

Question Paper

Quantitative Methods – II (132) : April 2004

1. As the population size increases relative to the sample size, the value of the finite population standard error of mean [< Answer >](#)
- (a) Decreases
 - (b) Gets closer to the infinite population standard error of mean
 - (c) Becomes equal to the population variance
 - (d) Becomes equal to population mean
 - (e) Becomes equal to the sample variance.
- (1 mark)
2. Which of the following is **false** with regard to the concept of expected value? [< Answer >](#)
- (a) It is applied for taking decisions under conditions of risk
 - (b) It is a weighted average of the possible values of a random variable
 - (c) Every value that may be assumed by the random variable is weighted by its probability of occurrence
 - (d) It is that value of the random variable, which has the highest probability of occurrence
 - (e) None of the above.
- (1 mark)
3. Which of the following elements is **not** commonly found in problems of decision making under uncertain conditions? [< Answer >](#)
- (a) The decision maker has an objective to be achieved
 - (b) There are several courses of action
 - (c) There is a calculable measure of benefit or worth of the various courses of action
 - (d) There are events which are not controllable by the decision maker
 - (e) The decision maker has knowledge of the probabilities of occurrence of the events which are not under his control.
- (1 mark)
4. Which of the following is **true** with regard to the expected value of perfect information? [< Answer >](#)
- (a) It is the expected value which can be achieved when all the uncertainties are removed from consideration
 - (b) It is the maximum expected value which can be achieved under the presence of uncertainties
 - (c) It is the minimum expected value which can be achieved under the presence of uncertainties
 - (d) It is the difference between the expected profit with perfect information and the highest expected profit without perfect information
 - (e) None of the above.
- (1 mark)
5. Which of the following criteria **cannot** be used for decision making if the decision maker does not know the probabilities associated with the various states of nature? [< Answer >](#)
- (a) Maximax criterion
 - (b) Maximin criterion
 - (c) Regret criterion
 - (d) Expected value
 - (e) Hurwicz criterion.
- (1 mark)
6. Which of the following is **false** with regard to a Bernoulli process? [< Answer >](#)
- (a) Each trial of the experiment has only two possible outcomes
 - (b) The probability of the outcome of any trial remains fixed over time
 - (c) The outcome of any trial affects the outcome of the following trial
 - (d) The possible outcomes of any trial may or may not be equally likely
 - (e) The process consists of a sequence of a specific number of identical trials
- (1 mark)

7. Which of the following is **not** a characteristic of normal probability distribution? [< Answer >](#)
- (a) The mean of the normally distributed population lies at the center of the distribution
 - (b) A normal distribution always has a variance of 1
 - (c) The mean, median and mode are equal
 - (d) Both the tails extend indefinitely and never meet the horizontal axis
 - (e) Half of the area under the normal distribution curve lies below the mean
- (1 mark)**
8. In which method of sampling each possible sample has an equal probability of being chosen and each item in the entire population has an equal probability of being included in the sample. [< Answer >](#)
- (a) Simple Random sampling
 - (b) Systematic sampling
 - (c) Stratified sampling
 - (d) Cluster sampling
 - (e) Judgemental sampling.
- (1 mark)**
9. Which criterion of decision-making is based upon the opportunity cost of making specific decisions? [< Answer >](#)
- (a) Maximax criterion
 - (b) Maximin criterion
 - (c) Hurwicz criterion
 - (d) Regret criterion
 - (e) Expected value.
- (1 mark)**
10. Which of the following is **not** a type of random sampling? [< Answer >](#)
- (a) Simple random sampling
 - (b) Stratified sampling
 - (c) Systematic sampling
 - (d) Judgmental sampling
 - (e) Cluster sampling.
- (1 mark)**
11. The expected value and variance of a variable which follows the standard normal probability distribution are [< Answer >](#)
- (a) 1 and 0 respectively
 - (b) 1 and 1 respectively
 - (c) 0 and 1 respectively
 - (d) 0 and 0 respectively
 - (e) -1 and 0 respectively.
- (1 mark)**
12. Which of the following is a case of type II error? [< Answer >](#)
- (a) The null hypothesis is true and rejected
 - (b) The null hypothesis is false and accepted
 - (c) The null hypothesis is true and accepted
 - (d) The null hypothesis is false and rejected
 - (e) None of the above.
- (1 mark)**
13. Which of the following indicates the long-term behaviour of a variable with reference to the secular trend line? [< Answer >](#)
- (a) Coefficient of correlation
 - (b) Cyclical variation
 - (c) Seasonal variation
 - (d) Irregular variation
 - (e) Coefficient of determination.
- (1 mark)**
14. Which of the following types of sampling is suitable when the population consists of well defined groups such that the elements of each group are homogeneous and the groups vary from each other? [< Answer >](#)
- (a) Judgmental sampling
 - (b) Stratified sampling
 - (c) Systematic sampling
 - (d) Cluster sampling
 - (e) Simple random sampling.
- (1 mark)**

[< Answer >](#)

15. Which of the following is **not true**?

- (a) The purpose of hypothesis testing is to make a judgment about the difference between the sample statistic and the hypothesized population parameter
- (b) When the null hypothesis is rejected the alternative hypothesis is accepted
- (c) The purpose of hypothesis testing is to test the correctness of the computed value of the sample statistic
- (d) The acceptance of the null hypothesis does not indicate that the null hypothesis is true
- (e) None of the above.

(1 mark)

[< Answer >](#)

16. Which of the following is **true** with regard to a two-tailed test of hypothesis at a significance level of 5 percent?

- (a) The rejection region lies in the right tail of the sampling distribution
- (b) The rejection region lies in the left tail of the sampling distribution
- (c) The rejection region lies in the middle of the sampling distribution
- (d) 2.5 percent of the area in each of the left and right tails of the sampling distribution serve as the rejection regions
- (e) 5 percent of the area in the middle of the sampling distribution is considered to be the acceptance region.

(1 mark)

[< Answer >](#)

17. Which of the following distributions can be identified by a pair of degrees of freedom?

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

(1 mark)

[< Answer >](#)

18. If the covariance of two random variables X and Y is equal to zero then it can be said that

- (a) The random variables are dependent on each other
- (b) The random variables have a positive correlation
- (c) The random variables have a negative correlation
- (d) The random variables are independent of each other
- (e) The variances of the two random variables are always zero.

(1 mark)

[< Answer >](#)

19. The control chart which is plotted using the variability of individual characteristics of the output is known as

- (a) $\bar{X}$ chart
- (b) R chart
- (c) p chart
- (d) K chart
- (e) None of the above.

(1 mark)

[< Answer >](#)

20. If the pattern of $\bar{X}$ chart of a process is 'Hugging the center line', then it indicates that the

- (a) Process mean may be drifting
- (b) Process mean may have shifted
- (c) Two distinct populations are being observed
- (d) Variation has been reduced
- (e) Few individual outliers are present.

(1 mark)

[< Answer >](#)

21. The value of chi-square statistic can never be negative, because

- (a) The difference between the observed and expected frequencies are always positive
- (b) The differences between the observed and expected frequencies are always squared
- (c) The observed frequency can never be negative
- (d) The expected frequency can never be negative
- (e) The expected frequency is always equal to the observed frequency.

(1 mark)

22. Which of the following is **not true** in the context of multiple regression? [< Answer >](#)
- (a) Multicollinearity does not reduce the accuracy of the predictive power of the model
 - (b) Multicollinearity does not reduce the effectiveness of the sensitivity analysis
 - (c) Multicollinearity reduces the reliability of the regression co-efficients
 - (d) Multicollinearity reduces the influence of the individual variables in the model
 - (e) Independent variables may together explain the dependent variable in case of a multicollinearity problem.
- (1 mark)**
23. Which of the following price indices has a downward bias? [< Answer >](#)
- (a) Laspeyres price index
 - (b) Paasche's price index
 - (c) Fisher's ideal price index
 - (d) Marshall Edgeworth price index
 - (e) None of the above.
- (1 mark)**
24. Which of the following is **true** according to the central limit theorem? [< Answer >](#)
- (a) The distribution of the sample is always symmetric
 - (b) The distribution of the sample is symmetric only for small sample sizes
 - (c) The sampling distribution of the mean approaches normality as the sample size increases
 - (d) The sampling distribution of the mean approaches normality as the sample size decreases
 - (e) The sampling distribution of the mean never approaches normality.
- (1 mark)**
25. The standard error of estimate [< Answer >](#)
- (a) Is a measure of central tendency for the distribution of the values estimated by the regression equation
 - (b) Measures the variability of the observed values of the dependent variable around their mean
 - (c) Measures the variability of the observed values of the dependent variable around the regression line
 - (d) Measures the variability of the observed values of the independent variable around their mean
 - (e) Measures the variability of the observed values of the independent variable around the regression line.
- (1 mark)**
26. When base year values are used as weight, then the weighted average of relatives price index is equal to [< Answer >](#)
- (a) Laspeyres price index
 - (b) Laspeyres quantity index
 - (c) Paasche's price index
 - (d) Paasche's quantity index
 - (e) Fisher's ideal price index.
- (1 mark)**
27. Standardizing a normal variable means [< Answer >](#)
- (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.
- (1 mark)**
28. The sampling distribution of mean is [< Answer >](#)
- (a) A distribution of all possible sample means for samples of a given size taken from the same population
 - (b) A distribution of all possible sample means for samples of a given size taken from different populations
 - (c) A distribution of all possible sample means for samples of different sizes taken from the same population
 - (d) A distribution of all possible sample means for samples of different sizes taken from different populations
 - (e) A distribution of the observations in a sample.

