

Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering - SEMESTER - V EXAMINATION - WINTER 2025

Subject Code: 3150409

Date: 17-11-2025

Subject Name: Biostatistics

Time: 10:30 AM TO 01:00 PM

Total Marks: 70

Instructions

- 1. Attempt all questions.**
- 2. Make suitable assumptions wherever necessary.**
- 3. Figures to the right indicate full marks.**
- 4. Simple and non-programmable scientific calculators are allowed.**

Q.1 (a) Explain binomial distribution with the formula and example when its used. **Marks 03**

(b) Describe how a histogram and a pie chart are used to display frequency distributions. State one limitation of each in biological data analysis. **04**

(c) A biotechnology company is testing whether three different storage temperatures impact the shelf life (in days) of a probiotic supplement. Supplement samples are randomly divided into three groups and stored at 4°C, 20°C, and 37°C. After a standardized period, the shelf life for each sample is recorded in whole days. The company wants to know if there is a significant difference in the mean shelf life between the temperature groups, using one-way ANOVA. F-value for , at is 3.55. **07**

Temperature	Shelf Life (days)
4°C	29, 32, 34, 30, 28, 36, 27
20°C	19, 24, 21, 26, 25, 18, 22
37°C	14, 11, 16, 12, 15, 10, 13

Q.2 (a) What is kurtosis and why is it significant in statistical data? **03**

(b) Define skewness. Explain types with relevant examples. **04**

- (c) A biotechnology researcher wants to study whether there is a relationship between the seedling height (in cm) and root length (in cm) of 8 genetically modified plant samples. She suspects that seedlings with greater height may also develop longer roots but is not sure if the relationship is strong or even monotonic. Calculate the Spearman's rank correlation coefficient to determine the strength and direction of the association between height and root length.

07

Plant Sample	Height (cm)	Root Length (cm)
1	12	13
2	15	16
3	9	8
4	20	18
5	13	14
6	18	15
7	16	17
8	10	12

OR

- (c) A researcher studying plant growth wants to understand the relationship between the number of irrigation cycles (X) and the observed stem length (Y) in a greenhouse experiment. The researcher collects the following pairs of observations on X and Y:

07

Irrigation cycles (X)	Stem length (Y, cm)
1	2
2	3
3	5
4	6
5	4

- Find the two regression equations (of Y on X and X on Y) from these pairs.
- Hence, calculate:

i) The predicted value of stem length Y when X = 2.5 irrigation cycles and ii) The predicted value of irrigation cycles X when stem length Y = 4.5 cm

- Q.3 (a)** State difference between Histogram and frequency polygon for graphical representation of statistical data.

03

- (b) Define non-parametric tests. Explain why the Mann-Whitney U test would be preferred over the t-test in comparing two small independent groups.

04

- (c) Applications of fertilizers were tested for the yield of rice grown in 10 plots. Another seed of 10 plots of similar size & condition were taken as control. Test the effect of fertilizer. (Reference value at significance level 5% = 2.10) 07

Plot No.:	1	2	3	4	5	6	7	8	9	10
Fertilizer applied	16	14	18	15	13	17	16	15	14	13
Fertilizer not applied	10	12	11	9	13	13	12	14	13	11

OR

- (a) Give difference between graph and diagram. 03
- (b) Compare parametric and non-parametric tests focusing on assumptions, types of data, and examples of each test. 04
- (c) During an experiment to evaluate dietary effects on rat body weight, ten rats were weighed after being fed rice for one month. Subsequently, the rats were provided grams in their diet for another month, and their weights were measured again. The table below presents the body weights (in grams) of each rat for both periods. Use the data to investigate whether replacing rice with grams in the rats' nutrition resulted in a statistically significant change in their body weights. (Reference table value at 5% significance level, with DoF=9 are Two-tailed= 2.26; One-tailed= 1.83) 07

Rat1 Rat2 Rat3 Rat4 Rat5 Rat6 Rat7 Rat8 Rat9 Rat10

Weight Month 1	50	60	58	52	51	62	58	55	50	65
Weight Month 2	56	58	68	61	56	59	64	60	50	62

- Q.4 (a) In a class of 50 biotechnology students: 03
- 30 students study Bioinformatics
 - 25 students study Molecular Biology
 - 15 students study both Bioinformatics and Molecular Biology

Draw a Venn diagram to represent this information. Also, find:

- a) The number of students who study only Bioinformatics
- b) The number of students who study only Molecular Biology
- c) The number of students who study neither subject
- (b) A bag contains 5 white and 3 black balls. Two balls are drawn at random one after the other without replacement. Find the probability that both the balls drawn are black. 04
- (c) A college conducts both day & night classes intended to be identical. A sample of 100 day students yields examination results as under. $X_1 = 72.4$ & $\sigma_1 = 14.8$. A sample of 200 night students yields examination results as under $X_2 = 73.9$ & $\sigma_2 = 17.9$. Are the two means statistically equal at 10% level? (Table value: $Z = 1.645$) 07

OR

- (a) Find $A \cup B$ and $A \cap B$ and draw venn diagram as well 03
 A = Set of all the letters of the word POPULATION.
 B = Set of all the letters of the word PEOPLE.

- (b) In a sample of 100 mosquitoes, 25 are classified as grade A and 10 as grade B. 04
 Assuming some mosquitoes could belong to both grades, use the addition rule of probability to determine the probability that a randomly selected mosquito is either grade A or grade B.

- (c) Four of the self fertilized F1 plants that Mendel observed for segregating of yellow and green seeds colour showed the following results among their seeds. Test the homogeneity of the four plants for the 3:1 ratio, and determine whether the data can be summed to calculate chi-square. (Critical Value at 0.05 for 3 df is 7.82.) 07

Plants	1	2	3	4
Yellow Seeds	25	32	14	70
Green Seeds	11	7	5	27

- Q.5 (a) Define: Deciles and Z – score, write the brief about their calculation 03

- (b) Calculate the arithmetic mean for the daily wages from the following data: 04

Wages in Rs.	10–20	20–30	30–40	40–50	50–60	60–70
Number of workers	5	10	30	20	15	10

- (c) Calculate the mean, median, S.D. variance and covariance of the following data: 07

Height in inches	95–105	105–115	115–125	125–135	135–145
No. of children	19	23	36	70	52

OR

- (a) Define: Percentiles, Quartiles, Quintiles 03

- (b) Find the median & median class of the data given below: 04

Class boundaries	15–25	25–35	35–45	45–55	55–65	65–75
Frequency	4	11	19	14	0	2

- (c) Work out the mean & the standard error of the mean of the following frequency distribution of blood sugar scores (mg per deciliter) of a sample of goats. 07

Class intervals:	51–55	56–60	61–65	66–70	71–75	76–80
Frequencies:	7	15	30	25	14	9
