Introduction to Process Capability

Data Science for Quality Management: Process Capability

with **Wendy Martin**

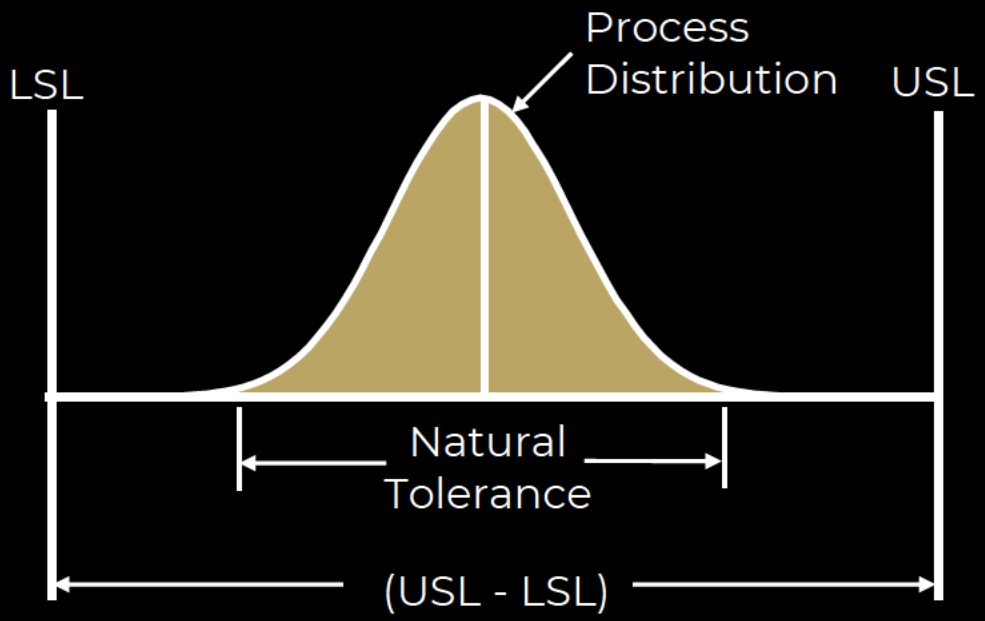
Learning objective:

Define the three indices of capability: C_p, C_{pk} and C_{pm}

Definition: C_p

- C_p: Is the number of “full curves” that could fit within the specification limits without regard for centering or targeting
- Based on dispersion / spread only
- Definition applies to both normal and non-normal process distributions

Index for Assessing the *Potential* Capability of the Process - C_p



$$C_p = \frac{USL - LSL}{NT}$$

$$C_p = \frac{USL - LSL}{6\sigma}$$

when data are normally distributed

Definition: C_{pk}

- C_{pk}: Is the number of “half curve widths” that could fit between the estimated process mean and the nearest specification limit
- Looks at the relative spread versus relative distance from the mean to the spec limits

Definition: C_{pk}

- Specifically related to the % out of specification, or threat of being out of specification

Definition: C_{pk}

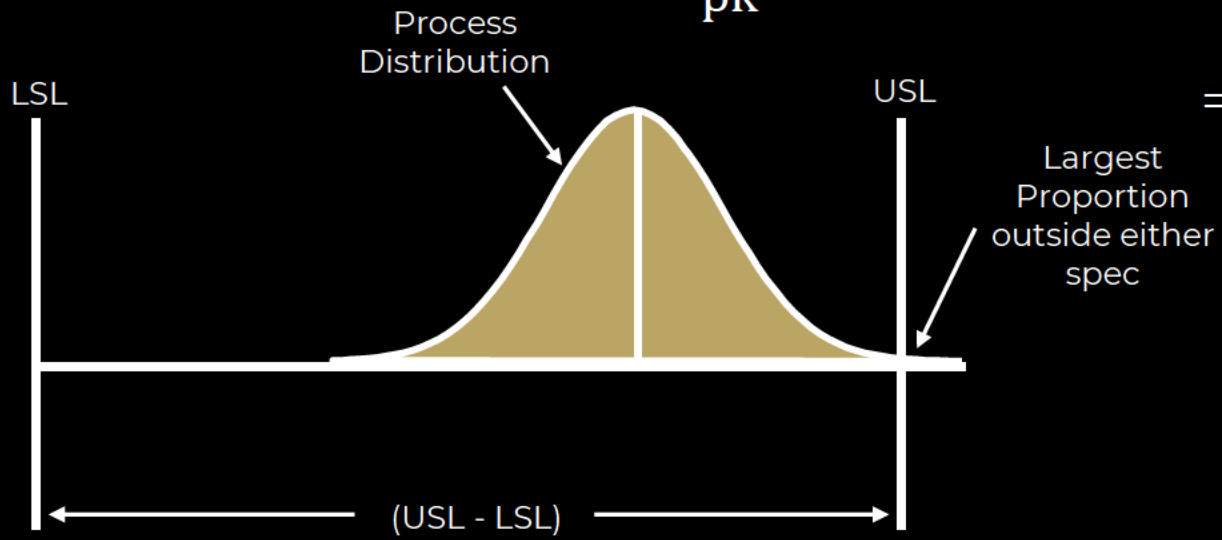
- The “nearest specification limit” is a conceptual definition associated with the specification limit with the greatest percent out of specification, or the greatest risk of going out of specification given a specific shift in the process average