(1 mark)

[< Answer >](#)

29. Which of the following is **true**?

- (a) The standard error of mean increases as the sample size increases
- (b) The standard error of mean decreases as the sample size increases
- (c) The standard error of mean for sample sizes of 2 and above, is more than the standard deviation of population
- (d) The standard error of mean for sample sizes of 2 and above, is equal to the standard deviation of population
- (e) None of the above.

(1 mark)

[< Answer >](#)

30. The finite population correction factor

- (a) Increases as the sample size increases
- (b) Decreases as the sample size increases
- (c) Remains constant for all possible sample sizes
- (d) Is equal to 1 for sample sizes of 2 and above
- (e) Is more than 1 for sample sizes of 2 and above.

(1 mark)

[< Answer >](#)

31. The graph of which of the following distributions is flat?

- (a) t distribution
- (b) Normal distribution
- (c) Continuous uniform distribution
- (d) Chi-square distribution
- (e) None of the above.

(1 mark)

[< Answer >](#)

32. In hypothesis testing, if the level of significance is made smaller, the rejection region

- (a) Becomes larger
- (b) Becomes smaller
- (c) Remains the same
- (d) Becomes equal to the acceptance region
- (e) Becomes larger than the acceptance region.

(1 mark)

[< Answer >](#)

33. If the level of significance of a hypothesis test is increased from 0.01 to 0.05, the probability of a Type II error

- (a) Will also increase from 0.01 to 0.05
- (b) Will not change
- (c) Will decrease
- (d) Will be zero
- (e) Will be equal to the new significance level.

(1 mark)

[< Answer >](#)

34. An estimate of the variance of a population based on the combination of two sample results is known as the

- (a) Pooled estimate of mean
- (b) Significance level
- (c) Pooled estimate of variance
- (d) Confidence level
- (e) Standard error of estimate.

(1 mark)

[< Answer >](#)

35. For a given sample data, if a hypothesis is rejected at the 3% level of significance,

- (a) It must also be rejected at the 2% level of significance
- (b) It must also be rejected at the 5% level of significance
- (c) It will sometimes be rejected and sometimes not be rejected at the 5% level of significance
- (d) It will never be rejected at the 5% level of significance
- (e) It will never be rejected at the 2% level of significance.

(1 mark)

[< Answer >](#)

36. If two independent large samples are taken from two populations, the sampling distribution of the difference between the two sample means

- (a) Can be approximated by a binomial distribution
- (b) Will have a variance of one

- (c) Can be approximated by a normal distribution
- (d) Will always have a mean of one
- (e) Will always have a mean of zero.

(1 mark)

[< Answer >](#)

37. The sampling distribution of the test statistic for a goodness of fit test is the

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

(1 mark)

[< Answer >](#)

38. In conducting either a goodness of fit or contingency table test, the larger the differences between the observed and expected frequencies the more likely it is that

- (a) The null hypothesis will be accepted
- (b) The null hypothesis will be rejected
- (c) The distribution of the test statistic will approach the binomial distribution
- (d) The distribution of the test statistic will approach the standard normal distribution
- (e) The distribution of the test statistic will approach the F distribution.

(1 mark)

[< Answer >](#)

39. Which of the following is the most appropriate example of a discrete random variable?

- (a) Weight of a randomly selected human being
- (b) Volume of liquid in a randomly selected container
- (c) Length of a randomly selected object
- (d) Number of passengers travelling in a randomly selected bus
- (e) None of the above.

(1 mark)

[< Answer >](#)

40. When the population standard deviation is unknown, the population has a normal or near-normal distribution and the sample size is small, which distribution is used in developing an interval estimate?

- (a) Standard normal distribution
- (b) Chi-square distribution
- (c) Normal distribution
- (d) t distribution
- (e) Binomial distribution

(1 mark)

[< Answer >](#)

41. A typist has completed a draft of a 700 page document required by a statistician. The statistician has randomly selected some pages and estimated that there was 89.9 percent probability that the average number of typographical errors per page in the entire document will lie between 4.2317 and 4.7683. The average number of typographical errors per page for the pages selected by the statistician was 4.5 and the standard deviation was 1.2. The statistician selected a large sample of the pages in the document and the number of pages selected by the statistician was more than 5 percent of the number pages in the entire document.

How many pages were selected by the statistician for estimating the average number of typographical errors per page in the entire document? (Round off your answer to the nearest integer).

- (a) 5
- (b) 25
- (c) 35
- (d) 50
- (e) 70.

(3 marks)

[< Answer >](#)

42. 60 percent of the medium sized software firms based in Karnataka planned to send their representatives to Australia in order to explore business opportunities there. An export-import group in Australia has invited some of the medium sized software firms based in Karnataka, to participate in a conference to explore the possibilities of developing trading relationships. The probability that exactly 10 of the invited software firms will send their representatives to the conference is 0.19833 and the probability that exactly 11 of the invited software firms will send their representatives to the conference is 0.16223.

How many medium-sized software firms based in Karnataka, did the Australian export-import group invite? (Round off your answer to the nearest integer)

- (a) 10
- (b) 12
- (c) 16
- (d) 32
- (e) 40.

(2 marks)

[< Answer >](#)

43. The Food Fun Restaurant prepares a chicken dish, Super Chicken, every Sunday. From each whole chicken that is cooked, two portions of the dish are prepared. Each portion of the dish costs Rs.32 including labor and other costs of preparation. It is observed over a long period of time that the demand for the dish is normally distributed with a mean of 210 portions and a standard deviation of 50 portions. The dish is perishable and the unsold portions of the dish cannot be preserved and sold later. The manager of the restaurant has found out that the restaurant can earn the maximum profit on this dish if it uses 96 whole chickens to prepare the dish on Sundays. It is assumed that the objective of the restaurant is to maximize profit from the sale of this dish and it always prepares the optimal number of portions of this dish.

What is the selling price of each portion of the dish? (Round off your answer to the nearest integer)

- (a) Rs. 25 (b) Rs. 50 (c) Rs.75 (d) Rs. 80 (e) Rs. 160.

(3 marks)

[< Answer >](#)

44. Magnus Products Ltd. manufactures fast moving consumer goods. Its customers include independent dealers as well as departmental stores. Presently, there are 200 departmental stores among its customers; the remaining are independent dealers. It has been observed that the departmental stores tend to pay their dues regularly. However, of late some delays have been observed in the payment practices of the independent dealers. The independent dealers constitute 80 percent of all its customers. The general manager of the company ordered a random survey of all the trade debtors in the independent dealers category. 80 trade debtors in the independent dealers category were randomly surveyed and it was found that 60 of them were in excellent standing. A 95 percent confidence interval has to be constructed for the absolute number of trade debtors belonging to the independent dealers category that meet the criteria of excellent standing.

Which of the following represents the confidence interval for the absolute number of trade debtors in the independent dealers category, which are in excellent standing?

- (a) 36 ± 24 (b) 60 ± 12 (c) 120 ± 24 (d) 600 ± 72 (e) 1200 ± 36 .

(3 marks)

[< Answer >](#)

45. Many public interest groups working for the cause of the economically backward sections of the society have expressed their concern over the rising prices of life-saving drugs. One such group has been observing the prescription prices of various life-saving drugs. Recently it has collected a small sample of the prescription prices of a life-saving drug used to treat patients suffering from neurological ailments. The sample data collected are reproduced below:

Price (in Rs.) :	150	140	155	145	143	132	131	137	139	138
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It is assumed that the prescription prices for this drug at all the retail outlets in the country are normally distributed.

What is the interval estimate for the true mean price (in Rs.) of the drug for the entire population, at a 95 percent confidence level?

- (a) 141 ± 2.376 (b) 141 ± 5.375 (c) 141 ± 7.513 (d) 141 ± 13.771 (e) 141 ± 56.445 .

(2 marks)

[< Answer >](#)

46. The advertisement expenditure and the sales of Orient Industries Ltd. for the last six years, are given below:

(Rs. in lakh)

Advertisement expenditure (X)	87	113	110	138	130	123
Sales (Y)	680	740	790	1070	830	990

An estimating equation to predict sales from advertisement expenditure has to be formulated using the simple regression technique. Which of the following represents the correct estimating equation developed by the simple regression technique?

- (a) $\hat{Y} = 40.567X$ (b) $\hat{Y} = 6.9281 + 40.567X$
 (c) $\hat{Y} = 40.567 + X$ (d) $\hat{Y} = 6.9281X$

(e) $\hat{Y} = 40.567 + 6.9281X$.

