INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

COMPUTER SCIENCE AND ENGINEERING

COURSE HANDOUT

Course Name	**PROBABILITY AND STATISTICS**
Course Code	AHS010
Programme	B.Tech
Semester	II
Course Coordinator	Mr. J Suresh Goud
Course Faculty	Ms. P Srilatha
Lecture Number	36
Topics Covered	Point Estimation, Interval Estimations
Course Learning Outcome's	Understand the concept of estimation for classical inference involving confidence interval.

Estimation: Point Estimation, Interval Estimations

Estimation: Estimation refers to the process by which one makes inferences about a population, based on information obtained from a sample.

Estimations are two types

1. Point estimate
2. Interval estimate

Point estimate: A point estimate of a population parameter is a single value of a statistic.

Example: The sample mean x is a point estimate of the population mean μ. Similarly, the sample proportion *p* is a point estimate of the population proportion *P*.

Interval estimate: An interval estimate is defined by two numbers, between which a population parameter is said to lie.

Example: $a < x < b$ is an interval estimate of the population mean μ. It indicates that the population mean is greater than *a* but less than *b*.

Estimator

An estimator is a statistic that estimates some fact about the population. You can also think of an estimator as the rule that creates an estimate.

Example: The sample mean ($\bar{x}$) is an estimator for the population mean, μ.

Estimator has the following properties

1. Biased Estimator
2. Unbiased Estimator
3. Efficient Estimator
4. Sufficient Estimator

Biased Estimator:

In statistics, an estimator is a rule for calculating an estimate of a quantity based on observed data. For example, you might have a rule to calculate a population mean. The result of using the rule is an estimate (a statistic) that hopefully is a true reflection of the population. The bias of an estimator is the difference between the statistic's expected value and the true value of the population parameter. If the statistic is a true reflection of a population parameter it is an unbiased estimator. If it is not a true reflection of a population parameter it is a biased estimator.

The word bias in the regular English language implies that you have a personal reason to misrepresent a piece of information. However, in statistics, it doesn't mean that the interviewer, the researcher or even the respondent in an interview is biased in some way. It just means that the estimator being used doesn't produce a good estimate.

Example:

You are playing the party game “Pin the tail on the donkey.” (If you aren’t familiar with the game, a picture of a donkey is placed on the wall and you are given a paper tail to pin on the donkey while you are blindfolded. The person who pins the tail closest to the actual spot where the real tail should go wins the game). You try six times to pin the tail in the right place and each time you pin the tail in the wrong place, at the bottom or to the front of the donkey. Your estimation for the actual spot where the tail should have gone is a biased estimator because you put the tails in the wrong place.

Unbiased Estimator:
An unbiased estimator is an accurate statistic that’s used to approximate a population parameter. “Accurate” in this sense means that it’s neither an overestimate nor an underestimate. If an overestimate or underestimate does happen, the mean of the difference is called a “bias.”
In more mathematical terms, an estimator is unbiased if:

$$E(\hat{\theta}) = \theta$$

NOTE:
That’s just saying if the estimator (i.e. the sample mean) equals the parameter (i.e. the population mean), then it’s an unbiased estimator.

You might also see this written as something like “An unbiased estimator is when the mean of the statistic’s sampling distribution is equal to the population’s parameter.” This essentially means the same thing: if the statistic equals the parameter, then it’s unbiased.

Efficient Estimator:
An estimator is a statistic that estimates some fact about the population.

Example: The $\bar{X}$(the sample mean) is an estimator for the population mean, μ. Your options for finding $\bar{X}$ are limitless: you could have a sample of ten, fifty of three hundred and one. You could use different classes, ages, or heights (depending on what you are trying to estimate). You could use a simple random sampling technique, or a more complex one like stratified sampling. Out of all these possible scenarios, an efficient estimator is one that has small variances (the estimator with the smallest possible variance is also called the “best” estimator). In other words, the estimator deviates as little as possible from the “true” value you are trying to estima.

Sufficient Estimator: A statistic that estimates the population parameter as well as if you knew all of the data in all possible samples.