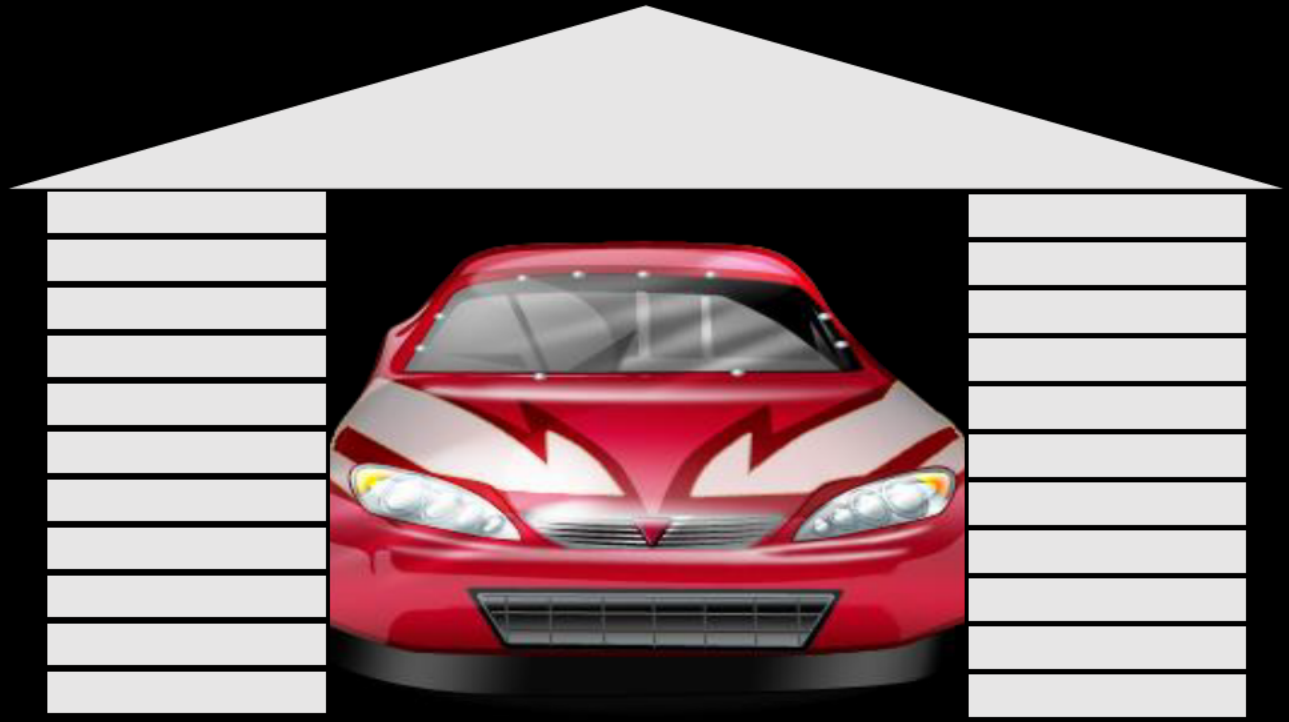
Definition: C_{pk}

- Is C_p with a penalty imposed for being off center
- Definition applies (conceptually) to both normal and non-normal process distributions

