

Question Paper

Quantitative Methods -II (MSF1B2): July 2007

- Answer all questions.
- Marks are indicated against each question.

1. Consider the following sample of paired observations:

[< Answer >](#)

X	3	4	7	6	5
Y	15	12	10	11	13

The covariance between X and Y is

- (a) -2.75
- (b) -2.20
- (c) -1.75
- (d) 1.75
- (e) 3.75.

(1 mark)

2. Consider the following Distribution:

[< Answer >](#)

X	0	1	2	3
P(X = x)				

Expected value of X is

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

(1 mark)

3. Consider the following joint probability distribution.

[< Answer >](#)

X	-2	-1	0	-1	0
Y	1	0	1	2	0
P(X, Y)	0.1	0.2	0.1	0.3	0.3

If $Z = (X + Y)$, then the value of $V(Z)$ is

- (a) 0.79
- (b) 0.69
- (c) 0.59
- (d) 0.49
- (e) 0.39.

(1 mark)

4. If X follows a binomial distribution with mean 4.5. We know that probability of zero success is 0.00001 and probability of one success is 0.00045. Then what is the probability of exactly two successes?

[< Answer >](#)

- (a)
- (b)
- (c)
- (d)
- (e)

(1 mark)

5. Daily demand for ice-creams at a stall follows Binomial distribution with $n = 5$ and $p =$. There is a profit of Rs.2 for every ice-cream sold and there is a loss of Re.1 for every ice-cream unsold. If 5 ice-creams are available for sale, then expected net profit per day is

[< Answer >](#)

- (a) Rs.25

- (b) Rs.20
- (c) Rs.15
- (d) Rs.10
- (e) Rs. 5.

(2 marks)

[< Answer >](#)

6. Which of the following statements is **not true**?

- (a) In discrete uniform distribution probability of happening of any event is constant
- (b) If Bernoulli experiment is repeated without replacement we use hypergeometric distribution
- (c) The hypergeometric distribution may be replaced by the binomial distribution if is large enough
- (d) The standard normal distribution is a normal distribution with mean $\mu = 0$ and a standard deviation $\sigma = 1$
- (e) The F-distribution is the distribution of the ratio of two random variables. Both random variables have yet another distribution, called the Chi-square distribution.

(1 mark)

[< Answer >](#)

7. Which of the following statements are **true** regarding binomial distribution?

- I. Each trial has only two possible outcomes.
 - II. The trials are statistically independent.
 - III. The probability of the outcome of any trial remains fixed over time.
 - IV. Mean of the distribution is always less than variance.
- (a) Both (I) and (II) above
 - (b) Both (II) and (III) above
 - (c) Both (III) and (IV) above
 - (d) (I), (II) and (III) above
 - (e) All (I), (II), (III) and (IV) above.

(1 mark)

[< Answer >](#)

8. If X follows continuous uniform distribution. It's probability density function is given by

What is the variance of the distribution?

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

(1 mark)

9. Which of the following statement(s) is/are **true** regarding the Lognormal Distribution?

[< Answer >](#)

- I. If $Y = \ln(X)$ is normally distributed random variable, then X is said to be a lognormal variable.
 - II. If $Y = \ln(X)$ is normally distributed random variable, then Y is said to be a lognormal variable.
 - III. In finance "Continuous compounded returns are required to be normal". This property is described as "Stock Prices are Lognormal".
- (a) Only (I) above
 - (b) Only (II) above
 - (c) Only (III) above
 - (d) Both (I) and (III) above
 - (e) All (I), (II) and (III) above.

(1 mark)

10. A normal variable has a mean of 10 and a standard deviation of 5. What is the probability that the normal variable will take a value in the interval 10 to 19.8?

[< Answer >](#)

- (a) 0.475
- (b) 0.950
- (c) 0.238
- (d) 0.575
- (e) 0.675.

(1 mark)

11. Which of the following statement(s) is/are **true** regarding decision theory assumptions?

[< Answer >](#)

- I. The decision maker can define all decision alternatives or strategies which are being considered.

- II. The decision maker can define the various states of nature for the decision setting which are not under control.
 III. The decision maker can estimate quantitatively the consequences (benefits or costs) of selecting any decision alternative and having any state of nature occurrence.
- (a) Only (I) above
 (b) Only (II) above
 (c) Only (III) above
 (d) Both (II) and (III) above
 (e) All (I), (II) and (III) above.

(1 mark)

12. A discounting clothing store chain purchases trousers from a manufacturer for Rs.150 each. The store will initially sell the trouser for Rs. 200 each. It will then sell all unsold items for Rs.125 each to another discounter.

[< Answer >](#)

Historical data have been gathered which confirm that monthly demand for the item assumes three possible values. The following table gives this demand information along with their respective probabilities of occurrence. The store is trying to decide how many units of the item to stock in a month.

Estimate of demand	Probability
300	0.23
500	0.43
800	0.34

What is the expected (average) profit corresponding to the quantity which maximizes expected monthly profit?

- (a) Rs.15,000
 (b) Rs.15,750
 (c) Rs.21,550
 (d) Rs.21,700
 (e) Rs.22,000.

(2 marks)

13. Ruchi Pizza Shoppe features pizzas. The cost of preparation (including labor charges) comes to Rs.9.00 and the selling price is Rs.15.00 per pizza. Data taken from last year indicate that demand for pizzas is normally distributed with mean $\mu = 145$ pizzas and standard deviation, _____ pizzas. How many pizzas should the shop prepare so as to reduce losses from spoilage? (Round off your answer to the nearest integer)

[< Answer >](#)

- (a) 132
 (b) 134
 (c) 136
 (d) 138
 (e) 140.

(2 marks)

14. A stock-out may lead to losses on account of which of the following statements?

[< Answer >](#)

- I. Loss of potential customers.
 II. Loss of goodwill among existing customers.
 III. The need to make emergency purchases at high cost either to satisfy the demand or keep the production line moving.
 IV. Idle time costs when the production has to temporarily halted till the quantity ordered is received in stores.
- (a) Both (I) and (II) above
 (b) Both (III) and (IV) above
 (c) (I), (II) and (III) above
 (d) (II), (III) and (IV) above
 (e) All (I), (II), (III) and (IV) above.

(1 mark)

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

[< Answer >](#)

- (a) A population is a collection of all the data points being studied
 (b) A sample is a part of a population
 (c) If we want to draw some conclusions about a population, we can do so by studying a suitable sample of the population
 (d) In destructive testing, sampling is the only available course
 (e) Sampling involves more work as compared with a census.

(1 mark)

16. Which of the following statement(s) is/are **true** regarding advantages of sampling?

[< Answer >](#)

- I. A study of a sample is usually cheaper than a study of the population.
 - II. Sampling usually provides information quicker than a census so that timely decisions can be taken.
 - III. In sampling the chances of errors while processing the data are more.
- (a) Only (I) above
 - (b) Only (II) above
 - (c) Only (III) above
 - (d) Both (I) and (II) above
 - (e) All (I), (II) and (III) above.

(1 mark)

17. Which of the following statement(s) is/are **true** regarding sampling?

[< Answer >](#)

- I. In Simple Random Sampling each possible sample has an equal chance of being selected.
 - II. In Systematic Sampling each element has an equal chance of being selected, but each sample does not have the same chance of being selected.
 - III. In Stratified Sampling, the population is first subdivided into strata and a sample is selected from each stratum at random.
- (a) Only (I) above
 - (b) Only (II) above
 - (c) Only (III) above
 - (d) Both (I) and (II) above
 - (e) All (I), (II) and (III) above.

(1 mark)

18. Which of the following statement(s) is/are **true** regarding estimation?

[< Answer >](#)

- I. If an estimate of a population parameter is given by a single value, then the estimate is called an interval estimate.
 - II. If an estimate of a population parameter is given by two distinct numbers between which the parameter may be considered to lie, then the estimate is called a point estimate.
 - III. The interval estimate indicates the accuracy (or precision) of an estimate.
- (a) Only (I) above
 - (b) Only (II) above
 - (c) Only (III) above
 - (d) Both (I) and (II) above
 - (e) All (I), (II) and (III) above.

