of correlation
 - The coefficient of determination.

28. If the covariance between two variables is positive then, the coefficient of correlation between them will be in the range of
- 0 to -1.00
 - 0 to -0.50
 - 0 to -0.25
 - 0 to 2.00
 - 0 to 1.00.
29. A multiple regression equation has
- Multiple dependent variables
 - One independent variable
 - One dependent variable
 - A standard error of estimate equal to zero
 - A standard error of estimate equal to 1.
30. For a given number of data points, n , and a given number of independent variables, k , the degrees of freedom of a multiple regression equation is equal to
- n
 - $n + 1$
 - $n - 1$
 - $n - k$
 - $n - k - 1$.
31. For a multiple regression relationship given by $\hat{Y} = a + b_1X_1 + b_2X_2$, the problem of multicollinearity arises when
- There is a low correlation between Y and X_1
 - There is a low correlation between Y and X_2
 - There is a high correlation between X_1 and X_2
 - There is a high correlation between Y and X_1
 - There is a high correlation between Y and X_2 .
32. Which of the following are used as weights in a quantity index?
- Prices
 - Quantities
 - Values
 - Sum of the quantities in the base year and the current year
 - None of the above.
33. Which of the following is **true** with regard to a value index?
- It measures the overall change in prices
 - It measures the overall change in quantities
 - It measures the change in total monetary worth
 - It can distinguish between the price changes and quantity changes
 - None of the above.
34. Which of the following indices is a ratio of the sum of the current year prices to the sum of the base year prices?
- Unweighted aggregates price index
 - Laspeyres price index
 - Paasches price index
 - Fisher's ideal price index
 - None of the above.

35. Weighted average of relatives price index for various years can be readily compared if
- Base year values are used as weights
 - Current year values are used as weights
 - Base year prices are used as weights
 - Current year prices are used as weights
 - Sum of base year and current year quantities are used as weights.
36. Weighted average of relatives price index calculated using base year values as weights is equal to
- Paasches price index
 - Laspeyres price index
 - Fisher's ideal price index
 - Unweighted average of relatives price index
 - Unweighted aggregates price index.
37. Which of the following represents the long-term movement of a variable?
- Secular trend
 - Cyclical fluctuation
 - Seasonal variation
 - Irregular variation
 - None of the above.
38. Which of the following types of change in a time series is studied using ratio to moving average method?
- Secular trend
 - Seasonal variation
 - Cyclical fluctuation
 - Irregular variation
 - None of the above.
39. Which of the following is a quality control chart that is plotted using the variability of individual characteristics of the output of a process?
- Scatter diagram
 - Histogram
 - R chart
 - p chart
 - $\bar{X}$ chart.
40. Which of the following techniques enables us to test whether means of more than two populations are equal?
- Analysis of variance
 - Chi-square test
 - Decision tree analysis
 - Marginal analysis
 - Correlation analysis.

END OF SECTION A

Section B : Problems (60 Points)

- This section consists of questions with serial number 41 - 84.
- Answer all questions.
- Points are indicated against each question.

41. For a binomial experiment, the standard deviation of the distribution of the number of successes is 3.6 and the probability of success is 0.4. What is the mean of the distribution of the number of successes?

- a. 1.44
- b. 3.60
- c. 6.00
- d. 12.96
- e. 21.60

(1 point)

42. The possible returns from a security are given below:

Return (%)	-5	8	12	16
Probability (%)	10	20	40	30

What is the expected return from the security?

- a. 10.20%
- b. 10.70%
- c. 11.40%
- d. 12.30%
- e. 13.40%

(1 point)

43. The variances of variables, X and Y, are 49 and 16 respectively, and the covariance between them is 14. What is the coefficient of correlation between X and Y?

- a. 0.2857
- b. 0.50
- c. 0.875
- d. 0.05
- e. Cannot be determined.

(1 point)

44. A fund manager's index of optimism is 0.6 and, the maximum and minimum profits from a portfolio are Rs.20,000 and Rs.3,000 respectively. According to Hurwicz criterion, how much profit from this portfolio will be considered?

- a. Rs.13,200
- b. Rs.13,800
- c. Rs.15,000
- d. Rs.18,000
- e. Cannot be determined.

(1 point)

45. The population variance is 576 and the size of a sample taken from the population is 36. What is the standard error of mean?

a. 0.67
b. 1.50
c. 4.00
d. 16.00
e. 96.00.

(1 point)

46. For a simple linear regression equation $\sum (Y - \hat{Y})^2 = 256$ and the standard error of estimate is 4. What is the number of observations?

a. 4
b. 12
c. 16
d. 18
e. 24.

(1 point)

47. The regression relationship between the variables X and Y is given by $\hat{Y} = 4 + 5X$ and, it explains 64% of the changes in the variable Y. What is the coefficient of correlation between X and Y?

a. -0.80
b. 0.80
c. 0.08
d. -0.08
e. 0.64.

(1 point)

48. The error sum of squares for a multiple regression equation with 3 independent variables, is 1024. If the number of observations is 68 then, what is the standard error of estimate?

a. 3.88
b. 4.00
c. 5.02
d. 15.06
e. 45.18.

(1 point)

49. For a basket of commodities, Laspeyres price index is 121 and Paasches price index is 169. What is Fisher's ideal price index for the same basket of commodities?

a. 130
b. 135
c. 143
d. 145
e. 150.

(1 point)

50. Zardine India actually sold 72,000 cars in the year 2002 against the estimated 64,000 cars for the same year according to the secular trend equation. What is the percent of trend measure for the year 2002?

- a. 88.89
- b. 112.50
- c. 120
- d. 125
- e. 136.

(1 point)

Questions 51 – 53 are based on the following information:

Pioneer Bank has observed that 70% of its borrowers pay their loan installments regularly. It is assumed that the loan accounts are independent of each other. The manager of the bank has randomly selected 6 loan accounts.

51. What is the probability that **at least** four out of the six borrowers are paying their loan installments regularly?

