VIT®

Vellore Institute of Technology

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Reg. No. :

Final Assessment Test (FAT) - May 2024

Programme	**B.Tech.**	Semester	**WINTER SEMESTER 2023 - 24**
Course Title	**PROBABILITY AND STATISTICS**	Course Code	**BMAT202L**
Faculty Name	**Prof. Lakshmanan Shanmugham**	Slot	**F1+TF1**
		Class Nbr	**CH2023240500843**
Time	**3 Hours**	Max. Marks	**100**

General Instructions:

- Statistical tables are need to be provided
- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.

Answer any 10 questions (10 X 10 Marks = 100 Marks)

01. From the prices X and Y of shares A and B respectively given below, state which share is more stable in value. (10 marks) **[10]**

Price of Share A (X)	55	54	52	53	56	58	52	50	51	49
Price of Share B (Y)	108	107	105	105	106	107	104	103	104	101

02. a). The average salary of male employees in a firm was Rs. 520/- and that of females was Rs. 420/-. The mean salary of all the employees was Rs. 500/-. Find the percentage of male and female employees. [5 marks] **[10]**

b) Consider the following statistical experiment: The manager of a call centre which attends complaints on washing machines, at the end of the day on 15/4/2024 pulls out one call randomly from among the recording of all the calls of that day. Define two random variables appropriate for this experiment with one of them continuous and another discrete. [5 marks]

03. In a residential apartment complex there are 100 flats. Regarding this set of 100 flats as sample space, we have two random variables as below. **[10]**

X: the number of people residing in a specific flat.

Y: the total number of cell phones owned by the residents of that flat.

The entries in the following table gives how many flats are there for each specific combination of values of X and Y.

$Y \setminus X$	2	3	4	5
2	10	6	4	0
3	8	18	4	5
4	5	6	12	2
5	0	2	10	8

(a) Write the marginal probability mass function for Y. [5 marks]

(b) Find the conditional average for the number of residents of the flat given the condition that they own 4 cell phones. [5 marks]

04. (a) From the data relating to the yield of dry bark (X_1), height (X_2) and girth (X_3) for 18 cinchona plants, the following correlation coefficients were obtained: $r_{12} = 0.77$, $r_{13} = 0.72$ and $r_{23} = 0.52$. Find the partial correlation coefficients $r_{12.3}$ and multiple correlation coefficient $R_{1.23}$. [5 marks] **[10]**

(b) A machine runs on an average of 1250 hours/year. A random sample of 49 machines has an annual average use of 1269 hours with standard deviation 84 hours. Does this suggest to believe that machines are used on the average more than 1250 hours annually at 0.05 level of significance? [5marks].

05. From the following data **[10]**

Sales X	91	97	108	121	67	124	51	73	111	57
Purchases Y	71	75	69	97	70	91	39	61	80	47

Obtain

(a) two regression coefficients [3 marks]

(b) two regression equations [3 marks]

(c) coefficient of correlation between X and Y. [4 marks]

06. (a) Let X be a random variable which assumes Poisson distribution. **[10]**

(i) Find $P(X = 4)$ if $P(X = 1) = P(X = 2)$ [2.5 marks]

(ii) Find $E[X]$ if $2P(X = 0) + P(X = 2) = 2P(X = 1)$. [2.5 marks]

(b) In a city the daily consumption of electric power in million kilowatts hours is a random variable with Gamma distribution with parameter, $\lambda = \frac{1}{2}$ and $\kappa = 3$. If the power plant of this city has a daily capacity of 12 million kilowatts hours, what is the probability that this power supply will be inadequate on any given day. (5 marks)

07. The mean yield for one acre is 662 *kgs* with S.D 32. Assuming normal distribution, how many one acre plots in a batch of 1000 plots would you expect to yield. **[10]**

(a) Over 700 *kgs* [3 marks]

(b) Below 650 *kgs* [3 marks]

(c) What is the lowest yield of the best 100 plots. [4 marks]

08. A study of A.C. machines made by company A found that 19 out of 200 machines were defective, while only 5 out of 100 machines made by company B were defective. At 0.05 level of significance, is there any reason to believe that **[10]**

(a) there is significant difference in performance of A.C. machines between the two companies A and B? [7 marks]

(b) products of B are superior to products of A? [3 marks]

09. The following data relate to the marks obtained by 11 students in two test, one held at the beginning of the year and the other at the end of the year after intensive coaching. Do the data indicate that the students have got benefited by the coaching?. **[10]**

Test-I	19	23	16	24	17	18	20	18	21	19	20
Test-II	17	24	20	24	20	22	20	20	18	22	19

10. Four varieties A, B, C, D of a fertilizer are tested in a Randomized Block Design with 4 replication. The plot yields in pounds are as follows **[10]**

A 12	D 20	C 16	B 10
D 18	A 14	B 11	C 14
B 12	C 15	D 19	A 13
C 16	B 11	A 15	D 20

Analyse the experimental yield.

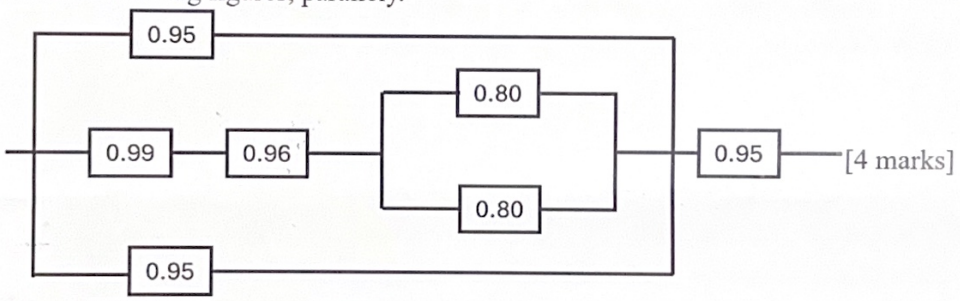
11. The density function of the time to failure in years of the machine manufactured by a Company A is given by [10]

$$f(t) = \frac{400}{(10+2t)^3}, \quad t \geq 0.$$

(a) Determine the reliability function for the first five years of operation [2 marks]
(b) Compute MTTF [2 marks]
(c) What is the design life for the reliability 0.99? [2 marks]
(d) Will a one-year burn-in-period improve the reliability in (a)? [2 marks]
(e) Verify that the hazard rate is decreasing. [2 marks]

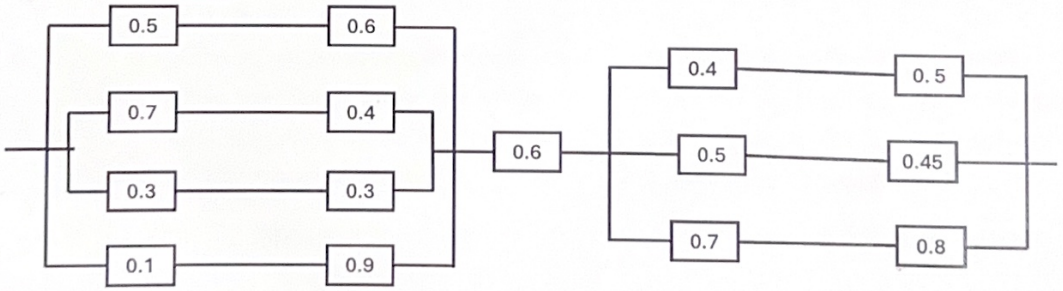
12. Compute the reliability of the system obtained by connecting the subsystems (a) and (b), given in the following figures, parallely. [10]

(a)



[4 marks]

(b)



[6 marks]