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CAIIB PAPER-1
Module-A Unit-7

Advanced Bank Management (ABM)

CAIIB Paper 1 (ABM) Module A Unit 7: Estimates

Estimates

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

We can make **two types of estimates** about a population: **a point estimate and an interval estimate.** A point estimate is a single number that is used to estimate an unknown population parameter If, while watching a cricket team on the field, you say. 'Why, I bet they will get 350 runs,' you have made a point estimate. A department head would make a point estimate if she said, 'Our current data indicate that this course will have 350 students next year.'

Estimator And Estimates

Asample statistic that is used to estimate a population parameter is called an estimator. The sample mean x can be an estimator of the population mean μ, and the sample proportion can be used as an estimator of the population proportion. We can also use the sample range to estimate the population range. When we have observed a specific numerical value of our estimator, we call that value as an estimate. In other words, an estimate is a specific value of a statistic or an estimator. We form an estimate by taking a sample and computing the value taken by our estimator in that sample. Suppose, we calculate the mean odometerreading (mileage)from a sample of used taxis and find it to be 98,000 miles. If we use this specific value to estimate the mileage for a whole fleet of used taxis, the value 98,000 miles would be an estimate.

Criteria of a Good Estimator

Some statistics are better than others. Fortunately, we can evaluate the quality of a statistic as an estimator by using four criteria:

- **Unbiased:** This is a desirable property for a good estimator to have. The term unbiased refers to the fact that a sample mean is an unbiased estimator of a population mean because the mean of the sampling distribution of sample means taken from the same population is equal to the population mean itself.
- **Efficiency:** Another desirable property of a good estimator is efficiency. Efficiency refers to the size of the standard error of the statistic. If we compare two statistics from a sample of the same size and decide which one is the more efficient estimator, we would pick the statistic with the smaller standard error or standard deviation of the sampling distribution.
- C**onsistency**: A statistic is a consistent estimator of a population parameter if, as the sample size increases, it becomes almost certain that the value of the statistic comes very close to the value of the population parameter. If an estimator is consistent, it becomes more reliable with large samples.
- **Sufficiency:** An estimator is sufficient if it makes so much use of the information in the sample that no other estimator could extract from the sample, additional information about the population parameter being estimated.

Point estimate

- **A point estimate is often insufficient, because it is either right or wrong. If you are told only that her point estimate of enrollment is wrong, you do not know how wrong it is, and you cannot be certain of the estimate's reliability**.
- If you learn that it is off by only 10 students, you would accept 350 students as a good estimate of future enrollment. But if the estimate is off by 90 students, you would reject it as an estimate of future enrollment. Therefore, a point estimate is much more useful if it is accompanied by an estimate of the error that might be involved.

Interval estimate

- **An interval estimate is a range of values used to estimate a population parameter. It indicates the error in two ways**: by the extent of its range and by the probability of the true population parameter lying within that range. In this case, the department head would say something like, 'I estimate that the enrollment in this course next year will be between 330 and 380 and that it is very likely that the exact enrollment will fall within this interval.'
- She has a better idea of the reliability of her estimate. If the course is taught in sections of about 100 students each, and if she had tentatively scheduled five sections, then on the basis of her estimate, she can now cancel one of those sections and offer an elective instead.

Estimator

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

Criteria of a Good Estimator

Some statistics are better than others. Fortunately, we can evaluate the quality of a statistic as an estimator by ***using four criteria:***

- **Unbiased**: This is a desirable property for a good estimator to have. The term unbiased refers to the fact that a sample mean is an unbiased estimator of a population mean because the mean of the sampling distribution of sample means taken from the same population is equal to the population mean itself.
- **Efficiency:** Another desirable property of a good estimator is that it be efficient. Efficiency refers to the size of the standard error of the statistic.
- **Consistency:** A statistic is a consistent estimator of a population parameter if as the sample size increases, it becomes almost certain that the value of the statistic comes very close to the value of the population parameter.

