



VIT[®]

Vellore Institute of Technology
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Final Assessment Test – April 2023

Course: BMAT202L - Probability and Statistics

Class NBR(s): 0668 / 0691 / 0724 / 0745 / 0758 / 0762 / 0787 / 0823 / 2549 / 2555

Slot: G1+TG1

Time: Three Hours

Max. Marks: 100

KEEPING MOBILE PHONE/SMART WATCH, EVEN IN 'OFF' POSITION, IS TREATED AS EXAM MALPRACTICE
General Instructions: Statistical tables are permitted

Answer any **TEN** Questions

(10 X 10 = 100 Marks)

1. The accompanying frequency distribution of fracture strength (MPa) observations for ceramic bars fired in particular kiln is given in the following data

Class	81-83	83-85	85-87	87-89	89-91	91-93	93-95	95-97	97-99
Frequency	6	7	17	30	43	28	22	13	3

Compute mean, median and mode of the class of frequency distribution.

2. The following table gives the monthly wages of 72 workers in a factory. Compute the standard deviation, quartile deviation, coefficient of variation and skewness.

Monthly wages (in Rupees)	12.5-17.5	17.5-22.5	22.5-27.5	27.5-32.5	32.5-37.5
No. of workers	2	22	19	14	3

Monthly wages (in Rupees)	37.5-42.5	42.5-47.5	47.5-52.5	52.5-57.5
No. of workers	4	6	1	1

3. A fair coin is tossed three times. Let the random variable X denotes 0 or 1 according as head or tail occurs on the first toss, and let Y denotes the number of heads which occur.

- Find the joint probability distribution of X and Y .
- Find Covariance of X and Y .
- Find Correlation of X and Y .
- Are X and Y independent random variables?

4. A fast food restaurant operates both a drive through facility. On a randomly selected day, let X and Y respectively, be the proportions of the time that the drive-through and walk-in facilities are in use, and suppose that joint density function of these random variables is

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

- Find the marginal density functions of X and Y .
- Find the probability that the drive-through facility is busy less than one-half of the time.

5. A study was performed on a type of bearing to find the relationship of amount of wear y to x_1 = oil viscosity and x_2 = load. The following data were obtained from Response surface methodology.

Wear (y)	193	172	113	230	91	125
Oil viscosity (x_1)	16.0	22.0	33.0	15.5	43.0	40.0
Load (x_2)	851	1058	1357	816	1201	1115

- Find the multiple linear regression model to the above data set.
- Predict the wear when the oil viscosity is 20 and load is 1200.

6. The following data were obtained in a study of the relation between the weight and chest size of infants at birth.

Weight(Kg)	2.75	2.15	4.41	5.52	3.21	4.32	2.31	4.30	3.71
Chest size (cm)	29.5	26.3	32.2	36.5	27.2	27.7	28.3	30.3	28.7

- (i) Find the Karl Pearson's coefficient of correlation and estimate the chest size of an infant whose weight is 5 Kg.
- (ii) What percentage of the variation in an infant chest sizes explained by difference in weight?
7. When a circuit boards used in the manufacture of compact disc players tested, the long-run percentage of defectives is 5 %. If X denotes the number of defective boards in a random sample of size 25 so that X is a Binomial variate,
- (i) Determine the $P(X \leq 4)$, $P(X > 5)$ and $P(1 \leq X \leq 5)$.
- (ii) What is the probability that none of the 25 boards is defective?
- (iii) Calculate the expected value and standard deviation of the distribution.
8. Consider babies born in the normal range of 37-43 weeks gestational age. Extensive data supports the assumption that for such babies born in the United States, birth weight is normally distributed with mean 3432 grams with standard deviation 482 grams.
- (i) What is the probability that the birth weight of a randomly selected baby of this type exceeds 4000 grams? Is between 3000 and 4000 grams?
- (ii) What is the probability that the birth weight of randomly selected baby of this type is either less than 2000 grams or greater than 5000 grams?
9. A random sample of 1000 electric bulbs produced by manufacturer A showed a mean life time of 1190 hours and a standard deviation of 90 hours. A sample of 75 bulbs produced by manufacturer B showed a mean life of 1230 hours with a standard deviation of 120 hours. Is there difference between the mean life time of two brands at 5% level of significance.
10. To examine the hypothesis that the husbands are more intelligent than the wives, an investigator took a sample of 10 couples and administered them a test which measures the I.Q. The results are as follows:

Husbands	117	105	97	105	123	109	86	78	103	107
Wives	106	98	87	104	116	95	90	69	108	85

Test the hypothesis with a reasonable test at the level of significance 0.05.

11. Given the following contingency table for hair colour and eye colour. Find the value of χ^2 . Is there good association between the two objectives?

		Hair Colour			Total
		Fair	Brown	Black	
Eye Colour	Blue	15	5	20	40
	Grey	20	10	20	50
	Brown	25	15	20	60
	Total	60	30	60	150

12. A system has three components connected in parallel from a reliability point of view having the reliabilities 0.20, 0.40, 0.50, respectively for a mission of 400 hours. What is the percentage of increase in the reliability of the system in each of the following cases:
- (i) Reliability of the first component is increased by 0.1 that of the second and third components remains same.
- (ii) Reliability of the second component is increased by 0.1 that of the first and third components remains same.
- (iii) Reliability of the third component is increased by 0.1 that of the first and second components remains same.

