B. Tech Computer Science & Engineering (School of Technology)(IOT)

SEMESTER –IV

MATH2361
PROBABILITY AND STATISTICS

UNIT-III ESTIMATION

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Learning Content

- **Introduction Estimation**
- **Population v/s Sample**
- **Statistic, parameter, sampling distribution**
- **Point Estimation**
- **Properties of estimator**
- **Interval Estimators**

Introduction Estimation- Population v/s Sample

- The field of statistical inference consists of those methods used to make decisions or draw conclusions about a **population from the sample.**
- A **population** consists of the totality of the observations (finite or infinite) which we are concerned. Each observation in a population is a value of a random variable X having some distribution f(x) (ex.Normal)
- When we refer to a “normal population” or, the “population f(x), we mean a population whose observations are values of a random variable having a some function

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These methods utilize the information contained in a **sample** from the population in drawing conclusions.

A **sample** is a subset of a population.

To eliminate any possibility of bias in the sampling procedure, a **random sample** is required, i.e., the observations are made independent and at random.

Statistic: function of random samples or group of observations.

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- **Parameter**: Any statistical constant in population and it is unknown quantity it is necessary to estimate by statistic
- There are two procedures for making inferences:

Estimation and Hypothesis

Estimation:

Estimation is a statistical technique to determine the estimates or estimators to unknown parameter in a population .

There are 2 types of estimators:

Point estimator and

Interval estimator

Estimator and Estimate

Any sample statistic that is used to estimate a population parameter is called estimator.

i.e. An estimator is a sample statistic to find parameter.

An estimate is a specific observed value of a statistic. In other words every specific value of an estimator is an estimate

Point Estimation

- **Point Estimator**
  - A point estimator draws inference about a population by estimating the value of an unknown parameter using a single value or a point.
  - A point estimate is a single number that is used to estimate the an unknown population parameter EX: The avg. price of book is Rs.400 i eμ= 400 is point estimate of parameter
  - e.g., Estimate the population mean weight using the sample mean weight

Examples for Point Estimate

Unknown Parameter θ	Statistic $\hat{\Theta}$	Point Estimate $\hat{\theta}$
μ	$\overline{X} = \frac{\Sigma X_i}{n}$	$\overline{x}$
σ^2	$S^2 = \frac{\Sigma(X_i - \overline{X})^2}{n-1}$	s^2
p	$\hat{P} = \frac{X}{n}$	$\hat{p}$
$\mu_1 - \mu_2$	$\overline{X}_1 - \overline{X}_2 = \frac{\Sigma X_{1i}}{n_1} - \frac{\Sigma X_{2i}}{n_2}$	$\overline{x}_1 - \overline{x}_2$
$p_1 - p_2$	$\hat{P}_1 - \hat{P}_2 = \frac{X_1}{n_1} - \frac{X_2}{n_2}$	$\hat{p}_1 - \hat{p}_2$

nator’s characteristics (criteria of good estimator)

Unbiasedness: An unbiased estimator is one whose expected value is equal to the parameter it estimates.

i.e., E(statistic)=parameter .

Estimator's characteristics (criteria of good estimator)

- **Consistency:** An unbiased estimator is said to be consistent if the difference between the estimator and the parameter grows smaller as the sample size increases.

Estimator's characteristics (criteria of good estimator)

- **Efficiency:** For two unbiased estimators, the one with a smaller variance is said to be most efficient estimator than the other.

Estimator’s characteristics (criteria of good estimator)

Sufficiency: it makes so much use of the information in the sample no other could extract additional information about the parameter

If a statistic which satisfies all these 4 properties then it is a good estimator to a parameter

Interval estimation

- Interval estimation, the evaluation of a parameter

for example, the mean (average)—of a population by computing an interval, or range of values, within which the parameter is most likely to be located.

- Intervals are commonly chosen such that the parameter falls within with a 95 or 99 percent probability, called the confidence coefficient.
- Hence, the intervals are called confidence intervals; the endpoints of such an interval are called upper and lower confidence limits.

Interval Estimation

- The interval containing a population parameter is established by calculating that statistic from values measured on a random sample taken from the population and by applying the knowledge (derived from probability theory) of the fidelity with which the properties of a sample represent those of the entire population.

- The probability tells what percentage of the time the interval assignment will be correct but not what the chances are that it is true for any given sample.
- A certain percentage of the intervals computed from many samples will contain the true value of the parameter being sought.

Interval estimator

Definition:

- An interval estimate is a range of values to estimate a population parameter.
- Example

  The avg. price of book is in between Rs.350 and 450

  i e μ =350 and μ = 450 are interval estimates of parameter

Interval Estimate Formula, is Given Below

$$\mu = \bar{x} \pm Z_{\frac{a}{2}} \frac{\sigma}{\sqrt{n}}$$

Where, $\bar{x}$ = mean

$Z_{\frac{a}{2}}$ = the confidence coefficient

α = Confidence Level

Thank you

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