# Mean and Standard Deviation Charts

**Data Science for Quality Management: Xbar and R / Xbar and S charts / X and MR charts**

with **Wendy Martin**

**Learning objectives:**

Generate the Xbar and S Chart using R software

Assess the Xbar and S chart for process control

Estimate the standard deviation from the S chart

# Step 5: Generate the Chart

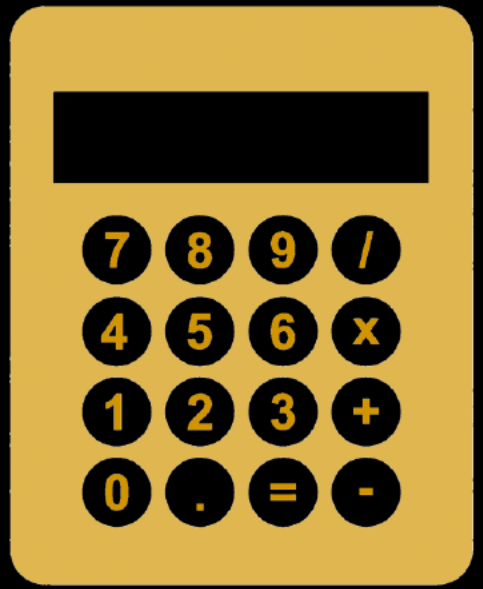
In R Studio

```
spc.chart.variables.mean.and.meanstandarddeviation()
```

# Sample Statistics

- Each sample mean is the average of the eight units in the sample.

- Each sample standard deviation is the standard deviation of the eight measures in the sample.



# Results of Centerline Calculations

$$\overline{\overline{X}} = 2.348$$

$$\overline{s} = 0.249$$

# Control Limit Formulas

$$\mathrm{UCL}_s = B_4 \bar{s}$$
$$\mathrm{LCL}_s = B_3 \bar{s} \text{ or none}$$

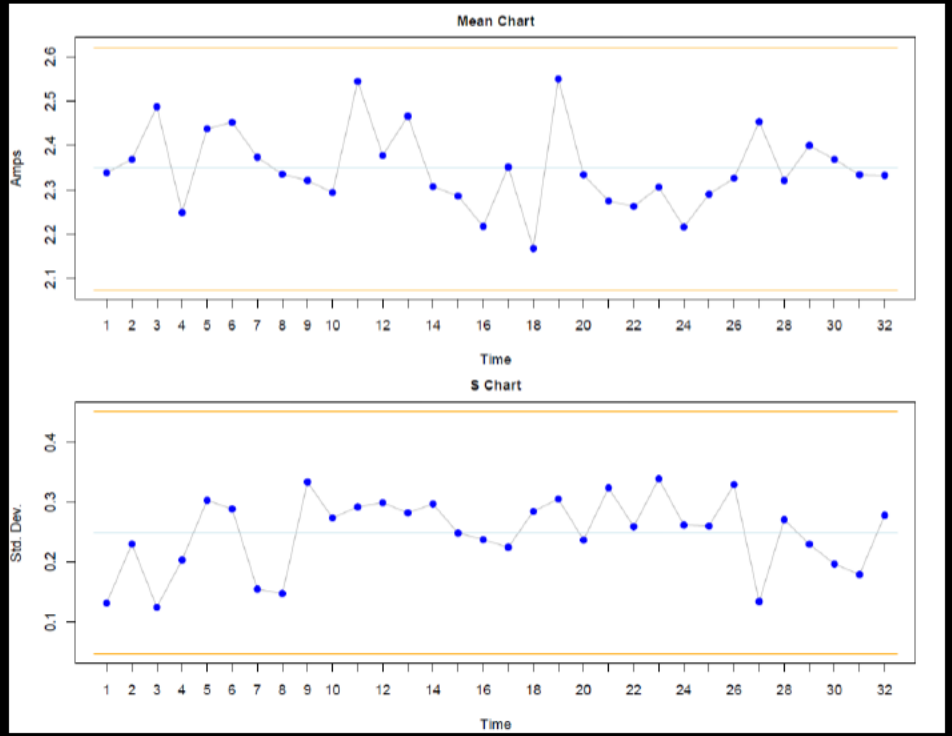
$$\mathrm{UCL}_{\bar{X}} = \bar{\bar{X}} + A_3 \bar{s}$$
$$\mathrm{LCL}_{\bar{X}} = \bar{\bar{X}} - A_3 \bar{s}$$

# Results of Control Limit Calculations

$$\mathrm{UCL}_s = 0.451$$
$$\mathrm{LCL}_s = 0.046$$

$$\mathrm{UCL}_{\bar{X}} = 2.622$$
$$\mathrm{LCL}_{\bar{X}} = 2.075$$

# Step 6: Assess the Process for Control



# Step 6: Assess the Process for Control

- If the “spread” chart is out of control, then the control limits on both the spread and center charts will be impacted (either for the good, or the bad) by the inclusion of the out of control condition into the calculation of the limits.

# Step 7: Assess the Process for Capability

- Assess the potential capability of the process due to spread (Cp)
- Assess the capability of the process to produce within specification (Cpk)
- Assess the capability of the process to conform to nominal (or target) (Cpm)

# 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
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- Luftig, J. and Petrovich, M. Quality with Confidence in Manufacturing. SPSS, Inc. Chicago, IL 1997
- 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