(1 mark)

19. A random sample of size 9 is selected from a symmetrical population with a unique mode. The sample mean and standard deviation are 150 and 25 respectively. What is the 95% confidence interval in which the populations mean (μ) will lie?

[< Answer >](#)

- (a) (120.78, 149.22)
- (b) (125.78, 159.22)
- (c) (130.78, 169.22)
- (d) (135.78, 179.22)
- (e) (140.78, 189.22).

(2 marks)

20. Which of the following statements 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)

21. Each day, the Indian Customs Service has historically intercepted about Rs. 28 million in contraband goods being smuggled into the country, with a standard deviation of Rs. 16 million per day. On 64 randomly chosen days in 1999, the Indian Customs Service intercepted an average of Rs. 30.3 million in contraband goods. The Customs Commissioner wants to test at a significance level of 5% whether the smuggling has increased above its historic level.

[< Answer >](#)

Which of the following conclusions can be drawn on the basis of the above test?

- (a) The average daily smuggling intercepted is same as the historic level
- (b) The sample mean is incorrect
- (c) The average daily smuggling intercepted is more than the historic level
- (d) The average daily smuggling intercepted is less than the historic level

- (e) The standard deviation in the smuggling intercepted has not increased significantly.

(2 marks)

22. Bindu Products Ltd. sells automatic electric ovens. It has found out that the average commission paid to the salesmen in the electric appliance industry is Rs. 54 per unit sold with a standard deviation of Rs. 12. It has taken a random sample of 36 salesmen recruited by it and has found that the average commission paid by it is Rs. 58 per unit sold. We want to test at 10% significance level whether the company is paying higher commission to its salesmen than the industry average.

[< Answer >](#)

Which of the following is the **appropriate** alternative hypothesis?

- (a) $H_1 : \mu \neq 54$
 (b) $H_1 : \mu > 54$
 (c) $H_1 : \mu < 54$
 (d) $H_1 : \mu = 58$
 (e) $H_0 : \mu = 54$.

(1 mark)

23. The following details are available with regard to a hypothesis test on difference between means of two populations:

[< Answer >](#)

H_0 :

H_1 :

$$n_1 = 16 \quad n_2 = 9$$

The samples are independently collected and it is assumed that the two populations have the same variance. The pooled estimate of the underlying common population variance is 217.032. The value of the test statistic is 0.1629. Which of the following is **true** with regard to _____? (Round off your answer to the nearest integer)

- (a) _____
 (b) _____
 (c) _____
 (d) _____
 (e) _____

(2 marks)

24. The following details are available with regard to a hypothesis test on means of two populations:

[< Answer >](#)

H_0 :

H_1 :

$$n_1 = 64$$

$$n_2 = 36$$

The samples collected from the two populations are independent.

What is the value of the test statistic?

- (a) 2.828
 (b) 0.125
 (c) 0.354
 (d) 1
 (e) 0.

(1 mark)

25. Which of the following statement(s) is/are **true** regarding Scatter Diagram?

[< Answer >](#)

- I. One of the easiest way of studying the correlation between the two variables is with the help of a scatter diagram.
 II. It gives an indication of the nature of the potential relationship between the variables.
 III. Using scatter diagram if the variables are related, we cannot see what kind of line, or estimating equation, describes this relationship.

- (a) Only (I) above
 (b) Only (II) above
 (c) Only (III) above
 (d) Both (I) and (II) above
 (e) All (I), (II) and (III) above.

(1 mark)

26. Which of the following statements are **true** regarding Pearson's coefficient of correlation?

[< Answer >](#)

- I. It lies between _____.

- II.
III.
IV.

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

(1 mark)

27. Which of the following statement(s) is/are **true** regarding Coefficient of Determination?

[< Answer >](#)

- I. It is the square of the correlation coefficient.
II. It explains to what extent the variation of a dependent variable is expressed by the independent variable.
III. A low value of it shows a good linear relationship between the two variables.

- (a) Only (I) above
(b) Only (II) above
(c) Only (III) above
(d) Both (I) and (II) above
(e) All (I), (II) and (III) above.

(1 mark)

28. The ranks of 5 students are given according to their marks in Statistics and Mathematics.

[< Answer >](#)

Student No.	1	2	3	4	5
Statistics	2	3	5	4	1
Mathematics	3	4	5	2	1

What is the Spearman's rank correlation coefficient?

- (a) 0.5
(b) 0.6
(c) 0.7
(d) 0.8
(e) 0.9.

(1 mark)

29. Students of the EAMCET batch are required to give a model examination before they sit for the main exam. The model exam is expected to give the students a chance of assessing their preparation under examination conditions. For a set of five students, the scores in the model exam and the corresponding main exam are as follows.

[< Answer >](#)

Student Number	Model Exam Score (X)	Main Exam Score (Y)
101	85	89
203	76	80
357	68	78
465	80	70
509	90	92

Construct a regression line for the plot of main exam score vs. model exam score. What is the predicted main exam score, when model exam score is 95? (Round off your answer to the nearest integer)

- (a) 90
(b) 91
(c) 92
(d) 93
(e) 94.

(2 marks)

30. Mr. Ruchirangadh, an investor, would like to find the expected return on the share of Himavarshini Oils Limited.

[< Answer >](#)

The following data have been gathered by him.

State of the Economy	Probability of Occurrence	Rate of Return on Share %
Boob	0.35	40
Normal	0.44	20

Recession	0.21	15
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What is the expected return from the shares?

- (a) 52.95%
- (b) 25.95%
- (c) 2.595%
- (d) 0.2595%
- (e) 5.295%.

(1 mark)

31. The following results are given for a set of paired data for variables X and Y:

[< Answer >](#)

Number of pairs of X and Y data = 10

$\sum X = 140$, $\sum Y = 150$,

$\sum (X - 10)^2 = 180$, $\sum (Y - 15)^2 = 215$, $\sum (X - 10)(Y - 15) = 60$.

What is the coefficient of correlation for the variables X and Y?

- (a) 0.855
- (b) 0.905
- (c) 0.915
- (d) 0.925
- (e) 0.935.

(1 mark)

32. The coefficient of correlation between 5X and 2Y is 0.60 and

[< Answer >](#)

What is the covariance between variables X and Y?

- (a) 300
- (b) 400
- (c) 500
- (d) 1500
- (e) 1200.

(1 mark)

33. Calculate the coefficient of correlation between variables X and Y, from the following data:

[< Answer >](#)

X	9	8	7	6	5	4	3	2	1
Y	15	16	14	13	11	12	10	8	9

- (a) 0.91
- (b) 0.93
- (c) 0.95
- (d) 0.97
- (e) 0.99.

(2 marks)

34. In which of the following conditions will the regression sum of squares for a simple regression relationship be equal to zero?

[< Answer >](#)

- (a) Correlation coefficient = 1
- (b) Correlation coefficient = -1
- (c) $0 < \text{Correlation coefficient} < 1$
- (d) $-1 < \text{Correlation coefficient} < 0$
- (e) Correlation coefficient = 0.

(1 mark)

35. Multicollinearity occurs in multiple regression analysis when

[< Answer >](#)

- (a) The residuals are correlated
- (b) Time is involved in the analysis
- (c) The independent variables are correlated
- (d) The residuals are not constant for all Y' values
- (e) The intercept is zero.

