JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATIONS- 2024

B. Tech.-IV Semester (BI)

COURSE CODE (CREDITS):18B11MA411 (3) MAX. MARKS: 35

COURSE NAME: BIOSTATISTICS

COURSE INSTRUCTORS: SST MAX. TIME: 2 Hours

Note: *(a) All questions are compulsory.*

(b) Marks are indicated against each question in square brackets.

(c) The candidate is allowed to make suitable numeric assumptions wherever required for solving problems.

(d) Use of a scientific calculator is allowed.

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1. Customers are used to evaluate preliminary product designs. In the past, 95% of highly successful products received good reviews, 60% of moderately successful products received good reviews, and 10% of poor products received good reviews. In addition, 40% of products have been highly successful, 35% have been moderately successful, and 25% have been poor products.

a) What is the probability that a product attains a good review?

b) If a new design attains a good review, what is the probability that it will be a highly successful product? **(CO1)[4M]**

2. The number of messages sent per hour over a computer network has the following distribution:

***x*, Number of messages**	10	11	12	13	14	15
***f(x)*, Frequency**	0.08	0.15	0.30	0.20	0.20	0.07

Determine the mean and standard deviation of the number of messages sent per hour. **(CO2)[3M]**

3. The time between arrivals of taxis at a busy intersection is exponentially distributed with a mean of 10 minutes. What is the probability that you wait longer than one hour for a taxi? **(CO2)[3M]**

4. A study is being made of the failures of an electronic component. There are four types of failures possible and two mounting positions for the device. The following data have been taken:

	Failure Type			
Mounting Position	**A**	**B**	**C**	**D**
1	22	46	18	9
2	4	17	6	12

Would you conclude that the type of failure is independent of the mounting position at the 0.05 level of significance? **(CO3)[5M]**

5. Oxide layers on semiconductor wafers are etched in a mixture of gases to achieve the proper thickness. The variability in the thickness of these oxide layers is a critical characteristic of the wafer, and low variability is desirable for subsequent processing steps. Two different mixtures of gases are being studied to determine whether one is superior in reducing the variability of the oxide thickness. Sixteen wafers are etched in each gas. The sample standard deviations of oxide thickness are $S_1 = 1.96$ angstroms and $S_2 = 2.13$ angstroms, respectively. Is there any evidence to indicate that either gas is preferable? **(CO3)[4M]**

6. Ten samples were taken from a plating bath used in an electronics manufacturing process, and the bath pH was determined. The sample pH values are 7.91, 7.85, 6.82, 8.01, 7.46, 6.95, 7.05, 7.35, 7.25, and 7.42. Manufacturing engineering believes that pH has a median value of 7.0. Do the sample data indicate that this statement is correct? Use the sign test with $\alpha = 0.05$ to investigate this hypothesis. **(CO3)[4M]**

7. An article in the Quality Control Handbook, 3rd edition (McGraw-Hill, 1962) presents the results of an experiment performed to investigate the effect of three different conditioning methods on the breaking strength of cement briquettes. The data are shown in the following table.

Conditioning Method	Breaking Strength (lb/in.^{2})				
1	553	550	568	541	537
2	553	599	579	545	540
3	492	530	528	510	571

Use Kruskal Walli's test at 0.05 level of significance, to find any indication that conditioning method affects breaking strength? **(CO4)[5M]**

8. A random sample of 64 bags of white cheddar popcorn weighed, on average, 5.23 ounces with a standard deviation of 0.24 ounce. Test the hypothesis that $\mu = 5.5$ ounces against the alternative hypothesis, $\mu < 5.5$ ounces, at the 0.05 level of significance. **(CO4)[3M]**

9. Consider the Markov chain with three states, $S = \{1,2,3\}$, that has the following transition matrix

$$\begin{bmatrix} \frac{1}{2} & \frac{1}{4} & \frac{1}{4} \\ \frac{1}{3} & 0 & \frac{2}{3} \\ \frac{1}{2} & \frac{1}{2} & 0 \end{bmatrix}$$

a) Draw the state transition diagram for this chain.

b) Obtain the steady state probabilities. **(CO5)[4M]**

$f_{0.05}(v_1, v_2)$

	v_1									
v_2	10	12	15	20	24	30	40	60	120	∞
1	241.88	243.91	245.95	248.01	249.05	250.10	251.14	252.20	253.25	254.31
2	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.50
3	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.36
6	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07

Table A.5 (continued) Critical Values of the Chi-Squared Distribution

	α									
v	0.30	0.25	0.20	0.10	0.05	0.025	0.02	0.01	0.005	0.001
1	1.074	1.323	1.642	2.706	3.841	5.024	5.412	6.635	7.879	10.827
2	2.408	2.773	3.219	4.605	5.991	7.378	7.824	9.210	10.597	13.815
3	3.665	4.108	4.642	6.251	7.815	9.348	9.837	11.345	12.838	16.266