(3 marks)

[< Answer >](#)

47. A simple regression equation is developed which relates the variables **X** and **Y** ; **X** is the independent variable and **Y** is the dependent variable. The following details are available:

Y	31	40	30	34	25	20
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$$\sum XY = 1000 \quad \sum X = 30 \quad \sum X^2 = 200$$

Number of data points = 6

What is the standard error of estimate of the regression equation?

- (a) 3.24 (b) 10.5 (c) 42 (d) 2.1 (e) 4.41.

(2 marks)

[< Answer >](#)

48. A sports magazine conducted a survey among the spectators of major cricket tournament and found that for any randomly selected person the probability that he supports Team A is 0.50, the probability that he supports Team B is 0.30 and the probability that he supports Team C is 0.20. It is assumed that these probabilities are accurate.

What is the probability that out of a randomly chosen group of eight persons at least six do not support Team B?

- (a) 0.238 (b) 0.30 (c) 0.448 (d) 0.552 (e) 0.90.

(2 marks)

[< Answer >](#)

49. The following details are available with regard to a regression relationship between the variables **X** and **Y**; **X** is the independent variable and **Y** is the dependent variable:

Slope of the estimated regression line = 2

Standard error of estimate = 3.24

$$\sum X^2 = 200 \quad \sum X = 30$$

Number of data points = 6

It is to be tested at a significance level of 2%, whether or not there is any linear relationship between the variables **X** and **Y**.

Which of the following statements are **correct**?

- I. The standard error of the slope of the estimated regression line is 3.24
- II. The standard error of the slope of the estimated regression line is 7.07
- III. The standard error of the slope of the estimated regression line is 0.46
- IV. The value of the test statistic is 2
- V. The value of the test statistic is 3.24
- VI. The value of the test statistic is 4.35
- VII. The appropriate distribution for this test is chi-square distribution with degrees of freedom = 4
- VIII. The appropriate distribution for this test is t distribution with degrees of freedom = 4
- IX. The appropriate distribution for this test is normal distribution
- X. At a significance level of 2% we can conclude that there is **no** linear relationship between the variables **X** and **Y**.
- XI. At a significance level of 2% we can conclude that there is a linear relationship between the variables **X** and **Y**.

- (a) I, IV and VII (b) II, V, VII and VIII
 (c) III, VI, VIII and XI (d) II, IV, IX and X
 (e) III, V, IX and X.

(3 marks)

[< Answer >](#)

50. From a population with a known variance two samples are independently collected. The first sample has a size **a** and has a standard error of mean of 2.4. The second sample has a size **b** and has a standard error of mean of 2.00.

If a sample of size **a + b** is taken from this population then what will be the standard error of mean?

- (a) 1.536 (b) 2.44 (c) 1.44 (d) 1.2 (e) 0.83.

(2 marks)

[< Answer >](#)

51. A simple regression equation is developed which relates the variables **X** and **Y** ; **X** is the independent variable and **Y** is the dependent variable. The following details are available:

Y	11	13	14	16	16	15	15	14	13	13
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$$\sum XY = 8190 \quad \sum X = 580 \quad \sum X^2 = 34000$$

Number of data points = 10

What percentage of the variations in **Y** is **not** explained by the regression equation?

- (a) 5% (b) 12.5% (c) 25% (d) 38.15% (e) 61.85%.

(2 marks)

[< Answer >](#)

52. The following data shows the total cost and variable cost of a firm over a period of eight years:

	(Rs. in lakhs)							
Year	1996	1997	1998	1999	2000	2001	2002	2003
Total cost	126	160	164	175	156	170	166	163
Variable cost	110	124	130	135	115	134	132	128

What is the coefficient of correlation between total cost and variable cost of the firm?

- (a) 0.457 (b) 0.543 (c) 0.873 (d) 0.806 (e) 0.904.

(3 marks)

[< Answer >](#)

53. From a group of 600 children belonging to the same age group, a sample of 25 children is taken. From this sample, the average weight of the children is found to be 24 kgs and the variance is found to be 10.24 (kg²).

A 95 percent confidence interval for the mean weight of the children in the group has to be constructed. The lower and upper confidence limits of the confidence interval are

- (a) 24.16 kgs and 37.84 kgs respectively
 (b) 20.25 kgs and 27.50 kgs respectively
 (c) 22.68 kgs and 25.32 kgs respectively
 (d) 25.5 kgs and 27.5 kgs respectively
 (e) 17.6 kgs and 24 kgs respectively.

(2 marks)

[< Answer >](#)

54. A multiple regression equation has to be developed between the variables **Y**, **X₁** and **X₂**. **X₁** and **X₂** are the independent variables, and **Y** is the dependent variable. The following details are available:

Number of data points = 11

$$\sum Y = 300 \quad \sum X_1 Y = 13377 \quad \sum X_2 Y = 4377 \quad \sum X_1 X_2 = 7122$$

$$\sum X_1 = 490 \quad \sum X_2 = 160 \quad \sum X_1^2 = 21862 \quad \sum X_2^2 = 2342$$

Which of the following represents the multiple regression relationship between the variables **Y**, **X₁** and **X₂**?

- a. $\hat{Y} = 13.42 - 0.5526X_1 + 1.1053 X_2$
 b. $\hat{Y} = -13.42 + 0.5526X_1 + 1.1053 X_2$
 c. $\hat{Y} = -147.622 - 0.5526X_1 - 1.1053 X_2$
 d. $\hat{Y} = 0.5526 + 13.42X_1 + 1.1053 X_2$
 e. $\hat{Y} = 147.622 - 1.1053 X_1 + 0.5526X_2$.

(3 marks)

55. The Chief Medical Officer of a hospital wants to determine the expected number of patients coming to the Out Patient Department (OPD) every day. The number of patients coming to the OPD every day is random variable. The hospital has arrived at the following probability distribution of the number of patients coming to the OPD every day, on the basis of past experience: [< Answer >](#)

No. of patients coming to the OPD per day	Probability
100	0.10
110	0.25
120	0.30
130	0.35

What is the expected number of patients coming to the OPD every day?

- (a) 100 (b) 110 (c) 119 (d) 130 (e) 460.

(1 mark)

56. For a binomial experiment, the standard deviation of the distribution of the number of successes is 2.4 and the probability of success is 0.6. What is the number of trials in the experiment? [< Answer >](#)

- (a) 12 (b) 16 (c) 24 (d) 48 (e) 96.

(1 mark)

57. The possible returns from a security are given below: [< Answer >](#)

Return (%)	-10	5	20	30
Probability (%)	10	20	40	30

What is the standard deviation of returns from the security?

- (a) 1% (b) 12.49% (c) 2% (d) 4% (e) 16%.

(2 marks)

58. The variances of variables, X and Y, are 441 and 256 respectively, and the covariance between them is 168. What is the coefficient of correlation between X and Y? [< Answer >](#)

- (a) 0.25 (b) 0.50 (c) 0.64 (d) 0.75 (e) 0.90.

(1 mark)

59. For a simple linear regression equation $\sum(Y - \hat{Y})^2 = 1024$ and the standard error of estimate is 8. What is the number of observations? [< Answer >](#)

- (a) 8 (b) 12 (c) 16 (d) 18 (e) 64.

(1 mark)

60. Alpha Cycles actually sold 78,000 bicycles in the year 2003 against the estimated 72,000 bicycles for the same year according to the secular trend equation. What is the relative cyclical residual measure for the year 2002? [< Answer >](#)

- (a) 8.33 (b) 108.33 (c) 92.31 (d) 7.69 (e) 116.66.

(1 mark)

61. In a test of ANOVA, the estimate of the population variance based on the variance among the sample means is 6.724 and the estimate of the population variance based on the variance within samples is 2.248. What is the F ratio for this test? [< Answer >](#)

- (a) 0.334 (b) 0.666 (c) 2.991 (d) 4.476 (e) 8.972.

(1 mark)

62. In a test of ANOVA, the number of samples used is 3 and the total size of all the samples is 16. If the significance level for the test is 0.05, then what is the critical value? [< Answer >](#)

- (a) 3.16 (b) 3.81 (c) 6.70 (d) 8.74 (e) 10.5.

(1 mark)

[< Answer >](#)

63. X and Y are two random variables independent of each other. The variances of the two variables are given below:

$$V(X) = 6.25$$

$$V(Y) = 2.25$$

$$\text{Let } Z = 2X + 4Y$$

What is the variance of Z?

- (a) 25 (b) 36 (c) 61 (d) 21.50 (e) 8.50.

(1 mark)

[< Answer >](#)

64. For a sample randomly collected from a population, the following details are available:

$$\text{Sum of the squares of the observations} = 7360$$

$$\text{Sum of the observations} = 320$$

$$\text{Number of observations} = 16$$

What is the estimated standard error of mean?

- (a) 1 (b) 2 (c) 4 (d) 8 (e) 16.

