Confidence Levels and Interval Estimates

Data Science for Quality Management: Sampling Distributions, Error and Estimation

with **Wendy Martin**

Learning objective:

Differentiate between confidence level and confidence interval

Confidence Level

- The confidence level is the probability associated with an interval estimate.
- This refers to the probability that the interval estimate includes the population parameter.

Confidence Level

- Typical confidence levels used are 90, 95, and 99%, with 95% confidence levels used most frequently
- Alpha, α, is one minus the confidence level

Confidence Interval

- The confidence interval is the range of the estimate. The confidence interval is often expressed in standard error values

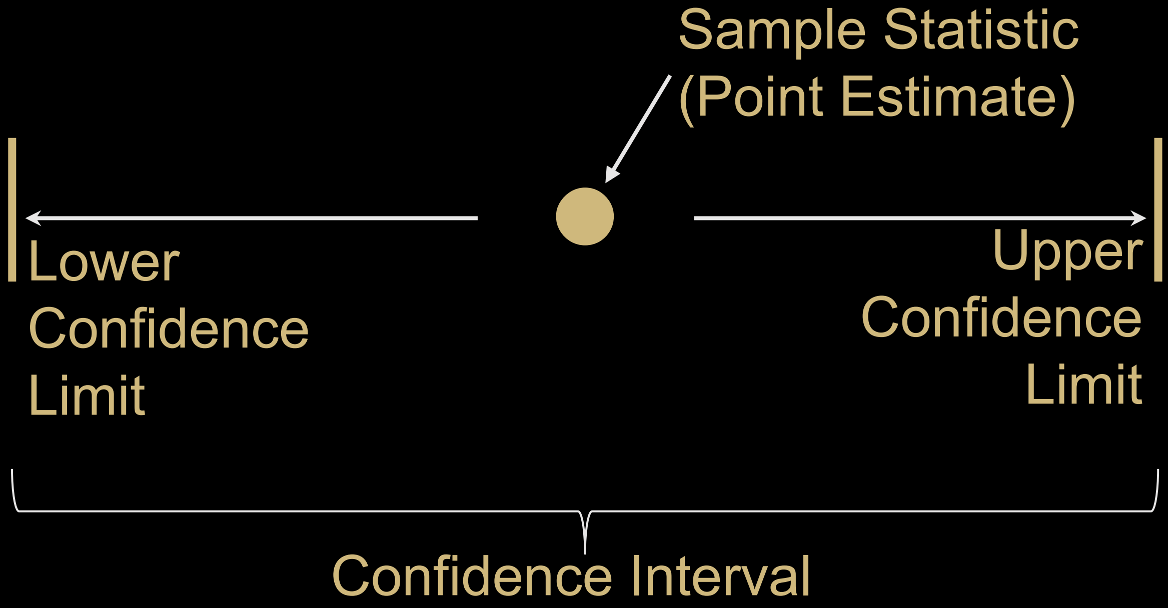
Confidence Intervals

- Confidence intervals provide a range of values in which we would expect to find the true population parameter, with a given level of confidence

Confidence Interval

- A 95% confidence interval for a population mean is the interval that has a 95% probability of the true population mean being found within it

Interval Estimation



Confidence Interval

- An interval estimate provides us a way to qualify our estimate by indicating the magnitude of the sampling error, and hence, the precision of our estimate

Confidence Interval

- To find this interval, we must look at the set of all possible parameters and assess each of those parameters for their probability of providing us with the sample statistic we observed

Interval Estimate Example

- A warranty group wishes to determine the mean life of batteries placed in new cars.
- A sample of 200 batteries is drawn and the mean battery life is found to be 38 months, with a standard deviation of 4 months.

Interval Estimate Example

- Their point estimate for the population mean is 38 months, but they also realize that sampling error is present, and they wish to quantify the uncertainty of this estimate.

