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# B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

## June 2025 Semester End Main Examinations

**Programme: B.E.**

**Semester: IV**

**Branch: Artificial Intelligence and Machine Learning**

**Duration: 3 hrs.**

**Course Code: 24AM4PCIST**

**Max Marks: 100**

**Course: INFERENTIAL STATISTICS**

**Instructions:** 1. Answer any FIVE full questions, choosing one full question from each unit.  
 2. Missing data, if any, may be suitably assumed.  
 3. Statistical tables may be allowed.

			UNIT - I			CO	PO	Marks
Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.	1	a)	Define “population” and “sample” with examples.			CO1	PO2	06
		b)	Explain in detail “unbiasedness” and “consistency”. If $X_1, X_2, \dots, X_n$ is a random sample of size ‘n’ from a population with mean $\mu$ and variance $\sigma^2$ . Check whether, sample mean is unbiased and consistent estimator to population mean $\mu$ .			CO2	PO2	08
		c)	Differentiate parametric and non-parametric tests.			CO1	PO2	06
	<b>OR</b>							
	2	a)	Let $X_1, X_2, X_3$ be a random sample of size 3 drawn from a population with mean $\mu$ and variance $\sigma^2$ . Consider the estimator $T = \frac{1}{3}(\lambda X_1 + X_2 + X_3)$ Determine the value of $\lambda$ such that $T$ is an unbiased estimator of the population mean $\mu$ . Justify your answer.			CO2	PO2	06
		b)	What is sufficiency? If $X_1, X_2, \dots, X_n$ is a random sample of size ‘n’ from a $N(\mu, \sigma^2)$ . Check whether sample mean $\bar{x}$ is sufficient to estimate population mean $\mu$ .			CO2	PO2	08
		c)	Differentiate point estimation and interval estimation.			CO2	PO2	06
	<b>UNIT - II</b>							
	3	a)	The following random sample is drawn using Simple Random Sampling Without Replacement (SRSWOR) procedure from a population of 300 units. 4, 3, 2, 2, 1, 4, 4, 5, 7, 6, 2, 1, 7, 8, 5 Solve the following to find estimates of i. Population mean, and ii. Population Variance			CO1	PO1	06

	b)	A population has 3 strata with sizes $N_1 = 30$ , $N_2 = 50$ and $N_3 = 20$ . If a sample of size 10 is to be drawn using proportional allocation, find the number of units to be sampled from each stratum. Also, explain how the <b>stratified mean</b> is computed.	CO1	PO1	<b>08</b>
	c)	Explain the procedure for selecting a sample using Systematic Sampling. A population has 100 units. How would you select a sample of size 10 using systematic sampling?	CO1	PO1	<b>06</b>
		<b>OR</b>			
4	a)	Calculate the total number of possible samples that can be collected from a population of size N using Simple Random Sampling with Replacement (SRSWR). In particular for a population with units $U_1$ , $U_2$ and $U_3$ consider all possible samples of size 2.	CO1	PO1	<b>05</b>
	b)	Explain the advantages and disadvantages of systematic sampling. In what situations can systematic sampling give biased results?	CO1	PO1	<b>07</b>
	c)	A sample of size n is drawn from a population of size N using simple random sampling without replacement. i. Derive the probability that a specific unit is included in the sample. ii. In a university of 600 students: A. What is the inclusion probability if $n = 60$ ? B. How does the inclusion probability change if the sample is selected using SRSWR (With replacement).	CO1	PO1	<b>08</b>
		<b>UNIT - III</b>			
5	a)	Define the following with example; i. Null hypothesis ii. Alternative Hypothesis Also, for the scenario below, state the null and alternative hypotheses: A greenhouse manager suspects that red or blue light may influence plant growth more than standard white light. They want to test if light colour affects plant growth rate.	CO3	PO4	<b>06</b>
	b)	Let X be a random variable with probability density function (PDF) given by: $f(x) = 1 - \theta^2, \quad \text{for } 0 \leq x \leq \frac{1}{1 - \theta^2}$ Consider the hypothesis test: • Null hypothesis: $H_0: \theta = \frac{1}{2}$ • Alternative hypothesis: $H_1: \theta = \frac{3}{4}$ The decision rule is to reject $H_0$ in favor of $H_1$ whenever $X > 1$ . Calculate the power of the test under alternative hypothesis.	CO3	PO4	<b>07</b>
	c)	Assume that student weights at an IGNOU Study Centre are normally distributed. A random sample of 10 students was selected, and their weights (in kg) were recorded as: 48, 50, 62, 75, 80, 60, 70, 56, 52, 77. Based on this sample, construct a 95% confidence interval for the average weight of students at the Study Centre.	CO2	PO4	<b>07</b>

