

Question Paper

Quantitative Methods-II (MSF1B2): October 2007

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

1. Which of the following statements is **false** with respect to Laspeyres price index?

[< Answer >](#)

- (a) It uses the quantities consumed during the base period in computing the index number
- (b) It is easier to construct than Paasche's price index
- (c) It requires quantity measures for only one period
- (d) It enables easy comparability of one index with another
- (e) This method generally tends to underestimate the rise in prices.

(1 mark)

2. The time that it takes to find a taxi when leaving a restaurant follows a left skewed distribution with a mean of 18 minutes and a standard deviation of 8 minutes. If 100 restaurant patrons are randomly sampled and the average time that it takes for them to find a taxi is calculated, then what is the probability that the sample mean will be less than 19 minutes?

[< Answer >](#)

- (a) 0.0050
- (b) 0.3944
- (c) 0.6025
- (d) 0.9332
- (e) 0.8944.

(1 mark)

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

[< Answer >](#)

Estimated population variance based on the variance among sample means = 25.50

F ratio = 1.25

What is estimated population variance based on the variance within the sample means?

- (a) 16.32
- (b) 20.40
- (c) 24.25
- (d) 26.75

(e) 31.88.

(1 mark)

4. The covariance between two variables X and Y is 300 and the coefficient of determination is 0.5625. If the variance of Y is 256, then what will be the slope of the regression relationship between Y and X (with X as the independent variable)?

[< Answer >](#)

- (a) 16.00
 (b) 5.00
 (c) 0.75
 (d) 0.48
 (e) 12.00.

(1 mark)

5. When sampling is done without replacement from a finite population such that the probability of success is **not** constant from trial to trial, the data follow a

[< Answer >](#)

- (a) Binomial distribution
 (b) Discrete uniform distribution
 (c) Normal distribution
 (d) Continuous distribution
 (e) Hypergeometric distribution.

(1 mark)

6. The center line and the lower control limit for  chart using the data given above are

[< Answer >](#)

- (a) 7.866 and 124.073
 (b) 7.866 and 127.627
 (c) 125.850 and 124.491
 (d) 125.850 and 127.627
 (e) 0.400 and 124.073.

(1 mark)

7. From the following data compute Laspeyres quantity index for the year 2006 with the year 2005 as base year:

[< Answer >](#)

Equity Shares	Quantity (Number of shares)		Price in 2005 (Rs. per share)
	2005	2006	
A	30	25	30
B	20	30	40
C	10	15	20

- (a) 118.42

- (b) 117.32
- (c) 116.22
- (d) 115.12
- (e) 114.02.

(1 mark)

8. For forecasting the demand of 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:

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

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

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

- (a) Rs. 14.236 thousand
- (b) Rs.139.356 thousand
- (c) Rs.154.786 thousand
- (d) Rs.229.786 thousand
- (e) Rs.241.186 thousand.

(1 mark)

9. The supervisor of security at a large departmental store would like to know if the store apprehends different numbers of shoplifters during the Christmas holiday season than in the weeks before or after the holiday. He gathered data on the number of shoplifters apprehended in the store during the months of November, December and January over the past 6 years. The information is as below:

November	43	38	59	55	39	48
December	54	40	48	35	50	49
January	35	27	34	40	30	32

A test of ANOVA has to be performed.

It is given that the variance between the sample means is 366 and the variance within the samples is 48. What is the value of the test statistic for the above test?

- (a) 5.125
- (b) 6.425
- (c) 7.625
- (d) 8.825
- (e) 9.925.

(1 mark)

10. The weighted average price of goods in a basket in the current year is 1.60 times their weighted average price in the base year. Both the weighted averages have been calculated using current year consumption quantities as weights.

[< Answer >](#)

Which of the following is **correct**?

- (a) Laspeyres price index = 1.60
- (b) Laspeyres price index = 160
- (c) Laspeyres quantity index = 160
- (d) Paasche's price index = 1.60
- (e) Paasche's price index = 160.

(1 mark)

11. Calculate the test statistic for a hypothesis test on population standard deviation, from the following data:

[< Answer >](#)

Sample size = 30

Hypothesized value of the population standard deviation = 1

Sample standard deviation = 0.73

- (a) 15.4541
- (b) 16.5042
- (c) 17.6543
- (d) 18.6044
- (e) 19.0045.

(1 mark)

12. Which of the following is/are **not** required for the two-sample test of means for independent samples when both samples contain less than 30 observations?

[< Answer >](#)

- I. Both the populations are normally distributed.
- II. Both the populations have equal variance.
- III. Both the samples have equal means.
- IV. Both the samples are of equal size.

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

(1 mark)

13. In a correlation study on variables X and Y, the following results are obtained:

[< Answer >](#)

Variables	X	Y
Mean	65	67

Standard Deviation	2.5	3.5
Coefficient of correlation	0.80	

Find the regression equation of X on Y with Y as the independent variable.

- (a) $= 24.5643 + 0.3542 Y$
- (b) $= 25.4643 + 0.4562 Y$
- (c) $= 26.7143 + 0.5714 Y$
- (d) $= 27.8543 + 0.6785 Y$
- (e) $= 28.5643 + 0.7584 Y$.

(1 mark)

14. If a deseasonalized value in a time series is 0.65 and the actual data corresponding to the deseasonalized value is 3, the seasonal index is

[< Answer >](#)

- (a) 120.3983
- (b) 253.1684
- (c) 461.5385
- (d) 216.1386
- (e) 231.5687.

(1 mark)

15. When the chi-square test is used as a test of independence, the number of degrees of freedom is related to

[< Answer >](#)

- (a) The sample size
- (b) The ratio of sample size and the population
- (c) Number of rows in the contingency table only
- (d) Number of columns in the contingency table only
- (e) Both the number of rows and the number of columns in the contingency table.

(1 mark)

16. Which of the following is a technique for studying seasonal variations?

[< Answer >](#)

- (a) Regression analysis
- (b) Residual method
- (c) Hypothesis testing
- (d) Ratio to moving average method
- (e) Linear programming.

(1 mark)

17. A daily sample of 30 items was taken over a period of 14 days in order to establish control limits of a p-chart. If a total of 21 defectives were found in all the samples taken, then what should be the upper control limit of the proportion of defectives?

[< Answer >](#)

- (a) 0.1525
- (b) 0.1602
- (c) 0.1694
- (d) 0.1825
- (e) 0.1910.

(1 mark)

18. The following data pertain to three commodities:

[< Answer >](#)

Commodity	Price in 2006 (Rs./kg)	Price in 2005 (Rs./kg)
Rice	12.50	10.50
Wheat	13.50	8.50
Pulses	25.00	20.00

The base year is 2005. The unweighted aggregates price index for the year 2006 is approximately

- (a) 115.6290
- (b) 125.4591
- (c) 130.7692
- (d) 250.5593
- (e) 410.0094.

(1 mark)

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

[< Answer >](#)

- (a) 3.88
- (b) 4.00
- (c) 5.02
- (d) 15.06
- (e) 45.18.

