REG.NO.:

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF ADVANCED SCIENCES
CONTINUOUS ASSESSMENT TEST - II
WINTER SEMESTER 2025-2026

SLOT: B2 +TB2

Programme Name & Branch : **B.Tech.**
Course Code and Course Name : **BMAT202L- Probability and Statistics**
Faculty Name(s) : **Common slot Question Paper**
Class Number(s) : **Common slot Question Paper**
Date of Examination : **16-03-2026**
Exam Duration : **90 minutes** **Maximum Marks: 50**

General instruction(s):

- Answer All Questions
- Students are permitted to bring any number of textbooks, printouts of e-books (complete / chapters) and handwritten notebooks (class notes). Statistical tables are permitted.
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes: CO2- Understand the basic concepts of random variables and find an appropriate distribution for analyzing data specific to an experiment.
  CO3- Apply statistical methods like correlation, regression analysis in analyzing, interpreting experimental data.
  CO4- Make appropriate decisions using statistical inference that is the central to experimental research.

Q. No	Question	M	CO	BL
1.	The two lines of regression for a bivariate distribution of random variables X and Y are given by the equations: $8x - 10y + 66 = 0$ & $40x - 18y - 214 = 0$. Given that the Variance of X is 9, solve for the following: (i). Calculate the expected values E(X) and E(Y). (ii). Find the Coefficient of Correlation between X and Y. (iii). Calculate the Standard Deviation of Y. (iv). Predict the value of x when y = 12.	10	3	2
2.	a) An irregular 8-faced die is thrown 40 times and the number of times a face showing "8" appears is 14. Assume the probability of getting 8 remains constant. If the die is thrown a further 15 times, find: (i). The probability that an 8 will occur exactly 5 times. (ii). The variance in the occurrence of 8.	5	2	3
	b) In an electronics assembly unit, the probability that a microchip is faulty is 1/800. The chips are packed in boxes of 20 chips each. For a shipment of 12,000 boxes estimate the approximate number of boxes containing: (i). No faulty chips. (ii). More than three faulty chips.	5		

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3.	In a competitive recruitment examination, candidates are graded based on their scores, which are assumed to follow a normal distribution. 12% of the candidates scored below 48 marks and were declared unsuccessful. 6% of the candidates scored above 82 marks and were awarded Distinction. Candidates scoring between 60 and 75 marks are placed in the Management Grade (Level 2). Answer the following: (i). Determine the mean and standard deviation of the distribution. (ii). What percentage of candidates qualified for the Management Grade (Level 2)? (iii). Find the cut-off marks for the top 2% of candidates.	10	2	2
4.	A pharmaceutical company claims that a newly developed vaccine reduces the infection rate of a certain disease. Before the vaccine was introduced, 312 individuals out of a random sample of 800 contracted the disease during a seasonal outbreak. After the vaccine was administered to a different random sample of 950 individuals, 285 contracted the disease. Assuming large sample approximation is valid, test whether the vaccine has significantly reduced the infection rate at the 1% level of significance.	10	4	3
5.	A nutrition researcher wants to compare the average daily protein intake (in grams) of two groups following different diet plans. Independent random samples were selected from each group with the following results: **Diet Plan A:** 72, 68, 75, 70, 74, 69, 73, 71, 76, 67 **Diet Plan B:** 65, 70, 68, 66, 72, 64, 69, 67, 71 Assuming that the population variances are equal, test at the 5% level of significance whether there is a difference in the mean protein intake between the two diet plans.	10	4	3

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Q1 :- (i) The point of intersection of two regression lines gives the mean E(X) and E(Y)

$$\boxed{E(X) = 13, \quad E(Y) = 17}$$

(ii) $r = \pm\sqrt{b_{xy} \cdot b_{yx}}$

$r = +\sqrt{4/5 \times 9/20}$

$$\boxed{r = 0.6}$$

First equation can be written as

$10y = 8x + 66 \Rightarrow y = \frac{4}{5}x + \frac{33}{5}$

$\Rightarrow b_{yx} = \frac{4}{5}$

2nd equation can be rewritten as:

$40x = 18y + 214$

$x = \frac{9}{20}y + \frac{107}{20} \Rightarrow b_{xy} = \frac{9}{20}$

(iii) $Var(X) = 9 \Rightarrow \sigma_x = \sqrt{Var(x)} = 3$

$b_{yx} = r\frac{\sigma_y}{\sigma_x}$

$\frac{4}{5} = 0.6\frac{\sigma_y}{3} \Rightarrow \boxed{\sigma_y = 4}$

(iv) In 2nd regression equation $x = \frac{9}{20}y + \frac{107}{20}$

substitute $y = 12$, we get $\boxed{x = 10.75}$

Q2 (a) Probability of getting 8 : $p = \frac{14}{40} = 0.35$

$q = 1 - p = 0.65$

Let X be the number of times 8 appears in next 15 throws

(i) $P(X=5) = {}^{15}C_5 (0.35)^5 (0.65)^{10} \simeq 0.212$

(ii) $Var(X) = npq = 15 \times 0.35 \times 0.65 = 3.4125$

(b)