(1 mark)

36. The following information was obtained from the manager of a city water department for predicting the consumption of water (in gallons) from the size of household:

[< Answer >](#)

Household size = X

Water consumption = Y

$$\Sigma X = 57 \quad \Sigma Y = 10,038 \quad n = 10$$

$$\Sigma X^2 = 433 \quad \Sigma Y^2 = 11,641,474 \quad \Sigma XY = 67,669$$

The equation of the least squares regression for water consumption on household size is given by:

(a) $= 97053.7 + 96.692X$

(b) $= 999.220 + 0.803X$

(c) $= -1.0028 + 0.0067X$

(d) $= 452.656 + 96.692X$

(e) $= 1003.8 - 96.692$

(2 marks)

37. Consider following daily price changes of a share.

[< Answer >](#)

Day	0	1	2	3	4	5	6	7	8
Price	101.1	101.05	101.5	105	105.6	106.5	105.4	110	109

Identify number of runs.

(a) 3

(b) 4

(c) 5

(d) 6

(e) 7.

(2 marks)

38. Calculate $R_{1,23}$ using following information with regard to the correlations among variables X_1 , X_2 and X_3 :

[< Answer >](#)

r_{12} (Between X_1 and X_2) = 0.8, r_{13} (Between X_1 and X_3) = 0.5 and

r_{23} (Between X_2 and X_3) = 0.3.

(a) 0.845

(b) 0.856

(c) 0.865

(d) 0.876

(e) 0.885.

(1 mark)

39. If Error sum of Squares is 83.88 and Total sum of Squares is 1134.66 then the value of Coefficient of Determination is

[< Answer >](#)

(a) 0.926

(b) 0.074

(c) 0.740

(d) 0.092

(e) Cannot be determined from the given information.

(1 mark)

40. Magna Products Ltd. manufactures and sells domestic products. The marketing manager of the company is concerned about the sales behavior of a kitchen-knife set manufactured and sold by the company. In his opinion the number of advertisements and price per set are significant determinants of sales. He has collected the following data from the records of the company for the past five years:

[< Answer >](#)

Sales ('000 sets sold)	Number of Advertisements	Price per set (Rs.)
30	2	120
58	5	110
67	9	135
79	12	125
14	8	140

If Y denotes sales (in thousands), X_1 denotes the number of advertisements and X_2 denotes the price per set (in Rupees), then obtain a multiple regression relationship of the form

$$Y = a + b_1 X_1 + b_2 X_2.$$

Find the number of sets that can be sold if the number of advertisements is 4 and price is Rs.126 per set, on the basis of the relationship.

(a) 27,968

- (b) 29,078
- (c) 30,188
- (d) 31,298
- (e) 32,308.

(2 marks)

41. Which of the following is **not true** with regard to the coefficients of multiple correlation $R_{1.23}$ between the dependent variable Y and the independent variables X_1 and X_2 ? [< Answer >](#)

- (a) $R_{1.23}$ is a non-negative number
- (b) $R_{1.23}$ can take values between 0 and 1
- (c) It is dependent on the coefficient of correlation between Y and X_1
- (d) It is dependent on the coefficient of correlation between Y and X_2
- (e) It is independent of the coefficient of correlation between X_1 and X_2 .

(1 mark)

42. Which of the following statements is **not true** regarding index numbers? [< Answer >](#)

- (a) Using Index numbers we can establish trends
- (b) Index numbers guide policy making
- (c) Index numbers are not used to determine the purchasing power of a rupee
- (d) Index numbers play a vital role in adjusting the original data to reflect reality
- (e) Index number is calculated as a ratio of the current value to a base value and expressed as a percentage.

(1 mark)

43. Calculate the unweighted aggregates price index for the year 2006 using the following data, taking year 2005 as base year? [< Answer >](#)

Commodity	Price (Rs/unit)	
	2005	2006
Rice	32	50
Wheat	25	25
Edible Oil	90	100
Fish	120	140
Potato	35	40

- (a) 85.56
- (b) 100.54
- (c) 105.55
- (d) 117.55
- (e) 126.52.

(1 mark)

44. If the ratio between Laspeyre's index number and Paasche's index number is 28 : 27, find the missing figure in the following table: [< Answer >](#)

Commodity	Base Year		Current Year	
	Price	Quantity	Price	Quantity
X	1	10	2	5
Y	1	5	?	2

- (a) 1
- (b) 2
- (c) 3
- (d) 4
- (e) 5.

(2 marks)

45. The following details are available with regard to a group of commodities: [< Answer >](#)

Average quantity consumed during the base year = 137.5 units
 Average quantity consumed during the current year = 95 units
 Both the averages are simple averages.

Which of the following is **true**?

- (a) Paasche's price index = 69.09

- (b) Paasche's quantity index = 69.09
- (c) Laspeyre's quantity index = 69.09
- (d) Unweighted aggregates price index = 69.09
- (e) Unweighted aggregates quantity index = 69.09.

(1 mark)

[< Answer >](#)

46. To measure changes in total financial worth, one should calculate

- (a) Price index
- (b) Value index
- (c) Quantity index
- (d) Price relative
- (e) Quantity relative.

(1 mark)

47. If the Laspeyre's price index and Paasche's price index are 117 and 119 respectively, then the Fisher's ideal price index will be approximately equal to

[< Answer >](#)

- (a) 116
- (b) 117
- (c) 118
- (d) 119
- (e) 111.

(1 mark)

48. If $P_0Q_0 = 288$, $P_1Q_0 = 291$, $P_1Q_1 = 311$ and $P_0Q_1 = 251$, then the value index is

[< Answer >](#)

- (a) 103.44
- (b) 105.77
- (c) 106.58
- (d) 107.98
- (e) 115.94.

(1 mark)

49. Which of the following price indices has a downward bias?

[< Answer >](#)

- (a) Marshall-Edgeworth price index
- (b) Fisher's price index
- (c) Laspeyre's price index
- (d) Paasche's price index
- (e) Laspeyre's quantity index.

(1 mark)

50. Which of the following index numbers does **not** satisfy the time reversal test?

[< Answer >](#)

- (a) Fisher's ideal index
- (b) Marshall-Edgeworth index
- (c) Fixed weights aggregate index
- (d) Laspeyre's index
- (e) Time reversal test is not applicable to index numbers.

(1 mark)

51. Repetitive and predictable movement around the trend line in one year or less is known as

[< Answer >](#)

- (a) Secular trend
- (b) Cyclical fluctuation
- (c) Irregular variation
- (d) Seasonal variation
- (e) Temporary variation.

(1 mark)

52. In a time series analysis, if relative cyclical residual measure is -0.346 and actual value of the dependent variable is 4.516 then the forecasted value of the dependent variable is

[< Answer >](#)

- (a) 3.4517
- (b) 4.1547
- (c) 4.3571
- (d) 4.5317
- (e) 5.1537.

(1 mark)

53. Which of the following is **not true** about the ratio to moving average method?

[< Answer >](#)

- (a) This method is used to identify the seasonal variations in a time series
- (b) An index is constructed with a base of 100
- (c) The magnitude of seasonal variations is measured by the individual deviations from the base of 100
- (d) The index is used to eliminate the seasonal effects in the time series
- (e) We multiply the original data points with the relevant seasonal index to deseasonalize the time series.

(1 mark)

54. Which of the following is **true** with respect to time series analysis?

[< Answer >](#)

- (a) The adjusted seasonal indices must always sum to 400
- (b) If a time series contains an odd number of elements, the coding for some of the entries will be in half-units
- (c) Over time, random movements tend to counteract one another in irregular variation in a time series
- (d) Once seasonal indices are computed for a time series, the series can be deseasonalized so that the series becomes free from all cyclical, seasonal and random variations
- (e) The relative cyclical residual can be computed for an entry in a time series by subtracting 1 from the percent of trend for that entry.

(1 mark)

55. For forecasting the demand for a product, whose expected life is 15 years and is expected to enter the maturity stage in the 9th year of its inception, the following trend equations are formulated:

[< Answer >](#)

$$= 139.35 + 7.536x \text{ (in thousand rupees)}$$

$$= 154.78 + 7.2x - 1.576x^2 \text{ (in thousand rupees)}$$

The most probable sales value of the product in the 12th year can be

- (a) Rs. 14.236 thousand
- (b) Rs. 139.350 thousand
- (c) Rs. 154.780 thousand
- (d) Rs. 229.780 thousand
- (e) Rs. 241.180 thousand.

