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Your Roll No.....

Sr. No. of Question Paper : 1318

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Unique Paper Code : 2922102402

Name of the Paper : Statistics for Business Economics-II

Name of the Course : **B.A. (Hons.) Business Economics (2026)**

Semester : IV

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **all** questions. Choice is available within each question.
3. Use of simple calculator is allowed.
4. Required statistical tables are attached with this paper.

1. Attempt any **two** questions:

10 x 2=20

- (a) (i) Let $X_1, X_2, X_3, \dots, X_7$ denote a random sample from a population having mean μ and variance σ^2 . Consider the following estimators of μ :

$$A = \frac{X_1 + X_2 + X_3 + \dots + X_7}{7}$$

$$B = \frac{2X_1 - X_6 + X_4}{2}$$

Find out which estimator is unbiased? Which estimator is best? Why do you say so?

- (ii) What do you understand by the Central Limit theorem. Discuss its significance.

- (b) (i) Let $X_1, X_2, \dots, X_n$ be a random sample of size n from a population with mean μ and variance σ^2 .

Show that $2\bar{X}$ is a biased estimator for μ^2 .

Find the amount of bias in this estimator.

- (ii) What do you understand by a point estimate and a point estimator? Given the following data on scores of a sample of 20 students in a test:

P.T.O.

12, 25, 10, 16, 19, 32, 22, 38, 7, 42, 45, 20, 10, 34, 29, 33, 44, 49, 11, 21

Find out the point estimator and estimate for determining the average performance of all students in the population. Also state the estimate you will use to separate the lowest 50% scoring students from the top 50%. Estimate its value.

- (c) A population consists of values $\{2, 4, 6\}$ with probabilities 0.3, 0.4 and 0.3 respectively.
- (i) Construct the sampling distribution of sample mean for samples of size 2 drawn from the population with replacement.
 - (ii) Compute the expected value of sample mean and compare it with the population mean.
 - (iii) Calculate the standard error of sample means.

2. . Attempt any **five** questions: (7 x 5 =35)

- (a) The amount of time that a customer spends waiting at an airport check-in counter is a random variable with mean 8.2 minutes and standard deviation 1.5 minutes. Suppose that a random sample of $n = 49$ customers is observed. Find the probability that the average time waiting in line for these customers is
- (i) Less than 10 minutes
 - (ii) Between 5 and 10 minutes
- (b) The life in hours of a 75-watt light bulb is known to be normally distributed with standard deviation of 25 hours. A random sample of 20 bulbs has a mean life of 1014 hours.
- (i) Construct a 92% two-sided confidence interval of the mean life.
 - (ii) Construct a 90% lower-confidence bound of the mean.
 - (iii) What sample size is needed if we want the width of the two-sided 95% confidence interval to be 6 hrs?
- (c) Consider a normal population distribution with the value of σ known. What is the confidence level for the interval $(\bar{x} \pm 2.49 \sigma/\sqrt{n})$ and the upper bound $(\bar{x} + 1.85 \sigma/\sqrt{n})$.

- (d) The sugar content of the syrup in canned peaches is normally distributed. A random sample of 10 cans yields a sample standard deviation of 4.8 milligrams. Find a 95% two-sided confidence interval for variance and standard deviation.
- (e) A sample of 15 observations is taken from a normally distributed population. The sample mean is found to be 52 and the sample standard deviation is 8.
- (i) Construct a 95% confidence interval for the population mean.
- (ii) How would the width of the confidence interval change if the sample size was increased to 25? Explain briefly.
- (f) You have been asked by the manager of an airport to evaluate which of two airlines does better in meeting their scheduled departure times. For each airline, you measure for 40 randomly selected flights: the time (in minutes) between scheduled departure and actual departure. You cannot assume that the populations of times are normally distributed or that there is homogeneity of variance. Your independent-sampling results are: airline (1)-- $\bar{x}_1 = 12.4$ min, $s_1 = 3.72$ min; airline (2)-- $\bar{x}_2 = 11.7$ min, $s_2 = 3.60$ min. What is the 99% confidence interval for $\mu_1 - \mu_2$?

3. Attempt any **five** questions:

(5 x 7=35)

- (a) The life in hours of a battery is known to be approximately normally distributed, with standard deviation 1.25 hours. A random sample of 10 batteries has a mean life of 40.5 hours.
- (i) Is there enough evidence to support the claim that battery life exceeds 40 hours?
- (ii) What is the p-value for the test in part (i)?
- (b) A cafe owner claims that the average daily sales at his outlet are at least ₹12,000. To examine this claim, a random sample of 16 days is selected. The sample shows an average daily sale of ₹11,200 with a sample standard deviation of ₹1,600.
- (i) Is there enough evidence to support the claim of the cafe owner? Test at $\alpha=0.01$
- (ii) Determine the p-value of the test.
- (c) An automatic filling machine is used to fill bottles with liquid detergent. A random sample of 20 bottles results in a sample variance of fill volume of 0.0153 (fluid ounces)². If the variance of fill volume deviates from 0.01 (fluid ounces)², an

unacceptable proportion of bottles will be underfilled or overfilled. Is there evidence in the sample data to suggest that the manufacturer has a problem of underfilled or overfilled bottles? Test at 1% significance level and assume that fill volume has a normal distribution.

- (d) Two catalysts may be used in a batch chemical process. Twelve batches were prepared using catalyst 1, resulting in an average yield of 86 and a sample standard deviation of 3. Fifteen batches were prepared using catalyst 2, and they resulted in an average yield of 8 with a standard deviation of 2. Assume that yield measurements are approximately normally distributed with the same standard deviation. Is there evidence to support a claim that catalyst 2 produces a higher mean yield than catalyst 1? Use $\alpha=0.01$. Calculate the p-value for the test?
- (e) Two companies manufacture a rubber material intended for use in an automotive application. Twenty-five samples of material from each company are tested in an abrasion test, and the amount of wear after 1000 cycles is observed. For company 1, the sample mean and standard deviation of wear are $\bar{x}_1=20$ milligrams/1000 cycles and $s_1=2$ milligrams/1000 cycles, while for company 2 we obtain $\bar{x}_2=15$ milligrams/1000 cycles and $s_2=8$ milligrams/1000 cycles. Do the data support the claim that the two companies produce material with different mean wear? Use $\alpha=0.05$, and assume each population is normally distributed but that their variances are not equal.
- (f) 120 patients were randomly divided into two groups--control group and treatment group, each consisting of 60 patients. The sample mean ICU stay (in days) and sample standard deviation for the treatment group was 19.9 and 39.1 days respectively whereas these values for the control group were 13.7 and 15.8 days
- Calculate the point estimate for difference between true average stay for the treatment and control groups.
 - Is there evidence to suggest that there is a significant difference between the true average ICU stays of patients belonging to the two groups?