KATHMANDU UNIVERSITY
End Semester Examination [C]
June/July 2024

Level : B.Sc./B.Tech.
Year : I
Time : 2 hrs. 30mins.

02 JUL 2024

Course : MATH 102
Semester : II
F. M. : 55

SECTION "C"
[3Q. × 7 = 21 marks]

1. The observations given below are obtained from the random variable X, the number of gallons of liquid product obtained per ton of coal feed:

7.6	8.2	7.1	10	6.5	9.6
6.1	6.2	7.6	6.2	9.5	6.7
7.4	9.5	9.2	8	8.5	9.3
8.8	9.6	9.7	6.8	7.1	7.7
8.7	7.8	8.7	8.2	8.2	7.4
9.0	8.8	7.3	7.9	7.1	7.9
7.6	6.7	8.1	6.2	5.3	7.4
7.7	9.1	7.9	8.7	8.4	8.1

a. Construct a stem leaf diagram for these data. Use the numbers 5, 6, 7, 8, 9, 10 as stems
b. Construct the box plot and interpret it.
c. Construct a frequency table and a relative frequency histogram for these data. Does the histogram suggest that X might not be normally distributed?

2. The following table presents the shear strengths (in kN/mm) and weld diameters (in mm) for a sample of spot welds. [1+2+2+1+1=7]

Diameter (x)	Strength (y)
4.2	51
4.4	54
4.6	69
4.8	81
5.0	75
5.2	79
5.4	89
5.6	101
5.8	98
6.0	102

a. Construct a scatter plot
b. Compute the least square line for predicting strength from diameter
c. Compute the fitted value and the residual for each point
d. If diameter increased by 0.3 mm, by how much would you predict the strength to increase
e. Predict the strength for a diameter of 5.5 mm.

3. A computer center has three printers, A, B, and C, which print at different speeds. Programs are routed to different available printers. The probability that a program is routed to printers A, B and C are 0.6, 0.3 and 0.1 respectively. Occasionally a printer will jam and destroy a printout. The probability that printers A, B and C will jam are .01, .05 and .04 respectively. Your program is destroyed when a printer jams. What is the probability that printer A is involved? Printer B is involved? Printer C is involved? Interpret the results [2+2+2+1=7]

SECTION "D"

[6Q. × 4 = 24 marks]

4. A sample of 40 grades is shown the table below. Test the hypothesis at the significance level .05 that the mean grade for all participants is 66. Also construct 95% confidence interval

71 67 55 64 82 66 74 58 79 61
78 46 84 93 72 54 78 86 48 52
67 95 70 43 70 73 57 64 60 83
73 40 78 70 64 86 76 62 95 66

5. The data represents the age in months of children and their mean daily dietary calorie intake.

Age (P)	14	16	16	20	20	24	30	32	34	36
Mean Cal (Q)	860	867	870	887	880	900	950	950	960	980

a. Estimate and interpret the line of regression.
b. Find the correlation coefficient

6. If scores are normally distributed with a mean of 30 and a standard deviation of 5, what percent of the scores is a) greater than 30, b) greater than 37 c) between 28 and 34?

7. Consider the random variable X whose density is given by

$$f(x) = \frac{(x-3)^2}{5}, x = 3, 4, 5$$

a. Verify that this function is a probability mass function
b. Find E(X) and V(X)

[1+3=4]

8. A professor has two classes in psychology: a morning class of 9 students, and an afternoon class of 12 students. On final examination scheduled at the same time for all the students, the classes received the grades shown in the table below. Can one conclude at the .05 significance level, that the average performance of morning class is worse than the average performance of afternoon class?

Morning Class	73, 87, 79, 75, 82, 66, 95, 75, 70
Afternoon Class	86, 81, 84, 88, 90, 85, 84, 92, 83, 91, 53, 84

9. A continuous random variable X has a probability density function $f(x) = 3x^2, 0 \leq x \leq 1$. Find a and b such that
a. $P(X \leq a) = 0.5$
b. $P(X \geq b) = 0.05$

SECTION "E"

[5Q. × 2 = 10 marks]

10. A continuous random variable X has the PDF f(x) = 2x if $0 < X \leq 1$. Find the cumulative distribution function (CDF) for X.