- a. 74.43%
- b. 85.10%
- c. 90.20%
- d. 92.95%
- e. 96.82%

(2 points)

52. What is the probability that **maximum** two out of the six borrowers are paying their loan installments regularly?

- a. 1.02%
- b. 1.10%
- c. 7.05%
- d. 18.52%
- e. 25.57%

(2 points)

53. What is the probability that **exactly** three out of the six borrowers are paying their loan installments regularly?

- a. 18.52%
- b. 25.57%
- c. 74.43%
- d. 85.10%
- e. 96.82%

(1 point)

Questions 54 – 60 are based on the following information:

The manager of a movie theatre in Hyderabad, Dreams, has observed that a certain hit movie has been shown for an average number of 49 days in various movie theatres in the rest of the state with a standard deviation of 6 days. The manager wants to check the popularity of the movie at Hyderabad and, has taken a random sample of 12 movie theatres out of 50 movie theatres in which that movie has been shown. He has found out that the movie has been shown for an average number of 46 days. It is to be tested whether the popularity of the movie at Hyderabad is significantly less than its popularity in the rest of the state, at a 1% significance level.

54. Which of the following correctly represent the null and alternative hypotheses for testing whether the mean observed period of showing the movie at Hyderabad is significantly less than the mean observed period in the rest of the state?

- I. $H_0 : \mu = 46$
- II. $H_1 : \mu = 46$
- III. $H_0 : \mu = 49$
- IV. $H_1 : \mu < 49$

- a. Both (I) and (II) above
- b. Both (II) and (III) above
- c. Both (III) and (IV) above
- d. Both (I) and (IV) above
- e. Both (II) and (IV) above.

(1 point)

55. The standard error of mean is

- a. 0.500
- b. 1.525
- c. 1.615
- d. 1.732
- e. 1.850

(1 point)

56. The probability distribution which is required for the hypothesis test is

- a. t distribution
- b. Normal distribution
- c. F distribution
- d. Chi-square distribution
- e. Binomial distribution.

(1 point)

57. The standardized value of the sample mean is approximately

- a. -6.00
- b. -1.97
- c. -1.86
- d. -1.732
- e. 1.97

(1 point)

58. The critical value for the test at 1% significance level is

- a. -2.32
- b. -2.15
- c. 2.20
- d. 2.32
- e. 2.45

(1 point)

59. What is the location of the rejection region in the probability distribution?

- a. The entire area to the left of the mean
- b. The entire area to the right of the mean
- c. Under both the tails
- d. Under the left tail
- e. Under the right tail.

(1 point)

60. At a 1% significance level, it can be said that the

- a. Sample statistic is incorrect
- b. Population standard deviation is incorrect
- c. Null hypothesis is accepted
- d. Null hypothesis is rejected
- e. Null hypothesis is true.

(1 point)

Questions 61 – 64 are based on the following information:

Softtech Solutions Ltd. has recorded the following levels of return on equity (ROE) over the last six years:

Year	1998	1999	2000	2001	2002
ROE (%)	15	19	21	27	35

A second degree estimating equation of the form $Y = a + bx + cx^2$, is required to be formulated for estimating the ROE for a given year. The time variable (X) has to be coded as $(x = X - \bar{X})$.

61. The 'b' coefficient of the estimating equation is approximately

- a. 1.2
- b. 2.4
- c. 3.6
- d. 4.8
- e. 5.4.

(2 points)

62. The 'a' coefficient of the estimating equation is approximately

- a. 4.8
- b. 8.6
- c. 12.25
- d. 16.56
- e. 21.69.

(2 points)

63. The 'c' coefficient of the estimating equation is approximately

- a. 0.857
- b. 1.125
- c. 2.250
- d. 3.126
- e. 4.196.

(2 points)

64. The estimated return on equity for the year 2003 is approximately

- a. 37.5%
- b. 40.36%
- c. 43.80%
- d. 45.25%
- e. 50.65%.

(1 points)

Questions 65 – 68 are based on the following information:

The advertisement expenditure and the sales of Magna Products Ltd. for the last six years, are given below:

(Rs. in lakh)

Advertisement expenditure	37	63	60	88	80	73
Sales	480	540	590	870	630	790

An estimating equation to predict sales from advertisement expenditure has to be formulated using the simple regression technique.

65. The slope of the estimating equation will be

- a. 3.252
- b. 4.186
- c. 6.120
- d. 6.928
- e. 7.236

(2 points)

66. The intercept of the estimating equation will be

- a. 6.928
- b. 69.285
- c. 120.560
- d. 186.979
- e. 228.462

(1 point)

67. If the advertisement expenditure is Rs.78 lakh then the estimated sales will be

- a. Rs.601.354 lakh
- b. Rs.650.246 lakh
- c. Rs.727.363 lakh
- d. Rs.752.624 lakh
- e. Rs.787.265 lakh

(1 point)

68. The standard error of estimate for the estimating equation will be

- a. Rs.26.356 lakh
- b. Rs.45.219 lakh
- c. Rs.55.126 lakh
- d. Rs.75.113 lakh
- e. Rs.94.449 lakh

(2 points)

Questions 69 – 77 are based on the following information:

Fortune Industries Ltd. used three different methods to train its new employees. The number of units of output produced per hour by different employees trained by one of the three training methods are given below:

Method A	50	45	55	44		
Method B	64	48	52	56	44	
Method C	46	42	48	45	57	42

It has to be tested whether the three different training methods lead to different levels of productivity. The significance level of the test is 5 percent.

69. Which of the following is/are the null and alternative hypotheses for testing whether the mean number of units produced per hour is different for the three different training methods?

- I. $H_0: \mu_A = \mu_B = \mu_C$
- II. $H_0: \mu_A \neq \mu_B \neq \mu_C$
- III. $H_1: \mu_A, \mu_B$ and μ_C are not all equal
- IV. $H_1: \mu_A = \mu_B = \mu_C$

- a. Both (I) and (III) above
- b. Both (I) and (II) above
- c. Both (I) and (IV) above
- d. Both (II) and (III) above
- e. Both (III) and (IV) above.

