KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2024

Level : B.Sc.
Year : II
Time : 2 hrs. 30mins.

15 JUL 2024

Course : MATH 208
Semester : I
F. M. : 55

SECTION "C"
[3 Q. × 9 = 27 marks]

1. A survey of 175 shops in a city is carried to study annual vat payment amount. The result of the survey is presented in table below-

Annual Vat Payment (Rs.)	No. of Shops
Below 1,000	14
Below 2,000	30
Below 3,000	70
Below 4,000	80
Below 5,000	140
Below 6,000	160
Below 7,000	170
Below 8,000	175

a. Develop a frequency distribution with classes of form 0-1,000, 1,000- 2,000, ….. 7,000 - 8,000.
b. Draw histogram of frequency distribution obtained in part (a).
c. Calculate mean, median, standard deviation, coefficient of variation and Pearson's coefficient of skewness using result obtained in part (a). [1+1+5]

2. A company manufactures an electronic device to be used in a very wide temperature range. The company knows that increased temperature shortens the life time of the device, and a study is therefore performed in which the life time is determined as a function of temperature. The following data is found:

Temperature in Celcius (x)	10	20	30	40	50	60	70	80	90
Life time in hours (y)	420	365	285	220	176	117	69	34	5

a. Construct a scatter plot to show that it is appropriate to apply linear regression.
b. Develop the linear regression model to establish relationship between temperature and life-time.
c. Predict the life time for the temperature of 0^0C.
d. Find correlation coefficient between temperature and life-time and interpret it. [1+4+1+1]

P.T.O.

3. It is intended to test whether alloying reduces the resistance of electric wire significantly. Observation of 9 pieces of unalloyed wire are observed to have following resistances (in Ohm) – 17.40, 10.79, 24.19, 8.94, 13.25, 15.67, 19.36, 9.93, 14.44. Next, the observation of 7 pieces of alloyed wire are found to have resistances (in Ohm) as- 13.59, 15.60, 9.45, 6.22, 11.26, 13.79, 12.20. First establish the fact that the variances of two samples are not significantly different at 2% level of significance. Next, test whether alloying wire decreases resistance significantly, on average at 5% level of significance.

OR

10 cars were equipped with radial tires and driven over a test course. Then the same 10 cars (with the same drivers) were equipped with regular belted tires and driven over the same course. After each run, the cars' fuel economy (in km/l) was measured. The results are presented below-

Radial tire	4.2	4.7	6.6	7.0	6.8	4.5	5.7	6.0	7.4	4.9
Belted tire	4.1	4.9	6.2	6.9	6.8	4.4	5.7	5.8	6.9	4.7

Is there evidence that radial tires produce better fuel economy? Assume normality of data, and use paired t-test at $\alpha = 0.05$. Also, find a 95% confidence interval for the mean difference in fuel economy between radial tires and belted tires.

SECTION "D"

[6 Q. × 4 = 24 marks]

4. Suppose through a medical data we know that flu causes fever in 80% of cases and approximately every 1 in 10,000 have flu at a given time and approximately every 1 out of 50 people are suffering from fever. Given that a patient has fever, find the probability that she has flu?

5. The probability density function of a random variable X is given by

$$f(x) = \frac{k}{x^4} \; ; x \geq 1$$

Find (i) the value of k, (ii) the cumulative distribution function of X (iii) mean of X, i.e., $E(X)$ (iv) variance of X, i.e., $V(X)$.

6. A computer virus is trying to corrupt two files. The probability that the virus will corrupt the two files independent of one another is estimated to be 0.24. Let X be random variable denoting number of files corrupted by the virus. Here X can take values 0 (corrupt none), 1 (corrupt any one) and 2 (corrupt both). Which probability distribution can be used to describe the situation? Find $P(X = 0)$, $P(X = 1)$ *and* $P(X = 2)$. Tabulate the result as a discrete probability distribution.

7. Suresh attempts to dial a connection to the internet for his email each day. He is successful on his first attempt 8 times out of 10. Use a normal approximation, showing first that it is valid, to find the probability that Suresh is successful on his first attempt at dialing a connection on 30 days or more over a period of 40 days.

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8. Let X be random variable having Poisson distribution. It is given that

$$P(X = 1) = P(X = 2)$$

Find the value of mean of the distribution. Hence find $P(X = 4)$ and $P(X < 2)$.