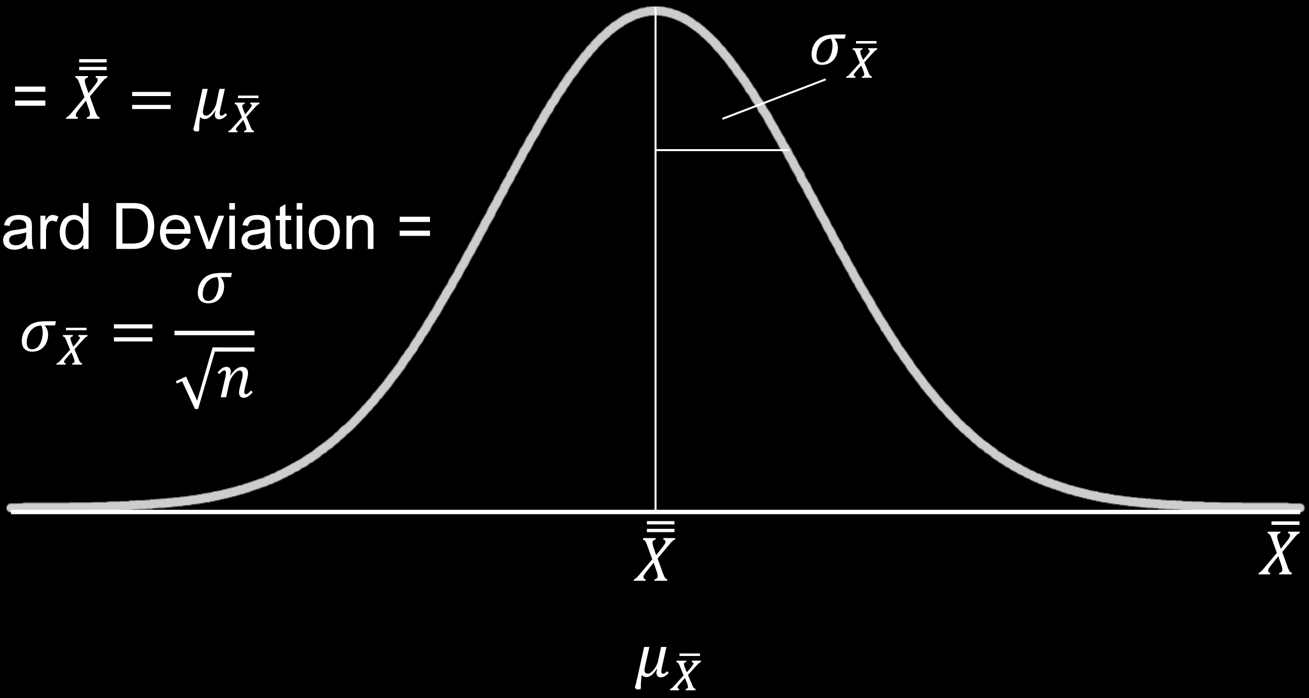
Interval Estimate Example

- The question they must answer is what population means could have given a sample mean of 38?