- **Sufficiency:** An estimator is sufficient if it makes so much use of the information in the sample that no other estimator could extract from the sample additional information about the population parameter being estimated.

Relationship between Confidence Level and Confidence Interval

- You may think that we should use a high confidence level, such as 99 per cent, in all estimation problems. After all, a high confidence level seems to signify a high degree of accuracy in the estimate. In practice, however, high confidence levels will produce large confidence intervals, and such large intervals are not precise; they give very fuzzy estimates.
- There is a direct relationship that exists between the confidence level and the confidence interval for any estimate. As you set a tighter and tighter confidence interval, you would get to a lower and lower confidence level.

Confidence Intervals

Statisticians use a **confidence interval** to express the precision and uncertainty associated with a particular sampling method. A confidence interval consists of three parts.

- A confidence level.
- A statistic.
- A margin of error.

The confidence level describes the uncertainty of a sampling method. The statistic and the margin of error define an interval estimate that describes the precision of the method. The interval estimate of a confidence interval is defined by the *sample statistic* ± *margin of error*.

For example, suppose we compute an interval estimate of a population parameter. We might describe this interval estimate as a 95% confidence interval. This means that if we used the same sampling method to select different samples and compute different interval estimates, the true population parameter would fall within a range defined by the *sample statistic* ± *margin of error* 95% of the time.

Confidence intervals are preferred to point estimates, because confidence intervals indicate (a) the precision of the estimate and (b) the uncertainty of the estimate.

Confidence Level

The probability part of a confidence interval is called a **confidence level**. The confidence level describes the likelihood that a particular sampling method will produce a confidence interval that includes the true population parameter.
Here is how to interpret a confidence level. Suppose we collected all possible samples from a given population, and computed confidence intervals for each sample. Some confidence intervals would include the true population parameter;

others would not. A 95% confidence level means that 95% of the intervals contain the true population parameter; a 90% confidence level means that 90% of the intervals contain the population parameter; and so on.

Margin of Error

In a confidence interval, the range of values above and below the sample statistic is called the **margin of error**.

For example, suppose the local newspaper conducts an election survey and reports that the independent candidate will receive 30% of the vote. The newspaper states that the survey had a 5% margin of error and a confidence level of 95%. These findings result in the following confidence interval: We are 95% confident that the independent candidate will receive between 25% and 35% of the vote.

Note: Many public opinion surveys report interval estimates, but not confidence intervals. They provide the margin of error, but not the confidence level. To clearly interpret survey results you need to know both! We are much more likely to accept survey findings if the confidence level is high (say, 95%) than if it is low (say, 50%).

Consider the following results of 10 tosses of a coin: H, T, T, T, T, H, T, H, T, T a) Estimate the probability of head (H) for this coin. b) Estimate the standard error of your estimate.

Let X denote the toss of a single coin. Further, let X = 1 if a head results, and X = 0 if a tail results. This X is a Bernoulli (p) random variable, where p denotes the probability of head. Let pˆ denote the estimator of p.

a) The estimated value of p is pˆ = (1 + 0 + 0 + . . . + 1 + 0 + 0)/10 = 0.3.
b) The estimated standard error of pˆ is √pˆ(1 − pˆ)/n) = √0.3(0.7)/10 = 0.14.

Suppose the following data shows the number of the problems from the Practice Problems Set attempted in the past week by 10 randomly selected students: 2, 4, 0, 7, 1, 2, 0, 3, 2, 1.

a) Find the sample mean.
b) Find the sample variance.
c) Estimate the mean number of practice problems attempted by a student in the past week.
d) Estimate the standard error of the estimated mean.

a) X = Pn i=1 Xi/n = (2 + 4 + . . . + 2 + 1)/10 = 2.2
b) S^2=∑n i=1(Xi − X)^2/(n − 1) = (2 − 2.2)^2 + (4 − 2.2)^2 + . . . + (2 − 2.2)^2 + (1 − 2.2)^2/(10−1) = 4.4
c) The estimate is X = 2.2
d) Estimated standard error of X is S/√ n = √ 4.4/10 = 0.66

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