(1 mark)

56. A time series for the years 1995-2006 had the following relative cyclical residuals (RCR), in chronological order as follows:

[< Answer >](#)

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
RCR	-1%	-2%	1%	2%	-1%	-2%	1%	2%	-1%	-2%	1%	2%

What will be the relative cyclical residual for 2007?

- (a) +3%
- (b) -1%
- (c) -2%
- (d) +2%
- (e) Cannot be determined on the basis of the given information.

(2 marks)

57. The following linear trend equations for estimation of national income and population have been constructed for a hypothetical economy for the period 2002 to 2006:

[< Answer >](#)

$$\text{National income, } = 4.86 + 1.5x$$

$$\text{Population, } = 5.25 + 1.25x$$

Assuming that the year 2004 is coded as 0 and time interval of 1 year is considered for developing the equations, in which year was the estimated per capita income highest?

- (a) 2002
- (b) 2003
- (c) 2004
- (d) 2005
- (e) 2006.

(2 marks)

58. What is the moving average of order three associated with 2 of the following data?

[< Answer >](#)

4	5	8	6	2	7	3	1	9
---	---	---	---	---	---	---	---	---

- (a) 5.667
- (b) 6.333
- (c) 5.333
- (d) 5.000
- (e) 4.000.

(1 mark)

59. Using the data given below calculate the center line, the lower control limit for $\bar{x}$ chart.

[< Answer >](#)

- (a) 7.866 and 124.073
- (b) 7.866 and 127.627
- (c) 125.85 and 124.149
- (d) 125.85 and 127.627
- (e) 0.40 and 124.073.

(1 mark)

60. Which of the following statement(s) is/are **true** regarding Control Charts?

[< Answer >](#)

- I. $\bar{x}$ and R charts are deal with quantitative variables.
 - II. P charts deal with qualitative factors.
 - III. If the plotted points are within the lower and the upper control limits and there is no increasing trend or decreasing trend or cyclic fluctuations then we can conclude that the process is out of control.
- (a) Only (I) above
 - (b) Only (II) above
 - (c) Only (III) above
 - (d) Both (I) and (II) above
 - (e) All (I), (II) and (III) above.

(1 mark)

61. For generating a $\bar{x}$ chart 40 samples are taken. The sum of all the observations is 560 and the value to be used for the centre line is 2.8. The size of each sample is

[< Answer >](#)

- (a) 5
- (b) 10
- (c) 18
- (d) 20
- (e) 36.

(2 marks)

62. For a data $\bar{x} = 0.45$ and $UCL = 0.737$. What is the value of n (number of samples)? (Round off your answer to the nearest integer)

[< Answer >](#)

- (a) 27
- (b) 31
- (c) 34
- (d) 38
- (e) 42.

(1 mark)

63. The movement of the dependent variable above and below the secular trend line over periods longer than one year is known as [< Answer >](#)

- (a) Cyclical variation
- (b) Secular trend
- (c) Seasonal variation
- (d) Irregular variation
- (e) Medium term variation.

(1 mark)

64. Which of the following is a quality control chart that is plotted using the variability of individual characteristics of the output of a process? [< Answer >](#)

- (a) Scatter diagram
- (b) Histogram
- (c) R chart
- (d) p chart
- (e) $\bar{x}$ chart.

(1 mark)

65. Which of the following statement(s) is/are **true** regarding Chi Square test?

[< Answer >](#)

- I. It is used to test whether the difference between the proportions representing more than two samples is significant or not.
 - II. It is employed to determine whether the two attributes according to which a population is categorized are independent of each other or not.
 - III. It is used to test whether any significant difference exists between the observed and theoretical distribution.
- (a) Only (I) above
 - (b) Only (II) above
 - (c) Only (III) above
 - (d) Both (II) and (III) above
 - (e) All (I), (II) and (III) above.

(1 mark)

66. The following information pertain to one-tailed test of variance:

[< Answer >](#)

Sample size = 41

Sample standard deviation = 15.9

As per the null hypothesis population standard deviation = 14

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

- (a) The value of the test statistic is 51.59. The test statistic follows a chi-square distribution with 40 degrees of freedom
- (b) The value of the test statistic is 51.59. The test statistic follows a t-distribution with 41 degrees of freedom
- (c) The value of the test statistic is 46.37. The test statistic follows a chi-square distribution with 40 degrees of freedom
- (d) The value of the test statistic is 46.37. The test statistic follows a t-distribution with 41 degrees of freedom
- (e) The value of the test statistic is 46.37. The test statistic follows a normal distribution.

(1 mark)

67. Which of the following test(s) can be used for determining whether a population has a Binomial probability distribution or not?

[< Answer >](#)

- I. The F-test.
- II. The t-test.
- III. The Chi-square test.

- (a) Only (I) above
- (b) Only (II) above
- (c) Only (III) above
- (d) Both (II) and (III) above
- (e) All (I), (II) and (III) above.

(1 mark)

68. In a test involving analysis of variance the following are found:

[< Answer >](#)

Estimate of the population variance based on the variance among sample means = 32.5

Estimate of the population variance based on the variance within the samples = 14.4

The F-ratio is equal to

- (a) 0.44
- (b) 0.0694
- (c) 0.64
- (d) 1.2569
- (e) 2.2569.

(1 mark)

69. In a test of ANOVA, the following are found:

[< Answer >](#)

Estimated population variance based on the variance among sample means = 11.60

F-ratio = 1.50

What is the estimated population variance based on the variance within the samples?

- (a) 7.733
- (b) 1.440
- (c) 2.425
- (d) 2.675
- (e) 0.129.

(1 mark)

70. In a chi-square test the contingency table has 4 rows and 4 columns. The number of degrees of freedom is

[< Answer >](#)

- (a) 3
- (b) 4
- (c) 8
- (d) 9
- (e) 16.

(1 mark)

71. 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) 10.50.

(1 mark)

72. The demand for a particular spare part in a factory was found to vary from day to day. In a sample study the following information was obtained:

[< Answer >](#)

Days	Mon	Tue	Wed	Thurs	Fri	Sat
No. of parts demanded	1124	1125	1110	1120	1126	1115

We need to test the hypothesis that the number of parts demanded does not depend on the day of the week. What is the value of the test statistic for the above test?

- (a) 0.159
- (b) 0.179
- (c) 0.279
- (d) 0.259
- (e) 0.079.

(2 marks)

73. The null hypothesis regarding a chi-square test of independence for a contingency table with 6 rows and 4 columns should be rejected (at 95% confidence) if the test statistic is greater than

[< Answer >](#)

- (a) 1.960
- (b) 1.640
- (c) 24.996
- (d) 36.415
- (e) 1.753.

(1 mark)

74. Which of the following statement(s) is/are **true** regarding simulation?

[< Answer >](#)

- I. If the mathematical model set up could always be optimized by the analytical approach, then, there would be no need for simulation.
- II. Only when interrelationships are too complex or there is uncertainty regarding the values that could be assumed by the variables or both, we would have to resort to simulation.
- III. Simulations can not be used to break down complex systems into sub-systems and study the behavior of each of these subsystems.

- (a) Only (I) above
- (b) Only (II) above
- (c) Only (III) above
- (d) Both (I) and (II) above
- (e) All (I), (II) and (III) above.

(1 mark)

75. Consider the following probability distribution of a variable **X** :

[< Answer >](#)

X	5	10	15	20	25	30	35
P(X)	0.1	0.05	0.05	0.1	0.3	0.2	0.2

In a Monte Carlo simulation process the number 19 was generated in a particular run from a uniform distribution of 0 – 99. The value of **X** in this run will be

- (a) 35
- (b) 20

- (c) 25
(d) 15
(e) 30.

(2 marks)

76. A Quality Control Engineer at Maharathi automobiles wants to check the variability in the number of defects in the cars coming from two assembly lines A and B. When he collected data it was as shown below.

