නව නිර්දේශය / புதிய பாடத்திட்டம் / New Syllabus

NEW

ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2019 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2019 ஓகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2019

15.08.2019 / 1300 – 1500

ව්‍යාපාර සංඛ්‍යානය I
வணிகப் புள்ளிவிவரவியல் I
Business Statistics I

31 E I

පැය දෙකයි
இரண்டு மணித்தியாலம்
Two hours

Instructions:
* *Answer **all** questions.*
* *Write your **Index Number** in the space provided in the answer sheet.*
* *Statistical tables will be provided. Use of calculator is **not allowed**.*
* *Instructions are given on the back of the answer sheet. Follow those carefully.*
* *In each of the questions **1** to **50**, pick one of the alternatives from (1), (2), (3), (4), (5) which is **correct** or **most appropriate** and **mark your response on the answer sheet with a cross** (×) on the number of the correct option in accordance with the instructions given at the back of the answer sheet.*

1. Which of the following statements is true?
   (1) The data collected through newspapers and periodicals are primary data.
   (2) Making inferences about the whole population by studying only a random sample selected is a misuse of statistics.
   (3) Sampling errors cannot be reduced by increasing the sample size.
   (4) Statistics does not study an individual value.
   (5) The purpose of a pilot survey is to test the questionnaire.

2. Consider the following statements.
   A - Histogram can be constructed even for a frequency distribution with unequal class intervals.
   B - The area between the 45 degree line and the Lorenze curve is called Gini co-efficient.
   C - If the Lorenze curve lies exactly on 45 degree line, the value of the Gini co-efficient is zero.
   Of the above statements,
   (1) only *A* is true. (2) only *C* is true.
   (3) only *A* and *C* are true. (4) only *B* and *C* are true.
   (5) all *A*, *B* and *C* are true.

3. Consider the following statements regarding scales of measurements.
   A - There is no relationship among subgroups in nominal scale of measurements.
   B - Since interval scale of measurements has unit of measurements, it can be used for mathematical operations.
   C - Ratio scale of measurements is the only scale which has a fixed starting point.
   Of the above statements,
   (1) only *A* is true. (2) only *C* is true.
   (3) only *A* and *B* are true. (4) only *A* and *C* are true.
   (5) all *A*, *B* and *C* are true.

4. The most suitable diagram to represent the total value with the component values is
   (1) Simple bar diagram. (2) Multiple bar diagram. (3) Pictogram.
   (4) Profile chart. (5) Pie diagram.

[see page two

5. The import of a commodity increased by 20% in 2008, decreased by 18% in 2009 and then increased by 30% in the following year. The increase or decrease in each year is measured relative to its previous year. Which of the following is equal to the average rate of change of imports per annum?

(1) 10% (2) 10.7% (3) 22.6%

(4) $[(0.2)(-0.18)(0.3)]^{\frac{1}{3}}$ (5) $[(100+20)(100-18)(100+30)]^{\frac{1}{3}} - 100$

6. If the mid values (X_i) of class intervals of a frequency distribution were transformed into U_i values as $U_i = \dfrac{X_i - A}{C}$, which of the following gives the mean $\bar{X}$ and the standard deviation σ of the distribution respectively?

(1) $\bar{X} = A + \bar{U},\ \sigma_x = C\sigma_u$ (2) $\bar{X} = A + C\bar{U}, \sigma_x = C\sigma_u$

(3) $\bar{X} = A - C\bar{U},\ \sigma_x = C\sigma_u$ (4) $\bar{X} = \bar{U},\ \sigma_x = C\sigma_u$

(5) $\bar{X} = A + C\bar{U},\ \sigma_x = \sigma_u$

7. In a moderately skewed distribution, the mode and the mean are 32 and 35 respectively. What is the median of the distribution?

(1) 32 (2) 33 (3) 34 (4) 35 (5) 36

8. For a certain distribution, Kelly's coefficient of skewness is 0.2 and P_{10} = 60 and median = 80. What is the value of P_{90} of the distribution?

