REG.NO.:

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: D2+TD2

Programme Name & Branch : **B.Tech.**
Course Code and Course Name : **BMAT202L - Probability and Statistics**
Faculty Name(s) : **Common Slot QP**
Class Number(s) : **Common Slot QP**
Date of Examination : **19/03/2025**
Exam Duration : **90 minutes** **Maximum Marks: 50**

General instruction(s):

- Answer All Questions
- Statistical Tables are permitted
- 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: Basic concepts of random variables and find an appropriate distribution for analyzing data specific to an experiment.
CO3: Statistical methods like correlation, regression analysis in analyzing, interpreting experimental data.
CO4: Statistical inference that is the central to the experimental research.

Q. No	Question	M	CO	BL
1.	A departmental store gives an in-service training to its salesmen, which is followed by a test. It is considering whether it should terminate the services of any salesman who does not do well in the test. The following data give test scores and sales made by 9 salesmen during a certain period. Test Scores: 18, 23, 28, 25, 30, 26, 19, 24, 23 Sales(Rs. '000): 51, 56, 68, 57, 70, 65, 53, 61, 59 (i) Obtain the two regression equations (ii) If the firm wants a minimum sales value of Rs. 50,000, what is the test score that will justify the continuous of the services. (iii) Estimate the most probable sales volume of a salesman making a score of 32.	10	3	3
2.	An irregular 6 faced dice is thrown thirty times and the number of sixes seen is eight. If the dice is thrown a further twelve times find: (a) the probability that a six will occur exactly twice; (b) the expected number of sixes; (c) the variance of the number of sixes.	5 5	2	2
3.	The Vellore Institute of Technology installed 10,000 electric led bulbs in the Vellore campus. If these bulbs have an average life of 1,000 burning hours with a standard deviation of 200 hours, how many bulbs might be expected to fail (i) in the first 800 burning hours? (ii) between 800 and 1200 burning hours? After how many burning hours would you expect (iii) 10% of the bulbs to fail? (iv) 10% of the bulbs to be still burning? Assume that the life of the bulbs is normally distributed.	10	2	3

REG.NO.:

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: D2+TD2

4.	A survey claims that 9 out of 10 doctors recommend aspirin for their patients with headaches. To test this claim, a random sample of 100 doctors is obtained. Of these hundred doctors, 82 indicate that they recommend aspirin. Is this claim accurate?	10	4	3
5.	A sample of 100 bulbs of brand A gave a mean lifetime of 1200 hours with a S.D. of 70 hours, while another sample of 120 bulbs of brand B gave a mean lifetime of 1150 hours with S.D. of 85 hours. Can we conclude that brand A bulbs are superior to brand B bulbs?	10	4	3

****

1). Y = 1.608X + 21.4 and X = 0.5578 Y – 9.4682;

Given Y =50, X = 18.432& Given x=32, the value of Y = 72.92

2). P = 8/30=4/15➔ q =11/15; Hence P[x=2] = 0.211; mean = 3.2; Variance = 2.347

3). I). P[x< 800] = 0.1587➔ 1587 bulbs

Calculate the probability of failure between 800 and 1200 hours.

$$P(-1 < z < 1) = P(z < 1) - P(z < -1)$$
$$P(-1 < z < 1) = 0.8413 - 0.1587$$
$$P(-1 < z < 1) = 0.6826$$

Step 7

Calculate the number of bulbs expected to fail between 800 and 1200 hours.

Number of bulbs $= 10,000 \times 0.6826$

Number of bulbs $= 6826$

Step 8

Find the z-score for the bottom 10% (0.10).

From the Z-table, $z \approx -1.28$

Step 9

Calculate the burning hours for 10% failure.

$x = z\sigma + \mu$

$x = -1.28 \times 200 + 1000$

$x = -256 + 1000$

$x = 744$ hours

Step 9

Calculate the burning hours for 10% failure.

$x = z\sigma + \mu$

$x = -1.28 \times 200 + 1000$

$x = -256 + 1000$

$x = 744$ hours

Step 10

Find the z-score for the top 10% (0.90).