[< Answer >](#)

Sample	Size	Standard Deviation
A	16	3.2
B	10	4.8

and represent the variances of the respective populations to which the samples belong.

For testing the hypothesis, H_0 : , the value of F-statistic will be

- (a) 0.44
(b) 0.67
(c) 0.82
(d) 1.50
(e) 2.25.

(1 mark)

77. A random sample of 15 people is taken from a village in which 40% favor a particular political stand. What is the probability that at least 4 individuals in the sample favor this political stand?

[< Answer >](#)

- (a) 0.0047
(b) 0.0219
(c) 0.0634
(d) 0.0905
(e) 0.9095.

(2 marks)

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

[< Answer >](#)

If $X = 5$,

If $X = 10$,

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

Number of data points = 6

What is the mean of the observed values of the dependent variable, Y ?

- (a) 15
(b) 32
(c) 47
(d) 18
(e) 25.

(2 marks)

79. The seasonal index sales of a company for four quarters of year 2006 are 200, 180, 160 and 260 respectively. If the total sales in the first quarter are worth Rs.50,000, estimate the worth of sales expected during the 4th quarter of the year.

[< Answer >](#)

- (a) Rs.35,000
(b) Rs.45,000
(c) Rs.55,000
(d) Rs.55,500
(e) Rs.65,000.

(1 mark)

80. A welfare society claiming to be promoters of sex education sought the views of parents from the three Indian cities of Hyderabad, Mumbai and Kolkata on introducing sex education at the school level. The views of 80 parents selected at random from each of the three states were found as under:

[< Answer >](#)

	Hyderabad	Mumbai	Kolkata
Support	50	20	45
Reject	30	60	35

Do the sample data provide enough evidence to support the view that the proportion of parents in favour of introducing sex education in schools is the same in all the three states? Use level of significance.

- (a) H_1 is accepted, thus the proportion of parents in favour of introducing sex education in schools is the same in all the three states
- (b) H_0 is rejected, thus proportion of parents in favour of introducing sex education in schools is not same in all the three states
- (c) H_1 is rejected, thus the proportion of parents in favour of introducing sex education in schools is not the same in all the three states
- (d) H_0 is accepted, thus proportion of parents in favour of introducing sex education in schools is not same in all the three states.
- (e) The result leads to either type I error or type II error.

(2 marks)

Suggested Answers

Quantitative Methods -II (MSF1B2): July 2007

1. Answer : (a)
- Reason : For a paired sample $\{X, Y\}$
- Here $n=5$, $\sum X=25$, $\sum Y=61$
- and $\sum XY=211$

[< TOP](#)
[≥](#)

2. Answer : (d)
- Reason : Expected value of X is given by
- $$E(X) = \sum X \cdot P(X)$$

[< TOP](#)
[≥](#)

3. Answer : (b)
- Reason : Given that $Z = X + Y$.
- Notice that Z takes on the values -1, 1 and 0 with probabilities 0.3, 0.4 and 0.3 respectively.

Z	-1	0	1
P(Z)	0.3	0.3	0.4

$$E(Z) = \sum Z \cdot P(Z) = 0.1$$

$$V(Z) = \sum Z^2 \cdot P(Z) - (E(Z))^2 = 0.69$$

Or

X	P(X)	XP(X)	$(X - (-0.7))^2 P(X)$	Y	P(Y)	YP(Y)	$(Y - 0.8)^2 P(Y)$
-2	0.1	-0.2	0.169	0	0.5	0	0.32
-1	0.5	-0.5	0.045	1	0.2	0.2	0.008
0	0.4	0	0.196	2	0.3	0.6	0.432
Total		-0.7	0.41	Total	0.8		0.76

To compute $\text{Cov}(X, Y)$, we must examine the joint distribution

$$V(Z) = V(X+Y) = V(X) + V(Y) + 2\text{Cov}(X, Y) = 0.41 + 0.76 + 2 \times (-0.24) = 0.69.$$

4. Answer : (c)
- Reason :

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[≥](#)

5. Answer : (e)
- Reason : $n = 5$,
- Profit for each ice-cream is 2 Rs.
- Loss for each ice-cream is 1 Rs.
- X: number of ice-creams sold.
- Y: Profit for selling X number of ice-creams.
- Let us suppose 3 ice-creams are sold on one day ($X=3$). So that 2 ice-creams are unsold on that day.
- Then $Y =$

[< TOP](#)
[≥](#)

X:	0	1	2	3	4	5
Y:	-5	-2	1	4	7	10

P(X):

6. Answer : (c)

[< TOP](#)

Reason: The following statements are true.

[≥](#)

- (a) In discrete uniform distribution probability of happening of any event is constant.
- (b). If Bernoulli experiment is repeated without replacement we use hypergeometric distribution.
- (c) The hypergeometric distribution may be replaced by the binomial distribution if is **small** enough.
- (d) The standard normal distribution is a normal distribution with mean $\mu = 0$ and a standard deviation $\sigma = 1$.
- (e) The F-distribution is the distribution of the ratio of two random variables. Both random variables have yet another distribution, called the Chi-square distribution.

7. Answer : (d)

[< TOP](#)Reason: The following statements are **true** regarding binomial distribution.[≥](#)

- I. Each trial has only two possible outcomes.
- II. The trials are statistically independent.
- III. The probability of the outcome of any trial remains fixed over time.
- IV. Mean of the distribution is always **greater** than variance.

Since, let us assume that mean is less than variance.

So

 $1 < q$, which is not true, because total probability is equal to one. i.e., $p + q = 1$.

Therefore, our assumption is false.

Hence mean is always greater than variance.

IV statement is wrong.

So option (d) is correct.

8. Answer : (c)

[< TOP](#)

Reason : The probability density function of a typical random variable is given by

[≥](#)Mean = $E(X) =$ Variance = $V(X) =$ Given that $a=1$ and $b=5$.

Variance =

9. Answer : (d)

[< TOP](#)Reason : The following statements are **true** regarding to Lognormal distribution.[≥](#)

- I. If $\ln(X)$ is a normally distributed random variable, then X is said to be a lognormal variable.
- III. In finance "Continuous compounded returns are required to be normal". This property is described as "Stock Prices are Lognormal".

So option (d) is correct.

10. Answer : (a)

[< TOP](#)

Reason : Given that, A normal variable has a mean of 10 and a standard deviation of 5.

[≥](#)

We have to find the probability that the normal variable will take a value in the interval 10 to 19.8.

i.e., We have to find

11. Answer : (e)

[< TOP](#)Reason : The following statements are **true** regarding decision theory assumptions.[≥](#)

- I. The decision maker can define all decision alternatives or strategies which are being considered.
- II. The decision maker can define the various states of nature for the decision setting which are not under control.
- III. The decision maker can estimate quantitatively the consequences (benefits or costs) of selecting any decision alternative and having any state of nature occurrence.

So option (e) is correct.

12. Answer : (d)

[< TOP](#)

Reason : Conditional Profit Table:

[≥](#)

Stock Decision (Probability)	Possible demand		
	300	500	800

	(0.23)	(0.43)	(0.34)
300	15,000	15,000	15,000
500	10,000	25,000	25,000
800	2,500	17,500	40,000

Expected Monthly Profit Computation

Stock 300 trousers

Conditional Profit (Rs.)	Probability of Occurrence	Expected Monthly Profit(Rs.)
15,000	0.23	3,450
15,000	0.43	6,450
15,000	0.34	5,100
		15,000

Stock 500 trousers

Conditional Profit (Rs.)	Probability of Occurrence	Expected Monthly Profit(Rs.)
10,000	0.23	2,300
25,000	0.43	10,750
25,000	0.34	8,500
		21,550

Stock 800 trousers

Conditional Profit (Rs.)	Probability of Occurrence	Expected Monthly Profit (Rs.)
2,500	0.23	575
17,500	0.43	7,525
40,000	0.34	13,600
		21,700

The expected (average) profit corresponding to the Stock 800 trousers Maximizes expected monthly profit which is 21,700.