9. The number of non-confirming (or defective) book bindings of 30 samples each containing 50 books are given below-

Sample #	Defectives	Sample #	Defectives	Sample #	Defectives
1	7	11	7	21	12
2	9	12	5	22	5
3	7	13	16	23	11
4	8	14	8	24	5
5	7	15	11	25	11
6	12	16	15	26	9
7	16	17	10	27	10
8	6	18	16	28	11
9	8	19	8	29	10
10	15	20	15	30	9

How many lots of book are observed? How many books are observed in each lot? What is the proportion of non-confirming books in 7^{th} lot? Draw number-of-defective chart (i.e., d-chart) for given data, locate control lines on the chart and recommend whether the binding process is out of control.

SECTION "E"

[5 Q. × 2 = 10 marks]

10. Calculate mean and median for following data: 41, 25, 34, 41, 33, 24, 34, 47, 32, 37.

11. There are 6 computer chips two of which are defective. If two chips are selected one-by-one without replacing, find probability of getting both defective chips.

12. Let X be a random variable with following probability distribution-

X	-2	-1	0	1	2
p(x)	1/10	2/10	4/10	2/10	1/10

Find $E(X^2)$.

13. Find $'c'$ if $P(-c < Z < c) = 0.98$

14. On average 3 shooting stars are seen in night sky in the period of 15 minutes. What is the probability of seeing no shooting stars in the period of 30 minutes?

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SECTION "A"
[10 Q. × 1 = 10 marks]

Fill in the blank space(s) by most appropriate words or symbol(s):

1. A data distribution is positively skewed if its median lies closer to the _____ quartile.
2. The third quartile of a data distribution of 50 elements lies at 38.25^{th} place. If 38^{th} value is 283 and 39^{th} value is 286, then the value of third quartile is _____.
3. A lot contains 7 good and 3 bad items. An item is selected and is found to be good. If another item is selected without replacing the first item selected, then the probability that the second item selected is good _____.
4. For a random variable X, P(X = 0) = 1/8, P(X = 1) = 3/8, P(X = 2) = 3/8 and P(X = 3) = 1/8, then E(X) has value _____.
5. The median (M_d) of a random variable X can be defined as the value for which $P(X \leq M_d) =$ _____.
6. If mean of a binomial distribution with probability of success being 0.45 is 18, then number of trials associated with the distribution is _____.
7. Poisson distribution can be considered as a limiting form of $B(n,p)$ distribution under the considerations that number of trials is infinite, i.e., $n \to \infty$ and _____ _____.
8. There are two points of inflection of $N(\mu, \sigma^2)$ distribution and they lie at _____ and at _____.
9. Correlation is the study of inter-relationship of a variable with one or more other variables, whereas, regression is the study of _____ of a variable with one or more other variables.
10. The pooled or combined variance of two samples of sizes 9 and 7 and sample variances 2.5 and 3.2 respectively is _____.

SECTION "B"

[10 Q. × 1 = 10 marks]

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

11. _____ is a measure of variation or dispersion of data.
[mean median mode range]

12. $P(A|A) =$ _____
[0 1 0.5 0.25]

13. In a group of 100 persons, 60 are graduates and 40 are employed and 20 are both. A person is randomly selected from the group and is known to be employed, then the probability of this selected person to be graduate is _____.
[$\frac{60}{100}$ $\frac{20}{100}$ $\frac{20}{40}$ $\frac{20}{60}$]

14. If X is random variable then $P(X \leq x)$ is a non-decreasing function of X. It is denoted by $F_X(x)$ and is called _____.
[probability mass function probability density function
probability generating function cumulative distribution function]

15. A researcher is interested in analyzing the time taken by computers of different brands but having similar configuration to execute a batch file. He/she can achieve his objective by implementing _____ distribution.
[binomial Poisson normal chi-square]

16. The 'GPA' of a student depends on 'study_hours'. Here the variable 'study_hours' is _____ variable.
[independent dependent response regressive]

17. If $P(t_{12} \geq 1.78) = 0.05$, then it is expressed as _____.
[$t_{12,0.05} = 1.78$ $t_{1.78,12} = 0.05$ $t_{12,1.78} = 0.05$ $t_{0.05,12} = 1.78$]

18. F-distribution is used to carry inference on _____ of two normal populations.
[difference in means ratio of means
difference in variances ratio of variances]

19. For a right tailed test on mean of a normal population, if the value of the test statistic is Z_0, then the null hypothesis will be rejected at 5% level of significance, if _____.
[$Z_0 \geq 1.96$ $Z_0 \leq 1.96$ $Z_0 \geq 1.64$ $Z_0 \leq 1.64$]

20. _____ chart does not belong to control chart for attributes.
[$\bar{X}$ chart p-chart d-chart c-chart]