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 2024-2025

SLOT: D1+ TD1

Programme Name & Branch : **B.Tech**
Course Code and Course Name : **BMAT 202L, Probability and Statistics**
Date of Examination : **19-03-2025, 2:00 PM-3:30PM**
Exam Duration : **90 minutes** **Maximum Marks: 50**

General instruction(s):

- Answer All Questions
- Use of Statistical Table is allowed.
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyze, 5 – Evaluate, 6 – Create)
- Course Outcomes (Type the CO statements covered in this question paper. Use the CO number as per the syllabus copy)
  CO2: Understand the basic concepts of random variables and find an appropriate distribution for analyzing data specific to an experiment
  CO3: Apply statistical method like correlation, regression analysis in analyzing interpreting experimental data
  CO4: Make appropriate decision using statistical inference that is to central to experimental research

<table>
<tr><th>Q. No</th><th>Question</th><th>M</th><th>CO</th><th>BL</th></tr>
<tr><td>1.</td><td>The following tables gives the aptitude test scores(X) and productivity indices(Y) of 10 workers selected at random:
<table><tr><td>X</td><td>60</td><td>62</td><td>65</td><td>70</td><td>72</td><td>48</td><td>53</td><td>73</td><td>65</td><td>82</td></tr><tr><td>Y</td><td>68</td><td>60</td><td>62</td><td>80</td><td>85</td><td>40</td><td>52</td><td>62</td><td>60</td><td>81</td></tr></table>a) Calculate productivity index of a worker whose test score is 92.
b) Calculate test score of a worker whose productivity index is 75.</td><td>10</td><td>3</td><td>1</td></tr>
<tr><td>2.</td><td>A. (i) Bring out the fallacy if any, in the statement: “The mean of a binomial distribution is 28 and standard deviation is 6.”
(ii) A machine produces on an average 20% defective bolts. A batch is accepted if a sample of 5 bolts taken from that batch contains no defective and rejected if the sample contains 3 or more defectives. In other cases, a second sample is taken. What is the probability that second sample is required.
B. If the probability that an individual suffers a bad reaction from an injection of a given serum is 0.001. Determine the probability that out of 2000 individual
(i) At most 2 will suffer a bad reaction.
(ii) At least 3 individual will suffer a bad reaction.</td><td>2+ 3+ 5</td><td>2</td><td>2</td></tr>
</table>

3.	In an examination it is laid down that a student passes if he scores 35 percent or more marks. He is placed in first, second or third division according as he scores 60% or more marks, between 45% and 60% marks, and marks between 35% and 45%, respectively. He gets distinction in case he secures 75% or more marks. It is noticed from the result that 15% of the students failed in the examination whereas 10% of them obtained distinction. Assuming normal distribution of marks, obtain (i) Mean and standard deviation of the distribution (ii) Calculate the percentage of the students got third division in the examination.	10	2	2
4.	The mean height of 50 male students who showed above average participation in college athletics were 68.2 inches with a standard deviation of 2.5 inches, while other 50 male students who showed no interest in such participation had a mean height of 67.5 inches with a standard deviation of 2.8 inches. Test the hypothesis that male students who participate in college athletics are taller than other male students, using 5% level of significance.	10	4	3
5.	1000 apples kept under one type of storage found to show rotting to the extent of 4%. 1500 apples kept under another kind of storage showed 3% rotting. Can it be reasonably concluded that the second type of storage is superior to the first. Test at 2% level of significance.	10	4	3

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Solⁿ-1 $\bar{X}=65$, $\bar{Y}=65$

X	X-65	$(X-65)^2$	Y	Y-65	$(Y-65)^2$	$(X-65)(Y-65)$
60	-5	25	68	3	9	-15
62	-3	9	60	-5	25	15
65	0	0	62	-3	9	0
70	5	25	80	15	225	75
72	7	49	85	20	400	140
48	-17	289	40	-25	625	425
53	-12	144	52	-13	169	156
73	8	64	62	-3	9	-24
65	0	0	60	-5	25	0
82	17	289	81	16	256	272
		894			1752	1044

$b_{xy} = .596$ $\quad b_{yx} = 1.168$

X on Y → $\boxed{X = 26.26 + 0.596Y}$

for $Y = 75$

$X = 70.96$

Y on X → $\boxed{Y = -10.92 + 1.168X}$

for $X = 92$

$Y = 96.536$

2.