(1 point)

70. The estimate of the population variance on the basis of the variance among the sample means is

- a. 45.25
- b. 48.36
- c. 52.58
- d. 55.65
- e. 57.25

(2 points)

71. The variance of the number of units produced per hour for employees who have been trained by method A is

- a. 20.25
- b. 25.67
- c. 28.26
- d. 30.75
- e. 33.65

(1 point)

72. The variance of the number of units produced per hour for employees who have been trained by method B is

- a. 25.67
- b. 31.07
- c. 45.28
- d. 59.20
- e. 63.24

(1 point)

73. The variance of the number of units produced per hour for employees who have been trained by method C is

- a. 20.25
- b. 25.67
- c. 31.07
- d. 45.28
- e. 59.20

(1 point)

74. The estimate of the population variance on the basis of the variance within the samples is

- a. 25.67
- b. 31.07
- c. 38.646
- d. 39.097
- e. 59.20.

(1 point)

75. The F ratio for the samples is

- a. 0.80
- b. 1.345
- c. 1.54
- d. 1.75
- e. 2.01

(1 point)

76. For a significance level of 5 percent, the critical value of F ratio is

- a. 1.194
- b. 2.025
- c. 2.512
- d. 3.525
- e. 3.89

(1 point)

77. At a significance level of 5 percent it can be said that the

- a. Sample data are incorrect
- b. Sample means are incorrect
- c. Null hypothesis is accepted
- d. Null hypothesis is rejected
- e. Sample F ratio is incorrect.

(1 point)

78. A wholesaler of food grains wants to know the overall change in prices of the commodities he deals in. The following data are provided by him:

Commodity	Year			
	1996		2002	
	Price (Rs./Kg.)	Quantity (Kg.)	Price (Rs./Kg.)	Quantity (Kg.)
Wheat	7.50	5000	10.25	4800
Rice	10.00	6000	14.00	5500
Pulses	25.00	3000	28.00	3500
Sugar	10.60	3000	14.50	2400
Salt	2.60	500	4.50	600

Fisher's ideal price index for the basket of commodities, for the year 2002 considering the year 1996 as the base year, is

- 126.28
- 127.35
- 128.12
- 129.00
- 130.25.

(2 points)

Questions 79 – 80 are based on the following information:

A survey was conducted in a city, on the retail prices of a specific type of mangoes. At a confidence level of 95 percent it was estimated that the mean retail price of the fruit fell between Rs.25.50 per kg and Rs.27.46 per kg. The number of retail fruit merchants sampled was 36 and less than 5 per cent of the population of the retail fruit merchants in the city were sampled.

79. The mean price per kg of the fruit for the sample, is

- Rs.25.50
- Rs.26.48
- Rs.27.46
- Rs.28.75
- Rs.29.50.

(2 points)

80. The standard deviation of the price per kg of the fruit for the sample, is

- Re.0.50
- Re.1.00
- Rs.1.50
- Rs.3.00
- Rs.6.00

(2 points)

81. The manager of Food Fun, a fast food shop, is deliberating on the number of pieces of a popular snack, "Double Delight," to prepare for the evening. Each piece of "Double Delight" costs Rs.10 to prepare and is sold at Rs.16. The item is prepared and sold only during the evenings. Any unsold pieces cannot be stored because the item is highly perishable. The manager of the shop has provided the following data on the sales of the item over the past 200 days:

Number of pieces sold	No. of days
150	10
151	20
152	30
153	60
154	40
155	24
156	16

It is assumed that in future, the demand for the item can assume only one of the aforementioned values. What is the optimal number of pieces of the item that should be prepared for the evening so that the profit is maximum?

- 150
- 151
- 152
- 153
- 156.

(3 points)

Questions 82 – 83 are based on the following information:

An investment manager has identified three portfolios represented as X, Y and Z for investment. Investment has to be made in only one of the three portfolios. According to his assessment, three states of nature are possible during the period of holding the investment, which will lead to different gains in rupee-terms. The following table provides the information on the monetary gains from each portfolio under the three states of nature along with the probabilities of occurrence of the three states of nature:

Portfolio	States of nature		
	S_1	S_2	S_3
	$P(S_1) = 0.25$	$P(S_2) = 0.40$	$P(S_3) = 0.35$
X	Rs.1,00,000	Rs.2,50,000	Rs.-50,000
Y	Rs.-40,000	Rs.1,50,000	Rs.2,00,000
Z	Rs.4,00,000	Rs.-50,000	Rs.1,00,000

82. According to the expected value criterion, in which portfolio should the investment be made?

- X
- Y
- Z
- Either of the three portfolios
- None of the portfolios.

(1 point)

83. What is the maximum amount that the investment manager may spend in order to obtain further information from extremely reliable sources, which will remove all the uncertainties affecting his investment decision?

- Rs. 25,000
- Rs. 62,500
- Rs.1,20,000
- Rs.1,50,000
- Rs.2,70,000.

(2 points)

84. A management consultant has collected the following data on the sales and advertising expenses of eight firms in the apparell industry:

Sales (Rs. in crore)	52	52	57	62	67	58	56	60
Advertising expenses (Rs. in crore)	11	13	16	17	18	14	15	16

Approximately what percentage of the variation in sales is explained by the variation in advertising expenses?

- a. 40%
- b. 50%
- c. 64%
- d. 81%
- e. 90%.

(3 points)

