Frequently Asked Questions

1. **Distinguish between an estimator and an estimate.**

Answer:

An estimator of a population parameter is a random variable that depends on the sample information and whose realizations provide approximations to the unknown parameter of the population. An estimator is a statistic whose value depends on the particular sample drawn. Hence estimator is a function of the sample observations

An estimate is an indication of the value of an unknown quantity based on observed data.

More formally, an estimate is the particular value of an estimator that is obtained from a particular sample of data and used to indicate the value of a parameter. When we have observed a specific value of our estimator we call that value an estimate. In other words an estimate is a specific observed value of a statistic

2. Name two types of estimates.

Answer:

We can make two types of estimators about the population - Point Estimates and Interval Estimates.

A point estimate of a population parameter is a single value of a statistic. For example, the sample mean $\bar{x}$ is a point estimate of the population mean μ. Similarly, the sample proportion *p* is a point estimate of the population proportion *P*. A point estimate is a single number that is used to estimate an unknown parameter.

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

3. What do you mean by an unbiased estimator? Explain

Answer:

The expected value (mean) of the estimator's sampling distribution is equal to the underlying population parameter; that is, there is no upward or downward bias. An estimator t of a parameter θ is said to be unbiased if $E(t) = \theta$. Hence any estimate is said to be unbiased if the average value of the estimator of the population parameter is equal to the actual value of the parameter.

Unbiased estimators determine the tendency, on the average, for the statistics to assume values close to the parameter of interest.

4. Explain briefly consistent estimators

Answer:

Larger sample sizes tend to produce more accurate estimates; that is, the sample parameter converges on the population parameter. An estimator is a consistent estimator of a population parameter if as the sample size increases it becomes almost certain that the value of statistic comes very close to the value of the population parameter. If an estimator is consistent it becomes more reliable with large samples. The values of sample mean and sample proportions are consistent estimates, since from their formulas as **n** get big, the standard errors gets small.

5. State the difference between point estimators and interval estimators

Answer:

A point estimator gives one particular value t which is used as an estimate of the underlying population parameter. For example, the sample mean is essentially a point estimator of a population mean. However, because of the presence of sampling error, sometimes it is more useful to start with this point estimate, and then establish a range of values both above and below the point estimator. Next, by using the probability-numbers characteristic of normally distributed variables, we can state the level of confidence we have that the actual population mean will fall somewhere in our range. This process is known as "constructing a confidence interval".

A point estimator is often insufficient, because the value of it it is either right or wrong. If you are told only that her point estimate of enrolment is wrong, you do not know how wrong it is, and you cannot be certain of the estimates reliability. If you learn that it is off by only 10 students you would accept 350 students as a good estimate of future enrolment. Therefore point estimator and hence estimate is much more useful if it is accompanied by an estimate of the error that might be involved.
An interval estimator is a range of value used to estimate a population parameter. An interval estimator is defined by two numbers, between which a population parameter is said to lie. For example, *a* less than x less than *b* is an interval estimate of the population mean μ. It indicates that the population mean is greater than "a" but less than "b".
It indicates an error in two ways.

a. by the extent of its range and
b. the probability of the true population parameter lying within the range.

6. Write a note on efficiency of an estimate.

Answer:
While there are many unbiased estimates for the same parameter of the population, the most efficient has a sampling distribution with the smallest variance. Our aim is to get such an estimate which has the least standard error. An estimate with least standard error is said to be an efficient estimate of the population parameter.

7. What do you mean by bias in the estimate?

Answer:
When the estimated value of the parameter lies away from the actual value of the parameter there exists bias in the estimate. The samples selected and the nature, size of the samples may be the reasons for getting the biased estimates. Bias in the estimate can be measured as the difference between the actual value of the parameter to be estimated and the estimated value of the parameter.

8**. What cautions to be taken while selecting a best estimator?**

Answer:

A given sample statistic is not always the best estimator of its analogous population parameter. Consider a symmetrically distributed population in which the values of the median and then mean coincide. In this instance a sample mean would be an unbiased and consistent estimator of a population median. Because as the sample size increase the value of the sample mean would tend to come very close to the population median. And sample mean would be more efficient estimator of the population median than the sample median itself because in large samples the sample mean has a smaller standard error than the sample median. At the same time the sample median in a symmetrically distributed population would be an unbiased and consistent estimator of the population mean but not the most efficient estimator because in large samples its standard error is larger than that of the sample mean. In this case the best estimator would be a sample mean than sample median. Hence there may exist more than one estimator for the same population parameter but we should be careful while selecting the best estimator.

