Probability with RSDs

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

with **Wendy Martin**

Learning objective:

Estimate probability using the Random Sampling Distribution of the mean

Estimating Probability Using the RSD of the Mean

- Note that when we use the Standard Error of the Estimate to find areas on the RSD of the means, the z-score employed becomes:

Estimating Probability Using the RSD of the Mean

$$Z_{\bar{x}} = \frac{\bar{X} - \mu}{\sigma_{\bar{x}}} = \frac{\bar{X} - \mu}{\sigma / \sqrt{n}}$$

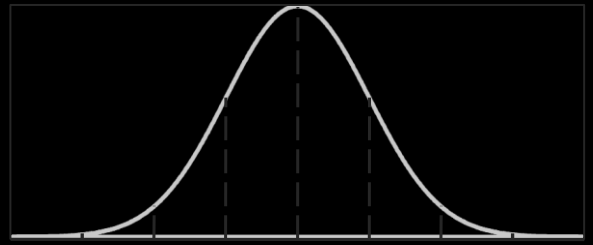
RSD of the Mean – Example 1

- A process has historically manufactured parts at a mean, μ, of 1.325, with a standard deviation, σ, of 0.045.

RSD of the Mean – Example 1

- Drawing a random sample of 25 units, what is the probability of finding an $\bar{X}$ of 1.433 or more for the sample if no change has occurred in the mean or dispersion of the process?

RSD of the Mean – Example 1



$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}} = \frac{0.045}{\sqrt{25}} = 0.009$$

$$Z_{\bar{X}} = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}} = \frac{1.433 - 1.325}{0.009} = 12$$

RSD of the Mean – Example 1

- The probability associated with this Z score is….really, really small!

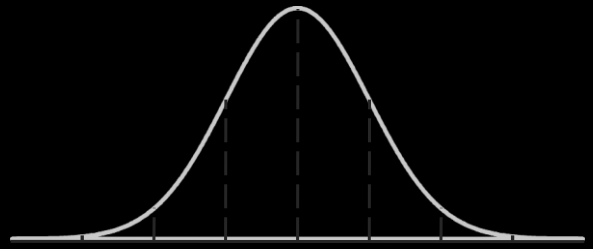
RSD of the Mean – Example 2

- A process has historically manufactured parts at a mean, μ, of 50, with a standard deviation, σ, of 14.4.

RSD of the Mean – Example 2

- Drawing a random sample of 16 units, what is the probability of finding an $\bar{X}$ of 55 or more for the sample if no change has occurred in the mean or dispersion of the process?

RSD of the Mean – Example 2



$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}} = \frac{14.4}{\sqrt{16}} = 3.6$$

$$Z_{\bar{X}} = \frac{\bar{X} - \mu}{\sigma_{\bar{X}}} = \frac{55 - 50}{3.6} = 1.389$$

RSD of the Mean – Example 2

- The probability associated with this Z score = 0.0824

RSD Examples

Statistic	RSD	Standard Error
$\bar{X}$	RSD of the mean	of the mean
$\tilde{X}$	RSD of the median	of the median
p	RSD of the proportion	of the proportion
R	RSD of the range	of the range

Sources

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