(1) 100 (2) 110 (3) 130 (4) 140 (5) 160

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

(1) Bowley's co-efficient of skewness cannot be used when a distribution has open end classes.
(2) Kelly's co-efficient of skewness covers more extreme values than Bowley's co-efficient of skewness.
(3) The distribution with a negative co-efficient of skewness has a longer tail to the right.
(4) Bowley's co-efficient of skewness is based on only the central 50% of the observations.
(5) In a distribution with a longer tail to the right, mean > median > mode.

10. The means of runs scored by the five batsmen A, B, C, D and E in a series of 10 innings are 75, 60, 50, 45 and 20 respectively. The standard deviations of their runs are 30, 25, 30, 15, 10 respectively. Who is the most consistent batsman of the five batsmen?

(1) A (2) B (3) C (4) D (5) E

11. A motor car travels 250 km with the speed of 50 km/hour, 120 km with the speed of 40 km/hour and the remaining 50 km with the speed of 25 km/hour. Which of the following is equal to average speed of the motor car for the entire trip?

(1) $38\frac{1}{3}$ km h^{-1} (2) 42 km h^{-1} (3) $63\frac{2}{3}$ km h^{-1}

(4) 140 km h^{-1} (5) $(50 \times 40 \times 25)^{\frac{1}{3}}$ km h^{-1}

12. Consider the following data set.

14, 15, 8, 10, 13, 18, 9, 11, 7, 16, 19, 22, 21

Select the correct answer which gives the first quartile, second quartile, and the third quartile of this data set respectively.

(1) 8, 9, 16 (2) 9.5, 14, 18.5 (3) 9, 14, 18 (4) 8.5, 9.5, 16.5 (5) 10, 15, 19

13. Which of the following statements is true about regression and correlation?

(1) If a constant is subtracted from the two variables X and Y, the correlation co-efficient between X and Y will also change accordingly.
(2) If correlation co-efficient between X and Y is zero, we can conclude that there is no relationship between X and Y.
(3) The correlation co-efficient is only a measure of linear relationship between X and Y.
(4) The free hand method can also be used to fit a multiple regression model.
(5) If the regression co-efficient of Y on X is b_1 and the regression co-efficient of X on Y is b_2 then the correlation co-efficient between X and Y is $b_1 b_2$.

[see page three

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14. Consider the following statements regarding the regression analysis.

A - If the regression co-efficient of Y on X is positive, the correlation co-efficient between X and Y is also positive.

B - The co-efficient of determination is equal to the square of the correlation co-efficient in simple linear regression.

C - A multiple regression model can have only two independent variables.

Of the above statements,

(1) only B is true. (2) only A and B are true.
(3) only A and C are true. (4) only B and C are true.
(5) all A, B and C are true.

15. If the yield increases by 12 kg when the fertilizer increases by 5 kg according to a fitted regression line, what is the regression co-efficient?

(1) 0.42 (2) 2.4 (3) 5 (4) 7 (5) 10

16. Consider the following statements about the approaches to probability.

A - For the probability of a certain event, every person gets the same answer as the correct answer under classical approach to probability.

B - If the number of all possible outcomes of an experiment is n and the number of outcomes favourable to the event A is m, the probability of the event A occurs is $P(A) = \frac{m}{n}$.

C - Under the mathematical approach to probability, it is not required that the probability of the sample space $P(S) = 1$.

Of the above statements,

(1) only A is true. (2) only A and B are true.
(3) only A and C are true. (4) only B and C are true.
(5) all A, B and C are true.

17. The sample space for a certain random experiment is $S = \{a_1, a_2, a_3, a_4\}$. The Probability function for the given sample space is

(1) $P(a_1) = \frac{1}{2}, P(a_2) = \frac{1}{2}, P(a_3) = -\frac{1}{4}, P(a_4) = \frac{1}{5}$.