Probability a chip is faulty $p = \frac{1}{800}$, $n = 20$

$\lambda = np \Rightarrow \boxed{\lambda = 0.025}$

$P(X=x) = \frac{e^{-\lambda}\lambda^x}{x!}$ (i) $P(X=0) = e^{-0.025} = 0.9753$

Expected number of such boxes $= 12000 \times 0.9753 \simeq 11704$

(ii) $P(X>3) = 1 - P(X \leq 3) = 1 - [P(X=0) + P(X=1) + P(X=2) + P(X=3)]$

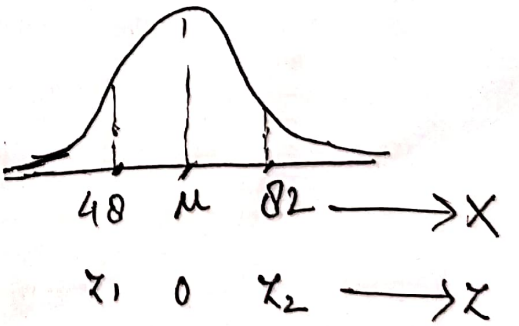
$P(X>3) = 1 - 0.999999 \simeq 0.000001$

Expected number of such boxes $= 12000 \times 0.000001 \simeq 0.012$

Approximately 0 boxes

Q3. Given $P(X<48) = 0.12$

$P(X>82) = 0.06$



$P(0<Z<z_1) = 0.5 - 0.12 = 0.38$

$P(0<Z<z_2) = 0.5 - 0.06 = 0.44$

$z_1 = \frac{x_1 - \mu}{\sigma} \Rightarrow -1.18 = \frac{48-\mu}{\sigma}$ —(1)

$z_2 = \frac{x_2 - \mu}{\sigma} \Rightarrow 1.56 = \frac{82-\mu}{\sigma}$ —(2)

From (1) & (2) $\boxed{\mu = 62.64}$, $\boxed{\sigma = 12.41}$

(b) $P(60 < X < 75) = P(-0.212 < Z < 0.995)$

$= P(0.212 < Z < 0) + P(0 < Z < 0.995)$

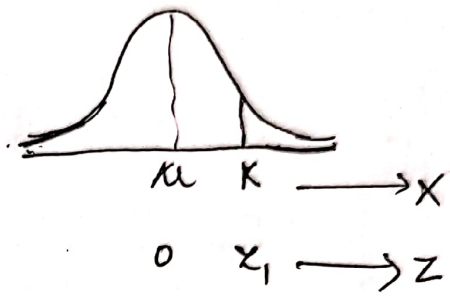
$= 0.0832 + 0.3389 = 0.4221$

Percentage of candidates qualified for Management Grade (level 2) $= 100 \times 0.422 = 42.2\%$.

(c)

$P(X > k) = 0.02$

$P(X < k) = 0.5 - 0.02 = 0.48$



$P(0 < Z < Z_1) = 0.48$

$Z_1 = 2.06$ (From table)

Also $Z_1 = \frac{X - \mu}{\sigma}$

$2.06 = \frac{k - 62.64}{12.41} \Rightarrow \boxed{k = 88.2}$

Q4:-

$H_0: p_1 \leq p_2$

$H_1: p_1 > p_2$ (right tailed test)

$Z = \frac{p_1 - p_2}{\sqrt{PQ(1/n_1 + 1/n_2)}}$, $P = \frac{n_1 p_1 + n_2 p_2}{n_1 + n_2} = \frac{312 + 285}{1750}$

$\boxed{P = 0.3411, \quad Q = 1 - P = 0.6589}$

$Z = \frac{0.09}{0.2274} = 3.96$

$Z_\alpha = 2.33$. Since $|Z| > |Z_\alpha| \Rightarrow H_0$ is rejected

At the 1% level, the vaccine significantly reduces the infection rate.

Q5 $H_0: \mu_1 = \mu_2$

$H_1: \mu_1 \neq \mu_2$ (two tailed test)

$$t = \frac{\bar{x_1} - \bar{x_2}}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}, \qquad s^2 = \frac{\Sigma(x_i - \bar{x_1})^2 + \Sigma(x_j - \bar{x_2})^2}{n_1 + n_2 - 2}$$

$$\boxed{s^2 = 8.38 \Rightarrow s = 2.89}$$

$$= \frac{71.5 - 68}{2.89\sqrt{\frac{1}{10} + \frac{1}{9}}}$$

$$\bar{x_1} = \frac{715}{10} = 71.5, \quad \bar{x_2} = \frac{612}{9} = 68$$

$t = 2.64$

Degree of freedom $= n_1 + n_2 - 2$

$= 10 + 9 - 2 = 17$

$\alpha = 5\%$.

$t_\alpha(17) = 2.10$

$t > t_\alpha \Rightarrow H_0$ is rejected

At the 5% level, there is a significant difference in the mean protein intake between the two diet plans.