

Individuals and Moving Range Charts

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

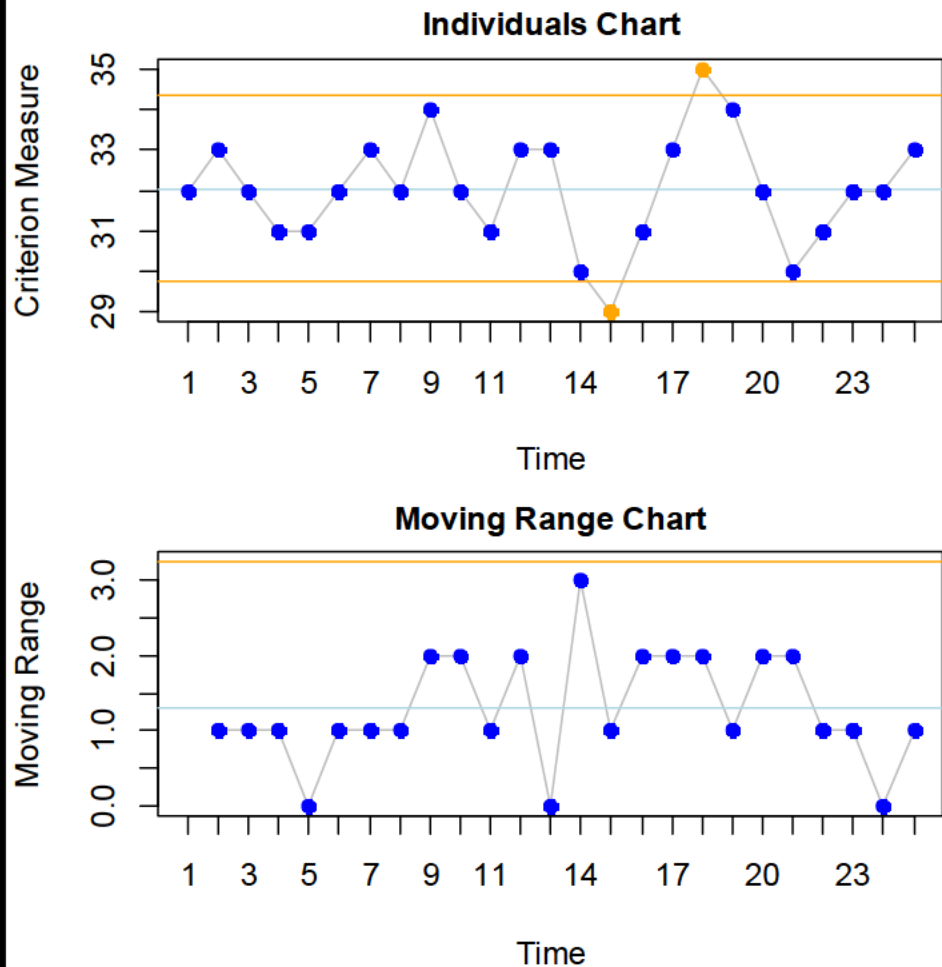
Learning objectives:

Generate the \bar{X} and MR chart using R software

Assess the \bar{X} and MR chart for process control

Estimate the standard deviation from the MR chart

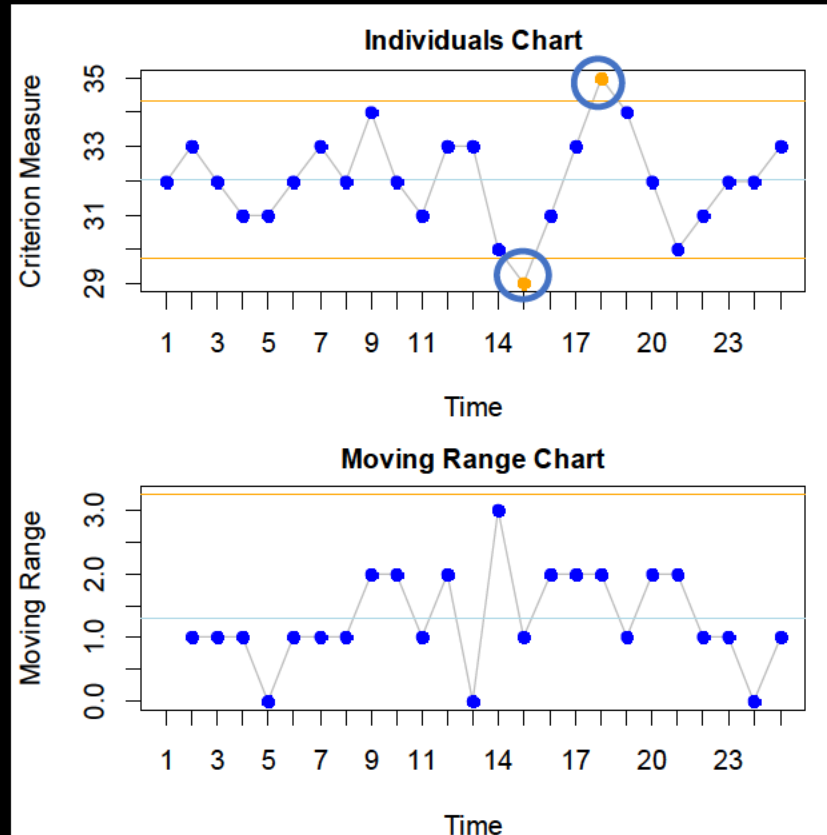
Plot the Control Chart(s)



Step 6: Assess Process Control

- First, evaluate the Moving Range chart
 - Only look for points outside the limits
- Next, evaluate the X chart
 - Use all control rules

Step 6: Assess Process Control



Step 7: Assess Process Capability

$$\hat{\sigma} = \frac{\overline{MR}}{d_2} = 1.145$$

$$C_{p(\text{pot.})} = \frac{USL - LSL}{6\hat{\sigma}} = \frac{35 - 29}{6(1.145)} = 0.874$$

Step 7: Assess Process Capability

- Process Performance Measure - P_p

$$P_p = \frac{USL - LSL}{6s} = \frac{35 - 29}{6(1.369)} = 0.731$$

Why does the P_p indicate a lower capability?
(Hint: what is different between the formulae for C_p and P_p ?)
What does this tell you about the process?

Conclusions

- Using two-sigma limits, the process does not demonstrate control. Using three-sigma limits, it does.
- Follow-up investigation is warranted
- Possibly increase sampling frequency and watch closely

Conclusions

- Take measures before and after addition of chemicals
- Inherent variation must be reduced

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
- Spooner-Jordan, V. Understanding Variation. Luftig & Warren International, Southfield, MI 1996
- 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