(2) $P(a_1) = \frac{1}{2}, P(a_2) = \frac{1}{4}, P(a_3) = -\frac{1}{4}, P(a_4) = \frac{1}{2}$.

(3) $P(a_1) = \frac{3}{2}, P(a_2) = \frac{1}{4}, P(a_3) = \frac{1}{8}, P(a_4) = \frac{1}{8}$.

(4) $P(a_1) = \frac{1}{2}, P(a_2) = 0, P(a_3) = \frac{1}{4}, P(a_4) = \frac{1}{4}$.

(5) $P(a_1) = \frac{1}{4}, P(a_2) = \frac{1}{5}, P(a_3) = \frac{1}{5}, P(a_4) = \frac{1}{4}$.

18. If A and B are any two events with $P(A) = P_1$, $P(B) = P_2$ and $P(A \cap B) = P_3$ then the probability of the event $A \cup (A' \cap B)$ is

(1) $P_1 + P_2 - P_3$. (2) $P_2 - P_3$. (3) $P_1 - P_3$.
(4) $1 - P_1 - P_2 + P_3$. (5) $1 - P_3$.

19. If A and B are two events with $P(A \cap B) = \frac{1}{2}$, $P(A' \cap B') = \frac{1}{3}$ and $P(A) = P(B) = k$ then the value of k is,

(1) $\frac{1}{3}$. (2) $\frac{1}{2}$. (3) $\frac{7}{8}$. (4) $\frac{8}{9}$. (5) $\frac{7}{12}$.

20. If A, B and C are any three events, which of the following expressions gives the probability that A or B occur but **not** C occurs?

(1) $P(A \cap B \cap C')$ (2) $P[(A \cup B) \cap C']$
(3) $P\left[(A' \cap C') \cup (B' \cap C')\right]$ (4) $1 - P[(A \cup B) \cap C']$
(5) $P[(A' \cup B') \cap C]$

[see page four

21. The random variable X has the following probability distribution.

x	0	1	2	3	4	5
$f(x)$	0.1	K	0.2	$2K$	0.3	K

Which could be the smallest value of X for $P(X \leq x) > 0.5$?
(1) 1.0 (2) 2.0 (3) 2.5 (4) 3.0 (5) 4.0

22. If a random variable X has a poisson distribution with $P(X = 1) = P(X = 2)$ then what is the value of $P(X > 0)$?
(1) 0.1353 (2) 0.3879 (3) 0.4060 (4) 0.5940 (5) 0.8647

23. If a male birth or a female birth are equally likely, what is the probability that there are fewer girls than boys in a family of 5 children?
(1) 0.0313 (2) 0.1583 (3) 0.1876 (4) 0.5001 (5) 0.8126

24. The marks of a certain examination are in a normal distribution with mean 76 and standard deviation 15. If the best 15% of the students are awarded A passes, what is the approximately minimum mark to receive an A pass?
(1) 77 (2) 85 (3) 91 (4) 92 (5) 94

25. 2.5% of the items produced by a certain factory is defective. If a random sample of 100 items is selected from these items, the probability that at most one item is defective is
(1) 0.0821. (2) 0.2052. (3) 0.2873. (4) 0.7127. (5) 0.9179.

26. Consider the following statements about the systematic sampling.
A - If the units in the sampling frame are in a random order we can expect that precision of the systematic sampling is same as the precision of the simple random sampling.
B - Systematic sampling can be considered as a cluster sampling with the selection of one cluster from k clusters of size n.
C - In systematic sampling, $\frac{N}{n}$ is called the sampling fraction.

Of the above statements,
(1) only A is true. (2) only A and B are true.
(3) only A and C are true. (4) only B and C are true.
(5) all A, B and C are true.

27. Which of the following statements is true about sampling?
(1) If the sampling fraction is large, the finite population correction can be ignored.
(2) If the variations among clusters are large, cluster sampling is more efficient.
(3) Quota sampling can be considered as a non-probability stratified sampling.
(4) Cluster sampling is not used when there is no sampling frame.
(5) The method of selecting a sample giving a known probability to every unit of the population is called simple random sampling.

