Q. Code:785911

Reg. No. | | | | | | | | | | | | |

B.E / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Fourth Semester

MA22451-INTRODUCTION TO BIOSTATISTICS

(Biotechnology)

(Regulation 2022)

(Use of Statistical Tables is permitted)

TIME:3 HOURS **MAX.MARKS: 100**

CO1 To have an in depth understanding of the various concepts that are used in biological models and apply the same appropriately

CO2 To understand and apply the concepts of probability and random variables in the study of biological models.

CO3 To apply the concepts of two dimension random variables and extend the same to multiple random variables.

CO4 To frame suitable hypothesis and test the same using the appropriate test.

CO5 To apply statistical quality control methods on real time problems.

PART- A (20x2=40Marks)

(Answer all Questions)

		Marks	CO	RBT LEVEL
1	Calculate the median of the following frequency distribution:	**2**	**1**	**2**

x	1	2	3	4	5	6	7	8	9
f	8	10	11	16	20	25	15	9	6

2	Calculate the mean of the following frequency distribution:	**2**	**1**	**2**

x	1	2	3	4	5	6	7	8
f	4	9	16	25	22	15	7	3

3	A cyclist pedals from his house to his college at a speed of 10 kmph and back from college to his house at 15 kmph. Find the average speed.	**2**	**1**	**3**
4	Eight coins were tossed together and the number of heads resulting was noted. The operation was repeated 256 times and the frequencies (f) that were obtained for different values of x, the number of heads are shown in the following table: Calculate the quartiles.	**2**	**1**	**2**

x	0	1	2	3	4	5	6	7	8
f	1	8	28	56	70	56	28	8	1

5	Let A and B be two events such that $P(A)=\frac{1}{3}, P(B)=\frac{3}{4}, P(A\cap B)=\frac{1}{4}$.Compute $P\left(\frac{A}{B}\right)$ and $P(A\cap \overline{B})$.	**2**	**2**	**3**
6	If X and Y are independent binomial variates following $B\left(5,\frac{1}{2}\right)$ and $B\left(7,\frac{1}{2}\right)$ respectively find $P[X+Y=3]$.	**2**	**2**	**3**
7	If the probability is 0.05 that a certain kind of measuring device will show excessive drift, what is the probability that the sixth of these measuring devices tested will be the first to show excessive drift?	**2**	**2**	**3**
8	If X is a normal variate with $mean=20$ and S.D = 10. Find $P[15\le X\le 40]$	**2**	**2**	**3**
9	The following table gives the joint probability distribution of X and Y. Find the marginal distribution function of X and Y.	**2**	**3**	**3**

Y \ X	1	2	3
1	0.1	0.1	0.2
2	0.2	0.3	0.1

10	The joint p.d.f. of random variable (X,Y) is given as $$f(x,y)=\begin{cases}k, 0<x<y<1\\ 0, otherwise\end{cases}$$ Find k .	**2**	**3**	**3**
11	If X has mean 4 and variance 9, while Y has mean –2 and variance 5 and the two are independent find $E[XY^2]$.	**2**	**3**	**3**
12	Let X and Y be two independent random variables with Var(X) = 9 and Var (Y) = 3. Find Var (4X – 2Y + 6).	**2**	**3**	**3**
13	The critial value of a test statistic is determined from	**2**	**4**	**2**

(a) Calculations from the data

(b) Calculations based on many actual repetitions of the same experiment

(c) The sampling distribution of the statistic assuming Alternative Hypothesis

(d) The sampling distribution of the statistics assuming Null Hypothesis

14 Herbicide A has been used for years in order to kill a particular type of weed. An experiment is to be conducted in order to see whether a new herbicide, Herbicide B, is more effective than Herbicide A. Herbicide A will continue to be used unless there is sufficient evidence that Herbicide B is more effective. The alternative hypothesis in this problem is **2 4 3**

(a)Herbicide A is more effective than Herbicide B

(b)Herbicide B is more effective than Herbicide A

(c)Herbicide A is not more effective than Herbicide B

(d)Herbicide B is not more effective than Herbicide A

15 A sample of 100 students is taken from large population. The mean height of the students in this sample is 160cm. If in the population, the mean height is 165cm and the Standard deviation is 10cm compute the test statistic. **2 4 3**

16 Find the value of χ^2 for the following data: **2 4 3**

	Smokers	Nonsmokers
Literates	83	57
Illiterates	45	68

17 Find the lower and upper control limits for $\bar{X}$ and R chart when each sample is of size 5 and $\bar{\bar{X}} = 10.42 \text{ and } \bar{R} = 7.9.$ **2 5 3**