(1 mark)

20. In which of the following conditions will the regression sum of squares of a simple regression relationship is equal to total sum of squares?

[< Answer >](#)

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

(1 mark)

21. Which of the following errors can occur at the time of observation, approximation and processing of data?

[< Answer >](#)

- (a) Sampling errors
- (b) Non-sampling errors
- (c) Random occurrence errors
- (d) Systematic errors
- (e) Estimation errors.

(1 mark)

22. The following figures show the distribution of digits in numbers chosen at random from a telephone directory.

[< Answer >](#)

Digits	0	1	2	3	4	5	6	7	8	9
Frequency	102	110	99	96	107	93	110	97	96	85

A curious student wants to test whether the digits may be taken to occur equally frequently in the directory. What is the critical value for the above test at a significance level of 5%?

- (a) 13.362
- (b) 14.684
- (c) 15.987
- (d) 16.919
- (e) 18.307.

(1 mark)

23. For a binomial probability distribution with parameters n and p (where n is number of trials and p is probability of success on any trial), the product of these two parameters will be equal to the

[< Answer >](#)

- (a) Mean
- (b) Standard deviation
- (c) Variance
- (d) Median
- (e) Range.

(1 mark)

24. 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)

25. A variable X, which has a normal distribution, has a mean of 24 and a standard deviation of 5. The probability that the value of X lies in the interval 20 to 28 is approximately [< Answer >](#)

- (a) 0.2472
- (b) 0.3152
- (c) 0.3852
- (d) 0.4952
- (e) 0.5762.

(1 mark)

26. The coefficient of correlation between variables X and Y is 0.75. The coefficient of variation of X is 20% and the coefficient of variation of Y is 10%. The mean of X is 30 and the mean of Y is 40. What is the covariance between X and Y? [< Answer >](#)

- (a) 4
- (b) 6
- (c) 18
- (d) 24
- (e) 48.

(1 mark)

27. The Lower Control Limit in an R chart if $n = 7$ and $\bar{R} = 7.1$, is [< Answer >](#)

- (a) 0.3383
- (b) 0.4383
- (c) 0.5383
- (d) 0.6583
- (e) 0.7483.

(1 mark)

28. Given the value of the coefficient of determination, then the regression equation [< Answer >](#)

- (a) Must have a positive slope
- (b) Must have a negative slope
- (c) Could have either a positive or a negative slope
- (d) Must have a positive intercept
- (e) Must have a negative intercept.

(1 mark)

29. 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. If the significance level is 0.05 then

- (a) The critical value is 1.645 and the null hypothesis is rejected
- (b) The critical value is --1.96 and the null hypothesis is accepted
- (c) The critical values are and the null hypothesis is rejected
- (d) The critical values are and the null hypothesis is accepted
- (e) The critical values are and the null hypothesis is accepted.

(1 mark)

30. There are 16 questions, each of 5 multiple choices of which only one choice is correct. If a student do not know the correct answer and decides to guess answer for every question, then what is the probability of answering exactly 7 questions correctly?

[< Answer >](#)

- (a) 0.2432
- (b) 0.3065
- (c) 0.0207
- (d) 0.0197
- (e) 0.0859.

(1 mark)

31. 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 its normal curve
- (b) It is multi-modal distribution
- (c) The mean, median and mode are equal
- (d) The two tails of normal probability distribution extend indefinitely and never touch the horizontal axis
- (e) It is symmetric distribution.

(1 mark)

32. Let d_x and d_y represent the deviations from assumed means of the data of variables X and Y respectively. The data of X and Y are paired. The following results are available:

[< Answer >](#)

$$\Sigma d_x d_y = 3,044, \text{ number of pairs of observations} = 10$$

$$\Sigma d_x = -170, \quad \Sigma d_y = -20, \quad \Sigma x^2 = 8,288, \quad \Sigma y^2 = 2,264.$$

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

- (a) 0.4701
- (b) 0.5602
- (c) 0.6703
- (d) 0.7804
- (e) 0.8905.

(1 mark)

[< Answer >](#)

33. Consider the following information for a given year 2006:

Commodity	$\bar{x}$	$P_n Q_n$
Rice	118.42	10,000
Wheat	130.77	4,050
Salt	160.00	1,300
Sugar	145.00	9,600
Pulses	137.78	13,250

The weighted average of relatives price index for the year 2006 was

- (a) 118.4292
- (b) 130.7793
- (c) 134.5394
- (d) 137.7895
- (e) 139.2096.

(1 mark)

[< Answer >](#)

34. Which of the following statements is **false**?

- (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)

35. The mean and standard deviation of a sampling distribution are 15.00 and 0.03 respectively. The Upper Control Limit for the corresponding chart will be [< Answer >](#)

- (a) 0.15
- (b) 0.45
- (c) 15.09
- (d) 16.09
- (e) 18.09.

(1 mark)

36. Which of the following is **true** with regard to a given coefficient of correlation and its corresponding coefficient of determination?

[< Answer >](#)

- (a) The coefficient of determination is greater than or equal to zero always
- (b) The coefficient of determination is negative always
- (c) The coefficient of determination is zero always
- (d) The coefficient of determination always has the same sign as the coefficient of correlation
- (e) The coefficient of determination is always higher in magnitude than the coefficient of correlation.

(1 mark)

37. Janaki, the manager of the quality department of a tire manufacturing company wants to study the average tensile strength of rubber used in making a certain brand of radial tire. The population is normally distributed and the population standard deviation is known. She wants to test the null hypothesis that the mean tensile strength is equal to 800 pounds per square inch against the alternative hypothesis that the mean tensile strength is not equal to 800 pounds per square inch. The calculated test statistic is 1.50. If the significance level is 0.10, then

[< Answer >](#)

- (a) The critical value is 1.282 and the null hypothesis is rejected
- (b) The critical value is 1.282 and the null hypothesis is accepted
- (c) The critical values are and the null hypothesis is rejected
- (d) The critical values are and the null hypothesis is accepted
- (e) The critical values are and the null hypothesis is rejected.

(1 mark)

38. Anil, the manager of a food chain outlet wants to ensure that the variability in the service time by their bearers is in control. He does a sampling of the average time taken by the bearers in serving the customers in the outlet. He finds that the mean of the sample range to be 1.5 minutes. If he has collected five samples each of ten observations to conduct the test then what is the upper control limit of the R chart?

[< Answer >](#)

- (a) 0.3355
- (b) 1.0054
- (c) 1.5003
- (d) 2.6652
- (e) 3.1711.

(1 mark)

39. The following details are available for a hypothesis test on population proportion:

[< Answer >](#)

$$H_0: p = 0.40$$

$$H_1: p \neq 0.40$$

Value of the test statistic on standardized scale = 1.5492

Sample size = 360

What is the sample proportion?

- (a) 0.44
- (b) 0.56
- (c) 0.40
- (d) 0.60
- (e) 0.04.