28. In simple random sampling without replacement, which of the following gives the probability that a certain specified unit of the population is included in the sample?
(1) $\frac{1}{N}$ (2) $\frac{n}{N}$ (3) $\frac{n-1}{N}$ (4) $\frac{1}{NC_n}$ (5) $\frac{1}{N^n}$

29. According to the central limit theorem, the sampling distribution of the sample proportion p is
(1) normal for large samples.
(2) normal if the population proportion is $\pi = 0.5$.
(3) approximately normal if the population size is large.
(4) approximately normal if the sample size is large.
(5) approximately normal only if the population is infinite.

30. Which of the following statements is true?

(1) The accuracy of an estimate is measured by its standard error.
(2) $\bar{X} - \mu$ is always a statistic since it is a function of the sample elements.
(3) The standard error of the mean of a sample from a finite population is larger than the standard error of the mean of a sample from an infinite population for the same sample size.
(4) Chi-square distribution is skewed to the left.
(5) The shape of the T-distribution depends only on the sample size.

31. It is required to estimate the population mean μ by the sample mean $\bar{X}$ of a random sample taken from the population $N(\mu, 100)$. What is the sample size 'n' required for estimating population mean μ, within the range $\mu \pm 5$ with probability 0.954?

(1) 4 (2) 11 (3) 15 (4) 16 (5) 80

32. In a random sample of size 16 from a normal population with mean μ and variance $\sigma^2 = 25$, the sample mean was $\bar{X} = 75$ and the sample variance was $s^2 = 16$. The best 95% confidence interval for μ is

(1) $(73.04, 76.96)$ (2) $(72.55, 77.45)$ (3) $(72.33, 77.67)$
(4) $(72.87, 77.13)$ (5) $(71.94, 78.06)$

33. Consider the following statements about confidence intervals.

A - If the sample size is small the confidence interval for the mean μ of a normal distribution based on the *t*-distribution is wider than the confidence interval based on *z*-distribution.
B - One way of reducing the width of a confidence interval for a given confidence level is to increase the sample size.
C - The meaning of the 95% confidence interval for population mean μ is that the variable μ lies in the interval with probability 0.95.

Of the above statements,

(1) only *A* is true. (2) only *B* is true.
(3) only *A* and *B* are true. (4) only *B* and *C* are true.
(5) all *A*, *B* and *C* are true.

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

(1) If the mean of a normal population with unknown variance is μ, $H_0 : \mu = 100$ is a composite hypothesis.
(2) If the $p-$value of a hypothesis test is high the null hypothesis is more credible.
(3) The value of a test statistic is calculated under the assumption that the null hypothesis is true.
(4) The probability that the H_1 hypothesis is accepted when H_1 is true is called the power of the test.
(5) A better hypothesis test can be performed by reducing the significance level.

35. The mean of a random sample of size 45 from distribution $N(\mu_1, 90)$ is 920 and the mean of a random sample of size 50 from $N(\mu_2, 100)$ distribution is 925. When testing hypothesis $H_0 : \mu_1 = \mu_2$ against $H_1 : \mu_1 < \mu_2$ at 5% significance level, the conclusion is

(1) reject H_0 : since $p-$value $= 0.0062 < 0.05$
(2) do not reject H_0 : since $p-$value $= 0.0062 < 0.05$
(3) reject H_0 : since $p-$value $= 0.0124 < 0.05$
(4) do not reject H_0 : since $p-$value $= 0.0124 < 0.05$
(5) reject H_0 : since $p-$value $= 0.0124 < 1.64$

36. The critical region for testing the hypothesis $H_0 : \mu = 62$ against $H_1 : \mu = 63$ by taking a random sample of size 30 from $N(\mu, 120)$ population is given by $\bar{X} > 64$. The probability of type I error for this hypothesis test is

(1) 0.1587. (2) 0.1915. (3) 0.3085. (4) 0.3413. (5) 0.6587.