END OF SECTION B

Suggested Answers

Quantitative Methods – II (132) : April 2003

Section A : Basic Concepts

1. Answer : (d)
Reason : A continuous random variable is one which can assume any value within a given range. The values that may be assumed by such a variable are not restricted to integers, even values, odd values or any other limited number of values.
2. Answer : (d)
Reason : The expected value of a random variable is not a prediction for the value that the random variable will assume. It is a measure of central tendency for the random variable and it is the mean of the probability distribution of the random variable. It is the weighted mean of the values of the random variable; the probabilities of the various possible values of the random variable are used as weights.
3. Answer : (c)
Reason : In a Bernoulli process the probability of outcome of any trial remains constant over time. A Bernoulli process is related with a discrete random variable and each trial of the process has exactly two outcomes. Moreover the outcomes of the trials are independent of each other.
4. Answer : (c)
Reason : The normal distribution is a symmetrical distribution. It is a continuous distribution; it is unimodal; its mean, median and mode are equal; and its tails extend indefinitely without touching the horizontal axis.
5. Answer : (d)
Reason : Standardizing a normal variable means converting the variable into a standard normal variable. It does not mean finding out the central tendency of the values of the variable or finding out the dispersion of the values of the variable or expressing the values of the variable as percentages of their means or finding out the coefficient of variation for the possible values of the variable.
6. Answer : (e)
Reason : When decisions are made under conditions of risk, the decision maker is well aware about all the possible future states of nature and can assign probabilities of occurrence to the various states of nature. But he/she is not completely certain regarding the occurrence of any particular state.
7. Answer : (e)
Reason : Under uncertain conditions, a decision maker may use any of the given criteria depending on the nature of the decision maker. e.g. maximax criterion for an optimistic person, maximin for a pessimistic person, Hurwicz criterion for subjective judgement and regret criterion by considering the relevant opportunity cost.
8. Answer : (a)
Reason : An optimistic decision maker uses the maximax criterion under uncertain conditions.
9. Answer : (d)
Reason : The expected value of perfect information (EVPI) is the difference between the expected profit with perfect information and maximum expected profit without perfect information. All the other alternatives do not define EVPI correctly.
10. Answer : (c)
Reason : In marginal analysis, the minimum required probability of selling an additional unit, that justifies stocking of that additional unit, decreases if the marginal profit increases. This statement can be justified through the following relationship $p^* = \frac{ML}{ML + MP}$
11. Answer : (b)

Reason : In simple random sampling, each possible sample has an equal chance of being included in the sample as the items are drawn at random. But in the other sampling processes, that technique is not followed as the selection is made on the basis of certain criteria, apart from random process.

12. Answer : (e)

Reason : In cluster sampling and stratified sampling techniques, the population is divided into several groups from where the samples are drawn. But in simple random sampling, the samples are drawn at random while in systematic sampling, a systematic plan is followed for the selection of the samples from any population (the population is not divided into groups). So the alternative (e) is correct.

13. Answer : (a)

Reason : A type II error occurs in hypothesis testing when the null hypothesis is false and accepted.

14. Answer : (b)

Reason : In a standard normal distribution, mean is equal to zero.

15. Answer : (d)

Reason : There is a different t distribution for different degrees of freedom. The degree of freedom is dependent on the sample size. Hence, there is a different t distribution for different sample sizes.

16. Answer : (b)

Reason : Standard error of mean is defined as $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$. This implies that, as the sample size increases, the standard error of mean decreases.

17. Answer : (a)

Reason : The sampling distribution of mean is a distribution of all possible means for samples of a given size taken from the same population. The conditions mentioned in the other alternatives are not true in this context. So, the alternative (a) is correct.

18. Answer : (e)

Reason : The finite population correction factor is used for calculating the standard error of mean when the population is finite and sampling is done without replacement. The other alternatives state incorrect purposes for using the finite population correction factor. So (e) is the correct alternative.

19. Answer : (b)

Reason : The finite population correction factor is $\sqrt{\frac{N-n}{N-1}}$

$\therefore$ As the sample size n increases, the finite population correction factor decreases.

20. Answer : (e)

Reason : Here, the alternative hypothesis will be $H_1: \mu_2 < \mu_1$; that may be written as $H_1: \mu_1 - \mu_2 > 0$

21. Answer : (b)

Reason : In any right tailed test of hypothesis, the rejection region lies under the right tail. So the alternative (b) is correct.

22. Answer : (c)

Reason : The standard error of estimate for any regression equation is given by:

$$S_e = \sqrt{\frac{\sum (y - \hat{y})^2}{n - 2}} \text{ where}$$

y = Observed values of the dependent variable

$\hat{y}$ = Estimated values from the estimating equation that correspond to each Y value and

n = Number of data points.

23. Answer : (b)

Reason : The dependent variable decreases as the independent variable increases in an estimating equation signifies that there is a negative nature of association between the two variables. Hence the correlation co-efficient will be negative and will lie in the range of 0 to -1.00 (because correlation coefficient cannot be less than -1).

24. Answer : (a)

Reason : Coefficient of determination represents the proportion of variation in the dependent variable that is explained by the regression line. Coefficient of correlation signifies the nature of association between two variables. Coefficient of variation states the extent of variability in a set of data points. Standard error of estimate measures the variability of the observed values around the regression line. So the alternative (a) is correct.

25. Answer : (a)

Reason : The coefficient of determination is always positive because it is the square of the coefficient of correlation. Since the coefficient of correlation is a real number, the coefficient of determination must be positive.

26. Answer : (b)

Reason : If the regression equation is a perfect estimator of the dependent variable, then the following are possible:

- i. The standard error of estimate is zero as $\sum (y - \hat{y})^2 = 0$.
- ii. The coefficient of determination is 1.00 as the coefficient of correlation is either +1.00 or -1.00.
- iii. Naturally, all the data points must lie on the regression line.

Hence, the alternative (b) is correct.

27. Answer : (c)

Reason : The standard error of estimate for any regression equation is given by $s_e = \sqrt{\frac{\sum (y - \hat{y})^2}{n - 2}}$

That represents the extent to which the observed values of the dependent variable differ from the predicted values according to the regression line. The factors mentioned in the other alternatives do not represent that fact. So the alternative (c) is correct.

28. Answer : (e)

Reason : The coefficient of correlation is defined as $r = \frac{\text{cov}(x, y)}{\sigma_x \cdot \sigma_y}$

Now, $\text{cov}(x, y) > 0$ and the standard deviation is the positive square root of variance. $\therefore r > 0$ and hence $0 < r \leq 1$ (because r cannot be more than 1).

29. Answer : (c)

Reason : Any multiple regression equation consists of only one dependent variable and more than one independent variables.

30. Answer : (e)

Reason : For a given number of data points, 'n', and a given number of independent variables, k, the degrees of freedom of a multiple regression equation is equal to $n - k - 1$

31. Answer : (c)

Reason : For a multiple regression relationship, the problem of multicollinearity arises when there is a high correlation between the independent variables. The other alternatives are the incorrect interpretations of multicollinearity.