13.

Answer : (c)

Reason : We calculate the minimum required probability that is required to justify the preparation of an additional Pizza.

Using our terminology Maximum Profit, $MP=15-9=6$.

Maximum Loss, $ML=9$.

Therefore,

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The Manager wants to increase the number until it reaches point B. Since, 0.50 of the area under the curve is located between the mean and right hand tail, 0.1 of the shaded area will be on the left hand side of the mean. The nearest value to 0.1 is 0.1026. therefore we are to find the area under the curve contained between the mean and point B. from the tables we know that B is 0.26 standard deviation from the mean.

Solving for B we have

$$= 0.26 \times \text{Standard deviation}$$

$$= 0.26 \times 35 = 9.1.$$

$$\text{Point B} = \text{Mean} \quad 9.1 = 135.9 \quad 136.$$

Therefore, they should prepare 136 pizzas to avoid losses due to spoilage.

14.

Answer : (e)

Reason : The following statements are **true** regarding stock-out could lead to losses on account of,

I. Loss of potential customers.

II. Loss of goodwill among existing customers.

III. The need to make emergency purchases at high cost either to satisfy the demand or keep the production line moving.

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IV. Idle time costs when the production has to temporarily halted till the quantity ordered is received in stores.

So option (e) is correct.

15. Answer : (e)

Reason : The following statements are **true**.

- (I) A Population is a collection of all the data points being studied
- (II) A Sample is a part of a population
- (III) If we want to draw some conclusions about a population, we can do so by studying a suitable sample of the population
- (IV) In destructive testing sampling is the only available course
- (V) Sampling involves **less** work as compared with a census.

So option (e) is correct.

[< TOP](#)
[≥](#)

16. Answer : (d)

Reason : The following statements are **true** regarding advantages of sampling.

- I. A study of a sample is usually cheaper than a study of the population.
- II. Sampling usually provides information quicker than a census so that timely decisions can be taken.
- III. In sampling the chances of errors while processing the data are **less**.

So option (d) is correct.

[< TOP](#)
[≥](#)

17. Answer : (e)

Reason : The following statements are **true** regarding sampling.

- I. In Simple Random Sampling each possible sample has an equal chance of being selected.
- II. In Systematic Sampling each element has an equal chance of being selected, but each sample does not have the same chance of being selected.
- III. In Stratified Sampling, the population is first subdivided into strata. And a sample is selected from each stratum at random.

So option (e) is correct.

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[≥](#)

18. Answer : (c)

Reason : The following statements are **true** regarding estimation

- I. If an estimate of a population parameter is given by a single value, then the estimate is called a **Point** estimate.
- II. If an estimate of a population parameter is given by two distinct numbers between which the parameter may be considered to lie, then the estimate is called an **interval** estimate.
- III. The interval estimate indicates the accuracy (or precision) of an estimate.

So option (c) is correct.

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[≥](#)

19. Answer : (c)

Reason : Here, $\mu = 150$

$$s = 25$$

$$n = 9$$

$$\text{Degrees of freedom} = n - 1 = 9 - 1 = 8$$

If we refer to the **t** table we see that for 8 degrees of freedom, the area in both tails combined is 0.5 or 5%, when $t = 2.306$.

Hence, area under the curve between

So, the 95% confidence interval is

Hence, we are 90% confident that the population mean lies in the interval 130.78 to 169.22.

[< TOP](#)
[≥](#)

20. Answer : (c)

Reason : According to the CLT the sampling distribution of mean approaches normality as the sample size increases.

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[≥](#)

21. Answer : (a)

Reason : We set H_0 : The average daily smuggling intercepted is same as the historic level ($\mu = 28$)

We set H_1 : The average daily smuggling intercepted has increased above the historic level ($\mu > 28$)

The sample size is large and population standard deviation is known, hence we use normal distribution to test this hypothesis.

The test statistic $z =$

This is a right tailed test; hence the critical region falls in the right tail.

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[≥](#)

The critical value is $z = 1.645 > 1.15$

Since the test statistic falls in the acceptance region, we accept the null hypothesis and conclude at 5% level of significance that the average daily smuggling intercepted is same as the historic level.

22. Answer : (b)

Reason : The null hypothesis for this test would be : The company is paying same commission to its salesmen as the industry average.

$$H_0 : \mu = 54$$

The alternative hypothesis for this test would be : The company is paying higher commission to its salesmen than the industry average

$$H_1 : \mu > 54.$$

23. Answer : (b)

Reason :

24. Answer : (c)

Reason : Value of the test statistic =

25. Answer : (d)

Reason : The following statements are **true** regarding Scatter Diagram.

- I. One of the easiest ways of studying the correlation between the two variables is with the help of a scatter diagram.
- II. It gives an indication of the nature of the potential relationship between the variables.
- III. Using scatter diagram if the variables are related, we **can** see what kind of line, or estimating equation, describes this relationship.

So option (d) is correct.

26. Answer : (d)

Reason : The following statements are **true** regarding Pearson's coefficient of correlation.

- I. It lies between .
- II.
- III.
- IV.

So option (d) is correct.

27. Answer : (d)

Reason : The following statements are **true** regarding Coefficient of Determination.

- I. It is the square of the correlation coefficient.
- II. It explains to what extent the variation of a dependent variable is expressed by the independent variable.
- III. A **high** value of it shows a good linear relationship between the two variables.

So option (d) is correct.

28. Answer : (c)

Reason : Let rank of student in Statistics is X_i

Let rank of student in Mathematics is Y_i

$$\text{Then } D_i = X_i - Y_i$$

n	Statistics	Mathematics	Difference between ranks (D_i)	D_i^2
1	2	3	-1	1
2	3	4	-1	1
3	5	5	0	0
4	4	2	2	4
5	1	1	0	0
Total			0	6

Here

29. Answer : (c)

Reason : The equation of simple regression line is .

Student	Y	Y ²	X	X×Y	X ²
101	89	7921	85	7565	7225

Σ	203	80	6400	76	6080	5776
	357	78	6084	68	5304	4624
	465	70	4900	80	5600	6400
	509	92	8464	90	8280	8100
Total	409	33769	399	32829	32125	

The coefficient b is

The coefficient a is

Therefore, the equation for the regression line is

When model exam score (X) is 95,

30. Answer : (b)

Reason : The expected return from the share applying the probabilities would be,
 $(0.35 \times 40) + (0.44 \times 20) + (0.21 \times 15) = 25.95\%$.

31. Answer : (c)

Reason : Let the assumed mean for X series be 10 and assumed mean for Y series be 15.

Now, $\Sigma(X - 10) = \Sigma X - 10n = 140 - 100 = 40 = \Sigma dx$

And $\Sigma(Y - 15) = \Sigma Y - 15n = 150 - 150 = 0 = \Sigma dy$

The coefficient of correlation,

$$r = \frac{\Sigma dx dy}{\sqrt{\Sigma dx^2 \Sigma dy^2}} = \frac{40 \times 0}{\sqrt{40^2 \times 0^2}} = \frac{0}{0} = 0$$

32. Answer : (a)

Reason : Given that,

$$\Sigma x = 30, \Sigma y = 40, \Sigma xy = 150$$

$$r = \frac{\Sigma xy - \frac{\Sigma x \Sigma y}{n}}{\sqrt{(\Sigma x^2 - \frac{(\Sigma x)^2}{n})(\Sigma y^2 - \frac{(\Sigma y)^2}{n})}}$$

33. Answer : (c)

Reason : We use the following table to calculate the correlation coefficient:

X	x = X -	x ²	Y	y = Y -	y ²	xy
9	4	16	15	3	9	12
8	3	9	16	4	16	12
7	2	4	14	2	4	4
6	1	1	13	1	1	1
5	0	0	11	-1	1	0
4	-1	1	12	0	0	0
3	-2	4	10	-2	4	4
2	-3	9	8	-4	16	12
1	-4	16	9	-3	9	12
$\Sigma X = 45$	$\Sigma x = 0$	$\Sigma x^2 = 60$	$\Sigma Y = 108$	$\Sigma y = 0$	$\Sigma y^2 = 60$	$\Sigma xy = 57$

We have $r = \frac{\Sigma xy - \frac{\Sigma x \Sigma y}{n}}{\sqrt{(\Sigma x^2 - \frac{(\Sigma x)^2}{n})(\Sigma y^2 - \frac{(\Sigma y)^2}{n})}}$ and

34. Answer : (e)

Reason :

35. Answer : (c)

Reason : Multicollinearity occurs when the independent variables are correlated.