[see page six

37. A candidate in a local electoral area claims that at least 50% of the voters will vote for him. To test his claim a random sample of 100 voters was selected and 48 voters said that they would vote for him. The candidate's claim cannot be rejected at 5% significance level since,

(1) $z = -0.4 > -1.64$
(2) $z = 0.4 < 1.64$
(3) $z = -0.39 > -1.64$
(4) $z = 0.39 < 1.64$
(5) $-1.96 < z = -0.4 < 1.96$

38. The number of errors in 100 accounts selected at random from a company are given below.

Number of Errors	0	1	2	3	4	5	6
Number of Accounts	40	35	19	2	0	2	2

What is the table (critical value) value of the Chi-square distribution in testing goodness of fit at 5% level of the poisson distribution fitted for this distribution?

(1) 5.99 (2) 7.81 (3) 9.49 (4) 11.1 (5) 12.6

39. The incomplete analysis of variance table constructed to compare mean output of three machines is given below.

Analysis of variance table

Source	SS	df	MS	F
Between samples	a	2	65	d
Within samples	96	12	c	
Total Variation	226	b		

Select the statement which gives the correct values for a, b, c, d respectively.

(1) $a=130$, $b=10$, $c=8$, $d=8.125$
(2) $a=322$, $b=14$, $c=8$, $d=8.125$
(3) $a=130$, $b=24$, $c=84$, $d=0.773$
(4) $a=130$, $b=14$, $c=8$, $d=8.125$
(5) $a=130$, $b=10$, $c=8$, $d=0.123$

40. Consider the following statements about time series analysis.

A - Method of semi-average can be used only when the trend is linear.
B - The multiplicative model of time series assumes that the components caused due to various factors affect each other.
C - In moving average method, it is assumed that the trend varies according to a line.

Of the above statements,

(1) only *A* is true.
(2) only *B* is true.
(3) only *A* and *B* are true.
(4) only *A* and *C* are true.
(5) all *A*, *B* and *C* are true.

41. The trend equation with the origin 2006 is given by $Y_t = 56 - 4t$. Time unit = 1 year. If the origin is shifted from 2006 to 2002 what is the new trend equation?

(1) $Y_t = 56 - t$
(2) $Y_t = 40 - 4t$
(3) $Y_t = 76 - 4t$
(4) $Y_t = 72 - 4t$
(5) $Y_t = 72 + 4t$

42. In a certain shop the seasonal index for the garment sales is 80 for the first quarter and 130 for the fourth quarter. If the value of the total sales for the first quarter is Rs. 100 000, what is the sales value of the garments that the shop should keep for the fourth quarter in order to meet the demand?

(1) Rs. 61 530 (2) Rs. 130 000 (3) Rs. 162 500 (4) Rs. 500 000 (5) Rs. 800 000

43. The moving average of order 3 of the values 15, 24, 21, 33 and 42 are given by

(1) 20, 22, 30 (2) 20, 26, 32 (3) 20, 23, 32 (4) 20, 24, 33 (5) 20, 25, 34

[see page seven

44. The statistical chart constructed to control the number of defects per unit of a product is
(1) nP - chart. (2) P - chart. (3) C - chart. (4) $\overline{X}$ - chart. (5) R - chart.

45. The average number of defectives in 10 samples each of the size 100 was found to be $\overline{P} = 0.20$. The Lower control limit (L.C.L.) and Upper Control Limit (U.C.L.) of the P – chart respectively are
(1) (0. 16, 0. 24). (2) (0. 18, 0. 28). (3) (0. 20, 0. 32). (4) (0. 08, 0. 32). (5) (0. 08, 0. 20).

46. Consider the following statements.
A - Rejecting a good lot is called producer's risk.
B - The maximum allowable number of defectives in the sample in acceptance sampling is called acceptance number.
C - The quality level of a bad lot is called the Acceptable Quality Level.