32. Answer : (a)

Reason : In any quantity index, prices are used as weights. It is evident from the index numbers designed

by Laspeyres, Paasche, Fisher, and Marshall – Edgeworth

33. Answer : (c)

Reason : The value index, an aggregate of all values, measures the changes in values in the base year and the values in the given year. It can be calculated by using the following formulae

$$\frac{\sum P_1 Q_1}{\sum P_0 Q_0} \times 100$$

i.e. It measures the change in total monetary worth. So, the alternative (c) is correct.

34. Answer : (a)

Reason : Unweighted aggregates price index can be calculated by $\frac{\sum P_1}{\sum P_0} \times 100$ which is the ratio of the

sum of the current year prices to the sum of the base year prices. It is neither Laspeyre's price

index $\left(\frac{\sum P_1 Q_0}{\sum P_0 Q_1} \times 100 \right)$, nor Fisher's ideal price index (the geometric mean of the Laspeyre's

and Paasche's price indices). So, the alternative (a) is correct.

35. Answer : (a)

Reason : The weighted average of relatives price index with the base year values used as weights, can be readily compared because the weights in the base year and current year remain the same (and for every year the same weights are used).

36. Answer : (b)

Reason : The weighted average of relatives price index calculated by using the base year values as weights is given by:

$$\frac{\sum \left\{ \left(\frac{P_1}{P_0} \times 100 \right) \times P_0 Q_0 \right\}}{\sum P_0 Q_0} = \frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times 100$$

which is same as Laspeyres price index.

37. Answer : (a)

Reason : The long term movement of a variable is represented by the secular trend. But cyclical fluctuation indicates the pattern of business cycles experienced by any economy or industry that is generally for a short term. Seasonal variation is observed in a variable under consideration during certain months in the successive years. Lastly, irregular variation occurs randomly. Hence the alternative (a) is correct.

38. Answer : (b)

Reason : Seasonal variation is studied by using the ratio to moving average method. In none of the other time series stated, data is studied by using this method. So the alternative (b) is correct.

39. Answer : (c)

Reason : The variability of the individual characteristics of the output of a process is plotted in a R chart. While p chart shows the proportion of data points that satisfies a given attribute and in $\bar{x}$ charts, the observed sample means of the output are plotted against the time variable. The scatter diagram reveals the nature of association between two variables in bi-variate data. Grouped data are presented in a histogram. So the alternative (c) is correct.

40. Answer : (a)

Reason : Analysis of variance can be used to test whether means of more than two populations are equal. No other techniques, mentioned in the other alternatives, can be applied in this respect. So the alternative (a) is correct.

Section B : Problems

41. Answer : (e)

Reason : Here, $p = 0.4 \therefore q = 0.6$

Standard deviation (s) = 3.6

$$\therefore \text{Variance} = s^2 = npq = 3.6^2$$

$$\therefore \text{Mean} = np = \frac{npq}{q} = \frac{3.6^2}{0.6} = 21.6$$

42. Answer : (b)

Reason : The expected return = $(-5) \times 0.10 + 8 \times 0.20 + 12 \times 0.4 + 16 \times 0.3 = 10.70$ percent.

43. Answer : (b)

Reason : The coefficient of correlation between x and y = $\frac{\text{Cov}(x,y)}{\sqrt{v(x)} \cdot \sqrt{v(y)}} = \frac{14}{\sqrt{49 \times 16}} = 0.5$

44. Answer : (a)

Reason : According to Hurwicz criterion, profit from this portfolio

$$= 20,000 \times 0.6 + 3,000 \times 0.4 = \text{Rs.} 13,200.$$

45. Answer : (c)

Reason : Variance = $\sigma^2 = 576$

$$\therefore \sigma = \sqrt{576} = 24$$

The standard error of mean is $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{24}{\sqrt{36}} = 4.00$

46. Answer : (d)

Reason : For any simple linear regression equation, the standard error of estimate =

$$\sqrt{\frac{\sum (y - \hat{y})^2}{n - 2}} = 4.00$$

$$\text{So, } \frac{\sum (y - \hat{y})^2}{n - 2} = 16 \text{ i.e. } n - 2 = \frac{256}{16}$$

Or, $n = 18$.

47. Answer : (b)

Reason : Coefficient of determination = $r^2 = \frac{64}{100} = 0.64$

$$\therefore \text{Coefficient of correlation} = \sqrt{r^2} = \sqrt{0.64} = 0.8$$

Since the regression equation has a positive slope the coefficient of correlation is positive.

48. Answer : (b)

Reason : For any multiple regression, the standard error of estimate =

$$\sqrt{\frac{\sum (y - \hat{y})^2}{n - k - 1}} = \sqrt{\frac{1024}{68 - 3 - 1}}$$

$$= \sqrt{\frac{1024}{64}} = \sqrt{16} = 4.00$$

49. Answer : (c)

Reason : Laspeyres price index (L) = 121 and Paasches price index (P) = 169. $\therefore$ Fisher's ideal price

$$\text{index will be} = \sqrt{L \times P} = \sqrt{121 \times 169} = 143$$

50. Answer : (b)

$$\text{Reason : The percent of trend measure} = \frac{y}{\hat{y}} \times 100 = \frac{72,000}{64,000} \times 100 = 112.50$$

51. Answer : (a)

Reason : The probability that a client is regularly paying the loan installments is 0.70.

The probability that at least 4 out of the six borrowers pay their loan installments regularly

$$\begin{aligned} &= {}^6C_4 (0.7)^4 \cdot (0.3)^2 + {}^6C_5 (0.7)^5 \cdot (0.3) + {}^6C_6 (0.7)^6 \\ &= 15 \times (0.7)^4 \cdot (0.3)^2 + 6 \times (0.7)^5 \times 0.3 + (0.7)^6 \\ &= 0.7443 \text{ i.e. } 74.43\% \end{aligned}$$

52. Answer : (c)

Reason : The probability that maximum 2 out of the six borrowers pay their loan installments regularly

$$\begin{aligned} &= {}^6C_0 (0.7)^0 \cdot (0.3)^6 + {}^6C_1 (0.7)^1 \times (0.3)^5 + {}^6C_2 \times (0.7)^2 \times (0.3)^4 \\ &= 1 \times 1 \times (0.3)^6 + 6 \times 0.7 \times (0.3)^5 + 15 \times (0.7)^2 \times (0.3)^4 \\ &= 0.07047 \text{ i.e. } 7.05\% \end{aligned}$$

53. Answer : (a)

Reason : The probability that exactly three out of the six borrowers pay their loan installments regularly

$$= {}^6C_3 \times (0.7)^3 \times (0.3)^3 = 0.18522 \text{ i.e. } 18.52\%$$

54. Answer : (c)

Reason : $H_0 : \mu = 49$

$H_1 : \mu < 49$.