(1 mark)

[< Answer >](#)

65. The production (in thousand liters) of a sunflower oil producing factory during seven years is given below:

Year	1997	1998	1999	2000	2001	2002	2003
Production ('000 liters)	80	90	92	85	94	100	95

What is the estimated production of sunflower oil for the year 2004 on the basis of a linear estimating equation that describes the trend in the sunflower oil production by the factory?

- (a) 90857 liters (b) 492904 liters (c) 94857 liters (d) 100429 liters (e) 93250 liters.

(2 marks)

[< Answer >](#)

66. For a simple regression equation the following results were obtained:

$$\text{If } X = 10, \hat{Y} = 94$$

$$\text{If } X = 15, \hat{Y} = 126$$

where X is the independent variable and $\hat{Y}$ is the estimated value of the dependent variable Y.

$$\sum Y = 660$$

Number of data points = 6

What is the mean of the values of the independent variable, X?

- (a) 12.5 (b) 25 (c) 32 (d) 40 (e) 50.

(2 marks)

[< Answer >](#)

67. A linear trend equation was developed for relating the annual operating cost of Beta Industries Ltd., with the year. The operating cost for the year 2000 was observed to be Rs. 66.55 lakh and the relative cyclical residual for that year was 10. The operating cost for the year 2001 was observed to be Rs. 75.26 lakh and the relative cyclical residual for that year was 6. The operating cost for the year 2002 was observed to be Rs. 78.24 lakh. In the linear trend equation, the time variable (X) has been coded as $x = X - 1999$.

What was the relative cyclical residual for the year 2002?

- (a) -4 (b) -2 (c) 1 (d) 2 (e) 4.

(3 marks)

[< Answer >](#)

68. Winner Textiles, a local manufacturer of men's dresses, markets its products in Mumbai and adjoining places. From its past records it knows that its products are carried in 30 percent of the men's clothing stores in Mumbai. The marketing manager of the firm wants to know if the percentage of the men's clothing stores in Thane, which carry its products is less than the percentage in Mumbai. He conducted a sample survey of the men's clothing stores in Thane. It was found out that the ratio of the number of men's clothing stores in Thane, which did not carry its products, to the number of men's clothing stores in Thane, which carried its products, was 3:1. Out of the men's clothing stores, which were sampled in Thane, ten stores carried its products. It is to be tested at a significance level of 5 percent, whether the

percentage of men's clothing stores in Thane, which carried its products, is significantly less than the percentage in Mumbai.

Which of the following statements are **correct**?

- I. A right tailed test of hypothesis is appropriate.
- II. A two-tailed test of hypothesis is appropriate.
- III. A left tailed test of hypothesis is appropriate.
- IV. The standard error of proportion is 0.9274.
- V. The standard error of proportion is 0.30.
- VI. The standard error of proportion is 0.21.
- VII. The standard error of proportion is 0.07246.
- VIII. The critical value for the test is 1.96.
- IX. The critical value for the test is -1.96.
- X. The critical value for the test is 1.645.
- XI. The critical value for the test is -1.645.
- XII. The standardized value of the sample proportion is 0.31.
- XIII. The standardized value of the sample proportion is -0.69.
- XIV. It can be concluded that the percentage of men's clothing stores in Thane, which carry the firm's products, is significantly less than the percentage in Mumbai.
- XV. It can be concluded that the percentage of men's clothing stores in Thane, which carry the firm's products, is **not** significantly less than the percentage in Mumbai.

- (a) I, IV, VIII, XII and XIV (b) II, V, IX, XII and XIV
 (c) I, VI, X, XIII and XIV (d) III, VII, XI, XIII and XV
 (e) II, VI, IX, XII and XIV.

(3 marks)

[< Answer >](#)

69. The prices and quantities of some commodities consumed by a family in the years 1999 and 2003 are given below:

Commodity	Year			
	1999		2003	
	Price (Rs./kg)	Quantity (kgs)	Price (Rs./kg)	Quantity (kgs)
Tea	700	12	900	10
Sugar	14.50	160	15.50	140
Milk Powder	100	16	130	15
Rice	14.00	500	16.00	490
Flour	12.00	350	13.50	400

What is Fisher's ideal price index for the basket of commodities consumed by the family, for the year 2003, considering 1999 as the base year?

- (a) 83.75 (b) 119.10 (c) 126.57 (d) 112.07 (e) 106.54.

(2 marks)

[< Answer >](#)

70. The following details pertain to a one-tailed test of variance:

Sample size = 31

Sample standard deviation = 15.9

Population standard deviation, as per the null hypothesis = 13

Which of the following statements is **correct**?

- (a) The value of the test statistic is 44.88. The test statistic follows a chi-square distribution with 30 degrees of freedom
- (b) The value of the test statistic is 44.88. The test statistic follows a t distribution with 30 degrees of freedom
- (c) The value of the test statistic is 46.37. The test statistic follows a chi-square distribution with 30 degrees of freedom
- (d) The value of the test statistic is 46.37. The test statistic follows a t distribution with 30 degrees of freedom

- (e) The value of the test statistic is 46.37. The test statistic follows a normal distribution.

(1 mark)

[< Answer >](#)

71. The following details pertain to a two-tailed test of equality of two variances:

Standard deviation of first sample = 17

Standard deviation of second sample = 7.5

Size of the first sample = 21

Size of the second sample = 25

Which of the following statements is **correct**?

- (a) The value of the test statistic is 5.14. The test statistic follows a **t** distribution with 4 degrees of freedom
- (b) The value of the test statistic is 5.14. The test statistic follows a chi-square distribution with 4 degrees of freedom
- (c) The value of the test statistic is 5.14. The test statistic follows a F distribution with 20 degrees of freedom in the numerator and 24 degrees of freedom in the denominator
- (d) The value of the test statistic is 5.14. The test statistic follows a **F** distribution with 24 degrees of freedom in the numerator and 20 degrees of freedom in the denominator
- (e) The value of the test statistic is 5.14. The test statistic follows a normal distribution.

(1 mark)

END OF QUESTION PAPER

Suggested Answers

Quantitative Methods – II (132) : April 2004

1. Answer : (a)

[< TOP >](#)

Reason : Finite population standard error of Mean = $\frac{\sigma}{\sqrt{n}} \times \sqrt{\frac{N-n}{N-1}}$

As the population size (N) increases relative to sample size (n) i.e.,

$$\text{as } \frac{n}{N} \rightarrow 0, \sqrt{\frac{N-n}{N-1}} \rightarrow 1.$$

$$\therefore \frac{\sigma}{\sqrt{n}} \times \sqrt{\frac{N-n}{N-1}} \rightarrow \frac{\sigma}{\sqrt{n}} \text{ (the infinite population standard error of mean).}$$

2. Answer : (d)

[< TOP >](#)

Reason : Expected value is not the value of the random variable which has the highest probability. Hence, alternative (d) is false; alternatives (a), (b) and (c) are true.

3. Answer : (e)

[< TOP >](#)

Reason : All the elements stated in the alternatives (a) through (d) are commonly found in problems of decision making under uncertain conditions. Under uncertainty the decision maker has no knowledge of the probabilities of occurrence of the events not under his control.

4. Answer : (d)

[< TOP >](#)

Reason : Alternative (a) is not true because when all the alternatives are removed we get the expected profit with perfect information. Alternatives (b) and (c) are not true because they are incorrect interpretations of the expected value of perfect information. Alternative (d) is the true meaning of expected value of perfect information.

5. Answer : (d)

[< TOP >](#)

Reason : Under uncertain conditions the decision maker is unaware of the probabilities of the various states of nature. Hence the expected value criterion cannot be used.

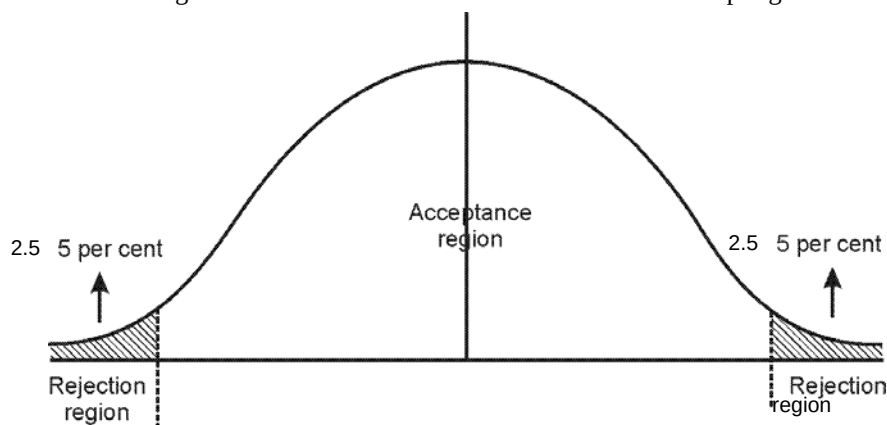
6. Answer : (c)

[< TOP >](#)

Reason : Alternative (a), (b), (d) and (e) are the characteristics of a Bernoulli process. (c) is false because the trials are independent.

