

u Charts: Control Charts for Count Data

**Data Science for Quality Management:
Control Charts for Discrete Data**
with **Wendy Martin**

Learning objectives:

Calculate Control Limits for the u chart using the exact calculation

Generate the u chart using R software

Assess the u chart for process control

Control Limits (Normal Approximation)

$$\text{UCL} = \bar{u} + 3 \sqrt{\frac{\bar{u}}{n_i}}$$

$$\text{LCL} = \bar{u} - 3 \sqrt{\frac{\bar{u}}{n_i}}$$

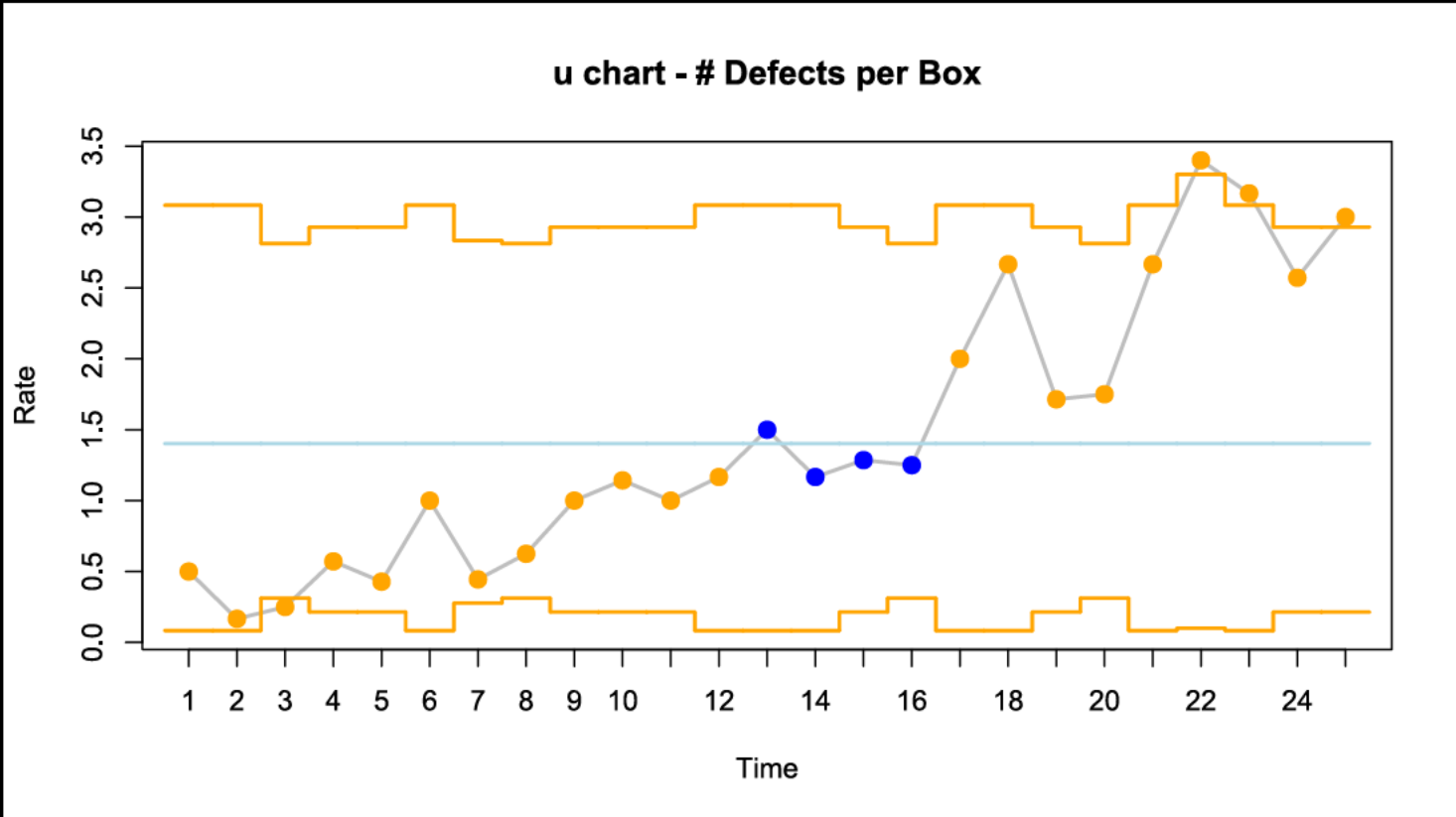
Note that the control limits will vary for each sample size calculated!

Exact Poisson Control Limits

- Using the Poisson distribution
 - Find UCL where $P(X \text{ and above}) \leq 0.00135$ and use $(X - 0.5)/n$ for the UCL
 - $\lambda = \bar{u} \times \text{average \# of boxes} = 1.40 \times \text{boxes at time } t = ?$
 - Find LCL where $P(X \text{ and below}) \leq 0.00135$ and use $(X + 0.5)/n$ for the LCL

Note that the control limits will vary for each sample size calculated!