55. Answer : (b)

$$\begin{aligned} \text{Reason : Standard error of mean, } \sigma_{\bar{x}} &= \frac{\sigma}{\sqrt{n}} \sqrt{\frac{N-n}{N-1}} \\ &= \frac{6}{\sqrt{12}} \times \sqrt{\frac{50-12}{50-1}} = 1.525 \end{aligned}$$

56. Answer : (b)

Reason : The standard deviation of the population is known. Hence the normal distribution is the appropriate distribution.

57. Answer : (b)

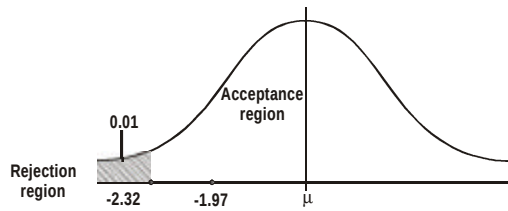
$$\text{Reason : The standardised value of the sample mean, } z = \frac{\bar{x} - \mu}{\sigma_{\bar{x}}} = \frac{46 - 49}{1.525} = -1.97$$

58. Answer : (a)

Reason : From the standard normal table it can be seen that the critical z value for an area approximately 0.49 to the left of the mean is -2.32.

59. Answer : (d)

Reason :



The rejection region lies under the left tail.

60. Answer : (c)

Reason : At a 1% significance level it can be said that the null hypothesis is accepted because the standardized value of the sample mean falls in the acceptance region.

61. Answer : (d)

Reason : Let the estimated equation be

$$Y = a + bx + cx^2$$

The values of a, b, and c can be obtained from the following equations

$$\sum Y = na + c \sum x^2 \quad \text{-----1}$$

$$\sum x^2 Y = a \sum x^2 + c \sum x^4 \quad \text{-----2}$$

$$b = \frac{\sum xY}{\sum x^2} \quad \text{----- 3}$$

Y	X	$X - \bar{X} = x$	x^2	x^4	xY	x^2Y
15	1998	-2	4	16	-30	60
19	1999	-1	1	1	-19	19
21	2000	0	0	0	0	0
27	2001	1	1	1	27	27
35	2002	2	4	16	70	140
117		0	10	34	48	246

$$\bar{X} = \frac{10,000}{5} = 2,000$$

From the equation (3), we get $b = 48 / 10 = 4.8$

62. Answer : (e)

Reason : Given below

63. Answer : (a)

Reason : From the equations 1 and 2 we get,

$$117 = 5a + 10c \quad \text{.....(1)}$$

$$246 = 10a + 34c \quad \text{.....(2)}$$

Multiplying equation 1 by 2 and subtracting equation 2 from it:

$$\begin{array}{r} 10a + 20c = 234 \\ 10a + 34c = 246 \\ \hline -14c = -12 \end{array}$$

$$\therefore c = \frac{12}{14} = 0.857 \quad (\text{Ans 63})$$

$$\therefore 10a + 20(0.857) = 234$$

$$\text{or, } 10a = 234 - 17.14$$

$$\text{or } 10a = 216.86$$

$$\therefore a = \frac{216.86}{10} = 21.69 \text{ approx (Ans 62)}$$

The estimating equation will be $Y = 21.69 + 4.8x + 0.857x^2$

64. Answer : (c)

Reason : The estimated return on equity for the year 2003 will be:

$$X = 2003 \therefore x = 2003 - 2000 = 3$$

$$Y = 21.69 + 4.8 \times 3 + 0.857 \times 9$$

$$\text{or, } Y = 43.803 \approx 43.80$$

$\therefore$ The return on equity for the year 2003 = 43.80%.

65. Answer : (d)

Reason : Let the following notations be used:

X = Advertisement expenditure

Y = Sales

$$\hat{Y} = a + bX$$

$$b = \frac{n \sum XY - \sum X \sum Y}{n \sum X^2 - (\sum X)^2}$$

$$\sum XY = 2,71,810 \quad \sum X = 401 \quad \sum Y = 3,900$$

$$\sum X^2 = 28,411 \quad n = 6$$

$$b = \frac{6(2,71,810) - (401)(3,900)}{6(28,411) - (401)^2} = \frac{66,960}{9,665} = 6.928$$

66. Answer : (d)

$$\text{Reason : } a = \bar{Y} - b\bar{X} = \left(\frac{3,900}{6} \right) - 6.928 \left(\frac{401}{6} \right) = 186.979$$

67. Answer : (c)

$$\text{Reason : For } X=78, \hat{Y} = 186.979 + (6.928 \times 78) = \text{Rs.}727.363 \text{ lakh}$$

68. Answer : (e)

$$\text{Reason : Standard error of estimate, } s_e = \sqrt{\frac{\sum Y^2 - a \sum Y - b \sum XY}{n - 2}}$$

$$\sum Y^2 = 26,48,000 \quad \sum Y = 3,900 \quad \sum XY = 2,71,810$$

$$n = 6 \quad a = 186.979 \quad b = 6.928$$

$$\therefore s_e = \sqrt{\frac{26,48,000 - (186.979 \times 3,900) - (6.928 \times 2,71,810)}{6 - 2}} = \text{Rs.}94.449 \text{ lakh.}$$

69. Answer : (a)

Reason : The statements of the hypothesis are as follows:

$$H_0 : \mu_A = \mu_B = \mu_C$$

$H_1 : \mu_A, \mu_B \text{ and } \mu_C \text{ are not all equal.}$

70. Answer : (c)

Reason : The observations are stated in the following table:

