PABNA UNIVERSITY OF SCIENCE AND TECHNOLOGY

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Assignment On : Sampling Distribution Of the Medians and Range

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Sampling Distribution of the Medians and Range

Introduction

Sampling distributions form the foundation of statistical inference. While much of classical statistics focuses on sampling distributions of means and proportions, other statistics like the median and range are also important, especially in non-parametric and descriptive statistics. This assignment explores the concept of sampling distributions of medians and ranges, explaining their behavior, theoretical properties, and practical applications.

1. Sampling Distribution: A Brief Overview

A sampling distribution is the probability distribution of a given statistic (like mean, median, or range) based on a random sample drawn from a population. It reflects how the statistic varies from sample to sample.

If we take all possible samples of a given size from a population and compute a statistic for each sample, the distribution of those statistics is the sampling distribution of that statistic.

2. Sampling Distribution of the Median

2.1 Definition of Median

The median is the middle value in an ordered dataset. If n is odd, the median is the $(n+1)/2$-th value. If n is even, it is the average of the $n/2$-th and $(n/2 + 1)$-th values.

2.2 Behavior of Median in Sampling

- The median is less sensitive to outliers than the mean, making it more robust.

- The sampling distribution of the median tends to be symmetrical for symmetrical populations and skewed for skewed populations.

- The standard error of the median is generally larger than that of the mean.

2.3 Properties

- For large samples, the sampling distribution of the median approaches normality due to the Central Limit Theorem.

- If the population is normal, the median and mean sampling distributions are both centered at the same value.

2.4 Example

Suppose we have a population: P = {2, 4, 6, 8, 10}. All possible samples of size 3 (without replacement) can be taken and their medians calculated. The distribution of these medians forms the sampling distribution of the median.

3. Sampling Distribution of the Range

3.1 Definition of Range

The range is the difference between the maximum and minimum values in a dataset: Range = max(X) - min(X)

3.2 Behavior of Range in Sampling

- The range is highly sensitive to outliers.

- Its sampling distribution is often skewed, especially for small sample sizes.

- As sample size increases, the expected range increases because extreme values are more likely to be observed.

3.3 Properties

- The range does not satisfy the Central Limit Theorem, and its sampling distribution is not normally distributed.

- The distribution of the range depends on the underlying population's distribution.

3.4 Example

From the same population P = {2, 4, 6, 8, 10}, if we draw all samples of size 3 and compute the range for each sample, the distribution of these values forms the sampling distribution of the range.

4. Applications

4.1 Use of Median in Practice

- Robust statistics: Median is useful when data have outliers or are non-normally distributed.

- Survey analysis: Median income or median house price are often reported over means due to skewness.

4.2 Use of Range in Practice

- Quality control: Range is used in control charts (e.g., R-charts).

- Initial variability analysis: Useful for a quick sense of data spread, especially in small datasets.