7. Answer : (b) [< TOP >](#)
Reason : Normal distributions may have different variances and the variance need not be 1 always.
8. Answer : (a) [< TOP >](#)
Reason : In simple random sampling each possible sample has an equal chance of being selected.
9. Answer : (d) [< TOP >](#)
Reason : Regret criterion is based upon the opportunity cost of making specific decisions.
10. Answer : (d) [< TOP >](#)
Reason : In judgmental sampling the sample is selected according to the judgment of the investigator. Hence some subjectivity creeps into the sampling process and the truly random nature of the sample is lost to some extent.
11. Answer : (c) [< TOP >](#)
Reason : The expected value and variance of the standard normal probability distribution are 0 and 1 respectively.
12. Answer : (b) [< TOP >](#)
Reason : A type II error occurs when the null hypothesis is accepted though it is false.
13. Answer : (b) [< TOP >](#)
Reason : The cyclical variation shows the long term behaviour of a variable, with reference to the secular trend line.

14. Answer : (b) [< TOP >](#)
Reason : When the population consists of well defined groups such that the elements of each group are homogeneous and the groups vary from each other, stratified sampling technique is used.
15. Answer : (c) [< TOP >](#)
Reason : The purpose of hypothesis testing is to make a judgement about the difference between the sample statistic and the hypothesized population parameter. The purpose of hypothesis testing is not to test the correctness of the sample statistics. Alternative (c) is not true. Alternatives (a), (b) and (d) are true.
16. Answer : (d) [< TOP >](#)
Reason : For a two tailed test of hypothesis at a significance level of 5%, the rejection region lies in each of the left and right tails to the extent of 2.5% of the area of the sampling distribution curve.



17. Answer : (d) [< TOP >](#)
Reason : F distribution is identified by a pair of degrees of freedom.
18. Answer : (d) [< TOP >](#)
Reason : (a) This is a wrong answer. If the covariance of two random variables X and Y is equal to zero then it can be said that the random variables are independent of each other. If the variables are dependent on each other then the covariance will assume any non-zero value.
(b) This is a wrong answer. If the coefficient of correlation is positive then we say that there is a

positive correlation between two variables.

(c) This is a wrong answer. If the coefficient of correlation is negative then we say that there is a negative correlation between two variables.

(d) This is the **correct** answer. If the covariance of two random variables X and Y is equal to zero then it can be said that the random variables are independent of each other.

(e) This is a wrong answer. If the covariance of the two random variables is zero it does not mean that the variances of the individual variables will be zero.

19. Answer : (b) [< TOP >](#)

Reason : The control chart which is plotted using the variability of individual characteristics of the output is known as R chart.

20. Answer : (d) [< TOP >](#)

Reason : When the pattern of $\bar{X}$ chart of a process is 'Hugging the center line', then it indicates that the variation has been reduced to a great extent.

21. Answer : (b) [< TOP >](#)

Reason : $X^2 = \sum \frac{(f_o - f_e)^2}{f_e}$, so, the main reason of X^2 being positive is that numerator is always positive.

22. Answer : (b) [< TOP >](#)

Reason : Multicollinearity reduces the effect of individual variables on the model. So It reduces the effect of any sensitivity analysis.

23. Answer : (b) [< TOP >](#)

Reason : Because people tend to spend less on goods when their prices are rising, Paasches index which bases on current weights, produces an index which has a downward bias.

24. Answer : (c) [< TOP >](#)

Reason : Alternatives (a), (b), (d) and (e) are not true. Alternative (c) is true.

25. Answer : (c) [< TOP >](#)

Reason : Standard error of estimate measures the variability, or scatter of the observed values of the dependent variable around the regression line.

26. Answer : (a) [< TOP >](#)

Reason : Laspeyres price index uses the quantities consumed during the base period as weights. When weighted average of relatives price index is computed using base year values as weights the price index simplifies to Laspeyres price index.

27. Answer : (d) [< TOP >](#)

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.

28. Answer : (a) [< TOP >](#)

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.

29. Answer : (b) [< TOP >](#)

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.

30. Answer : (b) [< TOP >](#)

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.

31. Answer : (c) < TOP >
Reason : The graph of continuous uniform distribution is flat. The other distributions have a peak.
32. Answer : (b) < TOP >
Reason : In hypothesis testing, if the level of significance is made smaller, the rejection region becomes smaller.
33. Answer : (c) < TOP >
Reason : A type II error occurs when the null hypothesis is accepted though it is false. Increasing the significance level increases the probability of rejecting the null hypothesis. Hence the probability of a type II error will decrease.
34. Answer : (c) < TOP >
Reason : An estimate of the population variance based on the combination of two sample results is known as a pooled estimate of variance.
35. Answer : (b) < TOP >
Reason : For a given sample data, if a hypothesis is rejected at the 3% level of significance, it must also be rejected at the 5% level of significance. It may or may not be rejected at the 2% significance level depending upon the position of the test statistic on the sampling distribution.
36. Answer : (c) < TOP >
Reason : If two independent large samples are taken from two populations, the sampling distribution of the difference between the two sample means can be approximated by a normal distribution.
37. Answer : (d) < TOP >
Reason : The sampling distribution for a goodness of fit test is the chi-square distribution.
38. Answer : (b) < TOP >
Reason : In conducting either a goodness of fit or contingency table test, the larger the differences between the observed and expected frequencies the more likely it is that the null hypothesis will be rejected.
39. Answer : (d) < TOP >
Reason : The most appropriate example of a discrete random variable is the number of passengers in a randomly selected bus.
40. Answer : (d) < TOP >
Reason : Whenever the population standard deviation is unknown, the population has a normal or near-normal distribution and the sample size is small, t distribution is used in developing an interval estimation.
41. Answer : (d) < TOP >
Reason : The sampling proportion is large as $n/N > 0.05$ (given)
Therefore we will use finite population correction factor to find standard error of mean,

$$\hat{\sigma}_{\bar{x}} = \frac{\sigma}{\sqrt{n}} \sqrt{\frac{N-n}{N-1}} = \frac{1.2}{\sqrt{n}} \sqrt{\frac{700-n}{699}}$$

Since the statistician selected a large sample (this means $n > 30$), the appropriate distribution is normal distribution.

Given : $p(4.2317 < X < 4.7683) = 0.899$

$$\Rightarrow Z = \pm 1.64$$

$$\therefore 4.2317 = \bar{x} - 1.64 \hat{\sigma}_{\bar{x}} \quad \text{-----} \quad \text{(A)}$$

$$4.7683 = \bar{x} + 1.64 \hat{\sigma}_{\bar{x}} \quad \text{-----} \quad \text{(B)}$$

Subtracting (A) from (B)

$$0.5366 = 3.28 \hat{\sigma}_{\bar{x}}$$

$$\text{or } 3.28 \times \hat{\sigma}_{\bar{x}} = 0.5366$$

$$\text{or } \hat{\sigma}_x = \frac{0.5366}{3.28}$$

Since the sampling fractions exceeds 5%,

$$\hat{\sigma}_x = \frac{s}{\sqrt{n}} \sqrt{\frac{N-n}{N-1}} = \frac{1.2}{\sqrt{n}} \sqrt{\frac{700-n}{699}}$$

$$\therefore \frac{1.2}{\sqrt{n}} \sqrt{\frac{700-n}{699}} = \frac{0.5366}{3.28}$$

Squaring both sides

$$\frac{(1.2)^2}{n} \times \frac{700-n}{699} = \left(\frac{0.5366}{3.28} \right)^2$$

$$\text{or } \left(\frac{1.2 \times 3.28}{0.5366} \right)^2 (700-n) = 699n$$

$$\text{or } (53.8033 \times 700) - 53.8033n = 699n$$

$$\text{or } n = 50.03 \sim 50$$

42. Answer : (c)

[< TOP >](#)

Reason : Let the no. of medium sized software firms invited be 'n'

X = No. of invited firms who will send their representatives

X has a binomial distribution with parameter's 'n' and p = 0.60

$$\text{Given : } p(X = 10) = {}^n C_{10} (0.60)^{10} (0.40)^{n-10} = 0.19833$$

$$p(X = 11) = {}^n C_{11} (0.60)^{11} (0.40)^{n-11} = 0.16223$$

$$\frac{p(X = 10)}{p(X = 11)} = \frac{{}^n C_{10} (0.60)^{10} (0.40)^{n-10}}{{}^n C_{11} (0.60)^{11} (0.40)^{n-11}} = 1.222524$$

$$\frac{\frac{n!}{10!(n-10)!} \times \frac{0.40}{0.60}}{11!(n-11)!} = 1.222524$$

$$\text{or } \frac{11!(n-11)!}{10!(n-10)!} = 1.833786$$

$$\text{or } \frac{11}{n-10} = 1.833786$$

$$\text{or } n = \frac{11 + (1.833786 \times 10)}{1.833786} = 15.9985 \approx 16$$

43. Answer : (b)

[< TOP >](#)

Reason : Let the selling price for each portion be 'R'

