VIT
Vellore Institute of Technology

Final Assessment Test – November 2024

Course: PMAT501L - Probability and Statistics

Class NBR(s): 4866 / 4868

Time: Three Hours

Slot: E

Max. M

- KEEPING MOBILE PHONE/ANY ELECTRONIC GADGETS, EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE
- DON'T WRITE ANYTHING ON THE QUESTION PAPER

General Instruction: Statistical Tables are permitted

Answer ALL Questions

(10 X 10 = 100 Marks)

1. In a bolt factory machines A, B, C manufacture respectively 25%, 35% and 40% of the total. Of their output 6%, 5%, and 4% respectively are defective bolts. A bolt is drawn at random from the product and it is found to be defective. What are the probabilities that it was manufactured by machines A, B and C. **[10]**

2. Let (X, Y) be a two- dimensional random variable with density function **[10]**

$$f(x,y) = \begin{cases} \frac{2}{3}(x+2y), & 0<x<1,\ 0<y<1 \\ 0 & otherwise \end{cases}$$

Find the conditional mean and the conditional variance given $Y = 1/2$.

3. A certain raw material is classified as to moisture content X (in percent) and impurity Y (in percent). Let X and Y have the joint probability mass function given by **[10]**

Y \ X	1	2	3	4
2	0.10	0.20	0.30	0.05
1	0.05	0.05	0.15	0.10

(i) Find the $E(X)$, $E(Y)$, $V(X)$ and $V(Y)$

(ii) If additional heating is needed with high moisture content and additional filtering with high impurity such that the additional cost is given by the function $C=2X+10Y^2$ in dollars, find $E(C)$.

4. Estimate the advertisement expenditure for sales of Rs. 47 Crores from the data given below: **[10]**

Sales (Rs. Crores)	14	16	18	20	24	30	32
Adv exp (Rs)	52	62	65	70	76	80	78

5. Calculate the Pearson's coefficient of correlation between income and savings as per the data given below: **[10]**

Income ('000)	39	65	62	90	82	75	25	98	36	78
Savings	47	53	58	86	62	68	60	91	51	84

6. If the average number of claims handled daily by an insurance company is 5, what proportion of days have less than 3 claims? What is the probability that there will be 4 claims in exactly 3 of the next 5 days? Assume that the number of claims on different days is independent. Mention the distribution. **[10]**

7. Given that X is a random variable (class average of a particular section in the FAT Exam) that is normally distributed with $\mu = 30$ and $\sigma = 4$. [10]
Determine the following:
i) $P(30 < x < 35)$
ii) $P(x > 21)$
iii) $P(x < 40)$

8. The mean breaking strength of cables supplied by a manufacturer is 1800 with a S.D of 100 by a new technique in the manufacturing process it is claimed that the breaking strength of the cables has increased. In order to test this claim a sample of 500 cables is tested. It is found that the mean breaking strength is 1850. Can we support the claim at 0.05 level of significance? [10]

9.a) The mean production of wheat of a sample of 100 fields is 210 lbs per acre with a standard deviation of 10 lbs. Another sample of 150 fields gives a mean of 220 lbs/acre with a SD of 12 lbs. Assuming the SD of fields as 11 lbs for the population test at 5% level of significance whether the difference between the means is significant. [10]

OR

9.b) A manufacturer has introduced a new formulation for an existing washing powder, but before launching the product nationally, he decided on a regional launch coupled with advertising on television on the local regional station. The manufacturer selects by means of a random sample a number of shops in the region. The sales of the old formulation before the advertisement and the sales of the new formulation after the advertisement were noted. The results were as follows: [10]

Shop	A	B	C	D	E	F	G	H	I	J
Sales before Ad.	79	88	131	103	115	91	57	116	101	94
Sales after Ad.	88	75	141	118	129	88	60	120	109	104

i) Show that there is a significant improvement in sales.
ii) Do you think the results show that the new formulation has improved sales?

10.a) A personnel manager is interested in trying to determine whether absenteeism is greater on one day of the week than on another. His records for the past year show this sample distribution: [10]

Day of the week	Monday	Tuesday	Wednesday	Thursday	Friday
No of absentees	66	57	54	48	75

Test whether the absence is uniformly distributed over the week.

OR

10.b) A researcher wants to compare the exam scores of students from two different teaching methods: Method A and Method B. Since the researcher cannot assume that the scores follow a normal distribution, they decide to use the Mann-Whitney U test to determine if there is a significant difference in the median scores between the two methods. [10]
The exam scores for each group are as follows:

- Method A (Group 1): 85, 90, 88, 92, 86, 89
- Method B (Group 2): 78, 82, 84, 81, 83, 80

Use the Mann-Whitney U test to determine if there is a statistically significant difference between the exam scores of students by Method A and Method B at a significance level of 0.05.

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