From the Z-table, $z \approx 1.28$

Step 11

Calculate the burning hours for 10% still burning.

$x = z\sigma + \mu$

$x = 1.28 \times 200 + 1000$

$x = 256 + 1000$

$x = 1256$ hours

(i) 1587 bulbs are expected to fail in the first 800 burning hours.

(ii) 6826 bulbs are expected to fail between 800 and 1200 burning hours.

(iii) 10% of the bulbs are expected to fail after 744 burning hours.

(iv) 10% of the bulbs are expected to be still burning after 1256 burning hours.

4).

What you're solving for

Testing the accuracy of the claim that $\frac{9}{10}$ doctors recommend aspirin using a hypothesis test.

What's given in the problem

- Claimed proportion: $p_0 = \frac{9}{10} = 0.9$
- Sample size: $n = 100$
- Number of doctors recommending aspirin in the sample: $x = 82$
- Significance level: $\alpha = 0.05$

Helpful information

- Test statistic for proportions: $z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$
- Sample proportion: $\hat{p} = \frac{x}{n}$
- For a one-tailed test with $\alpha = 0.05$, the critical z-value is -1.645.

How to solve

Calculate the sample proportion, compute the test statistic, and compare it to the critical value.

Step 1

Calculate the sample proportion

$$\hat{p} = \frac{x}{n}$$

$$\hat{p} = \frac{82}{100}$$

$$\hat{p} = 0.82$$

Step 2

Calculate the test statistic

$$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$$

$$z = \frac{0.82 - 0.9}{\sqrt{\frac{0.9(1-0.9)}{100}}}$$

$$z = \frac{-0.08}{\sqrt{\frac{0.09}{100}}}$$

$$z = \frac{-0.08}{\sqrt{0.0009}}$$

$$z = \frac{-0.08}{0.03}$$

$$z \approx -2.67$$

Step 3

Compare the test statistic to the critical value

Since this is a left-tailed test, we compare z to -1.645.

$-2.67 < -1.645$

The test statistic falls in the rejection region.

Step 4

Make a decision

Reject the null hypothesis.

The claim that $\frac{9}{10}$ doctors recommend aspirin is not accurate.

Solution

The claim is not accurate, we reject the null hypothesis.

5).

What's given in the problem

- Sample size of brand A bulbs: $n_1 = 100$
- Mean lifetime of brand A bulbs: $\bar{x}_1 = 1200$ hours
- Standard deviation of brand A bulbs: $s_1 = 70$ hours
- Sample size of brand B bulbs: $n_2 = 120$
- Mean lifetime of brand B bulbs: $\bar{x}_2 = 1150$ hours
- Standard deviation of brand B bulbs: $s_2 = 85$ hours

Helpful information

- Null hypothesis (H_0): $\mu_1 \leq \mu_2$ (Brand A bulbs are not superior to brand B bulbs)
- Alternative hypothesis (H_1): $\mu_1 > \mu_2$ (Brand A bulbs are superior to brand B bulbs)
- Significance level: Assuming $\alpha = 0.05$
- Z-test formula for comparing two means: $Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$
- Critical value for a one-tailed Z-test at $\alpha = 0.05$: $Z_{critical} = 1.645$

How to solve

Calculate the Z-test statistic and compare it to the critical value to determine if the null hypothesis should be rejected.

Step 1

Calculate the Z-test statistic

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

$$Z = \frac{1200 - 1150}{\sqrt{\frac{70^2}{100} + \frac{85^2}{120}}}$$

$$Z = \frac{50}{\sqrt{\frac{4900}{100} + \frac{7225}{120}}}$$

$$Z = \frac{50}{\sqrt{49 + 60.208}}$$

$$Z = \frac{50}{\sqrt{109.208}}$$

$$Z = \frac{50}{10.45}$$

$$Z = 4.78$$

Step 2

Compare the Z-test statistic to the critical value

Since $Z = 4.78 > Z_{critical} = 1.645$, we reject the null hypothesis.

Step 3

Conclusion

Brand A bulbs are superior to brand B bulbs.

Solution

Brand A bulbs are superior to brand B bulbs.