Marginal profit (MP) = R - 32

Marginal loss (ML) = 32

∴ Minimum required probability of selling each portion of the dish

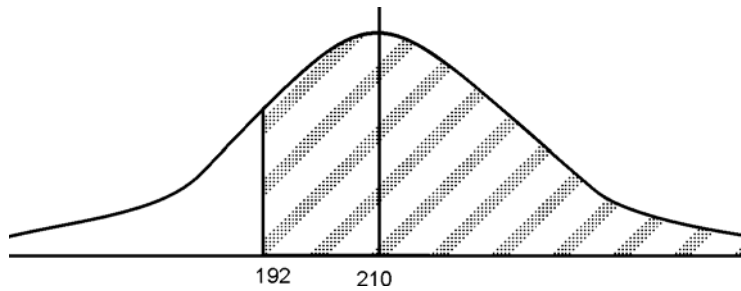
$$p^* = \frac{ML}{ML + MP} = \frac{32}{32 + R - 32} = \frac{32}{R}$$

According to the question this probability is satisfied at X = 96 x 2 = 192 portions

$$\Rightarrow p(X \geq 192) = p^* = \frac{32}{R}$$

Given: X (the number of portions of the dish, that is demanded) has a normal distribution units

$\mu = 210$ portions
and $\sigma = 50$ portions



$$\therefore p(X \geq 192) = p^*$$

$$\text{or } p(192 \leq X \leq 210) = p^* - 0.50 = \frac{32}{R} - 0.50$$

$$\text{or } p\left(\frac{192 - 210}{50} \leq z \leq \frac{210 - 210}{50}\right) = \frac{32}{R} - 0.50$$

$$\text{or } p(-0.36 \leq z \leq 0) = \frac{32}{R} - 0.50$$

$$\text{From tables } p(-0.36 \leq z \leq 0) = p(0 \leq z \leq 0.36) = 0.1406$$

$$\therefore 0.1406 = \frac{32}{R} - 0.50$$

$$\text{or } 0.6406 = \frac{32}{R}$$

$$\text{or } R = \frac{32}{0.6406} = 49.95 \approx 50 \quad \text{i.e. Rs.50}$$

44. Answer : (d)

[< TOP >](#)

$$\text{Reason : Total number of independent dealer accounts} = \frac{200}{(1 - 0.80)} \times 0.80 = 800$$

$$\text{Number of independent dealers surveyed} = 80$$

$$\text{Sampling fraction} = \frac{n}{N} = \frac{80}{800} = 0.10 > 0.05$$

Hence this can be treated as sampling done from a finite population.

$$\therefore \text{Proportion of excellent borrowers in the sample, } \bar{P} = \frac{60}{80} = 0.75$$

$$\bar{Q} = 1 - \bar{P} = 1 - 0.75 = 0.25$$

$$\text{Estimated standard error of proportion, } \hat{\sigma}_{\bar{P}} = \sqrt{\frac{\bar{P}\bar{Q}}{n}} \sqrt{\frac{N-n}{N-1}}$$

$$\sqrt{\frac{0.75 \times 0.25}{80}} \sqrt{\frac{800-80}{800-1}}$$

$$= 0.04841 \times 0.94928$$

$$= 0.04595$$

Since both $n\bar{P}$ and $n\bar{Q}$ are greater than 5, the sample can be treated as a large sample and normal distribution can be used. For a confidence level of 95%, $Z = \pm 1.96$

$$1.96 \hat{\sigma}_{\bar{P}} = 1.96 \times 0.04595 = 0.09006$$

Confidence interval for the proportion of accounts in the independent dealer category who are in the excellent standing =

$$0.75 \pm 0.09006$$

$\therefore$ Confidence interval for the absolute number of accounts in that category

$$= (0.75 \times 800) \pm (0.09006 \times 800)$$

$$= 600 \pm 72$$

45. Answer : (b)

[< TOP >](#)

Reason : Sample mean price (in Rs.), $\bar{x}$ =

$$\frac{150 + 140 + 155 + 145 + 143 + 132 + 131 + 137 + 139 + 138}{10} = 141$$

Sample variance s^2 =

$$\left[\frac{(150-141)^2 + (140-141)^2 + (155-141)^2 + (145-141)^2 + (132-141)^2 + (131-141)^2 + (137-141)^2 + (139-141)^2 + (138-141)^2}{10-1} \right] = \frac{508}{9}$$

$$\therefore \text{Sample standard deviation, } s = \sqrt{s^2} = \sqrt{\frac{508}{9}} = 7.513$$

$$\text{Estimated standard error of mean, } \hat{\sigma}_{\bar{x}} = \frac{s}{\sqrt{n}} = \frac{7.513}{\sqrt{10}} = 2.376$$

Since the sample is small (< 30) and the population standard deviation is not known, the t distribution is appropriate.

$\therefore$ For 95% confidence level and degrees of freedom $= 10 - 1 = 9$, $t = \pm 2.262$

$$\therefore \text{Confidence interval for the true mean price} = 141 \pm (2.262 \times 2.376) = 141 \pm 5.375$$

46. Answer : (e)

[< TOP >](#)

Reason : Let the following notations be used:

X = Advertisement expenditure

Y = Sales

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

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

$$\sum XY = 6,07,010 \quad \sum X = 701 \quad \sum Y = 5,100$$

$$\sum X^2 = 83,511 \quad n = 6$$

$$b = \frac{6(6,07,010) - (701 \times 5,100)}{6(83,511) - (701 \times 701)} = \frac{66,960}{9,665} = 6.9281$$

$$a = \bar{Y} - b\bar{X} = \left(\frac{5,100}{6} \right) - 6.9281 \left(\frac{701}{6} \right) = 40.567$$

$\therefore$ Regression equation is $\hat{Y} = 40.567 + 6.9281X$

47. Answer : (d)

[< TOP >](#)

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

Given:

$$n = 6 \quad \sum X = 30 \quad \sum X^2 = 200 \quad \sum XY = 1000$$

$$\sum Y = 180$$

$$\therefore b = \frac{(6 \times 1000) - (30 \times 180)}{(6 \times 200) - (30)^2} = 2$$

$$a = \bar{Y} - b\bar{X} = \frac{180}{6} - 2\left(\frac{30}{6}\right) = 20$$

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

$$\sum Y^2 = 5642$$

$$\therefore s_e = \sqrt{\frac{5642 - (20 \times 180) - (2 \times 1000)}{6 - 2}} = 3.24$$

48. Answer : (d)

[< TOP >](#)

Reason : The probability that a randomly selected person does not support Team B = $0.50 + 0.20 = 0.70 = p$.

Then the probability that he/she supports Team B is $1 - 0.70 = 0.30 = q$

Therefore we can assume that it follows a binomial distribution with probability of success (does not support Team B), $p = 0.70$ and probability of failure (supports Team B), $q = 0.30$.

The probability that at least six out of eight persons chosen does not support Team B is

$$\begin{aligned} P(6) + P(7) + P(8) &= {}^8C_6 \times (0.70)^6 \times (0.30)^2 + {}^8C_7 \times (0.70)^7 \times (0.30)^1 + {}^8C_8 \times (0.70)^8 \times (0.30)^0 \\ &= 0.2965 + 0.19765 + 0.057648 \\ &= 0.552 \text{ (approx.)} \end{aligned}$$

49. Answer : (c)

[< TOP >](#)

Reason : $H_0 : B = 0$ (There is no linear relationship)

$H_1 : B \neq 0$ (There is a linear relationship)

Standard deviation of the slope of the estimated regression line (S_b)

$$\begin{aligned} &= \frac{S_e}{\sqrt{\sum X^2 - n\bar{X}^2}} \\ &= \frac{3.24}{\sqrt{200 - 6 \times 5^2}} = 0.46 \end{aligned}$$

$$\text{Test statistic} = \frac{b - B_0}{S_b} = \frac{2 - 0}{0.46} = 4.35$$

Distribution : $t_{6-2} = t_4$ distribution

Critical values (two tailed test) = ± 3.747

We see that the observed value of the test statistic falls in the critical region

$\therefore$ We reject H_0 and conclude that $B \neq 0$, i.e., there is a linear relationship between variables X and Y.

