# Final Assessment Test – April 2025

VIT Vellore Institute of Technology

Course: **BMAT202L - Probability and Statistics**

Class NBR(s): / **1143 / 1144 / 1145 / 1146 / 1147 / 1148 / 1149 / 1150 / 1151 / 1152 / 1153 / 1154 / 1155 / 1156 / 1157 / 1158 / 1159 / 1160**

Slot: **D1+TD1**

Time: **Three Hours**

Max. Marks: **100**

- **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. A door to door salesman keeps a record of the number of homes he visits each day as given below. **[10]**

| Class interval | 0 – 9 | 10 – 19 | 20 – 29 | 30 – 39 | 40 - 49 |
|---|---|---|---|---|---|
| frequency | 3 | 8 | 24 | 60 | 21 |

Compute the mean, median and mode of the number of homes visited by the salesman.

2. Let $P(X = x) = \left(\frac{3}{4}\right)\left(\frac{1}{4}\right)^{x-1}$ ; $x = 1,2,3, \ldots$ be the probability mass function of the random variable $X$. Compute the following: **[10]**

(i) $P(X > 4)$

(ii) $P(X > 4 | X > 2)$

(iii) $E(X)$

(iv) $Var(X)$

3. If $X$ and $Y$ have the joint probability density function given by **[10]**

$$f(x,y) = \begin{cases} \frac{3}{4} + xy, & 0 < x < 1, 0 < y < 1 \\ 0, & otherwise \end{cases}$$

Find

(i) Marginal distribution functions of $X$ and $Y$

(ii) $f(x/y)$

(iii) $P\left(Y > \frac{1}{2}\right)$

(iv) Are $X$ and $Y$ independent?

4. The ranks were obtained by 10 students in Statistics and Mathematics. From the following data, to what extent is the knowledge of the students in the two subjects related? **[10]**

| Statistics | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mathematics | 2 | 4 | 1 | 5 | 3 | 9 | 7 | 10 | 6 | 8 |

5. The following table gives age $(X)$ in years of cars and annual maintenance cost $(Y)$ in hundred rupees **[10]**

| $X$ | 1 | 3 | 5 | 7 | 9 |
|---|---|---|---|---|---|
| $Y$ | 15 | 18 | 21 | 23 | 22 |

Find the regression lines and also estimate the maintenance cost for a 4-years old car.

6. A factory uses tools of a particular type. From time to time failures in these tools occur and they need to be replaced. The number of such failures in a day has a Poisson distribution with mean 1.25. At the beginning of a particular day there are five replacement tools in stock. A new delivery of replacements will arrive after four days. If all five spares are used before the new delivery arrives then further replacements cannot be made until the delivery arrives **[10]**

Find

(i) the probability that three replacements are required over the next four days.
(ii) the expected number of replacements actually made over the next four days.

7. Most graduate schools of business require applicants for admission to take the Graduate Management Admission Council's GMAT examination. Scores on the GMAT are roughly normally distributed with a mean of 527 and a standard deviation of 112. **[10]**

(i) What is the probability of an individual scoring above 500 on the GMAT?
(ii) How high must an individual score on the GMAT in order to score in the highest 5%?

8. In an investigation on the machines performance the following results are obtained **[10]**

| | Inspected | Defected |
|---|---|---|
| Machine A | 375 | 17 |
| Machine B | 450 | 22 |

Test whether there is any significant difference in performance of two machines at 5% level of significance.

9.a) Two hundred bolts were randomly selected from the output of each of the five machines. The defective bolts found were 5, 9, 13, 7 and 6. Using $\chi^2$ – test, is there a significant difference among the machines? Use 5% level of significance. **[10]**

**OR**

9.b) The following table gives the number of refrigerators sold by 4 salesman in three months May, June and July: **[10]**

| Month | Salesman | | | |
|---|---|---|---|---|
| | A | B | C | D |
| March | 50 | 40 | 48 | 39 |
| April | 46 | 48 | 50 | 45 |
| May | 39 | 44 | 40 | 39 |

Setup two-way ANOVA table and check is there a significant difference in the sales made by the four salesmen? Is there a difference in the sales made during different months? Use 5% level of significance.

10.a) An engineer has determined that the hazard rate function for a machine is $\lambda(t) = 0.23 + 0.01t^2,\ t \geq 0$, where $t$ is measured in years. [10]

(i) Calculate reliability for 3 years, assuming that no maintenance is performed

(ii) Calculate reliability for 3 years, assuming that annual maintenance is performed.

OR

10.b) Two parallel, identical and independent components have constant failure rate. If it is desired that $R_s(1000) = 0.95$. Find the component and system MTTF. In addition to the independent components if a common mode component with a constant failure rate of 0.00001 is connected to the system, find the new system MTTF. [10]

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