(1 mark)

[< Answer >](#)

40. Which of the following is **true** with regard to the method of least squares used in simple regression analysis?

- (a) It minimizes the sum of the squared values of the independent variable
- (b) It minimizes the sum of the squared differences between the values of the independent variable and their mean
- (c) It minimizes the sum of the squared differences between the actual values and estimated values of the dependent variable as per the regression equation
- (d) It minimizes the sum of the squared differences between the values of the dependent variable and their mean
- (e) It minimizes the sum of the squared values of the dependent variable.

(1 mark)

[< Answer >](#)

41. Four samples of output from a process have the means as 2.20, 2.80, 2.40, 2.60. The grand mean for the samples collected is

- (a) 2.25
- (b) 2.50
- (c) 2.65
- (d) 2.70
- (e) 2.75.

(1 mark)

[< Answer >](#)

42. If error sum of squares is equal to regression sum of squares, then which of the following is **true**?

- (a) Coefficient of correlation = 1
- (b) Coefficient of correlation = 1
- (c) Coefficient of correlation = 0.50
- (d) Coefficient of determination = 1
- (e) Coefficient of determination = 0.50.

(1 mark)

43. The area under the standard normal curve between the points 0 and 1.3 is 0.4032. The area between the points 1.3 and 1.3 is

[< Answer >](#)

- (a) 0.9062
- (b) 0.8962
- (c) 0.8064
- (d) 0.9064
- (e) 0.9864.

(1 mark)

44. From the following data compute Paasche's quantity index for the year 2006 considering the year 2005 as base year:

[< Answer >](#)

Commodity	Quantity (in units)		Price in 2006 (Rs. per unit)
	2005	2006	
A	30	25	35
B	20	30	45
C	10	15	25

- (a) 116.1616
- (b) 118.1818
- (c) 120.2020
- (d) 122.2222
- (e) 124.2424.

(1 mark)

45. A two-wheeler dealer has sold 30,000 two-wheelers during the year 2003-04. According to the secular trend equation, the estimated value for the year is 32,000. The cyclical variation for the year measured by the relative cyclical residual technique is

[< Answer >](#)

- (a) -6.25
- (b) 0.94
- (c) 6.25
- (d) 6.67
- (e) 106.67.

(1 mark)

46. If the pattern of chart of a process is 'Hugging the center line', then it indicates that the

[< Answer >](#)

- (a) Process mean may be drifting
- (b) Process mean may have shifted
- (c) Two distinct populations are being observed

- (d) Variation has been reduced to a great extent
- (e) Few individual outliers are present.

(1 mark)

47. Three training methods were compared to see if they led to similar productivity after training. The following are productivity measures for individuals trained by each method.

[< Answer >](#)

Method 1	46	41	51	39	53
Method 2	59	43	47	51	40
Method 3	42	38	45	42	53

A test of ANOVA has to be performed.

Find the estimate of the population variance using variance between the samples means.

- (a) 12
- (b) 14
- (c) 16
- (d) 18
- (e) 20.

(1 mark)

48. A type I error occurs in hypothesis testing when the

[< Answer >](#)

- (a) Null hypothesis is false
- (b) Alternative hypothesis is false
- (c) Null hypothesis is false and accepted
- (d) Null hypothesis is true and rejected
- (e) Null hypothesis is false and rejected.

(1 mark)

49. If we reject $H_0: \mu = 30$ in favor of $H_1: \mu < 30$ at a given level of significance with a negative value of the test statistic, then a test with $H_0: \mu = 30$ versus $H_1: \mu < 30$ using the same sample and the same level of significance will

[< Answer >](#)

- (a) Always accept H_0
- (b) Always reject H_0
- (c) Sometimes accept and sometimes reject H_0
- (d) Certainly lead to a Type I error
- (e) Certainly lead to a Type II error.

(1 mark)

50. The mathematical relation that enables us to predict the value of the dependent variable from the value of the associated independent variable, then the specific method used to find such relation is called

[< Answer >](#)

- (a) Correlation analysis
- (b) Regression analysis
- (c) Risk analysis
- (d) Decision tree analysis
- (e) Marginal analysis.

(1 mark)

51. 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) 0.4750
- (b) 0.3950
- (c) 0.2380
- (d) 0.5750
- (e) 0.6750.

(2 marks)

52. The prices and quantities of some commodities consumed by a family in the years 2005 and 2006 are given below:

[< Answer >](#)

Commodity	Year			
	2005		2006	
	Price (Rs./kg)	Quantity (kg)	Price (Rs./kg)	Quantity (kg)
Tea	600.00	10	800.00	8
Sugar	14.50	150	15.00	120
Milk Powder	90.00	15	120.00	12
Rice	13.50	500	15.50	480
Flour	12.00	300	13.50	250

What is the price index by Laspeyres method for the basket of commodities consumed by the family, for the year 2006, considering 2005 as the base year?

- (a) 83.33
- (b) 118.50
- (c) 102.92
- (d) 112.07
- (e) 120.00.

(2 marks)

53. The production (in thousand quintals) of a sugar factory during seven years is given below:

[< Answer >](#)

Year	1996	1997	1998	1999	2000	2001	2002
Production ('000 quintals)	75	85	87	80	89	95	90

What is the estimated production of sugar for the year 2003 on the basis of a linear estimating equation that describes the trend in the sugar production by the factory?

- (a) 85,857 quintals
- (b) 95,429 quintals
- (c) 88,250 quintals
- (d) 89,857 quintals
- (e) 4,87,904 quintals.

(2 marks)

54. Two random samples are drawn from two normal populations, 1 and 2 respectively, and their data are:

[< Answer >](#)

Sample from population 1	60	65	71	74	76	82	85	87		
Sample from population 2	61	66	67	85	78	63	85	86	88	91

We want to test whether the population 2 has larger variance than the population 1. What is the value of the appropriate test statistic for the above test?

- (a) 1.3464
- (b) 1.4675
- (c) 1.5826
- (d) 1.6247
- (e) 1.7188.

(2 marks)

55. An automobile-manufacturing firm is bringing out a new model car. In order to map out its advertising campaign, it wants to determine whether the model appeal depends on age group or not. The firm takes a random sample from persons attending a preview of the new model and obtained the following results:

[< Answer >](#)

Persons	Under 20	20 - 40	40 - 50	50 and over	Total
Who liked the car	146	78	48	28	300
Who disliked the car	54	52	32	62	200
Total	200	130	80	90	500

At significance level of 5% which of the following conclusions can be drawn on the basis of the appropriate statistical test?

- (a) The new car model appeals equally to all age groups

- (b) Persons above 50 years do not like the car as much as the other groups
- (c) Persons below 20 years like the car more than any other age group
- (d) The new car model does not appeal equally to all age groups
- (e) Persons belonging to age group 20 to 40 years like this model more than persons belonging to the other age groups.

(2 marks)

56. The following details are available with regard to a hypothesis test on population mean:

[< Answer >](#)

H_0 :

H_1 :

$n = 64$, $\bar{x} = 11$ and significance level = 0.05

It is later known that the true population mean is 11. Which of the following can be said with regard to the test?