50. Answer : (a)

[< TOP >](#)

Reason : Standard error of mean for sample size 'a' = $\frac{\sigma}{\sqrt{a}} = 2.4 = A$

Standard error of mean for sample size 'b' = $\frac{\sigma}{\sqrt{b}} = 2.0 = B$

$$\frac{A}{B} = \frac{2.4}{2.0}$$

or $\frac{\sigma/\sqrt{a}}{\sigma/\sqrt{b}} = 1.2$

or $\frac{\sigma}{\sqrt{a}} \times \frac{\sqrt{b}}{\sigma} = 1.2$

or $\sqrt{\frac{b}{a}} = 1.2$

or $b = 1.44a$

Sample size = $a + b = a + 1.44a = 2.44a$

$\therefore$ Standard error of mean for sample size 'a + b'

$$= \frac{\sigma}{\sqrt{a+b}} = \frac{\sigma}{\sqrt{2.44a}}$$

$$= \frac{1}{\sqrt{2.44}} \times \frac{\sigma}{\sqrt{a}}$$

$$= \frac{1}{\sqrt{2.44}} \times 2.4$$

$$= 1.536$$

51. Answer : (d)

[<TOP>](#)

Reason : Proportion of variation in Y, that is not explained by the regression line = 1- Coefficient of determination (r^2)

$$r^2 = \frac{a \sum y + b \sum XY - n \bar{Y}^2}{\sum Y^2 - n \bar{Y}^2}$$

$$\sum Y = 140 \quad \sum Y^2 = 1982 \quad n = 10$$

$$b = \frac{n \sum XY - \sum X \cdot \sum Y}{n \sum X^2 - (\sum X)^2} = \frac{(10 \times 8190) - (580 \times 140)}{(10 \times 34000) - (580 \times 580)} = 0.1944$$

$$a = \bar{Y} - b\bar{X} = \left(\frac{140}{10}\right) - 0.1944 \times \left(\frac{580}{10}\right) = 2.7248$$

$$r^2 = \frac{(2.7248 \times 140) + (0.1944 \times 8190) - (10 \times 14^2)}{1982 - (10 \times 14^2)}$$

$$= \frac{13.608}{22} = 0.6185$$

$\therefore$ Proportion of variation in Y that is not explained by the regression line

$$= 1 - r^2$$

$$= 1 - 0.6185 = 0.3815$$

⇒ Percentage of variations in Y that is not explained by the regression line
= 38.15%

52. Answer : (e)

[< TOP >](#)

Reason : Let the following notations be used:

X : Sales (Rs in lakhs)

Y : Operating costs (Rs in lakhs)

A	X	126	160	164	175	156	170	166	163	ΣX	= 1280
B	Y	110	124	130	135	115	134	132	128	ΣY	= 1008
C	$X - \bar{X}$	-34	0	4	15	-4	10	6	3		
D	$Y - \bar{Y}$	-16	-2	4	9	-11	8	6	2		
E	$(X - \bar{X})^2$	1156	0	16	225	16	100	36	9	$\Sigma(X - \bar{X})^2$	= 1558
F	$(Y - \bar{Y})^2$	256	4	16	81	121	64	36	4	$\Sigma(Y - \bar{Y})^2$	= 582
G	$C \times D$	544	0	16	135	44	80	36	6	$\Sigma(X - \bar{X})(Y - \bar{Y})$	= 861

$$\bar{X} = \frac{\Sigma X}{n} = \frac{1280}{8} = 160$$

$$\bar{Y} = \frac{\Sigma Y}{n} = \frac{1008}{8} = 126$$

$$r = \frac{\Sigma(X - \bar{X})(Y - \bar{Y})}{\sqrt{\Sigma(X - \bar{X})^2 \Sigma(Y - \bar{Y})^2}} = \frac{861}{\sqrt{1558 \times 582}} =$$

0.9042

53. Answer : (c)

[< TOP >](#)

Reason : $\bar{X} = 24$

$$s^2 \text{ (Variance)} = 10.24$$

$$n = 25 \quad N = 600$$

$$\text{Sampling fraction, } \frac{n}{N} = \frac{25}{600} = 0.042 < 0.05$$

$$\therefore \text{Estimated standard error of mean, } \hat{\sigma}_{\bar{X}} = \frac{s}{\sqrt{n}} = \frac{\sqrt{10.24}}{\sqrt{25}} = 0.64$$

Since the sample size is less than 30 and population variance is not known the t distribution will be used with 24 degrees of freedom.

t-values for the upper and lower confidence limits are ± 2.064

$$\therefore \text{Upper confidence limit} = \bar{X} + 2.064 \hat{\sigma}_{\bar{X}} = 24 + 2.064 \times 0.64 = 25.32 \text{ kg.}$$

$$\text{Lower confidence limit} = \bar{X} - 2.064 \hat{\sigma}_{\bar{X}} = 24 - 2.064 \times 0.64 = 22.68 \text{ kg.}$$

54. Answer : (b)

[< TOP >](#)

Reason : A multiple regression equation is obtained by solving the following equations:

$$\sum Y = na + b_1 \sum X_1 + b_2 \sum X_2$$

$$\sum X_1 Y = a \sum X_1 + b_1 \sum X_1^2 + b_2 \sum X_1 X_2$$

$$\sum X_2 Y = a \sum X_2 + b_1 \sum X_1 X_2 + b_2 \sum X_2^2$$

Putting in the relevant values in the equation :

$$300 = 11a + 490 b_1 + 160 b_2 \dots\dots\dots(A)$$

$$13377 = 490a + 21862 b_1 + 7122 b_2 \dots\dots\dots(B)$$

$$4377 = 160a + 7122 b_1 + 2342 b_2 \dots\dots\dots(C)$$

Multiplying (A) by 490 and (B) by 11, and subtracting (B) from (A):

147000	=	5390a	+	240100 b ₁	+	78400 b ₂
147147	=	5390a	+	240482 b ₁	+	78342 b ₂
—		—		—		—
— 147	=			— 382 b ₁		+ 58 b ₂

$$\therefore 147 = 382 b_1 - 58b_2 \dots\dots\dots(D)$$

Multiplying (B) by 160 and (C) by 490, and subtracting (C) from (B):

2140320	=	78400a	+	3497920b ₁	+	1139520b ₂
2144730	=	78400a	+	3489780b ₁	+	1147580b ₂
—		—		—		—
— 4410	=			8140b ₁	—	8060b ₂

$$\therefore 4410 = -8140 b_1 + 8060 b_2 \dots\dots\dots(E)$$

Multiplying (D) by 8140 and (E) by 382, and adding the two equations:

1196580	=	3109480 b ₁	—	472120 b ₂
1684620	=	— 3109480 b ₁	+	3078920 b ₂
2881200	=	2606800 b ₂		

$$\text{or } b_2 = \frac{2881200}{2606800} = 1.1053$$

Putting the value of b₂ in (D) :

$$147 = 382 b_1 - 58 \times 1.1053$$

$$\text{or } b_1 = \frac{147 + 64.1074}{382} = 0.5526$$

Putting the values of b₁ and b₂ in (A):

$$300 = 11a + (490 \times 0.5526) + (160 \times 1.1053)$$

$$\text{or } 11a = -147.622 \quad \therefore a = \frac{-147.622}{11} = -13.42$$

$\therefore$ The multiple regression equation is :

$$\hat{Y} = -13.42 + 0.5526X_1 + 1.1053X_2$$

55. Answer : (c)

[< TOP >](#)

Reason : Expected number of patients coming to the OPD everyday =

$$(100 \times 0.10) + (110 \times 0.25) + (120 \times 0.30) + (130 \times 0.35) = 119$$

56. Answer : (c) [< TOP >](#)

Reason : For a binominal distribution:

$$\text{Variance} = np(1 - p)$$

$$\therefore 2.4^2 = n(0.6)(1 - 0.6)$$

$$\text{or } n = \frac{2.4^2}{0.6 \times 0.4} = 24$$

57. Answer : (b) [< TOP >](#)

Reason : Expected return $E(x) = (-10 \times 0.10) + (5 \times 0.20) + (20 \times 0.40) + (30 \times 0.30)$
 $= 17$

$$\begin{aligned}\text{Variance of returns } V(x) &= \sum [X_i - E(X_i)]^2 p_i \\ &= (-10 - 17)^2 0.10 + (5 - 17)^2 0.20 + (20 - 17)^2 0.40 + (30 - 17)^2 0.30 \\ &= 156 (\%)^2\end{aligned}$$

$$\text{Standard deviation of returns} = \sqrt{V(X)} = \sqrt{156} = 12.49\%$$

58. Answer : (b) [< TOP >](#)

$$\text{Reason : } r_{x,y} = \frac{\text{CoV}(X, Y)}{\sigma_x \sigma_y} = \frac{168}{\sqrt{441 \times 256}} = 0.50$$

59. Answer : (d) [< TOP >](#)

$$\text{Reason : } \sqrt{\frac{\sum (Y - \hat{Y})^2}{n - 2}} = 8$$

$$\therefore \frac{\sum (Y - \hat{Y})^2}{n - 2} = 64$$

$$\text{or } \frac{1024}{64} = n - 2$$

$$\text{or } n = 16 + 2 = 18$$

60. Answer : (a) [< TOP >](#)

$$\text{Reason : Relative cyclical residual} = \frac{Y - \hat{Y}}{\hat{Y}} \times 100 = \frac{78000 - 72000}{72000} \times 100 = 8.33$$

61. Answer : (c) [< TOP >](#)

$$\text{Reason : Fratio} = \frac{\text{Estimate based on the variance among sample means}}{\text{Estimate based on the variances within the samples}}$$

$$= \frac{6.724}{2.248} = 2.991$$

62. Answer : (b) [< TOP >](#)

Reason : The applicable distribution is F distribution

No. of degrees of freedom for the numerator of the F statistic

$$= \text{No. of samples} - 1$$

$$= 3 - 1 = 2$$

No. of degrees of freedom for the denominator of the F statistic

$$= \text{Total sample size} - \text{No. of samples}$$

$$= 16 - 3 = 13$$

From F table, $F_{2,13}(\alpha = 0.05) = 3.81$

∴ Critical value = 3.81

63. Answer : (c)

[< TOP >](#)

