BBT402

Model Question Paper-1 with effect from 2022-23 (CBCS Scheme)

Sixth Semester B.E. Degree Examination

Subject Title: Biostatistics and Tools + Lab

Time : 3 hours Max marks: 100

Note : Answer any FIVE full questions, choosing ONE full questions from each module					
Module-1					
1	a.	You have access to a dataset obtained from a biology laboratory experiment, which includes measurements of cell growth rate (in cells per hour) and the corresponding nutrient concentration (in grams per liter) for a set of 5 samples. Your objective is to create a simple scatter plot to visually represent the relationship between cell growth rate and nutrient concentration in the experiment. Cell Growth Rate (cells/hour) Nutrient Concentration (g/L) 10 2 15 4 20 6 25 8 30 10	CO1	L1	10
	b.	You are provided with a dataset containing the measurements (in millimeters) of the wingspan of 50 butterflies. Your task is to create a histogram to represent the frequency distribution of the wingspan measurements. Additionally, generate a frequency polygon and an ogive based on the given data Wingspan (mm) 90, 92, 95, 96, 98, 100, 102, 104, 105, 106, 108, 110, 112, 113, 115, 116, 118, 120, 121, 122, 124, 125, 126, 128, 130, 132, 134, 135, 136, 138, 140, 142, 144, 145, 146, 148, 150, 152, 154, 155, 156, 158, 160, 162, 164, 165, 166, 168, 170, 172.	CO1	L2	10
Or					
2	a.	You are provided with a dataset containing the number of chloroplasts observed in 20 plant cells under a microscope. Your task is to calculate the mean (average) number of chloroplasts based on the given data. Number of Chloroplasts: 85, 72, 90, 65, 78, 92, 88, 76, 82, 70, 68, 75, 79, 83, 87, 91, 74, 81, 89, 84"	CO1	L1	10
	b.	"You have access to a dataset comprising the number of bacteria colonies observed on agar plates from 20 samples taken from a pond. Your objective is to compute the standard deviation and coefficient of variation for the number of bacteria colonies from the provided data. Number of Bacteria Colonies: 85, 72, 90, 65, 78, 92, 88, 76, 82, 70, 68, 75, 79, 83, 87, 91, 74, 81, 89, 84"	CO1	L2	10
Module-2					
3	a.	You are provided with a dataset containing the measurements of dissolved oxygen levels (in mg/L) and the corresponding water temperature (in degrees Celsius) recorded at different depths of a lake over the past 5	CO2	L1	10

		months. Your task is to estimate the correlation between dissolved oxygen levels and water temperature using the provided data. Depth (m) Dissolved Oxygen (mg/L) Water Temperature (°C) 1 8 10 2 7.5 9.5 3 7 9 4 6.5 8.5 5 6 8			
	b.	You have access to a dataset obtained from a biology laboratory experiment, which includes measurements of enzyme activity (in units) and the corresponding substrate concentration (in millimoles per liter) for a set of 5 samples. Your objective is to compute Karl Pearson's coefficient of correlation between enzyme activity and substrate concentration using the provided data. Enzyme Activity (units) Substrate Concentration (mmol/L) 10 2 15 4 20 6 25 8 30 10	CO2	L2	10
		Or			
4	a.	You are conducting an experiment to investigate the relationship between the concentration of a fertilizer solution and the growth of tomato plants. You have collected data on the concentration of the fertilizer solution (in grams per liter) and the corresponding increase in height of the tomato plants (in centimeters) after a certain period. Your task is to perform linear regression analysis on the provided dataset to determine the relationship between fertilizer concentration and plant growth." Fertilizer Concentration (g/L) Plant Growth (cm) 10 5 15 7 20 9 25 11 30 13	CO3	L1	10
	b.	You are conducting an experiment to investigate the probability of germination of seeds treated with a particular growth hormone. In your experiment, you have treated 10 seeds with the hormone, and you want to determine the probability distribution of the number of seeds that germinate. Your task is to analyze the data using binomial distribution to understand the likelihood of different outcomes. Number of Seeds Treated: 10 Probability of Germination (p): 0.8	CO3	L2	10
		Module-3			

<table>
<tr><td>5</td><td>a.</td><td>How do case reports, detailing adverse liver-related symptoms in individuals consuming a newly developed herbal supplement, compare with a proposed clinical trial in assessing the supplement's safety and efficacy?

<table>
<tr><th>Case</th><th>Age</th><th>Gender</th><th>Symptoms</th><th>Duration of Use</th><th>Other Medications/Supplements</th></tr>
<tr><td>1</td><td>45</td><td>Female</td><td>Elevated liver enzymes, jaundice, abdominal pain</td><td>2 weeks</td><td>None reported</td></tr>
<tr><td>2</td><td>55</td><td>Male</td><td>Fatigue, nausea, dark urine</td><td>1 month</td><td>None reported</td></tr>
<tr><td>3</td><td>38</td><td>Male</td><td>Loss of appetite, yellowing of the skin</td><td>3 weeks</td><td>None reported</td></tr>
</table></td><td>CO4</td><td>L2</td><td>10</td></tr>
<tr><td></td><td>b.</td><td>Calculate the relative risk and odds ratio to assess the association between exposure to a new pesticide and the incidence of crop damage in a farming community.
<table>
<tr><th>Exposure to Pesticide</th><th>Crop Damage</th></tr>
<tr><td>Yes</td><td>Yes</td></tr>
<tr><td>No</td><td>No</td></tr>
<tr><td>Yes</td><td>Yes</td></tr>
<tr><td>Yes</td><td>Yes</td></tr>
<tr><td>Yes</td><td>No</td></tr>
</table></td><td>CO4</td><td>L3</td><td>10</td></tr>
<tr><td colspan="6">Or</td></tr>
<tr><td>6</td><td>a.</td><td>Compare the effectiveness of prospective and retrospective study designs in evaluating the long-term effects of a new medication on patient outcomes in a clinical setting.
<table>
<tr><th>Study Design</th><th>Patient ID</th><th>Medication Usage</th><th>Patient Outcome</th></tr>
<tr><td>Prospective</td><td>1</td><td>Yes</td><td>Improved</td></tr>
<tr><td>Prospective</td><td>2</td><td>No</td><td>Worsened</td></tr>
<tr><td>Retrospective</td><td>3</td><td>Yes</td><td>Improved</td></tr>
<tr><td>Prospective</td><td>4</td><td>Yes</td><td>Worsened</td></tr>
<tr><td>Retrospective</td><td>5</td><td>No</td><td>Improved</td></tr>
</table></td><td>CO4</td><td>L2</td><td>10</td></tr>
<tr><td></td><td>b.</td><td>Design a double-blind experiment to assess the efficacy of a new pain relief medication compared to a standard medication, utilizing a placebo control group, and analyze the data to determine the treatment’s effectiveness in reducing pain intensity among participants with chronic lower back pain