Methods	Observations						Sum	Mean
A	50	45	55	44			194	48.5
B	64	48	52	56	44		264	52.80
C	46	42	48	45	57	42	280	46.67

$$\text{Grand mean} = \frac{194 + 264 + 280}{15} = 49.20 = \bar{X}$$

The estimate of the population variance on the basis of the variance among the sample means

$$= \hat{\sigma}_1^2 = \frac{1}{2} \{4x(48.5 - 49.2)^2 + 5(52.8 - 49.2)^2 + 6x(46.67 - 49.2)^2\}$$

$$\hat{\sigma}_1^2 = \frac{1}{2} \{4x0.49 + 12.96x5 + 6.4009x6\} = 52.58$$

71. Answer : (b)

Reason : Variance of the number of units produced per hour by employees who have been trained by method A,

$$\sigma_A^2 = \frac{1}{n_A - 1} \sum (x_{Ai} - \bar{x}_A)^2$$

$$n_A = 4 \text{ and } \bar{x}_A = 48.5$$

$$\begin{aligned} \text{Now, } \sum (x_{Ai} - \bar{x}_A)^2 &= (50 - 48.5)^2 + (45 - 48.5)^2 + (55 - 48.5)^2 + (44 - 48.5)^2 \\ &= (2.25 + 12.25 + 42.25 + 20.25) = 77 \end{aligned}$$

$$\text{So, } \sigma_A^2 = \frac{77}{4-1} = 25.67$$

72. Answer : (d)

Reason : Variance of the number of units produced per hour by employees who have been trained by method B,

$$\sigma_B^2 = \frac{1}{n_B - 1} \sum (x_{Bi} - \bar{x}_B)^2$$

$$n_B = 5 \text{ and } \bar{x}_B = 52.8$$

$$\begin{aligned} \sum (x_{Bi} - \bar{x}_B)^2 &= (64 - 52.8)^2 + (48 - 52.8)^2 + (52 - 52.8)^2 + (56 - 52.8)^2 + (44 - 52.8)^2 \\ &= 125.44 + 23.04 + 0.64 + 10.24 + 77.44 = 236.80 \end{aligned}$$

$$\text{So, } \sigma_B^2 = \frac{236.80}{4} = 59.20$$

73. Answer : (c)

Reason : Variance of the number of units produced per hour by employees who have been trained by method C,

$$\sigma_C^2 = \frac{1}{n_C - 1} \sum (x_{Ci} - \bar{x}_C)^2$$

$$n_C = 6 \text{ and } \bar{x}_C = \frac{280}{6} = 46.67$$

$$\begin{aligned} \text{Now, } \sum (x_{Ci} - \bar{x}_C)^2 &= (46 - 46.67)^2 + (42 - 46.67)^2 + (48 - 46.67)^2 + (45 - 46.67)^2 \\ &\quad + (57 - 46.67)^2 + (42 - 46.67)^2 \end{aligned}$$

$$= 0.44 + 21.81 + 1.77 + 2.79 + 106.71 + 21.81 = 155.33$$

$$\text{So, } \sigma_c^2 = \frac{155.33}{5} = 31.07$$

74. Answer : (d)

Reason : The estimate of the population variance on the basis of the variance within the samples =

$$\hat{\sigma}_2^2 = \sum \left(\frac{n_j - 1}{n_T - k} \right) s_j^2 = \frac{1}{15 - 3} \{25.67 \times 3 + 59.20 \times 4 + 31.07 \times 5\} = 39.097$$

75. Answer : (b)

Reason : The F ratio for the sample = $\frac{\hat{\sigma}_1^2}{\hat{\sigma}_2^2} = \frac{52.58}{39.097} = 1.345$ where the degrees of freedom are 2 and 12 for the numerator and denominator respectively.

76. Answer : (e)

Reason : The number of degrees of freedom for the numerator of the F ratio =

$$\text{Number of samples} - 1 = 3 - 1 = 2.$$

The number of degrees of freedom for the denominator of the F ratio =

$$n_T - k = 15 - 3 = 12.$$

The corresponding $F_{2,12}$ value at 5% level of significance obtained from the F table (critical value) = 3.89.

77. Answer : (c)

Reason : Since $3.89 > 1.345$ the F ratio for the samples falls in the acceptance region. Hence the null hypothesis is accepted.

78. Answer : (c)

$$\text{Reason : Fisher's ideal price index} = \sqrt{\frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times \frac{\sum P_1 Q_1}{\sum P_0 Q_1}} \times 100$$

$$\sum P_1 Q_0 = (10.25 \times 5000) + (14.00 \times 6000) + (28.00 \times 3000) + (14.50 \times 3000) + (4.50 \times 500) = 265000$$

$$\sum P_1 Q_1 = (10.25 \times 4800) + (14.00 \times 5500) + (28.00 \times 3500) + (14.50 \times 2400) + (4.50 \times 600) = 261700$$

$$\sum P_0 Q_0 = (7.5 \times 5000) + (10.00 \times 6000) + (25.00 \times 3000) + (10.60 \times 3000) + (2.60 \times 500) = 205600$$

$$\sum P_0 Q_1 = (7.5 \times 4800) + (10.00 \times 5500) + (25.00 \times 3500) + (10.60 \times 2400) + (2.60 \times 600) = 205500$$

$$\therefore \text{Fisher's ideal price index} = \sqrt{\frac{265000}{205600} \times \frac{261700}{205500}} \times 100 = 128.12 \text{ (approx.)}$$

79. Answer : (b)

Reason : The sample size is greater than 30 and the standard deviation of population is not known. Hence the appropriate distribution applicable is the normal distribution. A confidence interval of 95 per cent implies that 0.475 of the area of the normal curve is covered on either side of the sample mean. From the normal distribution table it is found that the appropriate z-value is 1.96.