- (a) There is insufficient information for doing the test
- (b) The t-distribution should be used
- (c) The test does not lead to either type I or type II error
- (d) The test leads to a type I error
- (e) The test leads to a type II error.

(2 marks)

57. 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 population 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)

58. Genesis Systems Ltd. produces different types of products in the field of information technology. The research and development department of the company has been witnessing a growth in the research activities over the past few years. The data on research expenditure in the recent past are given below:

[< Answer >](#)

Year	1997	1998	1999	2000	2001	2002
Research expenditure (Rs. in lakh)	40	47	54	62	69	77

Estimate the research expenditure (Rs. in lakh) for the year 2003.

- (a) 76.3667
- (b) 78.5667
- (c) 80.7667
- (d) 82.9667
- (e) 84.0667.

(2 marks)

59. For generating a chart 20 samples are taken. The sum of all the observations is 360 and the value to be used for the centre line is 1.8. The size of each sample is

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

(2 marks)

60. Magnus 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 three years:

Y	X ₁	X ₂
30	2	120
58	5	110
67	9	135
79	12	125
14	8	140

If Y denotes sales (in 000's), X₁ denotes the number of advertisements and X₂ denotes the price per set (in Rs.), then obtain a multiple regression relationship of the form:

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

What is the value of coefficient b₁ in the above regression relationship?

- (a) 5.302
- (b) 6.413
- (c) 7.524
- (d) 8.635
- (e) 9.746.

(2 marks)

61. From an association consisting of 540 individuals, a sample of 60 individuals is taken. From this sample, the average age of the individuals is found to be 31 years and the standard deviation is found to be 6.84 years. [< Answer >](#)

A 95% confidence interval for the mean age of the individuals in the association has to be constructed. The lower and upper confidence limits of the confidence interval are

- (a) 24.16 years and 37.84 years respectively
- (b) 28.12 years and 33.32 years respectively
- (c) 29.37 years and 32.63 years respectively
- (d) 30.17 years and 31.83 years respectively
- (e) 17.60 years and 44.41 years respectively.

(2 marks)

62. 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)

63. A linear trend equation was developed for relating the annual operating cost of Alpha industries Ltd., with the year. The operating cost for the year 1999 was observed to be Rs.63.18 lakhs and the relative cyclical residual for that year was 8. The operating cost for the year 2000 was observed to be Rs.72.45 lakhs and the relative cyclical residual for that year was 5. The operating cost for the year 2001 was observed to be Rs.77.91 lakhs. In the linear trend equation, the time variable (X) has been coded as: $x = X - 1998$. [< Answer >](#)

What was the relative cyclical residual for the year 2001?

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

(2 marks)

64. Shanta Biotech is a renowned company in providing bio-chemistry and bio-physics products. It provides clones of popular genes such as DNA, RNA [< Answer >](#) and Oops. The number of pairs sold for each brand on several different days is as follows:

DNA	RNA	Oops
8	11	9
4	10	7
2	4	5
10	10	9

For a test of ANOVA the estimated common population variance, using the variance within the samples, is

- (a) 3.0833
- (b) 5.4853
- (c) 7.6453
- (d) 9.0833
- (e) 12.4533.

(2 marks)

65. An economist believes that the rent charged by the owners of apartments is determined by the number of rooms and the distance from the city center. [< Answer >](#)
The following data pertains to a randomly collected sample of tenants living in apartments situated at various parts of the city:

Y	X ₁	X ₂
3,300	2	2
7,500	5	4
3,750	3	2
4,200	4	3
3,300	4	10
2,750	3	6

If Y denotes rent in rupees, X₁ denotes the number of rooms and X₂ denotes the distance from the city center in kilometers, then obtain a multiple regression relationship of the form

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

What is the value of the coefficient b_2 ?

- (a) 270.143
- (b) -280.254
- (c) -285.365
- (d) -290.476
- (e) 295.587.

(2 marks)

66. 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: [< Answer >](#)

	Y	62	80	60	68	50	40
--	---	----	----	----	----	----	----

$\sum X = 4000$ $\sum Y = 60$ $\sum XY = 800$ and number of data points = 6

What percentage of the variations in Y does the regression line **cannot** explain?

- (a) 9.1%
- (b) 17.4%
- (c) 34.8%
- (d) 82.6%
- (e) 91.0%.

(2 marks)

67. A company sells cornflakes in 1 kg boxes. It is aware that all the boxes do not have the same weight. The standard deviation of weights based on past data is 75 gm. If a random sample of 50 boxes is drawn from a day's production and the sample mean is 950 gm, then which of the following would be the **correct** conclusion about mean at 5% level of significance? [< Answer >](#)

- (a) It is insignificantly less than 1 kg at 5% level of significance
- (b) It is significantly less than 1 kg at 5% level of significance
- (c) It is significantly equal to 1 kg at 5% level of significance
- (d) It is insignificantly equal to 1 kg at 5% level of significance
- (e) It is significantly more than 1 kg at 5% level of significance.

(2 marks)

68. Softech Solutions Ltd. has recorded the following levels of Return On Equity (ROE) over the period 1998-2002: [< Answer >](#)

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

A second degree estimating equation of the form $y = a + bx + cx^2$, is required to be formulated for estimating the ROE for a given year. The time

variable (X) has to be coded as .

The value of coefficient 'c' of the estimating equation is approximately

- (a) 0.8571
- (b) 1.1252
- (c) 2.2503
- (d) 3.1264
- (e) 4.1965.

(2 marks)

69. 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.

(2 marks)

70. Madhavi, the chief manager of a Telephone manufacturing company, feels that the longer a group of employees work together on an assembly line, the higher the daily output rate. She has gathered the following data for a group of employees who worked together for 10 days:

[< Answer >](#)

Daily output (units)	4	7	5	6	8	2	3	10	9	12
Days worked together	1	2	3	4	5	6	7	8	9	10

Which of the following is the intercept of the estimated regression line with the daily output as the dependent variable?

- (a) 2.071
- (b) 3.399
- (c) 4.454
- (d) 5.503
- (e) 6.556.

(2 marks)

71. The following details are available with regard to a hypothesis test on population mean:

[< Answer >](#)

H_0 :

H_1 :

$n = 64$, $\bar{x} = 12$, $s^2 = 16$ and significance level = 0.05.

It is later known that the true population mean is 10. Which of the following can be said with regard to the test?

- (a) There is insufficient information for doing the test
- (b) The t-distribution should be used
- (c) The test does not lead to either type I or type II error
- (d) The test leads to a type I error
- (e) The test leads to a type II error.

(2 marks)

72. Two random samples were drawn from two normal populations and their values are:

[< Answer >](#)

A	66	67	75	76	82	84	88	90	92		
B	64	66	74	78	82	85	87	92	93	95	97

We want to test whether the population B has larger variance than the population A. What conclusions can be most appropriately drawn from the above test at a significance level of 5%?

- (a) The variances of the two populations are equal
- (b) The difference between the variances of the two populations is 38
- (c) The difference between the variances of the two populations is 76
- (d) The variance of the population A is larger than the variance of the population B
- (e) The variance of the population B is larger than the variance of the population A.