<table>
<tr><th>Participant</th><th>Group</th><th>Pain</th><th>Pain</th></tr>
</table></td><td>CO4</td><td>L3</td><td>10</td></tr>
</table>

		ID	Assignment	Intensity Before Treatment	Intensity After Treatment			
		1	Placebo	7	6			
		2	Standard	8	5			
		3	New Medication	9	4			
		4	Placebo	6	6			
		5	New Medication	7	3			
		Module-4						
7	a.	Design an experiment utilizing a randomized complete block design (RCBD) to investigate the effectiveness of three different fertilizers on the growth of tomato plants, with each fertilizer applied to plots within distinct blocks of soil types. Analyze the data using analysis of variance (ANOVA) to assess if there are significant differences in plant growth among the fertilizers within each soil type and across all soil types Sample Soil Type Fertilizer Plant Growth (cm) 1 Sandy Fertilizer A 12 2 Sandy Fertilizer B 14 3 Loamy Fertilizer A 16 4 Loamy Fertilizer B 18 5 Clayey Fertilizer A 10				CO5	L3	10
	b.	Design a Latin square experiment to study the effects of three different irrigation methods on the growth of four different crop varieties in a controlled agricultural setting. Analyze the data using analysis of variance (ANOVA) to determine significant differences in crop growth among the irrigation methods and crop varieties, accounting for potential confounding factors Plot Crop Variety Irrigation Method Crop Growth (cm) 1 A 1 12 2 B 2 14 3 C 3 15 4 D 1 16 5 A 2 18				CO5	L4	10
		Or						
8	a.	Design a full factorial experiment to investigate the impact of three factors (A, B, and C) at two levels each on the yield of a crop. Each factor represents a different agricultural treatment. Analyze the data to determine the main effects of each factor and any interaction effects between factors on the crop yield Sample Factor A Factor B Factor C Crop Yield 1 Low Low Low 10 2 High Low Low 12 3 Low High Low 14 4 High High Low 16 5 Low Low High 18				CO5	L3	10
	b.	Using a Plackett-Burman design, determine the significant factors influencing the yield of a chemical reaction in a laboratory setting. Design an experiment with the minimum number of runs necessary to identify these factors and analyze the data to identify the main effects of each factor				CO5	L4	10

		on the reaction yield. Run Factor A Factor B Factor C Factor D Reaction Yield 1 +1 -1 +1 -1 85 2 -1 +1 +1 -1 78 3 +1 +1 -1 -1 92 4 -1 -1 -1 +1 79 5 +1 -1 -1 +1 88			
		Module-5			
9	a.	Conduct a study to investigate the sampling distribution of the mean height of students in a school. Collect height data from a random sample of students and analyze the properties of the sampling distribution, including its mean, variance, and shape. Interpret the findings to understand the implications for making inferences about the population mean height based on sample means. Height Data for 5 Students (in inches): 67, 68, 70, 72, 65	CO5	L3	10
	b.	Design a hypothesis test to investigate whether a new fertilizer significantly increases the growth rate of a specific plant species compared to the standard fertilizer. Develop a controlled experiment where one group of plants is treated with the new fertilizer and another group with the standard fertilizer. Measure and analyze the growth rates of the plants over a defined period to determine if there is a statistically significant difference between the two treatments. Sample Growth Rate (cm) 1 14 2 15 3 13 4 16 5 12	CO5	L4	10
		Or			
10	a.	Design an experiment to investigate whether there is a significant association between flower color and genotype in a population of a particular plant species. Collect data on the flower color and genotype of a sample of plants from the population, and analyze the data using a chi-squared test to determine if there is a statistically significant relationship between the two variables Plant Flower Color Genotype 1 Red Homozygous 2 Red Heterozygous 3 Blue Homozygous 4 Red Heterozygous 5 Blue Heterozygous	CO5	L4	10
	b.	A research team is investigating the effects of a new drug on the growth rate of a particular type of bacteria. They conduct an experiment where they treat one group of bacterial cultures with the new drug and another group with a placebo. After a week of growth, they measure the population densities (in cells per unit volume) of both groups. The data obtained are as follows: New Drug Group: 12, 14, 15, 17, 16, 13, 14 Placebo Group: 9, 10, 11, 8, 12	CO5	L3	10

		Perform a Wilcoxon-Mann-Whitney Test to determine if there is a significant difference in the population densities between the two groups. Use a significance level of $\alpha = 0.05$. State your null and alternative hypotheses, calculate the test statistic, and make a conclusion based on the test results.			