(A) (i) $np = 28$, $\sqrt{npq} = 6$

$np = 28$, $npq = 36$

$\frac{1}{q} = \frac{7}{9} \Rightarrow q = 1.28$

as $p + q = 1$, q can never exceed 1

ie statement is wrong.

(ii) Prob. of defective bolt $p = 20\%$

$= 1/5$

prob. of non defective bolt $= 1 - 1/5 = 4/5$

$\boxed{n = 5}$

second sample is taken only when no. of defective bolts is either 1 or 2

ie prob. that second sample is taken

$= P(X=1)$ or $P(X=2)$

$= {}^5C_1 \left(\frac{1}{5}\right)^1 \left(\frac{4}{5}\right)^4 + {}^5C_2 \left(\frac{1}{5}\right)^2 \left(\frac{4}{5}\right)^3$

$= .6144$

(B) $n = 2000$, $p = .001$, $\lambda = np = 2$

$P(X = x) = e^{-\lambda} \lambda^x / x! = e^{-2} 2^x / x!$

(i) $P(X \le 2) = P(X=0) + P(X=1) + P(X=2)$

$= .13534 + .27068 + .27068$

$= .6767$

(ii) $P(X \geq 3) = 1 - P(X < 3)$

$= .3233$

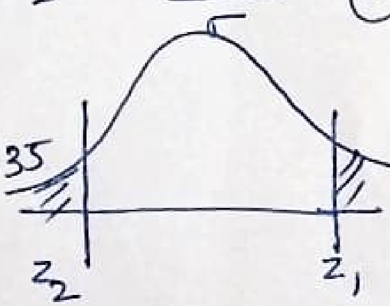
(4) given that $P(X \geq 75) = .1$

$P(X < 35) = .15$

let $z = \frac{X - \mu}{\sigma}$

at $X = 75$, say $z = z_1$, ie $z_1 = \frac{75 - \mu}{\sigma}$ — (1)

at $X = 35$, $z = z_2$ ie $z_2 = \frac{35 - \mu}{\sigma}$ — (2)



ie $P(Z \geq z_1) = .1$

$P(0 < Z < z_1) = .4$

From Table

$\boxed{z_1 = 1.29}$

$P(Z < z_2) = .15$

ie $P(0 < Z < z_2) = .35$

$\boxed{z_2 = -1.04}$

From (1) & (2)

$\sigma = 17.16$, $\mu = 52.86$

(ii) $P(35 < X < 45) = P(-.6025 < Z < -.54)$

$= .2257 - .2054$

$= .0203$

ie 2% students got third division.

1.7

Solⁿ $n_1 = 50$, $n_2 = 50$, $\bar{x}_1 = 68.2$, $\bar{x}_2 = 67.5$

$s_1 = 2.5$, $s_2 = 2.8$

$H_0 : \mu_1 = \mu_2$.

$H_1 : \mu_1 > \mu_2$.

$\alpha = 5\%$.

Table value $|Z_\alpha| = 1.645$

$$Z_{cal} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = 1.32$$

$Z_{cal} < Z_{tab}$

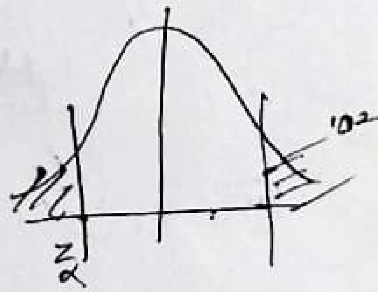
ie H_0 is accepted at 5% level of significance.

ie we conclude that college students are not taller than other male students.

(5) $p_1 = 4/100$, $p_2 = 3/100$

$n_1 = 1000$, $n_2 = 1500$

$$P = \frac{n_1 p_1 + n_2 p_2}{n_1 + n_2} = .038$$



$Q = 1 - P = .962$

$H_0 : p_1 = p_2$

$H_1 : p_1 < p_2$

$$Z_{cal} = \frac{p_1 - p_2}{\sqrt{PQ\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} = 1.2814$$

From Table

$|Z_\alpha| = 2.06$

as

$|Z_{cal}| < |Z_\alpha|$

is H_0 accepted

ie there is no significant difference b/w proportion of rotton apples in two storage.