(2 marks)

73. In the year Y, the prices of the commodities A, B and C are in the ratio of 2 : 5 : 7. In the year X prices of the commodities A, B and C were in the ratio of 2 : 4 : 6. Year X is the base year and year Y is the current year. If the price relative for the commodity A is 120, then what is the unweighted aggregate price index for the year Y?

[< Answer >](#)

- (a) 120
- (b) 60
- (c) 70
- (d) 140
- (e) 160.

(2 marks)

74. The pollution control department in a city is studying the number of chest disease cases reported due to air pollution, which have taken place over six years. The following data are collected from their records:

[< Answer >](#)

Year	2003	2002	2001	2000	1999	1998
Number of chest disease cases	205	185	195	165	175	155

What is the estimate of the number of chest disease cases for the year 2004? (Round off your answer to the nearest integer)

[Use coded value of year = $2(X - \quad)$ where X represents the year]

- (a) 185
- (b) 195
- (c) 201
- (d) 211
- (e) 345.

(2 marks)

75. Z is a binomial random variable. For 25 trials the standard deviation of Z is .
What will be the standard deviation of Z for 75 trials?

[< Answer >](#)

- (a) 6
- (b)
- (c)
- (d) 18
- (e) .

(2 marks)

Suggested Answers

Quantitative Methods-II (MSF1B2): October 2007

1. Answer : (e)

Reason : Laspeyres method generally tends to overestimate the rise in prices or has an upward bias

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2. Answer : (e)

Reason : By Central Limit Theorem for large samples the sample mean is approximately normally distributed with mean is equal to population mean and standard deviation is equal

$$\therefore \bar{x} = \mu = 18 \text{ min}$$

$$s = \sigma = 1.5 \text{ min}$$

$$\therefore P(Z < 1.25) = 0.50 + 0.3944 = 0.8944.$$

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3. Answer : (b)

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Reason : The required estimate of population variance based on the variance within the sample will be

[≥](#)

4. Answer : (d)

[< TOP](#)Reason : $r = \frac{\text{Covariance}}{\text{Standard Deviation of X} \times \text{Standard Deviation of Y}}$ and $r^2 =$ Coefficient of determination[≥](#)

Since the covariance is positive the coefficient of correlation (r) will also be positive. So here, r will be the positive square root of coefficient of determination.

$$\therefore r = \sqrt{0.5625} = 0.75 \quad \text{and} \quad \text{Standard Deviation of Y} = 16$$

$$\therefore \text{Covariance} = 0.75 \times 16 \times 16 = 192$$

$$\therefore b \text{ (slope of regression equation of Y on X)} = \frac{\text{Covariance}}{\text{Standard Deviation of X}^2} = \frac{192}{16^2} = 0.75$$

5. Answer : (e)

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Reason : The data may follow a binomial distribution if the probability of success is constant from trial to trial. The data may follow a uniform distribution if the probabilities of the outcomes of the trial are equal. The data may follow a normal distribution if the probability of success is constant from trial to trial. The data may follow a continuous distribution if the outcome is any value within a given range of values. When sampling is done without replacement from a finite population such that the probability of success is not constant from trial to trial, the data follow a hypergeometric distribution.

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6. Answer : (c)

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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:

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Lower control limit =

7. Answer : (a)

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Reason : Laspeyres quantity index = $\frac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$

$$= \frac{11842}{100} = 118.42$$

[≥](#)

8. Answer : (a)

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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

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

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

9. Answer : (c)

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Reason : The equality of the means of more than two samples is tested by analysis of variance.

[≥](#)

The test statistic for the given test is F ratio.

We find the test statistic as

10. Answer : (e)

Reason : Paasche's price index =

$$= \frac{\sum_1 \frac{P_1}{P_0} Q_1}{\sum_1 Q_1} \times 100$$

$$= 1.60 \times 100 = 160.$$

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11. Answer : (a)

Reason : The test statistic is the χ^2 statistic.

$$= (29 \times (0.73)^2) / 1$$

$$= 15.4541.$$

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12. Answer : (e)

Reason : The populations must follow the normal distribution and have equal standard deviations, but the sample sizes do not have to be the same or the sample means need not be equal.

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13. Answer : (c)

Reason : $\hat{Y} = a + bY$ $b =$

Equation of regression line of X on Y :

$$X - 65 = 0.80 (2.5 / 3.5) (Y - 67)$$

$$\text{or, } \hat{X} = 26.7143 + 0.5714 Y.$$

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14. Answer : (c)

Reason : Deseasonalized value =

$$\times 100$$

$\therefore$ Seasonal Index =

$$\times 100$$

$$= \quad \times 100 = 461.5385.$$

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15. Answer : (e)

Reason : (a) This is a wrong answer. The number of degrees of freedom does not depend on the sample size.

(b) This is the wrong answer. The number of degrees of freedom does not depend on the ratio of sample size and the population.

(c) This is the wrong answer. The number of degrees of freedom does not depend on the number of rows in the contingency table only.

(d) This is the wrong answer. The number of degrees of freedom does not depend on the number of columns in

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the contingency table only.

(e) This is the right answer. When the chi-square distribution is used as a test of independence, the number of degrees of freedom is related to both the number of rows and the number of columns in the contingency table.

16. Answer : (d)

Reason : The technique used for studying seasonal variations is known as ratio to moving average method.

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17. Answer : (c)

Reason : Given that, total number of samples = 14

Number of items per sample = 30

Number of defectives, d = 21

= Estimate of the process fraction defectives = 0.05

Central line for p chart = 0.05

Upper Control Limit for p chart =

=

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18. Answer : (c)

Reason : Unweighted aggregates price index =

= 130.7692.

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19. Answer : (b)

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

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

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

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

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20. Answer : (e)

Reason : Let us consider Regression Sum of Squares is equal to Total Sum of Squares.

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21. Answer : (b)

Reason : Non sampling errors occur at the time of observation, approximation and processing of data.

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22. Answer : (d)

Reason : The test is chi-square test of goodness of fit.

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Since the number of elements in the table is 10, the number of degrees of freedom for the chi square test is $10 - 1 = 9$.

At 5% level of significance, the value of chi-square for 9 degrees of freedom from the chi-square table is 16.919.

23. Answer : (a)

Reason : The product of the two parameters n and p will be equal to the mean.

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24. Answer : (c)

Reason :

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25. Answer : (e)

Reason : X lies within ± 0.8 times standard deviation of mean. So the probability is $2 \times 0.2881 = 0.5762$.

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26. Answer : (c)

Reason :

Coefficient of variation =

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$\therefore \text{Cov}(X, Y) = 0.75 \times 6 \times 4 = 18.$

27. Answer : (c)

Reason : The Lower Control Limit in an R Chart =
 $= 7.1 -$
 $= 0.5383.$

Hence from above discussion, we can infer that option (c) is correct.

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28. Answer : (c)

Reason : The coefficient of determination is a positive value. So the regression equation could have either a positive or a negative slope

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29. Answer : (c)

Reason : $H_0:$

$H_1:$

It is a two-tailed test at a significance level of 0.05. Both the samples are large. Hence the normal distribution should be used to approximate the sampling distribution of the difference between sample means.

