p Charts: Control Charts for Proportions / Percentages

Data Science for Quality Management: Control Charts for Discrete Data

with **Wendy Martin**

Learning objectives:

Generate the p chart using R software

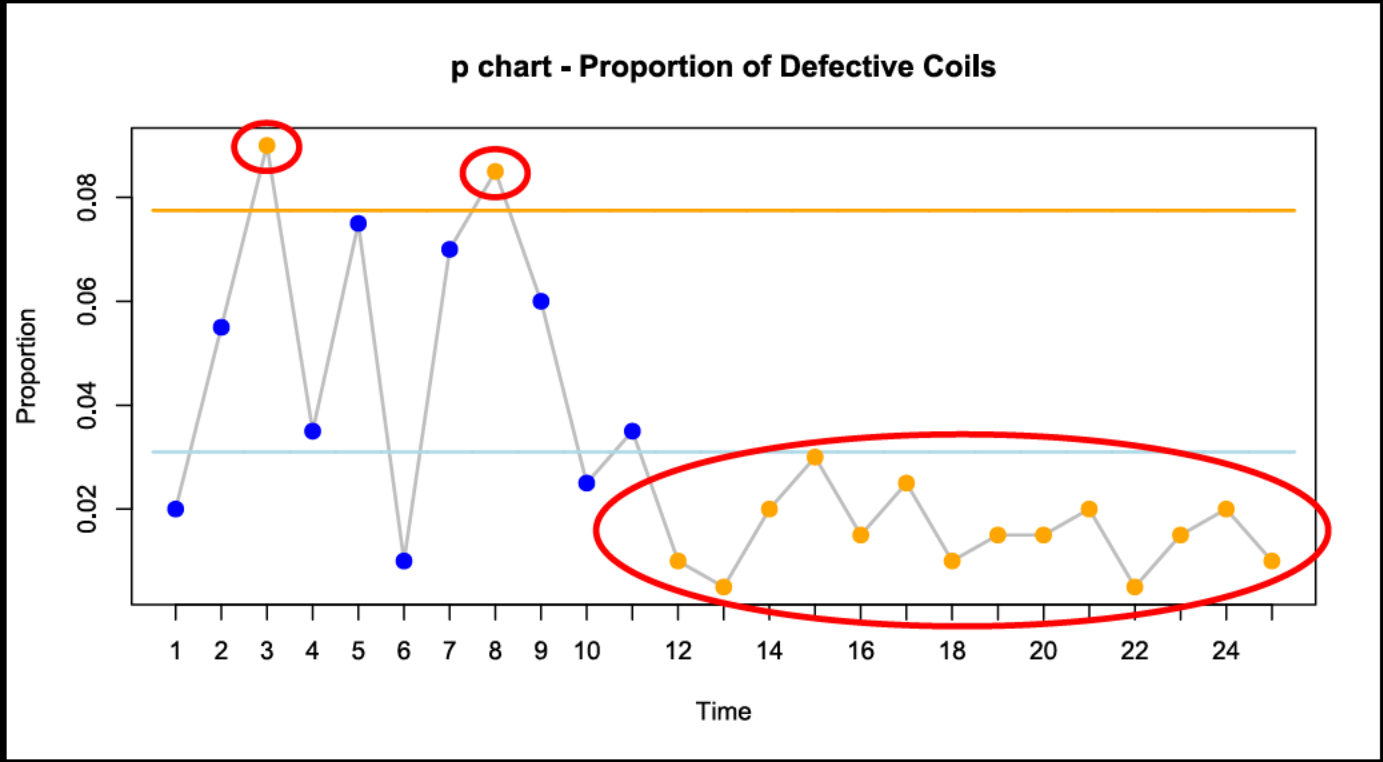
Assess the p chart for process control

Calculate an estimate for process capability

Step 6: Assess Process Control

- Look for points outside the limits, runs, trends, cycles, and unusual patterns of variation

Step 6: Assess Process Control



Step 6: Assess Process Control

- We find points outside the limits at the beginning and a run of 14 points below the centerline
- The process is not displaying control
- What happened?

Step 6: Assess Process Control

- Resistance gauge modified after ninth day
- Replot charts correctly by adding in “sets” for before and after the gauge modification
- We will do this by sub-setting the data before the gauge change and after the gauge change