36. Answer : (d)

Reason : Slope, $b = \frac{109 - 101.1}{10 - 0} = \frac{7.9}{10} = 0.79$

Intercept,

$$a = 101.1 - 0.79 \times 0 = 101.1$$

$$\text{Equation} = 101.1 + 0.79X$$

37. Answer : (c)

Reason : In a typical Runs Test the change in share prices may be classified as '+' meaning an increase and '-' meaning a decrease.

A run is said to last as long as the price changes do not change direction.

Day	0	1	2	3	4	5	6	7	8
Price	101.1	101.05	101.5	105	105.6	106.5	105.4	110	109
Daily Price change			+	+	+	+	-	+	-
Runs		1	2	3	4	5	6	7	8

Therefore, here the number of runs is 5.

So, option (c) is correct.

38. Answer : (a)

Reason : We have to calculate the multiple correlation coefficient treating variable X_1 as dependent and variables X_2 and X_3 as independent, i.e., we have to find

Substituting the given values

39. Answer : (a)

Reason : Coefficient of Determination

Given that Error sum of Squares = 83.88 and Total sum of Squares = 1134.66

40. Answer : (b)

Reason : Let the following notations be used:

Y : Sales ('000 sets)

X_1 : Number of advertisements

X_2 : Price per set.

The multiple regression relationship is—

$$Y = a + b_1X_1 + b_2X_2$$

$$\begin{aligned} Y_1 &= a + b_1X_{11} + b_2X_{21} \\ Y_2 &= a + b_1X_{12} + b_2X_{22} \\ Y_3 &= a + b_1X_{13} + b_2X_{23} \end{aligned}$$

We obtain the following values:

$$\begin{aligned} Y_1 &= 248 & X_{11} &= 36 & X_{21} &= 630 \\ Y_2 &= 2013 & X_{12} &= 318 & X_{22} &= 79950 \\ Y_3 &= 30860 & X_{13} &= 4625 & n &= 5 \end{aligned}$$

∴ We get the following equation :

$$248 = 5a + 36b_1 + 630b_2 \quad \text{--- (A)}$$

$$2013 = 36a + 318b_1 + 4625b_2 \quad \text{--- (B)}$$

$$30860 = 630a + 4625b_1 + 79950b_2 \quad \text{--- (C)}$$

Solving the above three equations we get ,

$$a = 215.358$$

$$b_1 = 6.413$$

$$b_2 = -1.682.$$

∴ The multiple regression equation is $Y = 215.358 + 6.413 X_1 - 1.682 X_2$

$$\text{For } X_1 = 4, X_2 = 126: Y = 215.358 + 6.413 (4) - 1.682 (126) = 29.078 \text{ (thousand sets)}$$

i.e. 29,078 sets

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∴ Sales will be equal to 29,078 sets.

41. Answer : (e)

Reason : The coefficient of multiple correlation is dependent on the coefficients of correlation between Y and X_1 , between Y and X_2 , and between X_1 and X_2 . Alternatives (a), (b), (c) and (d) are true.

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42. Answer : (c)

Reason : The following statements **true** regarding index numbers.

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- a) Using Index numbers we can establish trends
- b) Index numbers guide policy making
- c) Index numbers are **used** to determine the purchasing power of the rupee
- d) Index numbers play a vital role in adjusting the original data to reflect reality
- e) Index number is calculated as a ratio of the current value to a base value and expressed as a percentage.

43. Answer : (d)

Reason : The un weighted aggregate price index for the given commodity with year 1998 as base year =

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From the table we have $\sum P_0 = 302$ and $\sum P_1 = 355$

Therefore un weighted aggregate price index = 117.55.

44. Answer : (d)

Reason : Let the missing value be 'x'

Given that

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$$\begin{array}{c} x \\ x \quad x \\ x \end{array}$$

45. Answer : (a)

Reason : Unweighted aggregates quantity index =

$$= \frac{\sum P_1 Q_1}{\sum P_0 Q_1} = 69.09.$$

(Where 'n' represents the no. of commodities in the basket or group and it is the same for both the base and current years)

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46. Answer : (b)

Reason : To estimate changes in total financial worth, one should calculate value index.

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47. Answer : (c)

Reason : Fisher's Ideal Index is the geometric mean of Laspeyre's Index and Paasche's Index.

So, Fisher's Ideal Index = 118 (approx.)

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48. Answer : (d)

Reason : Value Index is $\frac{\sum P_1 Q_1}{\sum P_0 Q_1} = 107.98.$

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49. Answer : (d)

Reason : (a) This is a wrong answer. Marshall-Edgeworth method uses both the current year as well as the base year quantities as weights. Therefore it is not biased towards the base year or the current year.

(b) This is a wrong answer. Fisher's ideal index is free from any bias. Both the current year and base year prices and quantities are taken into account by this index.

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(c) This is a wrong answer. Laspeyre's index tends to overestimate the rise in prices or has an upward bias.

(d) This is the **right** answer. The Paasche's index generally tends to underestimate the prices and has a downward bias. Because people tend to spend less on goods when their prices are rising, the use of the Paasche's index which bases on current weighting, produces an index which does not estimate the rise in prices rightly showing a downward bias. Since all prices or all quantities do not move in the same order, the goods which have risen in price more than others at a time when prices in general are rising, will tend to have current quantities relatively small than the corresponding base quantities and they will thus have less weight in the Paasche's index.

(e) This is a wrong answer.

50. Answer : (d)

Reason : Laspeyre's index does not satisfy the time reversal test

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51. Answer : (d)

Reason : Repetitive and predictable movement around the trend line in one year or less is known as seasonal variation.

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52. Answer : (d)

Reason : Relative cyclical residual measure = $\frac{-0.346}{4.516} \times 100$
 $-0.346 = \frac{-0.346}{4.516} \times 100$
 or, $-0.346 + 100 = 4.516 \times 100$

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53. Answer : (e)

Reason : (a) This is true for the ratio to moving average method. This method is used to identify the seasonal trend in a time series.

(b) This is true for the ratio to moving average method. An index is constructed with a base of 100.

(c) This is true for the ratio to moving average method. The magnitude of seasonal variations is measured by the individual deviations from the base of 100.

(d) This is true for the ratio to moving average method. The index is used to nullify the seasonal effects in the time series.

(e) This is **not true** for the ratio to moving average method. We **divide** the original data points with the relevant seasonal index to deseasonalize the time series.

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54. Answer : (c)

Reason : The adjusted seasonal indices need not always sum to 400. It depends on the period of time series under consideration. If a time series contains an even number of elements, the coding for some of the entries will be in half-units. Over time, random movements tend to counteract one another in irregular variation in a time series. Once seasonal indices are computed for a time series, the series can be deseasonalized so that other three variation components remains. The relative cyclical residual can be computed for an entry in a time series by subtracting 100 from the percent of trend for that entry.

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55. Answer : (a)

Reason : The demand for a product with limited life cycle, especially for the years in which sales is expected to decline can be best estimated using curvilinear equation rather than linear trend. Hence, sales value in the year 12 can be better forecasted using the equation

$$= 154.78 + 7.2x - 1.576x^2. \text{ Substituting 12 in place of } x,$$

$$= 154.78 + 7.2(12) - 1.576 \times 12^2 = \text{Rs. } 14.236 \text{ thousand.}$$

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56. Answer : (e)

Reason : Based on the given information, it is not possible to determine the value, as it is difficult to forecast the cyclical fluctuations. It is because of the fact that time period of the cyclical variations varies from time to time.