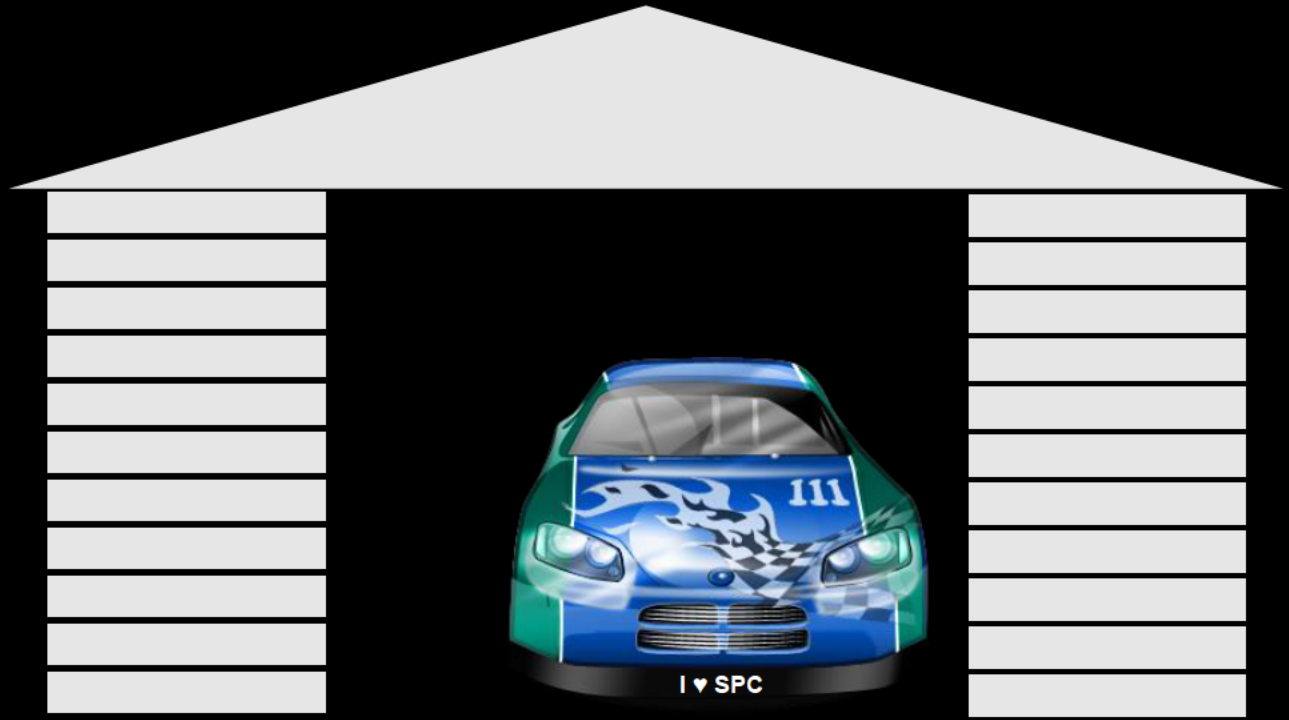
Index for Describing Capability As A Function of Nonconformance Rate: C_{pk}

$$C_{pk} = \frac{z_{(\text{Largest Proportion Outside Either Spec})}}{3} = \frac{\min(\text{USL} - \mu, \mu - \text{LSL})}{3\sigma}$$