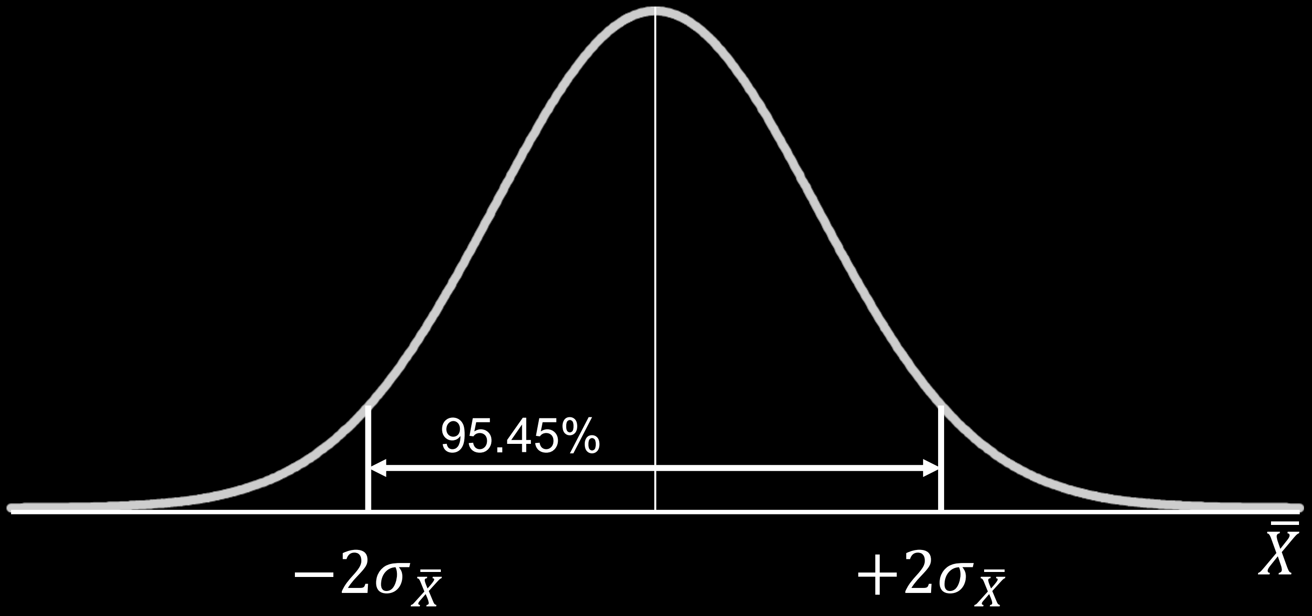
RSD of the Sample Averages

Mean = $\bar{\bar{X}} = \mu_{\bar{X}}$

Standard Deviation = $\sigma_{\bar{X}} = \dfrac{\sigma}{\sqrt{n}}$



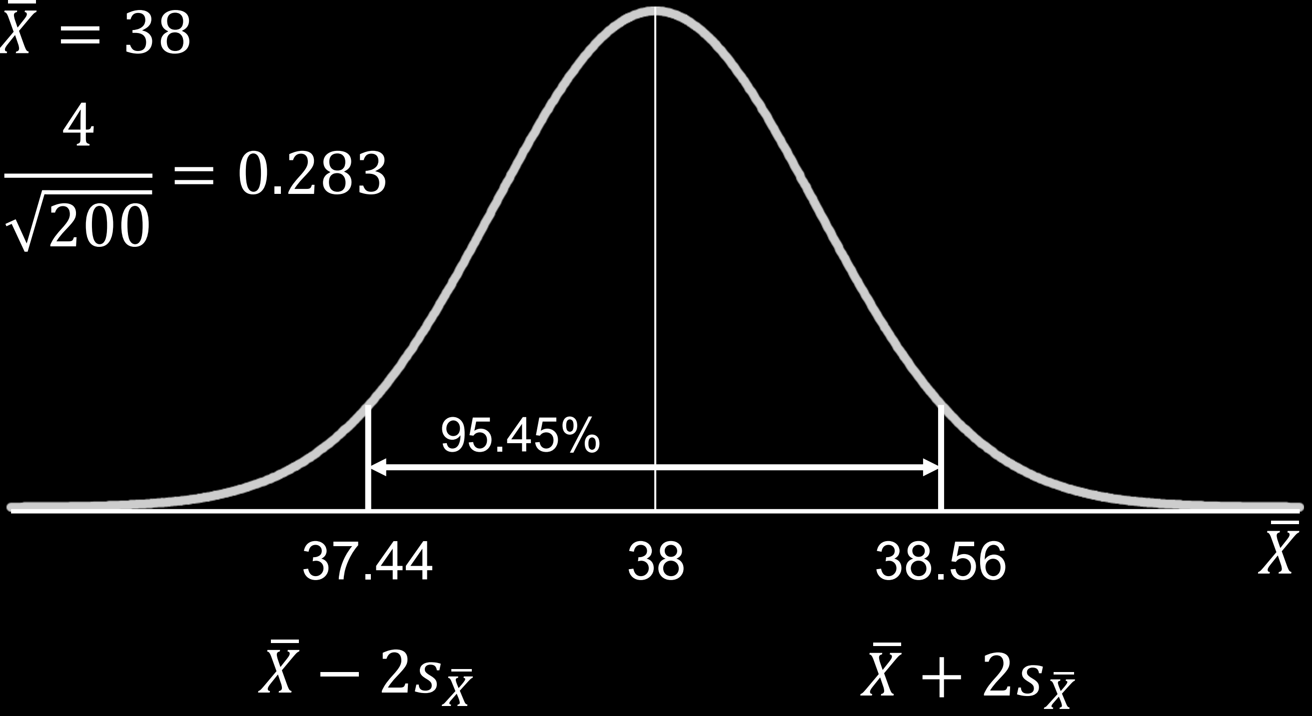
Interval Estimate Example



Interval Estimate Example

$$\mu \approx \bar{X} = 38$$

$$s_{\bar{X}} = \frac{4}{\sqrt{200}} = 0.283$$



Sources

- Luftig, J. An Introduction to Statistical Process Control & Capability. Luftig & Associates, Inc. Farmington Hills, MI, 1982