Of the above statements,
(1) only A is true. (2) only B is true.
(3) only A and B are true. (4) only A and C are true.
(5) all A, B and C are true.

47. For an acceptance sampling plan with $N = 1200$, $n = 100$ and $C = 1$, what is the probability of acceptance of a lot with fraction defective for 4%?
(1) 0.0183 (2) 0.0733 (3) 0.0916 (4) 0.9084 (5) 0.9817

48. A worker earned Rs. 30 000 per month in year 2005. The cost of living index increased by 25% in the year 2010 compared to 2005. What should be the salary of the worker in 2010, if his standard of living is to remain the same as in 2005?
(1) Rs. 32 000 (2) Rs. 35 000 (3) Rs. 37 500 (4) Rs. 75 000 (5) Rs. 120 000

49. The price index numbers for the years 2003-2010 are given in the following table. (Base year = 1998).

2003	2004	2005	2006	2007	2008	2009	2010
140	200	210	230	250	260	280	300

Select the correct answer which gives the new index numbers for 2004 and 2010 respectively, if the base year is shifted from 1998 to 2007.
(1) 70, 110 (2) 80, 120 (3) 85, 125 (4) 90, 130 (5) 125, 83

50. In a situation where prices are increasing, the index that tends to overestimate the price increase is
(1) Laspeyre's price index. (2) Paache's price index.
(3) Marshall - Edgewerth price index. (4) Fisher's price index.
(5) Simple aggregate price index.

* * *

AL/2019/31/E-II (NEW)

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නව නිර්දේශය/புதிய பாடத்திட்டம்/New Syllabus

NEW

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2019 අගෝස්තු
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2019 ஓகஸ்ற்
General Certificate of Education (Adv. Level) Examination, August 2019

ව්‍යාපාර සංඛ්‍යානය II
வணிகப் புள்ளிவிவரவியல் II
Business Statistics II

31 E II

17.08.2019 / 0830 – 1140

පැය තුනයි
மூன்று மணித்தியாலம்
Three hours

අමතර කියවීම් කාලය - මිනිත්තු 10 යි
மேலதிக வாசிப்பு நேரம் - 10 நிமிடங்கள்
Additional Reading Time - 10 minutes

Use **additional reading time** to go through the question paper, select the questions and decide on the questions that you give priority in answering.

Instructions:

* *Answer five questions selecting at least two questions from each part.*
* *Statistical tables and graph papers will be provided. Use of calculators is **not allowed**.*

Part I

1. (a) State **three** ways that Statistics may be misused. (03 *marks*)

(b) Describe the following methods of data collection stating advantages and disadvantages of each method.
(i) Direct Observation Method
(ii) Focus Group Interview Method
(iii) Electronic Data Collection Method (06 *marks*)

(c) Describe the following measurement scales giving examples.
(i) Nominal Scale (ii) Ranking Scale / Ordinal Scale
(iii) Interval Scale (iv) Ratio Scale (04 *marks*)

(d) The income distributions of the two groups, **A** and **B** are given in the following table.

Income (Thousands Rs.)	Number of Persons (in thousands)	
	Group A	Group B
10	14	08
30	05	07
40	01	06
44	03	02
76	02	02

(i) Calculate the cumulative percentages for the income, for the number of persons in group **A** and for the number of persons in group **B**.
(ii) Draw the **two** Lorenze curves in the same graph and comment on the income distributions of two groups. (07 *marks*)

[see page two

2. (a) Describe what is meant by skewness and kurtosis of a distribution.

The per hour wage rates of 100 workers are given in the following distribution.

Wage Rate	10-19	20-29	30-39	40-49	50-59	60-69
Number of workers	08	12	20	35	20	05

Calculate Kelly's coefficient of skewness based on percentiles and comment on the skewness of the distribution. (06 *marks*)

(b) The coefficients of variation of wages of male workers and female workers in a certain institute are 55% and 60% respectively, while the standard deviations are 22 and 15 respectively. If 80% of the workers are male, calculate the overall average wage of all workers. (04 *marks*)

(c) The heights of the students of a certain class are given in the following distribution.