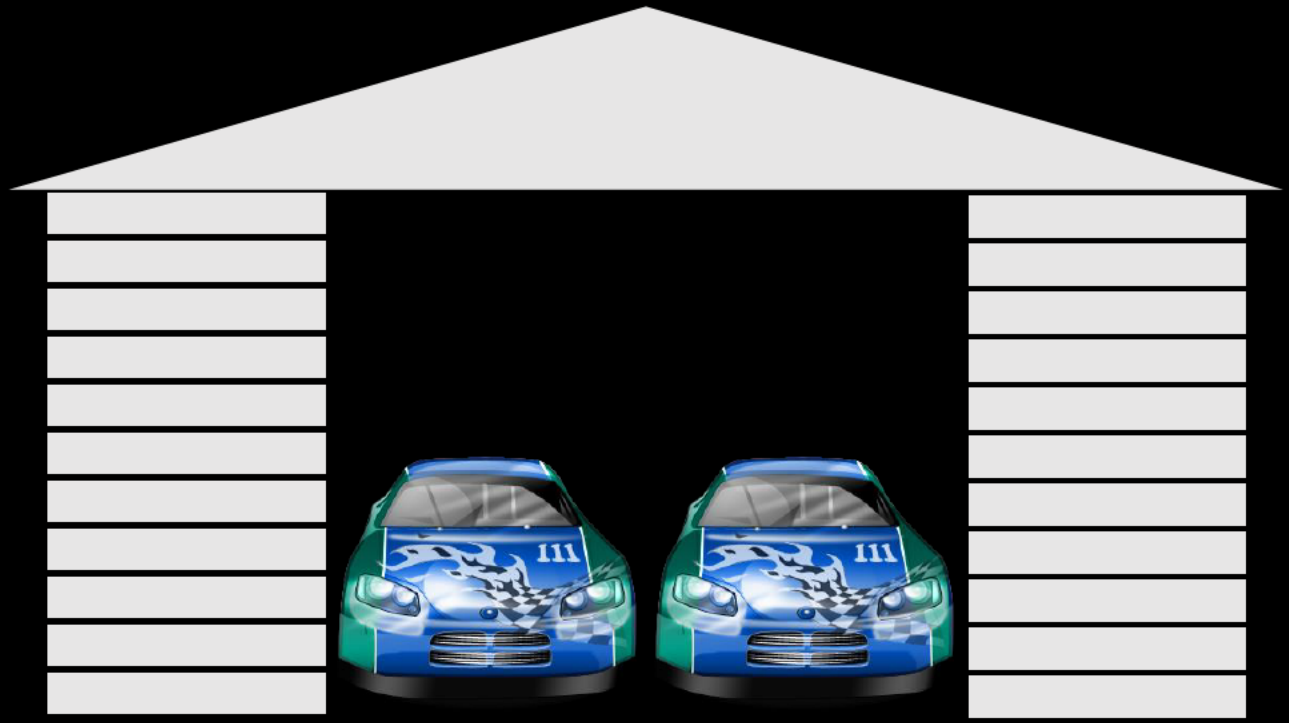




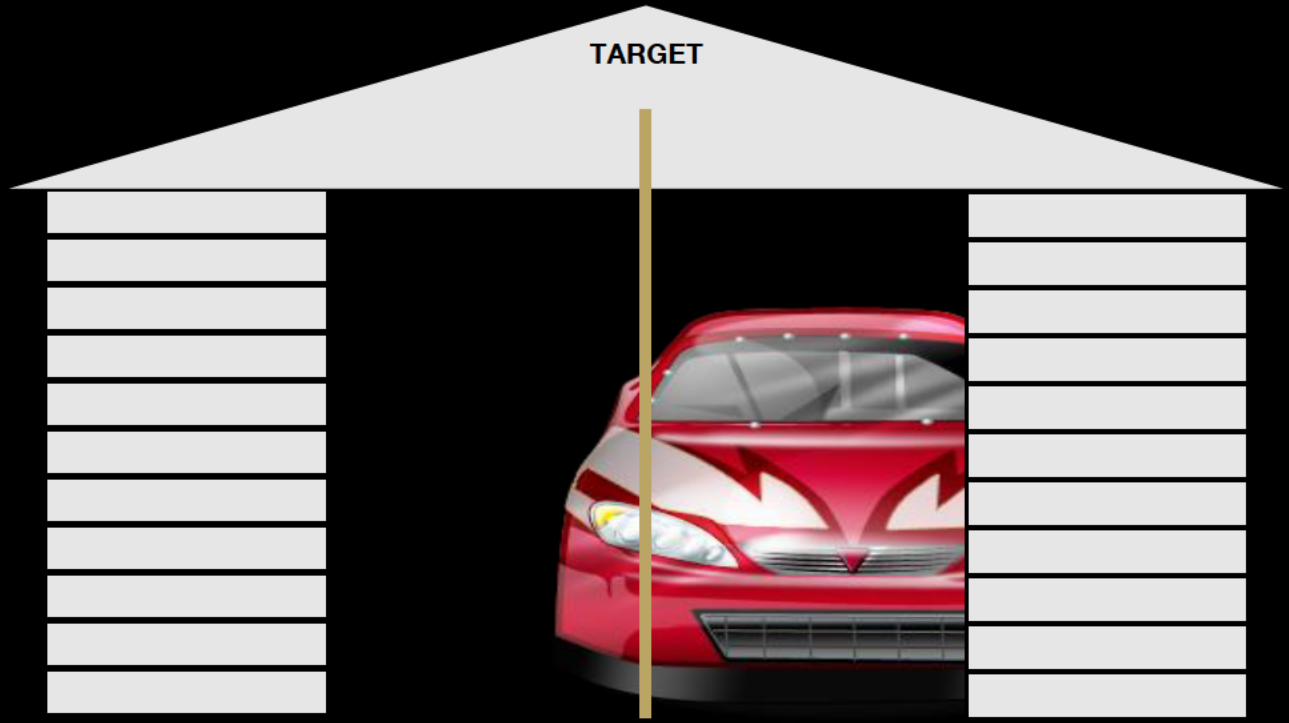
C_p of this process < 1.0



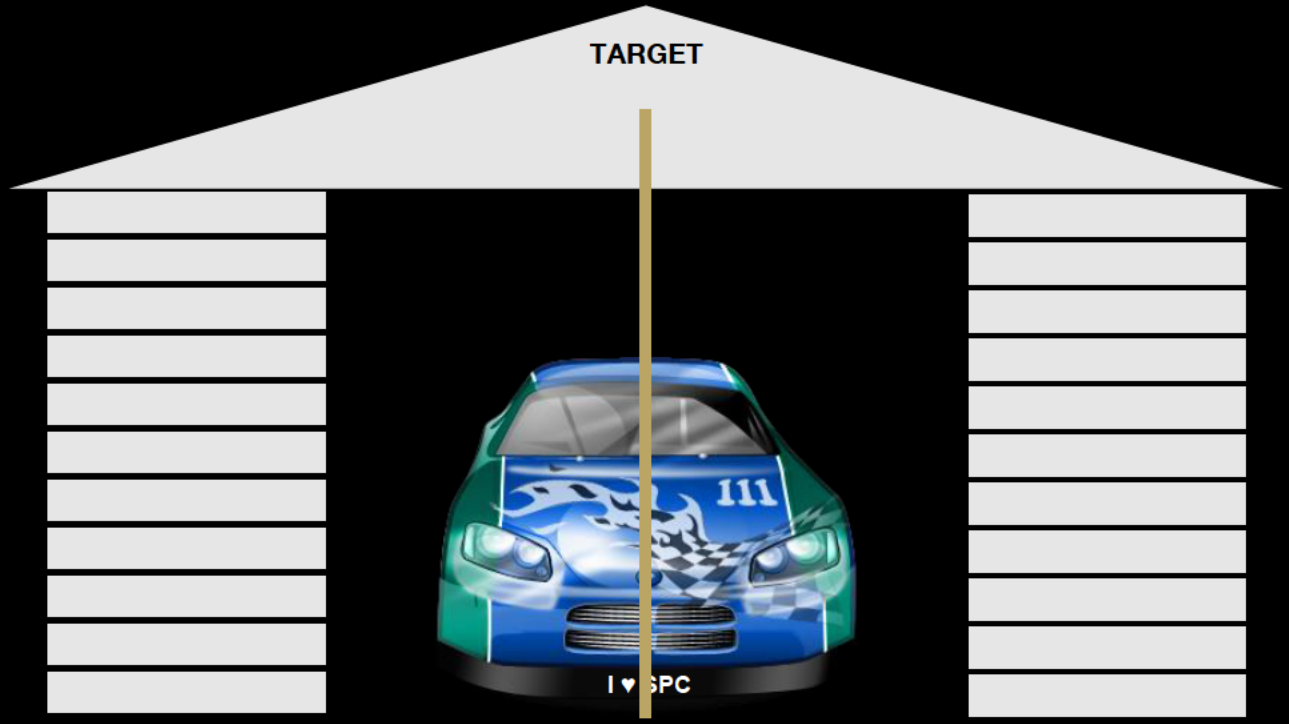
C_p of this process > 1.0



C of this process ≥ 2.0



C_{pk} of this process < 1.0



C_p of this process = C_{pk}

Sources

The material used in the PowerPoint presentations associated with this course was drawn from a number of sources. Specifically, much of the content included was adopted or adapted from the following previously-published material:

- Luftig, J. An Introduction to Statistical Process Control & Capability. Luftig & Associates, Inc. Farmington Hills, MI, 1982
- Luftig, J. Advanced Statistical Process Control & Capability. Luftig & Associates, Inc. Farmington Hills, MI, 1984.
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- Luftig, J. Guidelines for Reporting the Capability of Critical Product Characteristics. Anheuser-Busch Companies, St. Louis, MO. 1994
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- Littlejohn, R., Ouellette, S., & Petrovich, M. Black Belt Business Improvement Specialist Training, Luftig & Warren International, 2000
- Ouellette, S. Six Sigma Champion Training, ROI Alliance, LLC & Luftig & Warren, International, Southfield, MI 2005