18 Which of these charts is more economical in the long term? **2 5 2**

(a) $\bar{X}$ chart and R chart (b) C chart (c) P chart (d) U chart

19 When we want to troubleshoot the out-of-control process, we use _____ control charts. **2 5 2**

(a) $\bar{X}$ chart (b) C chart (c) P chart (d) U chart

20 The upper control limit defines **2 5 2**

(a) the highest standard deviation of the process

(b) the highest variance of the process

(c) the highest level that the process should operate within

(d) The highest specification that the customer wants

PART- B (5x 10=50Marks)

		Marks	CO	RBT LEVEL
21(a)	An analysis of monthly wages paid to the workers of two firms A and B belonging to the same industry gives the following results:	**(10)**	**1**	**3**

	Firm A	Firm B
Number of workers	500	600
Average daily wage	Rs. 186	Rs. 175
Variance distribution of wages	81	100

(a) Which firm A or B has a larger wage bill?

(b) In which firm A or B is there a greater variability in individual wages?

(c) Calculate the average daily wage and the variance of the distribution of wages of all the workers in the firms A and B taken together.

(OR)

(b)	An engineer conducts an experiment with the purpose of showing that adding a new component to the existing metal alloy increases the cooling rate. Faster cooling rates lead to stronger materials and improve other properties. Let x = percentage of the new component present in the metal and y = cooling rate during a heat – treatment stage in ◦F per hour. The engineer decides to consider several different percentages of the new component. Suppose that the observed data are:	**(10)**	**1**	**3**

X	0	1	2	2	4	4	5	6
y	25	20	30	40	45	50	60	50

Draw a scatter plot and determine the best fit curve.

22(a)	The diameter of an electric cable, say X, is assumed to be a continuous random variable with probability density function	**(10)**	**2**	**3**

$$f(x)=6x(1-x),0\le x\le 1,$$

(a) Check that the function is probability density function

(b) Determine b such that $P(X<b)=P(X>b)$

(c) Find the distribution of X

(d) Find $P\left(X\le\frac{1}{2}\middle|\frac{1}{3}<X<\frac{2}{3}¿\right.$.

(OR)

(b)	**(i)**	If X and Y are independent Poisson variates such that P(X=1)=P(X=2) and P(Y=2)=P(Y=3) find the variance of X-2Y.	**(6)**	**2**	**3**
	(ii)	The time (in hours) required to repair a machine is exponentially distributed with parameter $\lambda=\frac{1}{2}$. a) What is the probability that the repair time exceeds 2hrs? b) What is the conditional probability that a repair takes at least 11 hrs given that its duration exceeds 8 hrs.	**(4)**	**2**	**3**
23(a)		The joint probability mass function of the discrete random variables X and Y is given as $P(X = x, Y = y) = \begin{cases} \frac{x+y}{32}, x=1,2, y=1,2,3,4 \\ 0, otherwise \end{cases}$. Compute the covariance of X and Y.	**(10)**	**3**	**3**
		(OR)			
(b)		If X and Y each follow and exponential distribution with parameter 1 and are independent, find the probability density function of U=X-Y.	**(10)**	**3**	**3**
24(a)		Before an increase in excise duty on tea, 800 people out of a sample of 1000 were consumers of tea. After the increase in duty, 800 people were consumers of tea in a sample of 1200 persons. Find whether there is significant decrease in the consumption of tea after the increase in duty. Test at 5% level of significance.	**(10)**	**4**	**3**
		(OR)			
24(b)		Theory predicts that the proportion of beans in four groups A, B, C, D should be 9:3:3:1. In an experiment among 1600 beans, the numbers in the four groups were 882, 313, 287 and 118. Does the experiment support the theory? Test at 5% level of significance.	**(10)**	**4**	**3**
25(a)		Given below are the values of sample mean $\bar{X}$ and sample range R for 10 samples, each of size 5. Draw the appropriate mean and range charts and comment on the state of control of the process.	**(10)**	**5**	**3**

Sample No.	1	2	3	4	5
Mean	43	49	37	44	45
Range	5	6	5	7	7

Sample No.	6	7	8	9	10
Mean	37	51	46	43	47
Range	4	8	6	4	6

(OR)

(b)	10 samples each of size 50 were inspected and the numbers of defectives in the inspection were 2, 1, 1, 2, 3, 5, 5, 1, 2, 3. Draw the appropriate control chart for defectives.	**(10)**	**5**	**3**

PART- C (1x 10=10Marks)

(Q.No.26 is compulsory)

		Marks	CO	RBT LEVEL
26	If $X_1, X_2, X_3, \ldots, X_n$, are poisson variables with parameter $\lambda=2$, use the central limit theorem to estimate $P(120<S_n<160)$ where $S_n=X_1+X_2+X_3+\ldots+X_n \wedge n=75$.	**(10)**	**3**	**3**

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