Value of the test statistic =

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The critical values under the left and right tails obtained from the standard normal distribution are . The observed value of the test statistic is less than the left tail critical value; so it falls in the critical region. So we reject the null hypothesis.

30. Answer : (d)

Reason : Let $r=7$ and given $n = 16$.

The probability of answering a question correctly is taken as a success, then we have $p = 0.20$, $q = 0.80$, (i.e. each multiple choice has 0.2 probability of success).

Then applying the binomial distribution for r number of successes out of n trials is:

$P(r) =$.

31. Answer : (b)

Reason : There is only one mode in case of a normal probability distribution.

32. Answer : (d)

Reason : Given that,

$$\begin{aligned} &= -170, & &= -20, \\ &= 8288, & &= 2264 \\ &= 3044, & n = 10. \end{aligned}$$



33. Answer : (c)

Reason : Weighted average of relatives price index =

Commodity		$P_n Q_n$	
Rice	118.42	10,000	11,84,200
Wheat	130.77	4,050	529618.50

Salt	160	1,300	208,000
Sugar	145	9,600	13,92,000
Pulses	137.78	13,250	18,25,585
		$\Sigma = 38,200$	$\Sigma = 51,39,403.50$

$$= 51,39,403.50$$

$$= 38,200.$$

$$\therefore \text{Weighted average of relatives price index for year 2006 was } = 134.5394.$$

34. Answer : (e)

Reason : Given statement, Sampling involves more work as compared with a census is false.

Because the correct statement is Sampling involves less work as compared with a census.

So option (e) is correct.

35. Answer : (c)

Reason : The Upper Control Limit of Chart = $\bar{x} + 3 \sigma$

$$= 15.00 + 3 \times 0.03$$

$$= 15.09.$$

Hence option (c) is correct.

36. Answer : (a)

Reason : Coefficient of determination = r^2

(where 'r' is the coefficient of correlation and $-1 \leq r \leq 1$)

$$\therefore \text{Coefficient of determination} = r^2 \geq 0$$

Because square of a positive or, negative number is always positive.

Further if $r = 0$ then $r^2 = 0$, and if $r \neq 0$ then $r^2 \neq 0$

Also if $-1 \leq r \leq 1$ then $0 \leq r^2 \leq 1$

Hence all other alternatives except (a) are false

37. Answer : (d)

Reason : Since the population is normally distributed the sampling distribution of mean will also be normally distributed. Moreover since the population standard deviation is known we can use the standard normal distribution. The test is two tailed and the significance level is 0.10. So there are two critical values, one under each tail. The critical values are ± 1.645 . The test statistic is 1.50. So it falls in the acceptance region. Hence the null hypothesis is accepted.

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38. Answer : (d)

Reason : Given that $n = 10$. for $n = 10$, $d_1 = 1.5$, $d_2 = 3.078$ and $d_3 = 0.797$.

The Upper Control Limit for the R chart is given as,

$$= \bar{R} + A_2 \bar{R} = 1.5 \times 1.7768 = 2.6652.$$

39. Answer : (a)

Reason : Standardized test statistic =

$$\frac{\bar{x} - \mu}{\sigma / \sqrt{n}} = \frac{0.40}{\sqrt{0.0258}} = 1.5492$$

$$\therefore = 1.5492$$

$$\text{or } = 0.40 + (1.5492 \times 0.0258) = 0.44.$$

40. Answer : (c)

Reason : The method of least squares in simple regression analysis minimizes the sum of the squared differences between the actual values and estimated values of the dependent variable.

41. Answer : (b)

Reason : Grand mean = 2.50

42. Answer : (e)

Reason : $RSS + ESS = TSS$

$$RSS = ESS \Rightarrow$$

$\therefore$ Coefficient of determination = 0.50.

43. Answer : (c)

Reason : The area under the standard normal curve between the points 0 and 1.3 is 0.4032 and thus the area under the standard normal curve between the points -1.3 and 0 is also 0.4032, by symmetry. Hence the area under the standard normal curve between the points -1.3 to 1.3 is 0.8064.

44. Answer : (b)

Reason : Paasche's quantity index

$$=$$

45. Answer : (a)

Reason : The required cyclical variation for the given year by relative cyclical residual technique will be

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46. Answer : (d)

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

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47. Answer : (e)

Reason : We first find the value of the grand mean:

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Samples	I	II	III
	46	59	42
	41	43	38
	51	47	45
	39	51	42
	53	40	53
Total	230	240	220

The value of the grand mean

Variance between the samples can be computed as below:

n_j			n_j
5	46	0	0
5	48	4	20
5	44	4	20
Total			40

The variance between sample means =

48. Answer : (d)

Reason : A type I error occurs when the null hypothesis is true and rejected.

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49. Answer : (b)

Reason : If we reject $H_0: \mu = 30$ in favor of $H_1: \mu < 30$ at a given level of significance with a negative value of the

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test statistic, then a test with $H_0: \mu = 30$ versus $H_1: \mu < 30$ using the same sample and the same level of significance

will **always reject H_0** because in a one tailed test the critical region on the relevant tail is larger than a two tailed test for

the same level of significance.

50. Answer : (b)

Reason : The mathematical relation that enables us to predict the value of the dependent variable from the value of the associated independent variable, then the specific method used to find such relation is called regression analysis.

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51. Answer : (a)

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., follows We have to find .

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52. Answer : (e)

Reason : Laspeyres price index =

P_0 = Base year (2005) price

Q_0 = Base year (2005) quantity

P_1 = Current year (2006) price

Q_1 = Current year (2006) quantity

∴ Laspeyres price index for the year 2006 =

=

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53. Answer : (b)

Reason : Let the following notations be used:

X : Years

x : Coded value of year

Y : Production of sugar (thousand quintals)

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X		Y	xY	x ²
1996	3	75	-225	9
1997	2	85	-170	4
1998	1	87	-87	1
1999	0	80	0	0
2000	1	89	89	1
2001	2	95	190	4
2002	3	90	270	9
Σx				

∴

∴ For the year 2003 : $x = 2003 - 1999 = 4$

∴ Estimated sugar production = $85.857 + (2.393 \times 4) = 95.429$ (thousand quintals)
i.e. 95,429 quintals.

54. Answer : (b)

Reason : We calculate the variances of the two samples as follows:

Number	X_1	$(X_1 - \bar{X}_1)$	$(X_1 - \bar{X}_1)^2$	X_2	$(X_2 - \bar{X}_2)$	$(X_2 - \bar{X}_2)^2$
1	60	-15	225	61	-16	256
2	65	-10	100	66	-11	121
3	71	-4	16	67	-10	100
4	74	-1	1	85	8	64
5	76	1	1	78	1	1
6	82	7	49	63	-14	196
7	85	10	100	85	8	64
8	87	12	144	86	9	81
9				88	11	121
10				91	14	196
Sum	600		636	770		1200
Means	75			77		
Sample Variance			90.857			133.333

Keeping the large variance, in the numerator

The test statistic $F = \frac{133.333}{90.857} = 1.468$

55. Answer : (d)

Reason : This is a test of independence and therefore the null hypothesis should be “ The model appeals equally to all the age groups”, i.e. , the model appeal does not depend on age groups.

