Constructing a CI begins by calculating a point estimate from the sample data. However, a point estimate   provide any information about the variation around this average value. Accordingly, confidence intervals are used to communicate variation around a point estimate. This variation is measured via an interval of values known in statistical jargon as the margin of error.

Hence,

THE POINT ESTIMATE   &   THE MARGIN OF ERROR

Remember, both the point estimate and the margin of error are derived from the sample data.

THE POINT ESTIMATE

A point estimate is the average value calculated from the sample data.

Examples of everyday point estimates:

> From a representative sample, a   average height can be used to estimate the average height of a larger population -- The average height of men in the US is 5 feet 11 inches.

> From a representative sample, the average proportion of voters favoring a ballot proposal can be used to estimate the proportion of a larger population -- 68% of Michigan voters favor proposal A.

THE MARGIN OF ERROR

A margin of error is a range of values calculated from the sample data; the point estimate is contained within this interval.

Examples of margin of error estimates:

> The range of heights (from a representative sample) can be used to estimate the average range of heights of a larger population -- The average height of men in the US is between 5 feet 8 inches and 6 inches   inches).

> The range of the proportion of voters favoring a ballot proposal (from a representative sample) can be used to estimate the range of the proportions of a larger population -- The percentage of Michigan voters who favor proposal A is between 64% and 72%. The margin of error is 8% (72% minus 64%).

The margin of error consists of two parts:

1. A standard error
2. A distribution multiplier

THE STANDARD ERROR

The standard error (SE) is related to standard deviation of a dataset. The standard deviation tells you how spread out the data are. It is a measure of how far observed values are from the center (average) of the population distribution

The standard error is very similar to standard deviation. Both are measures of spread / dispersion. The more spread out the data are, the greater the standard error and the greater the standard deviation.

When conducting research, you often only collect data for a small sample of the entire population. This sample has an error associated with it. This occurs because each sample will be slightly different and each will produce slightly different estimates.

The standard error measures how different a sample estimate is likely to be from a population value. It tells you how the estimate would vary if you were to repeat a study using different samples (of the same size) taken from a single population. In other words, it quantifies the difference between a parameter (i.e., a population value) and a statistic (i.e., a sample value).

The most important connection/relationship between data and standard errors is

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THE DISTRIBUTION MULTIPLIER

      most often referred to as just the multiplier
      occasionally called a t-multiplier or z-multiplier
      sometimes termed a critical value

The multiplier is a function of the underlying population and the size/width of the confidence interval. Typical confidence intervals range from 50% to 99.9%, with the most common being 95%.

The concept of the multiplier is more easily explained and understood by looking at an example containing specific multiplier values used to generate a margin of error.

The table below lists six multipliers for normal distributions (aka z distributions) and their corresponding confidence levels. (are used when an assumption of an underlying normal population distribution is satisfied.)

Confidence Level	z multiplier
80%	1.282
90%	1.645
95%	1.960

Please note, that as confidence levels increase, so too do the magnitudes of the multipliers. These multiplier values are multiplied by the standard error value to generate the margin of error; hence, larger multipliers will increase the magnitude/size of the margin of error. Recall, that the overall confidence interval is calculated by adding and subtracting (±) the margin of error to the point estimate.

Consequently, the greater the confidence level, the greater the multiplier, the greater the margin of error, and the greater/wider the associated confidence interval.

Confidence Level	Multiplier	Margin of Error	Confidence Interval range/size