<b>OR</b>																	
6	a)	<p>Consider a population with distribution <math>X_i \sim N(\theta, 1)</math>, where <math>\theta</math> is an unknown mean. An experimenter postulates two possible hypothesis <math>H_0: \theta = 5.5</math> against <math>H_1: \theta = 8</math>.</p> <p>A random sample <math>X = (X_1, X_2, \dots, X_9)</math> of size 9 is collected.</p> <p>Consider the following tests</p> <p><b>Test 1:</b> Reject <math>H_0</math> if and only if <math>\frac{X_1 + X_2}{2} &gt; 7</math></p> <p><b>Test 2:</b> Reject <math>H_0</math> if and only if <math>\bar{X} &gt; 6</math>.</p> <p>Which test would you recommend and why (compare using calculation of error probabilities)?</p>	CO3	PO4	<b>09</b>												
	b)	<p>Provide a clear definition of a statistical hypothesis. How does a simple hypothesis differ from a composite hypothesis? Support your explanation with one relevant example of each type.</p>	CO1	PO1	<b>05</b>												
	c)	<p>Suppose we are conducting hypothesis tests</p> <ol style="list-style-type: none"> <li><math>H_0: \mu = \mu_0</math> versus <math>H_1: \mu \neq \mu_0</math></li> <li><math>H_0: \mu = \mu_0</math> versus <math>H_2: \mu &gt; \mu_0</math></li> </ol> <p>Calculate the P- value for the following observed values of the test statistic <math>Z_0: 3.10</math> and <math>Z_0: 0.60</math> for both the cases</p>	CO3	PO4	<b>06</b>												
		<b>UNIT - IV</b>															
7	a)	<p>In a city, a random sample of 400 people showed that 280 supported a ban on plastic. Test at 5% level of significance whether the majority (i.e., more than 50%) of the city's population supports the ban.</p>	CO3	PO4	<b>06</b>												
	b)	<p>Compare the equality of height of two male populations from the United States and Sweden, for a random sample of 30 males from each country at 5% level of significance with details given below.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>US Male</th> <th>Swedish Male</th> </tr> </thead> <tbody> <tr> <td><b>Sample Size</b></td> <td>30</td> <td>30</td> </tr> <tr> <td><b>Sample mean</b></td> <td>69.70</td> <td>71.51</td> </tr> <tr> <td><b>Population standard deviation</b></td> <td>3.12</td> <td>2.44</td> </tr> </tbody> </table>		US Male	Swedish Male	<b>Sample Size</b>	30	30	<b>Sample mean</b>	69.70	71.51	<b>Population standard deviation</b>	3.12	2.44	CO3	PO4	<b>07</b>
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	c)	<p>A vice principal wants to see if the proportion of students late to the first class differs from the proportion late to the class after lunch. She randomly selects 200 students from each group.</p> <ul style="list-style-type: none"> <li>• 30 students were late in the first class.</li> <li>• 45 students were late in the after-lunch class.</li> </ul> <p>At the 0.05 significance level, test whether there is a significant difference between the two proportions.</p>	CO3	PO4	<b>07</b>												
		<b>OR</b>															
8	a)	<p>In a survey, 150 out of 200 rural people and 130 out of 200 urban people preferred traditional medicine. Test at 1% level whether rural preference is significantly higher than urban.</p>	CO3	PO4	<b>07</b>												
	b)	<p>A factory claims its machines fill bottles with a mean of 500 ml. A sample of 40 bottles shows a mean of 495 ml and standard deviation of 10 ml. Test this claim at 5% significance.</p>	CO3	PO4	<b>07</b>												
	c)	<p>Explain in detail the steps to perform one sample Z-test.</p>	CO3	PO4	<b>06</b>												

UNIT - V					
9	a)	A machine fills soda bottles with 500 ml on average. A sample of 10 bottles has the following volumes (in ml): 495, 498, 502, 497, 499, 503, 496, 500, 504, 498. Test at 5% level if the machine is filling correctly using <b>t - test</b> .	CO3	PO4	<b>06</b>
	b)	A packaging machine is expected to fill sugar packets with a standard deviation of 2 grams. A sample of 10 packets has a sample standard deviation of 2.5 grams. Test at 5% significance whether the machine's variation has increased using <b><math>\chi^2</math> test</b> .	CO3	PO4	<b>07</b>
	c)	Two training programs were tested. Group A with sample size n=10, mean = 85, standard deviation = 5. Group B with sample size n=12, mean = 80, standard deviation = 6. Is there a significant difference in performance at 5% level using <b>t - test</b> ?	CO3	PO4	<b>07</b>
<b>OR</b>					
10	a)	Explain the need, procedure and applications of paired t-test.	CO3	PO4	<b>06</b>
	b)	A sample analysis of examination results of 500 students was made. It was found that 220 students had failed, 170 had secured third class, 90 had secured second class and 20 had secured first class. <b>Applying Chi-Square test</b> , check whether these figures support the general examination result which is in the ratio 4:3:2:1 for the respective categories?	CO3	PO4	<b>07</b>
	c)	Test equality of variances for a sample of size $n_1=10$ and $n_2=12$ with sample variances $s_1^2 = 25$ and $s_2^2 = 10$ using <b>F - test</b> .	CO3	PO4	<b>07</b>

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