The chi square value can be obtained as follows:

Observed Frequency (O)	Expected Frequency (E)	$(O-E)^2 / E$
146	120	5.633
54	80	8.450
78	78	0
52	52	0
48	48	0

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32	32	0
28	54	12.519
62	36	18.778

The value of Chi square statistic, $\chi^2 = 45.38$

The critical chi square value from the table at a 5% level of significance and $(2 - 1)(4 - 1) = 3$ degrees of freedom = 7.815.

Since the value of the test statistic exceeds the critical value, it falls in the critical region. So we reject the null hypothesis and conclude that “The new car model does not appeal equally to all age groups.”

56. Answer : (e)

Reason : $H_0 : \mu = 9$

$H_1 : \mu \neq 9$

The sample is large. So we shall use the normal distribution.

$$\bar{x} = 10.125$$

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} = 1.7778.$$

At $\alpha = 0.05$, Critical values are ± 1.96

The test statistic is less than the right tail critical value.

So it falls in the acceptance region.

$\therefore H_0$ is accepted.

But H_0 is false because $\mu = 11$. So the test leads to a type II error.

57. Answer : (c)

Reason : Here, $n = 150$

$$s = 25$$

$$n = 9$$

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

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

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Hence, we are 95% confident that the population mean lies in the interval 130.78 to 169.22.

58. Answer : (e)

Reason : Let the following notations be used:

X : Year

x : Coded value of year = $2(X - 1999.5)$

Y : Research expenditure (in Rs.)

Year X	$x = 2(X - 1999.5)$	Y	xy	x^2
1997	-5	40	-200	25
1998	-3	47	-141	9
1999	-1	54	-54	1
2000	1	62	62	1
2001	3	69	207	9
2002	5	77	385	25
$\Sigma X = 11997$		$\Sigma Y = 349$	$\Sigma xy = 259$	$\Sigma x^2 = 70$

$$= 1999.5$$

$$= a + bx$$

$$b = \frac{\Sigma xy}{\Sigma x^2} = \frac{259}{70} = 3.7$$

$$a = \frac{\Sigma Y}{n} = \frac{349}{6} = 58.1667$$

$\therefore$ The linear trend equation is $Y = 58.1667 + 3.7x$

$$\text{Year (X)} = 2003$$

$$x = 2(2003 - 1999.5) = 7$$

$$= 58.1667 + 3.7(7) = 84.0667$$

$\therefore$ The research and development expenditure for the year 2003 is Rs.84.0667 lakh.

59. Answer : (b)

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 $\bar{\bar{x}} = 1.8$. Sum of all the observations = $\Sigma x = 360$ (given)

Now, $\bar{\bar{x}} = \frac{\Sigma x}{n}$

Where,

n = Sample size = ?

k = number of samples = 20 (given)

$\therefore n =$

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$$\text{or } n = \quad = 10$$

60. 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–

$$\begin{aligned} Y &= a + b_1X_1 + b_2X_2 \\ \sum Y &= na + b_1\sum X_1 + b_2\sum X_2 \\ \sum YX_1 &= a\sum X_1 + b_1\sum X_1^2 + b_2\sum X_1X_2 \\ \sum YX_2 &= a\sum X_2 + b_1\sum X_1X_2 + b_2\sum X_2^2 \end{aligned}$$

We obtain the following values:

$$\begin{aligned} \sum Y &= 248 & \sum X_1 &= 36 & \sum X_2 &= 630 \\ \sum YX_1 &= 2013 & \sum YX_2 &= 318 & \sum X_1X_2 &= 79950 \\ \sum YX_2 &= 30860 & \sum X_1^2 &= 4625 & n &= 5 \end{aligned}$$

∴ 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, $a = 215.358$, $b_1 = 6.413$ and $b_2 = -1.682$.

61. Answer : (c)

Reason :

$$s = 6.84$$

$$n = 60 \quad N = 540$$

Sampling fraction,

∴ Estimated standard error of mean, $\sigma_{\bar{y}}$

$$=$$

$$=$$

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$$= 0.833$$

Since the sample size is greater than 30 the normal distribution will be used.

Z-values for the upper and lower confidence limit are

∴ Upper confidence limit = $\bar{x} + z_{\alpha/2} \cdot \frac{s}{\sqrt{n}}$

Lower confidence limit = $\bar{x} - z_{\alpha/2} \cdot \frac{s}{\sqrt{n}}$

62. Answer : (d)

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

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21,700

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

63. Answer : (b)

Reason : Let the linear trend equation be : $y = a + bx$

$x = X - 1998$ where X = time variable (year)

Given:

X	1999	2000	2001
$x = X - 1998$	1	2	3
Y	63.18	72.45	77.91
$\times 100$	8	5	
	58.5	69	

1999: $\times 100 = 8$

or $= 8$

or $= 108$ or $=$ Rs.58.5 lakh

2000: $= 5$

or $\times 100 = 5$

or $= 105$ or $=$ Rs.69 lakh.

$\therefore$ From above we have

$58.5 = a + b(1)$ i.e. $58.5 = a + b$ ----- (A)

$69 = a + b(2)$ i.e. $69 = a + 2b$ ----- (B)

$\therefore b = 10.5$

Putting the value of b in equation (A) we get

$a = 58.5 - 10.5 = 48$

$\therefore$ The linear trend equation is: $y = 48 + 10.5x$

Estimated value of Y for year 2001:

$X = 2001 \therefore x = 2001 - 1998 = 3$

$= 48 + 10.5(3) = 79.5$

Relative cyclical residual for 2001:

$= -2$

64. Answer : (d)

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Reason : The Means of the samples are

We calculate Within column variance as below:

$$s_1^2 = \frac{1}{4} [(2-3)^2 + (5-3)^2 + (3-3)^2 + (4-3)^2] = 13.3333$$

$$s_2^2 = \frac{1}{4} [(2-3)^2 + (4-3)^2 + (2-3)^2 + (3-3)^2] = 10.25$$

$$s_3^2 = \frac{1}{4} [(3-3)^2 + (4-3)^2 + (4-3)^2 + (3-3)^2] = 3.6667$$

$$\text{So, } s^2 = \frac{1}{3} \times (13.3333 + 10.25 + 3.6667) = 9.0833$$

Hence from above discussion, we can infer that option (d) is the answer.

65. Answer : (d)

Reason : Let the following notations be used:

Y : Rent (Rs.)