Step 6: Assess Process Control

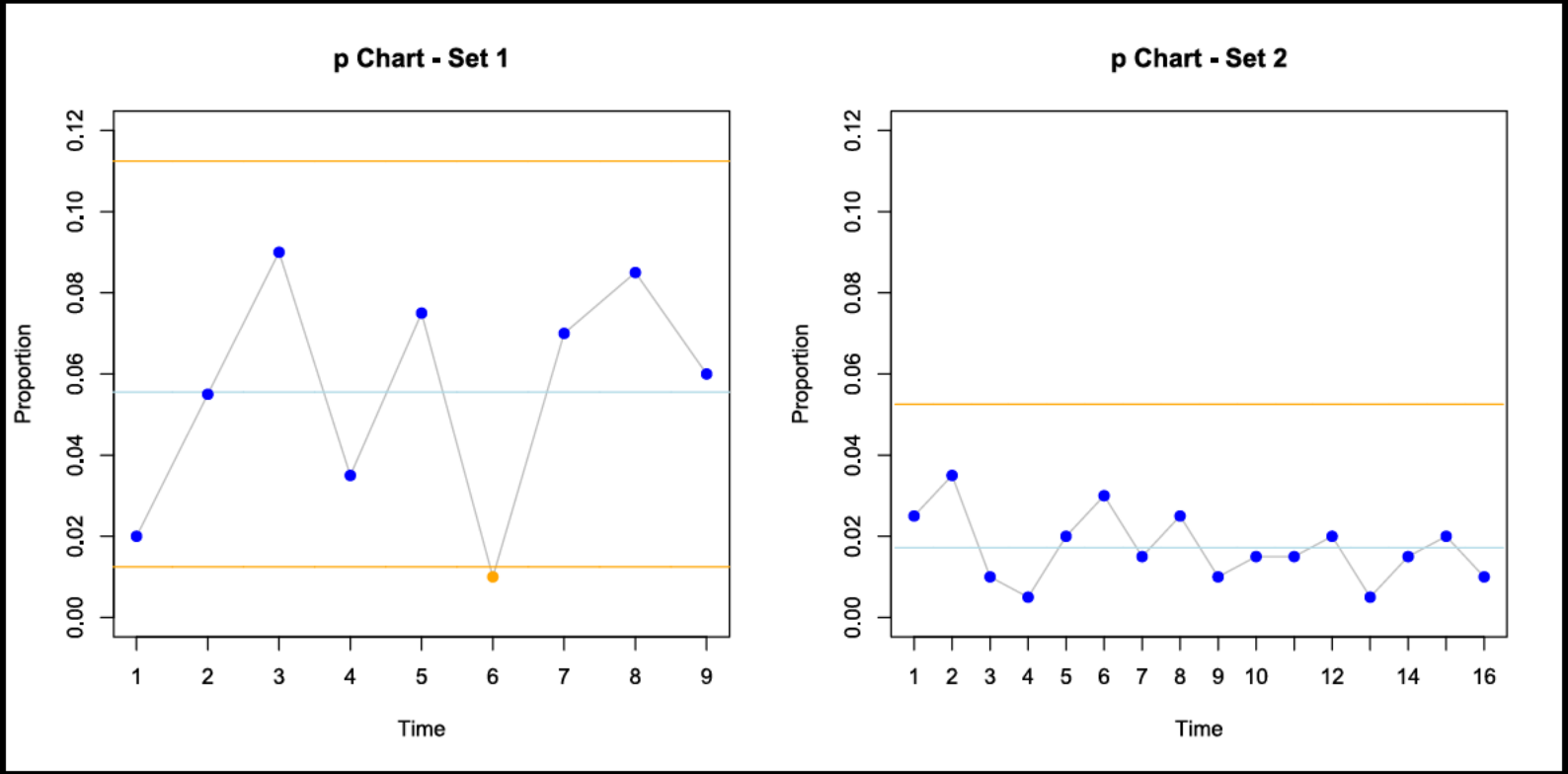
In Rstudio

```
p.set1<-subset(x = p.Chart,
subset = p.Chart$Set==1)

p.set2<-subset(x = p.Chart,
subset = p.Chart$Set==2)
```

count	Set	n	prop
4	1	200	0.020
11	1	200	0.055
18	1	200	0.090
7	1	200	0.035
15	1	200	0.075
2	1	200	0.010
14	1	200	0.070
17	1	200	0.085
12	1	200	0.060
5	2	200	0.025
7	2	200	0.035
2	2	200	0.010
1	2	200	0.005
4	2	200	0.020
6	2	200	0.030

Plot the Control Chart(s) II



Step 7: Assess Process Capability

- If we can assume that the process is stable, then the process capability is equal to p ($\bar{\pi}_{est}$) which is 0.0172 or 1.72%

- The nonconforming product rate limit is usually defined by customer requirements

Step 7 — Assess Process Capability

- What were our requirements when we had continuous data?
- Cp / Cpk / Cpm >= 1.00
- On one side of the distribution, no more than 0.135% out of spec

Step 7 — Assess Process Capability

- Could we convert this somehow to a Cpk? What did we do when we had non-normal data?
- If I had 1.72% OOS, I could use the Z score.
- Take Z value / 3 = Cpk (equiv).

= 2.1154/3 = 0.705

Conclusions

- There was a special cause of variation which was the change in resistance gauges
- After investigation, you concluded that this change was positive and resulted from a better understanding of the customer needs
- The process still makes more scrap than we would like, and the team should continue its work

Conclusions

What suggestion might you make to the team?

The team might consider using a variables chart to monitor the resistance. An Xbar and R or Xbar and s chart is much more powerful and would detect process changes with smaller sample sizes, leading to further process understanding.

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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- 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