Reason : X and Y are independent

$$\begin{aligned}\therefore V(Z) &= V(2X + 4Y) = 2^2V(X) + 4^2V(Y) \\ &= 4 \times 6.25 + 16 \times 2.25 \\ &= 61\end{aligned}$$

64. Answer : (b)

[< TOP >](#)

Reason : Sample standard deviation(s) = $\sqrt{\frac{\sum x^2}{n-1} - \frac{n\bar{x}^2}{n-1}} = \sqrt{\frac{7360}{15} - \frac{16 \times 20^2}{15}} = 8$

$$\bar{x} = \frac{\sum x}{n} = \frac{320}{16} = 20$$

$$\text{Estimated standard error of mean} = \frac{S}{\sqrt{n}} = \frac{8}{\sqrt{16}} = 2$$

65. Answer : (d)

[< TOP >](#)

Reason : Let the following notations be used:

X : Years

x : Coded value of year

Y : Production of sunflower oil (thousand liters)

X	$x = X - \bar{X}$	Y	xY	x^2
1997	-3	80	-240	9
1998	-2	90	-180	4
1999	-1	92	-92	1
2000	0	85	0	0
2001	1	94	94	1
2002	2	100	200	4
2003	3	95	285	9
		$\sum Y = 636$	$\sum xY = 67$	$\sum x^2 = 28$

$$\sum X = 14000$$

$$\therefore \bar{X} = \frac{14000}{7} = 2000$$

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

$$b = \frac{\sum xY}{\sum x^2} = \frac{67}{28} = 2.393$$

$$a = \bar{Y} = \frac{636}{7} = 90.857$$

$$\therefore \hat{Y} = 90.857 + 2.393x$$

For the year 2004: $x = 2004 - 2000 = 4$

∴ Estimated sugar production = $90.857 + (2.393 \times 4) = 100.429$ (thousand liters)

i.e. 100429 liters

66. Answer : (a)

[< TOP >](#)

Reason : A simple regression equation is of the form:

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

Given:

$$\text{If } X = 10, \quad \hat{Y} = 94 \therefore 94 = a + 10b \dots\dots\dots (A)$$

$$\text{If } X = 15, \quad \hat{Y} = 126 \quad \therefore 126 = a + 15b \dots\dots\dots (B)$$

Subtracting (A) from (B) we get:

$$32 = (15 - 10)b$$

$$32 = 5b$$

$$\text{or } b = \frac{32}{5} = 6.4$$

Putting the values of b in (B):

$$126 = a + 15 \times 6.4$$

$$\text{or } a = 126 - 96 = 30$$

$$\therefore \hat{Y} = 30 + 6.4X$$

$$\bar{Y} - b\bar{X} = \left(\frac{\sum Y}{n} \right) - b\bar{X}$$

Now, a =

$$\bar{X} = \left[\left(\frac{\sum Y}{n} \right) - a \right] \frac{1}{b} = \left[\left(\frac{660}{6} \right) - 30 \right] \frac{1}{6.4} = 12.5$$

$\therefore$ Mean of the observed values of X, i.e. $\bar{X} = 12.5$

67. Answer : (a)

[< TOP >](#)

Reason : Let the linear trend equation be : $\hat{Y} = a + bx$

$x = X - 1999$ where X = time variable (year)

Given:

X	2000	2001	2002
$x = X - 1999$	1	2	3
Y	66.55	75.26	77.91
$\frac{Y - \hat{Y}}{\hat{Y}} \times 100$	10	6	
$\hat{Y}$	60.5	71	81.5*

* Calculated below

$$2000: \quad \frac{Y - \hat{Y}}{\hat{Y}} \times 100 = 10$$

$$\text{or } \frac{66.55 - \hat{Y}}{\hat{Y}} \times 100 = 10$$

$$\text{or } \frac{66.55}{\hat{Y}} \times 100 = 110 \quad \text{or} \quad \hat{Y} = \frac{66.55}{110} \times 100 = \text{Rs.} 60.5 \text{ lakh}$$

$$2001: \quad \frac{Y - \hat{Y}}{\hat{Y}} \times 100 = 6$$

$$\text{or } \frac{75.26 - \hat{Y}}{\hat{Y}} \times 100 = 6$$

$$\text{or } \frac{75.26}{\hat{Y}} \times 100 = 106 \quad \text{or} \quad \hat{Y} = \frac{75.26}{106} \times 100 = \text{Rs.} 71 \text{ lakh.}$$

∴ From above we have

$$60.5 = a + b(1) \quad \text{i.e. } 60.5 = a + b \quad (A)$$

$$71 = a + b(2) \quad \text{i.e. } 71 = a + 2b \quad (B)$$

$$\therefore b = \frac{71 - 60.5}{2 - 1} = 10.5$$

Putting the value of b in (A) we get

$$a = 60.5 - 10.5 = 50$$

∴ The linear trend equation is: $\hat{Y} = 50 + 10.5x$

Estimated value of Y for year 2002:

$$X = 2002 \quad \therefore x = 2002 - 1999 = 3$$

$$\hat{Y} = 50 + 10.5(3) = 81.5$$

Relative cyclical residual for 2002:

$$\frac{Y - \hat{Y}}{\hat{Y}} \times 100 = \frac{78.24 - 81.5}{81.5} \times 100 = -4$$

68. Answer : (d)

[< TOP >](#)

Reason : Proportion of men's clothing stores in Thane which were sampled and found to carry the

$$\text{products of the firm, } \bar{p} = \frac{1}{3+1} = 0.25$$

$$\text{Sample size, } n = \frac{10}{0.25} = 40$$

$$H_0 : p = 0.30$$

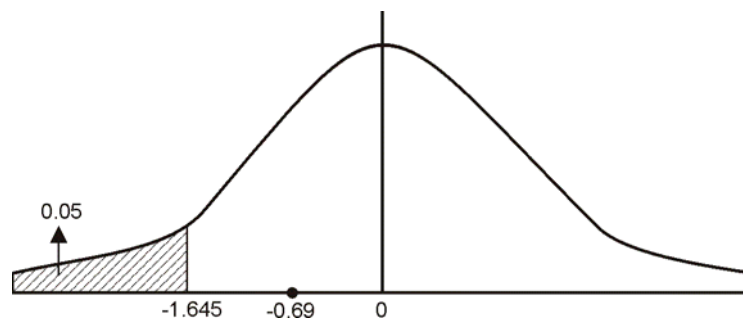
$$H_1 : p < 0.30$$

$$\text{Standard error of proportion, } \sigma_{\bar{p}} = \sqrt{\frac{p_{H_0} q_{H_0}}{n}} = \sqrt{\frac{0.30(1-0.30)}{40}} = 0.07246$$

Since both np and nq are more than 5 we can use the normal distribution as an approximation to the sampling distribution. At a significance level of 5%, the critical value for the test is -1.645.

The standardized value of the sample proportion,

$$Z = \frac{\bar{p} - p_{H_0}}{\sigma_{\bar{p}}} = \frac{0.25 - 0.30}{0.07246} = -0.69$$



From above we can see that the standardized proportion falls in the acceptance region.

Hence the null hypothesis is accepted. It can be concluded at a significance level of 5%, that the percentage of men's clothing stores in Thane which carry its products is not significantly less than the percentage in Mumbai.

69. Answer : (b)

[< TOP >](#)

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

$$\sum P_1 Q_0 = (900 \times 12) + (15.50 \times 160) + (130 \times 16) + (16 \times 500) + (13.50 \times 350) = 28085$$

$$\sum P_0 Q_0 = (700 \times 12) + (14.50 \times 160) + (100 \times 16) + (14 \times 500) + (12 \times 350) = 23520$$

$$\sum P_1 Q_1 = (900 \times 10) + (15.50 \times 140) + (130 \times 15) + (16 \times 490) + (13.50 \times 400) = 26360$$

$$\sum P_0 Q_1 = (700 \times 10) + (14.50 \times 140) + (100 \times 15) + (14 \times 490) + (12 \times 400) = 22190$$

$$\therefore \text{Fisher's ideal price index for year 2003} = \sqrt{\frac{28085}{23520} \times \frac{26360}{22190}} \times 100 = 119.10$$

70. Answer : (a)

[< TOP >](#)

Reason : The test statistic =
$$\frac{(n-1)S^2}{\sigma^2}$$

$$= \frac{(31-1)(15.9)^2}{(13)^2} = 44.88$$

The test statistic has a Chi-square distribution with $31 - 1 = 30$ degrees of freedom

71. Answer : (c)

[< TOP >](#)

Reason : The test statistic =
$$\frac{S_1^2}{S_2^2} = \frac{17^2}{7.5^2} = 5.14$$

The test statistic has a F distribution with $21 - 1 = 20$ degrees of freedom in the numerator and $25 - 1 = 24$ degrees of freedom in the denominator.

[< TOP OF THE DOCUMENT >](#)