9. How can we find the parameters estimates of best fit?

Answer:

Methods that enable us to estimate with reasonable accuracy the population proportion (the proportion of the population that possesses the given characteristic) and the population mean. To calculate the exact proportion or the exact mean would be an impossible goal. Even so, we will be able to make an estimate , make a statement about the error and will probably accompany this estimate and implement some controls to avoid as much of the errors as possible. As decision makers we will be forced to at times to rely on blind hunches.

In practice, we would prefer to have one estimator ($\hat{\theta}$) that is always the best. However, $\hat{\theta}$ is a function of the observed xi's so that actual value of the parameter

$$\theta = \hat{\theta} + \text{estimation error}$$

Thus, we may identify the "best estimator" as the one with:

a. Least bias (unbiased)
b. Minimum variance of estimation error (increase the likelihood that the observed parameter estimate represents the true parameter)

10. Briefly explain Standard error.

Answer

The standard error is the standard deviation of an estimator. The standard error is important because it is used to compute other measures, like confidence intervals and error. The variability of a statistic is measured by its standard error. The values of population parameters are often unknown, making it impossible to compute the standard deviation of a statistic. When this occurs, use the standard error.

The standard error is computed from known sample statistics, and it provides an unbiased estimate of the standard deviation of the statistic.

Hence Standard error is the standard deviation of the sampling distribution of the estimator.

For instance: The Standard error of sample mean $\bar{y}$ is

S.D ($\bar{y}$) =$\sqrt{v(\bar{y})}$

11. What do you mean by precision of an estimate?

Answer:

We can say that we have obtained a more précised estimate if the estimate has the variance less than variance of any other estimates. Let $\hat{\theta}$ and $\hat{\theta}'$ be two unbiased estimates for the parameter θ then $\hat{\theta}$ is said to be more efficient (more précised) than $\hat{\theta}'$ if V($\hat{\theta}$) < V($\hat{\theta}'$).

12. List some point estimates of population parameters

Answer:

From the sample, a value is calculated which serves as a point estimate for the population parameter of interest.

a) The best estimate of the population **percentage**, p, is the sample percentage, P.

b) The best estimate of the unknown population **mean**, μ, is the sample mean, $\bar{x} = \frac{\sum x}{n}$.

   This estimate of μ is often written $\hat{\mu}$ and referred to as 'mue hat'.

c) The best estimate of the unknown population **standard deviation**, σ, is the sample standard deviation s, where:

$$s = \sqrt{\frac{\sum (x-\bar{x})^2}{(n-1)}}$$

13. What do you mean by a sampling distribution?

Answer:

It is possible to draw more than one sample from the same population and the value of an estimator will in general vary from sample to sample. For example, the average value in a sample is a statistic. The average values in more than one sample, drawn from the same population, will not necessarily be equal. The probability distribution of these estimators is known as a sampling distribution.

The sampling distribution describes probabilities associated with an estimator when a random sample is drawn from a population.

The sampling distribution is the probability distribution or probability density function of an estimator.

14. How do you estimate the Mean Square error of an estimator?

Answer:

In order to compare a biased estimate with an unbiased estimate or two estimates with different amounts of bias, a useful criterion is the Mean Square Error (M.S.E) of the estimator measured from the population value that is being estimated. Hence Mean Square Error is an average of the squared deviations of actual value of the parameter from its estimated value $\hat{\mu}$

$$\text{M.S.E}(\hat{\mu}) = E(\hat{\mu} - \mu)^2$$

15. What is the role of a sample mean in Statistical estimation?

Answer:

In general, we use statistics as a means of characterizing the nature of some sample on the basis of a few key indicators.

The first indicator is known as The Sample Mean:

- The mean quantity in some sample represents the average value or the most probable value in the sample
- A sample mean is calculated by summing up the individual measurements and dividing by the number of measurements, usually denoted as N
- All samples can be characterized by a mean value regardless of the shape of the distribution
- Also according to Central Limit Theorem: The distribution of means of random sample taken from a population having mean μ and finite variance σ^2 approaches Normal distribution with mean μ and variance σ^2/n as n goes to infinity