X_1 : Number of rooms

X_2 : Distance (kms) from the city center

X_1	2	5	3	4	4	3	$\Sigma X_1 = 21$
X_2	2	4	2	3	10	6	$\Sigma X_2 = 27$
Y	3300	7500	3750	4200	3300	2750	$\Sigma Y = 24800$
$X_1 Y$	6600	37500	11250	16800	13200	8250	$\Sigma X_1 Y = 93600$
$X_2 Y$	6600	30000	7500	12600	33000	16500	$\Sigma X_2 Y = 106200$
X	4	25	9	16	16	9	$\Sigma X = 79$
X	4	16	4	9	100	36	$\Sigma X_2^2 = 169$
$X_1 X_2$	4	20	6	12	40	18	$\Sigma X_1 X_2 = 100$

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

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

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

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

Putting the values we get–

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$$24,800 = 6a + 21b_1 + 27b_2 \quad \text{--- (A)}$$

$$93,600 = 21a + 79b_1 + 100b_2 \quad \text{-- (B)}$$

$$1,06,200 = 27a + 100b_1 + 169b_2 \quad \text{-- (C)}$$

Solving the above three simultaneous equations we get the values,

$$a = 96.54, b_1 = 1526.84 \text{ and } b_2 = -290.476.$$

66. Answer : (b)

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

$$b =$$

$$a =$$

$\therefore$

$\therefore$ Proportion of variation in Y that is not explained by the regression line = $1 - r^2$

$$= 1 - 0.826 = 0.174$$

$\Rightarrow$ Percentage of variations in Y that is not explained by the regression line = 17.4%

67. Answer : (b)

Reason : Here $\bar{x}$ denotes the mean weight of boxes, the null and alternative hypothesis are

$H_0 : (\bar{x} = 1000)$ and $H_1 : (\bar{x} < 1000)$ respectively.

$$Z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}}$$

$$= (-50) / (7.07 / \sqrt{75}) = -4.71$$

the critical value of z at 5% level of significance is $z_{0.05} = -1.64$

since the calculated value of z is smaller than its critical value at 5% level of significance, the alternative hypothesis H_1 :

$(\bar{x} < 1000)$ is accepted.

Therefore the sample mean is significantly less than 1 kg at 5% level of significance.

68. Answer : (a)

Reason : Given that, the time variable (X) has to be coded as $X = \frac{x - a}{b}$.

We have to find 'c' coefficient of the estimating equation.

So, it is enough to solve the following normal equations

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

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

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Given that, $n = 5$.

Year (X)		ROE(%) (Y)	x^2	x^4	
1998	-2	15	4	16	60
1999	-1	19	1	1	19
2000	0	21	0	0	0
2001	1	27	1	1	27
2002	2	35	4	16	140
$\Sigma = 10,000$	$\Sigma = 0$	$\Sigma = 117$	$\Sigma = 10$	$\Sigma = 34$	$\Sigma = 246$

From the equations (I) and (II) we get,

$$117 = 5a + 10c \quad \dots\dots\dots(1)$$

$$246 = 10a + 34c \quad \dots\dots\dots(2)$$

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

$$10a + 20c = 234$$

$$10a + 34c = 246$$

$$\begin{array}{r} - \quad - \quad - \\ \hline -14c = -12 \end{array}$$

$$\therefore c = 0.8571.$$

69. Answer : (c)

Reason : Let rank of student in Statistics is X_i

Let rank of student in Mathematics is Y_i

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

70. Answer : (b)

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Reason : Estimated regression line is $\hat{Y} = a + bX$ where a is intercept and b is slope. To get the regression constants we tabulate the given data as below:

Days worked Together (X)	Daily Output(Y)	X^2	XY
1	4	1	4
2	7	4	14
3	5	9	15
4	6	16	24
5	8	25	40
6	2	36	12
7	3	49	21
8	10	64	80
9	9	81	81
10	12	100	120
Total = 55	66	385	411

The coefficient $a =$ _____ $=$ _____.

71. Answer : (d)

Reason : $H_0 : \mu = 10$

$H_1 : \mu > 10$

The sample is large. So we shall use the normal distribution.

$$\bar{x} = \frac{\sum X}{n} = \frac{55}{10} = 5.5$$

$$z = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}} = \frac{5.5 - 10}{\frac{2}{\sqrt{10}}} = -1.75$$

At $\alpha = 0.05$, the right tail critical value is 1.645.

The test statistic is more than the right tail critical value. So it falls in the rejection region.

$\therefore$ We reject H_0 . But the true mean is 10. So H_0 is true.

$\therefore$ This leads to type I error.

72. Answer : (a)

Reason : H_0 : Variances of the two populations are equal.

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H_1 : Population B has larger variance than the Population A.

We calculate the variances of the two samples as follows:

Number	X_1	$(X_1 - \bar{X})$	$(X_1 - \bar{X})^2$	X_2	$(X_2 - \bar{X})$	$(X_2 - \bar{X})^2$
1	66	-14	196	64	-19	361
2	67	-13	169	66	-17	289
3	75	-5	25	74	-9	81
4	76	-4	16	78	-5	25
5	82	2	4	82	-1	1
6	84	4	16	85	2	4
7	88	8	64	87	4	16
8	90	10	100	92	9	81
9	92	12	144	93	10	100
10				95	12	144
11				97	14	196
Sum	720		734	913		1298
Means	80	$\bar{X}$		83		
Sample Variance		$\bar{X}$	91.75			129.8

The test statistic $F = \frac{91.75}{129.8} = 0.7068$.

The critical value can be found by looking at the F table with:

The critical value from the table is $F_{(10, 8, 0.05)} = 3.35$.

As we find that the test statistic is less than the right tail critical value; so it falls in the acceptance region, and we accept the null hypothesis. Therefore we conclude that at 5% degree of significance that the variances of the two populations are equal.

73. Answer : (d)

Reason :

Year Y	Commodity	A	B	C
	Price	2K	5K	7K
Year X	Commodity	A	B	C
	Price	2L	4L	6L

Unweighted aggregates price index = $\frac{2000}{2000} \times 100 = 100$

Let the price of commodity A in the year Y be P_{1A} and in the year X be P_{0A} .

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$$\therefore \Sigma P_1 =$$

$$\Sigma P_0 = P_0 A +$$

$$\therefore x =$$

74. Answer : (d)

Reason : Let the following notations be used:

X = Year

Y = Number of diseases reported

x = Coded value for time variable (year)

X	$x = (X -) \times 2$	Y	xY	x^2
2003	$2.5 \times 2 = 5$	205	1025	25
2002	$1.5 \times 2 = 3$	185	555	9
2001	$0.5 \times 2 = 1$	195	195	1
2000	$-0.5 \times 2 = -1$	165	-165	1
1999	$-1.5 \times 2 = -3$	175	-525	9
1998	$-2.5 \times 2 = -5$	155	-775	25
	$\Sigma x = 0$	$\Sigma Y = 1080$	$\Sigma xY = 310$	$\Sigma x^2 = 70$

$$\therefore = a + bx$$

$$b =$$

$$a =$$

$\therefore$ We get: a = 180 and b = 4.43

$\therefore$ The estimating equation is: $= 180 + 4.43x$

The estimate of 2004 chest diseases = $180 + 4.43 \times (2004 - 2000.5) \times 2$

= 211 diseases

75. Answer : (c)

Reason :

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