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57. Answer : (e)

Reason : By careful observation of equations, it can be interpreted that as the time (i.e., the value of x increases by one unit) passes on, national income is increasing by 1.5 units, where as population is increasing only by 1.25 units. In other words, growth rate in national income is more than that in population. Hence, as the time passes on, per capita income goes on increasing. Hence, it will be highest in the year 2006. This can be proved through calculations.

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Year	2002	2003	2004	2005	2006
National income (A)	1.86	3.36	4.86	6.36	7.86

Population (B)	2.75	4	5.25	6.5	7.75
Per capita income (A/B)	0.676	0.84	0.926	0.978	1.014

58. Answer : (d)

Reason :

Data Points.	Moving total of order 3.	Moving averages
4		
5	17	5.667
8	19	6.333
6	16	5.333
2	15	5.000
7	12	4.000
3	11	3.667
1	13	4.333
9		

Here moving total 17 represents 4+5+8; moving total 19 represents 5+8+6 etc.,

Here moving average 5.667 is associated to 5,

Here moving average 6.333 is associated to 8,

Similarly,

Moving average 5.000 is associated to 2.

59. Answer : (c)

Reason : We know that the value of $\bar{x}$ is used to draw the center line. Therefore, from the given data the center line is drawn at 125.85. The lower control limits is calculated as follows:

Lower control limit =

60. Answer : (d)

Reason : The following statements are **true** regarding Control Charts.

I. $\bar{x}$ and R charts are deal with quantitative variables.

II. P charts deal with qualitative factors.

III. If the plotted points are within the lower and the upper control limits and there is no increasing trend or decreasing trend or cyclic fluctuations then we can conclude that the process is within **control**.

61. Answer : (a)

Reason : Let the size of each sample be x .

The value to be used for the centre line is the grand mean. In this case the grand mean $\bar{\bar{x}} = 2.8$. Sum of all the observations = $\Sigma x = 560$ (given)

Now, $\bar{\bar{x}} =$

Where,

n = Sample size =?

k = number of samples = 40 (given)

$\therefore n =$

or $n = 5$

62. Answer : (a)

Reason : Given that $\bar{p} = CL = 0.45 = p$.

63. Answer : (a)

Reason : The movement of the dependent variable above and below the secular trend line over periods longer than one year is known as cyclical variation

64. 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 bivariate data.

Grouped data are presented in a histogram. So the alternative (c) is correct.

65. Answer : (e)

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Reason : The following statements are **true** regarding Chi Square test.

- I. It is used to test whether the difference between the proportions representing more than two samples is significant or not.
 - II. It is employed to determine whether the two attributes according to which a population is categorized are independent of each other or not.
 - III. It is used to test whether any significant difference exists between the observed and theoretical distribution
- So option (e) is correct.

66. Answer : (a)
Reason : The test statistic =
= 51.59

The test statistic has a Chi-square distribution with $41 - 1 = 40$ degrees of freedom

67. Answer : (c)
Reason : Chi-square test is used to test the goodness of fit of a distribution. To test whether the observed frequencies are following Binomial distribution or not chi-square is used.

68. Answer : (e)
Reason : F ratio =
= 2.2569.

69. Answer : (a)
Reason : The required estimate of population variance based on the variance within the sample will be
= 7.733.

70. Answer : (d)
Reason : Number of degrees of freedom = (Number of rows - 1) (Number of columns - 1)
= $(4 - 1)(4 - 1) = 9$.

71. Answer : (b)
Reason : The applicable distribution is F distribution
No. of degrees of freedom for the numerator of the F statistic
= No. of samples - 1
= $3 - 1 = 2$
No. of degrees of freedom for the denominator of the F statistic
= Total sample size - No. of samples
= $16 - 3 = 13$
From F table,
 $\therefore$ Critical value = 3.81

72. Answer : (b)
Reason : Here we set up the null hypothesis, H_0 that the number of parts demanded does not depend on the day of week.
Under the null hypothesis, the expected frequencies of the spare part demanded on each of the six days would be:
this is a chi-square test of independence and the contingency table is given as:

Days	Frequency		$(f_i - e_i)^2$	
	Observed(f_i)	Expected(e_i)		
Mon.	1124	1120	16	0.014
Tues.	1125	1120	25	0.022
Wed.	1110	1120	100	0.089
Thurs.	1120	1120	0	0
Fri.	1126	1120	36	0.032
Sat.	1115	1120	25	0.022
Total	6720	6720		0.179

Then the value of chi-square is given by:

i.e.

73. Answer : (c)

Reason : 95% confidence level implies 5% significance level. The null hypothesis regarding chi-square test of independence for a contingency table with 6 rows and 4 columns should be rejected (at 95% confidence level i.e., 5% significance level) if the test statistic is greater than a chi-square value (for $\text{dof} = (6 - 1)(4 - 1) = 15$) = 24.996.

74. Answer : (d)

Reason : The following statements are **true** regarding Simulation.

- I. If the mathematical model set up could always be optimized by the analytical approach, then, there would be no need for simulation.
- II. Only when interrelationships are too complex or there is uncertainty regarding the values that could be assumed by the variables or both, we would have to resort to simulation.
- III. Simulations **can** be used to break down complex systems into sub-systems and study the behavior of each of these subsystems.

75. Answer : (d)

Reason :

X	Probability	Cumulative Probability	Random numbers allotted
5	0.10	0.10	00 - 09
10	0.05	0.15	10 - 14
15	0.05	0.20	15 - 19
20	0.10	0.30	20 - 29
25	0.30	0.60	30 - 59
30	0.20	0.80	60 - 79
35	0.20	1.00	80 - 99

Since the random number generated was 19 (which lies in between 15 – 19), the value of X in this run is 15.

76. Answer : (a)

Reason : $F = \frac{1}{2} = 0.44$.

77. Answer : (e)

Reason : $n = 15$

$p = 0.40$

$q = 1 - 0.40 = 0.60$

$P(r \geq 4) = 1 - P(r \leq 3) = 1 - \left[P(r=0) + P(r=1) + P(r=2) \right]$

$= 1 - \left[\binom{15}{0} (0.4)^0 (0.6)^{15} + \binom{15}{1} (0.4)^1 (0.6)^{14} + \binom{15}{2} (0.4)^2 (0.6)^{13} \right]$

$=$

$= 0.9095$

78. Answer : (c)

Reason : A simple regression equation is of the form:

Given:

If $X = 5$, $Y = 31$ $\therefore 31 = a + 5b$(A)

If $X = 10$, $Y = 47$ $\therefore 47 = a + 10b$ (B)

Subtracting (A) from (B) we get:

$47 - 31 = (10 - 5)b$

$16 = 5b$

or $b =$

Putting the values of b in (B):

$47 = a + 10 \times 3.2 = a + 32$

or $a = 47 - 32 = 15$

$\therefore Y = 15 + 3.2X$

Now, $a =$

$\therefore$

$\therefore$ Mean of the observed values of Y , i.e. $\bar{Y} = 47$

79. Answer : (e)

Reason : Estimated sales for the 4th quarter

$=$

$$= \quad = \text{Rs. } 65000.$$

80.

Answer : (b)

Reason : H_0 : the proportion of parents in favour of introducing sex education in schools is same in the three cities.

H_1 : the proportion is not the same

we have the test statistic is

as $v = 2df$, H_0 is rejected in favour of H_1 if $\chi^2_{\alpha/2}$, where $\chi^2_{\alpha/2}$

o_i	50	20	45	30	60	35
e_i	38.3	38.3	38.4	41.7	41.7	41.6

Since the calculated value of $\chi^2 = 25.813$ is greater than $\chi^2_{\alpha/2}$, H_0 is rejected. This means that the proportion of parents in favour of introducing sex education at the school level is not the same in the three states.

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