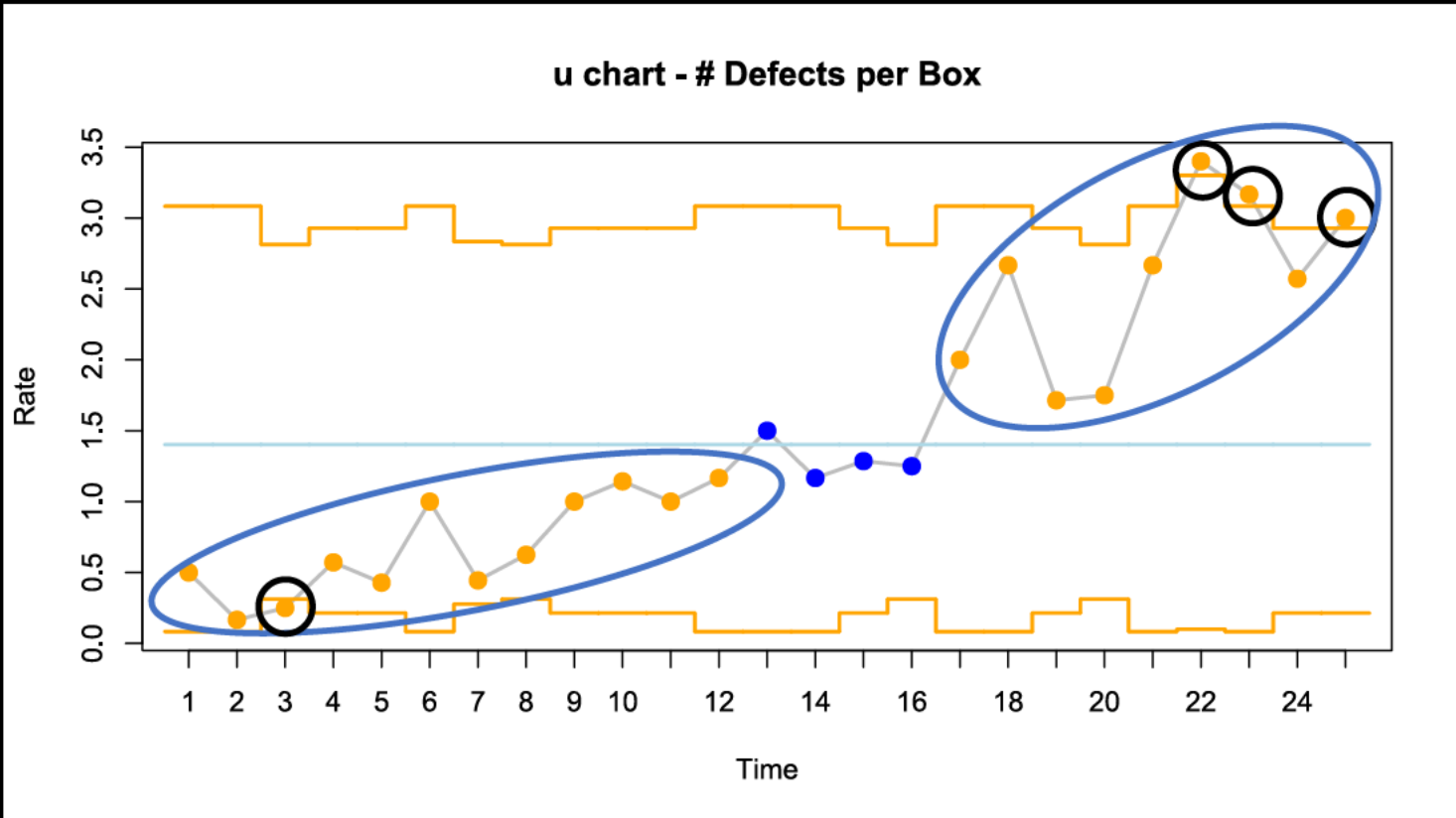
Control Chart(s)



Step 6 — Assess Process Control

- Assess the process for: points outside the limits, runs, trends, cycles, and unusual patterns of variation.

Step 6 — Assess Process Control



Step 6 — Assess Process Control

- We see a run below and a run above the centerline, with three points outside of the limits at the end of the time period.
- The process is not displaying a state of control.

Step 7 — Assess Process Capability

- If the process control chart reflects a state of statistical control, you can assess the process for capability.
- Like the c chart, the process average is often used to analyze capability in direct comparison to a required level or standard.
- Because a state of control does not exist, we cannot assess the capability of this process.

Conclusions

- Our data suggest that the rate of nonconformities in the ceramic substrates has increased dramatically over the past several months.
- This could very well be the source of the control module problems that the assembly employees have encountered.

Conclusions

- After further investigation, you discover that the supplier's contract has expired and that their last shipment has been sent.
- Five months ago, this supplier learned that their contract would not be renewed and, it appears, lost interest in maintaining high levels of quality.
- You immediately recommend a 100% inspection of the latest delivery.

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.
- Luftig, J. A Quality Improvement Strategy for Critical Product and Process Characteristics. Luftig & Associates, Inc. Farmington Hills, MI, 1991
- 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