$$\bar{x} = ? \quad s = ? \quad \hat{\sigma}_{\bar{x}} = ?$$

For the given confidence interval :

$$\text{Lower limit} = \text{Rs. 25.50 per kg}$$

$$\text{Upper limit} = \text{Rs. 27.46 per kg.}$$

$$\therefore \bar{x} - 1.96 \hat{\sigma}_{\bar{x}} = 25.50 \quad \text{(A)}$$

$$\bar{x} + 1.96 \hat{\sigma}_{\bar{x}} = 27.46 \quad \text{(B)}$$

Adding equations (A) and (B) we get :

$$2\bar{x} = 52.96$$

$$\text{or } \bar{x} = 26.48 \text{ (Rs. per kg.)}$$

$$\therefore \text{Mean price of the sample} = \text{Rs.26.48 per kg}$$

80. Answer : (d)

Reason : Subtracting equation (A) from equation (B) we get :

$$3.92 \hat{\sigma}_{\bar{x}} = 1.96$$

$$\therefore \hat{\sigma}_{\bar{x}} = \frac{1.96}{3.92} = 0.50 \text{ (Rs. per kg)}$$

$$\text{Now, } \hat{\sigma}_{\bar{x}} = \frac{s}{\sqrt{n}}$$

$$\therefore 0.50 = \frac{s}{\sqrt{36}}$$

$$\text{or } s = 0.50 \sqrt{36} = 3 \text{ (Rs. per kg)}$$

$$\therefore \text{Standard deviation of the sample} = \text{Rs.3.00 per kg.}$$

81. Answer : (d)

$$\text{Reason : Marginal profit (MP)} = 16 - 10 = \text{Rs.6}$$

$$\text{Marginal loss (ML)} = \text{Rs.10}$$

Minimum required probability of selling one or more additional pieces to justify their preparation,

$$p^* = \frac{ML}{ML + MP} = \frac{10}{10 + 6} = 0.625$$

No. of pieces	Probability	Cumulative probability that sales will be at this level or more
150	10 / 200 = 0.05	1.00
151	20 / 200 = 0.10	0.95
152	30 / 200 = 0.15	0.85
153	60 / 200 = 0.30	0.70
154	40 / 200 = 0.20	0.40
155	24 / 200 = 0.12	0.20
156	16 / 200 = 0.08	0.08

The number of pieces prepared must be such that the probability of selling three or more number of pieces (i.e. cumulative probability) is at least equal to the minimum required probability (p^*) of 0.625. From the above table it can be seen that –

For 153 pieces, cumulative probability = 0.70 > p^*

For 154 pieces, cumulative probability = 0.40 < p^*

Hence, the optimal number of pieces to be prepared is 153.

82. Answer : (b)

Reason : a. The expected value criterion can be applied as follows:

$$\text{Portfolio X : } 100000 (0.25) + 250000 (0.40) - 50000 (0.35) = \text{Rs.1,07,500}$$

$$\therefore \text{Expected gain from portfolio X} = \text{Rs.1,07,500}$$

$$\text{Portfolio Y : } -40000 (0.25) + 150000 (0.40) + 200000 (0.35) = \text{Rs.1,20,000}$$

$$\therefore \text{Expected gain from portfolio Y} = \text{Rs.1,20,000}$$

$$\text{Portfolio Z : } 400000 (0.25) - 50000 (0.40) + 100000 (0.35) = \text{Rs.1,15,000}$$

$$\therefore \text{Expected gain from portfolio Z} = \text{Rs.1,15,000}$$

From above, it can be seen that the maximum expected gain (Rs.1,20,000) is associated with Portfolio Y.

$\therefore$ Investment must be made in Portfolio Y.

83. Answer : (d)

Reason : b. The question actually asks for expected value of perfect information (EVPI). According to this concept, under conditions of complete certainty, the decision maker will always

make that decision which will lead to the maximum gain under any state of nature. In the current, context with the information from extremely reliable sources, the investment manager will make his investment decision under completely certain conditions. Thus, if he gets the perfect information that the state of nature S₁ will be occurring he will invest in portfolio X which provides the highest gain under S₁. Similarly with the perfect information on the occurrence of any other state of nature he will invest in that portfolio which will provide the highest gain under that state of nature. This is shown below:

Portfolio	State of Nature		
	S ₁ P(S ₁) = 0.25	S ₂ P(S ₂) = 0.40	S ₃ P(S ₃) = 0.35
Z	Rs.400,000	–	–
X	–	Rs. 250,000	–
Y	–	–	Rs.200,000

Expected gain under certainty (or expected gain with perfect information)

$$= 400000 (0.25) + 250000 (0.40) + 200000 (0.35)$$

$$= \text{Rs.}2,70,000$$

EVPI = Expected gain under certainty – Maximum expected gain without perfect information.

$$= 270000 - 120000$$

$$= \text{Rs.}150000$$

∴ The maximum amount that the investment manager may pay to obtain further information from reliable sources (i.e. expected value of perfect information) is Rs.1,50,000.

84. Answer : (d)

Reason : Let the following notations be used:

X: Advertising expenses (Rs. in crore)

Y: Sales (Rs. in crore)

Percentage of variation in Y that is explained by variation in X

$$= \text{Coefficient of determination} = r^2$$

$$r = \frac{\sum (X - \bar{X})(Y - \bar{Y})}{\sqrt{\sum (X - \bar{X})^2 \sum (Y - \bar{Y})^2}}$$

Y	52	52	57	62	67	58	56	60
X	11	13	16	17	18	14	15	16
$Y - \bar{Y}$	-6	-6	-1	4	9	0	-2	2
$X - \bar{X}$	-4	-2	1	2	3	-1	0	1
$(Y - \bar{Y})^2$	36	36	1	16	81	0	4	4
$(X - \bar{X})^2$	16	4	1	4	9	1	0	1
$(X - \bar{X})(Y - \bar{Y})$	24	12	-1	8	27	0	0	2
								72

$$\bar{Y} = \frac{\sum X}{n} = \frac{464}{8} = 58$$

$$\bar{X} = \frac{\sum Y}{n} = \frac{120}{8} = 15$$

$$\therefore r = \frac{72}{\sqrt{36 \times 178}} = 0.8994$$

$$\therefore r^2 = 0.8089 \approx 0.81$$

∴ The variation in advertising expenses explain 81% of the variation in sales.