Height (inches)	58-60	61-63	64-66	67-69	70-72	73-75
Number of students	10	20	30	20	15	05

Calculate the mean, median, mode, standard deviation and Karl Pearson's coefficient of skewness and comment on the distribution. (10 *marks*)

3. (a) What is an index number?

Explain the Laspeyre's price index and Paasche's price index in terms of the total cost of a basket of goods in the base year and total cost of a basket of goods in the given year. (03 *marks*)

(b) Consider the following table.

Item	Base Year		Current Year	
	Price	Total Value	Price	Total Value
A	6	300	10	560
B	4	240	06	360
C	2	200	02	240
D	8	320	12	960
E	10	300	12	288

Using the data in the table, calculate the following.

(i) Laspeyre's price index
(ii) Paasche's price index
(iii) Fisher's price index
(iv) Marshall-Edgeworth price index

Does the Marshall-Edgeworth price index satisfy the time reversal test and the factor reversal test? Give reasons for the answer. (07 *marks*)

(c) What is a Time Series?

Describe **three** uses of time series analysis in the business field.

Describe what is meant by cyclical variation and seasonal variation in time series analysis. (05 *marks*)

(d) The trend equation fitted by the method of least squares for the sales of garments is given below.

$Y = 840 + 72X$

Origin is 2005

Time unit = 1 year

Y = Number of units sold per year

(i) Convert this trend equation into a monthly trend equation.

(ii) Estimate the sale for the month of October in the year 2011. (05 *marks*)

[see page three

4. (a) A sales department of a certain company gives a training to its salesmen and then a test is held. The following table gives the test scores, and sales made by the salesmen after the training.

Test scores (X)	19	24	14	22	26	21	19	20	15	20
Sales (in Rs.1000) (Y)	36	48	31	45	50	37	39	41	33	40

$\sum X = 200,\ \sum Y = 400,\ \sum X^2 = 4120,\ \sum Y^2 = 16346,\ \sum XY = 8193$

(i) Calculate the correlation coefficient between test scores and sales, and state whether there is a relationship between them.

(ii) Fit the regression line of Y on X by the method of least squares.

(iii) Calculate the coefficient of determination and comment on your result.

(iv) The department is considering to terminate the service of some salesmen based on the test scores and sales. If the department expects a minimum sale of Rs. 30 000 from each salesman, what should be the minimum test score to consider the termination of the service of a salesman? (10 *marks*)

(b) Explain the difference between the terms of each pair given below.

(i) Chance variation and Assignable variation

(ii) Process Control and Product Control (04 *marks*)

(c) Explain the difference between **C-chart** and **U-chart**.
The number of defects in ten woollen carpets manufactured are given in the following table.

Carpet No.	1	2	3	4	5	6	7	8	9	10
Number of defects	2	3	6	5	3	3	6	4	5	3

Construct a suitable control chart for these data and state whether the quality characteristic under inspection is in control. (06 *marks*)

Part II

5. (a) Describe the classical approach to probability and relative frequency approach to probability, stating **two** limitations of each. (04 *marks*)

(b) If $P(A) = \frac{1}{2}$, $P(A \cup B) = \frac{3}{4}$ and $P(B') = \frac{5}{8}$,

(i) Find $P(A' \cap B')$, $P(A' \cup B')$ and $P(B \cap A')$

(ii) State whether the events A and B are independent. (04 *marks*)

(c) In a manufacturing industrial firm, there are 5 production engineers and 3 maintenance engineers in one section and there are 4 production engineers and 5 maintenance engineers in the other section. From any of these sections, a single selection of two engineers was made. Find the probability that one of them would be a production engineer and the other person would be a maintenance engineer. (04 *marks*)

(d) State the law of total probability and Bayes' Theorem.
The probability that a doctor will diagnose a disease X correctly is 0.8. The probability that a patient with disease X will die by his treatment after correct diagnosis is 0.3. The probability that a patient with disease X will die after not diagnosing the disease correctly is 0.7. If a patient with disease X died, find the probability that the doctor had diagnosed disease X correctly. (08 *marks*)

[see page four

6. (a) State the probability function of the binomial distribution. What are the conditions that should be satisfied by a random experiment for deriving this function?