11. A scale is calibrated by weighing a 1000 g test weight 60 times. The 60 scale readings have mean 1000.6 g and standard deviation of 2g. Test the hypothesis H_0: $\mu=1000$ versus H_1: $\mu\neq1000$.

12. Construct a 99% confidence interval for problem given in Q12.

13. Show that the probability function of sum of the values obtained in tossing two dice may be written as

$$P(x) = \frac{x-1}{36}, \qquad x = 2, 3, \ldots\ldots\ldots, 6$$

$$= (13-x)/36, \qquad x = 7, 8, \ldots\ldots\ldots, 12$$

14. A certain manufactured product is supposed to contain 23% potassium by weight. A sample of 10 specimens of this product had an average percentage of 23.2 with a standard deviation of 0.2. If the mean percentage is found to differ from 23, the manufacturing process will be recalibrated. State the appropriate null and alternative hypothesis

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SECTION "A"
[10Q. × 1 = 10 marks]

Fill in the blank space(s) by writing the most appropriate word(s) or symbol(s).

1. The number of parameters involved in a Normal Distribution is _____

2. Given μo = 130, $\bar{X}$ = 150, σ = 25 and n = 4; if hypothesis has to be tested for mean, what test statistics is appropriate? _____

3. In an unpaired samples t-test with sample sizes n_1= 11 and n_2= 11, the value of tabulated t should be obtained for _____ degrees of freedom

4. _____ is a plot that visually summarizes the data in terms of quartiles, mean and variance.

5. The correlation coefficient between X and -X is _____

6. In two rolls of a fair die, let A be the event that no fours, fives or sixes are rolled the P(A) is _____

7. One of the normal equations for fitting the line $Y = a + bX$ is given by $\sum_{i=1}^{n} X_i Y_i$ =_____

8. If f(x) = 1/10, x = 10, then E(X) is _____

9. The mean and variance are same in _____distribution

10. Coefficient of variation of a random variable distributed as binomial with parameters n and p is _____

SECTION "B"

[10 Q. ×1 = 10 marks]

Fill in the blank space (s) by choosing the most appropriate answer from among the given ones. **DO NOT TICK** the answers

11. According to Chebyshev's theorem, if $\mu = 2$ and $\sigma = 0.5$ for a random variable Y, then $P(1 < Y < 3) \geq a$, where a is _____
    a. 0.75 b. 0.80 c. 0.85 d. 0.90

12. The level of confidence is denoted by _____
    a. α b. β c. $1 - \alpha$ d. $1 - \beta$

13. The shape of the Normal Curve is _____
    a. Bell Shaped b. Flat c. Circular d. Spiked

14. A failing student is passed by an examiner, it is an example of _____
    a. Type-I error b. Type-II error c. Unbiased decision d. Difficult to tell

15. A passing student is failed by an examiner, it is an example of _____
    a. Type-I error b. Type-II error c. Best decision d. All of the above

16. The region where the null hypothesis is rejected is called _____
    a. Critical region b. Critical value c. Acceptance region d. Significant region

17. The method of _____ is the most systematic method of fitting a unique line of regression to the data
    a. Least squares b. least cubes c. square d. none of these

18. From the data given below, $\sum_{i=1}^{5} x_i^2 =$

x	0	1	2	3	4
y	1	0	3	10	21

    a. 12 b. 13 c. 14 d. 30

19. Which one is **NOT** an example of random experiment?
    _____
    a. A coin is tossed and the outcome is either a head or a tail
    b. A six-sided die is rolled
    c. Some number of persons will be admitted to a hospital emergency room during any hour.
    d. All medical insurance claims received by a company in a given year.

20. The distribution function F(x) is equal to _____
    a. $P(X = x)$ b. $P(X \leq x)$ c. $P(X \geq x)$ d. All of the above