On average, 20% of the nails produced by a certain machine is defective. A batch is accepted if a random sample of 10 nails taken from that batch does not contain defective nails and the batch is rejected, if the sample contains 3 or more defectives. In other cases, a second sample is taken. Find the probability of taking a second sample. (06 *marks*)

(b) Define the Poisson distribution and state **three** examples for the application of this distribution.

The number of telephone calls received at a switchboard in any time interval of length T minutes has a Poisson distribution with mean $\frac{1}{2}T$. The telephone operator leaves the switchboard for 6 minutes.

(i) Find the probability that **no call is coming** when the operator **is not at the switchboard**.

(ii) Find the probability that three or more calls are coming when the operator is **not at the switchboard**.

(iii) Find also the maximum length of time in nearest second for which the operator could be absent with 90% probability of receiving no calls.

$(\log_{10} e = 0.4343, \quad \log_{10} (0.90) = -0.0458)$ (06 *marks*)

(c) Explain **three** uses of the normal distribution in the field of statistics.

The life-time of a certain kind of bulbs has a normal distribution with mean life-time of 500 hours and standard deviation of 45 hours. Find,

(i) the percentage of bulbs with a life-time of at least 570 hours.

(ii) the percentage of bulbs with life-time **between** 485 and 515 hours.

(iii) the minimum life time of the best 5% of the bulbs. (08 *marks*)

7. (a) Describe the following methods of sampling, stating **two** advantages and **two** disadvantages of each sampling method.

(i) Stratified random sampling

(ii) Cluster sampling

(iii) Quota sampling

(iv) Systematic sampling (08 *marks*)

(b) Describe how the following population structures affect the expected precision of the systematic sampling.

(i) Population with the units in random order.

(ii) Population with linear trend.

(iii) Population with cyclic variations. (06 *marks*)

(c) (i) State the Central Limit Theorem.

Explain, why the Central Limit Theorem is considered as the most important theorem in Statistics.

(ii) A random sample of size 50 is taken from a Poisson distribution with mean $\lambda = 2$. Find the probability approximately that the sample mean will exceed 2.5. (06 *marks*)

[see page five

8. (a) Explain what is meant by Unbiasedness and Efficiency of a point estimator.

If $\{X_1, X_2, X_3\}$ is a random sample from a population with mean μ and variance σ^2,

show that both estimators $\hat{\theta}_1 = \dfrac{X_1 + X_2 + X_3}{3}$ and $\hat{\theta}_2 = \dfrac{X_1 + 2X_2 + X_3}{4}$ are unbiased estimators for μ.

Out of these estimators, what is the most efficient estimator? (06 *marks*)

(b) Samples of two types of electric bulbs were tested for finding their life-time and the following values were observed.

Types of bulbs	No. of bulbs used	Sample mean (hours)	Standard Deviation
A	50	2015	80
B	70	2045	60

(i) Construct a 95% confidence interval for the difference of mean life-time between ***A*** and ***B***.

(ii) Using the confidence interval, test the hypothesis that mean life-time of bulbs ***A*** and ***B*** are equal. (06 *marks*)

(c) The prices of a certain commodity in three cities ***P***, ***Q*** and ***R*** are given in the table.

City		
P	***Q***	***R***
14	10	2
6	8	8
8	8	6
12	4	4

$\sum x_{ij}^2 = 804$

Test whether the average prices of the commodity in the three cities are significantly different at 5% level. (08 *marks*)

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