u Charts: Control Charts for Count Data

Data Science for Quality Management: Control Charts for Discrete Data

with **Wendy Martin**

Learning objectives:

Calculate u for a sample

Create centerlines for the u chart

u Charts - Introduction

- Like the c chart, the u chart is an attributes control chart used to monitor a process for the number of occurrences per inspection unit

u Charts - Introduction

- Unlike the c chart, it is used where it is not possible or desirable to draw samples of equal size from one sampling period to another

u Charts - Introduction

- The u chart measures the average number of occurrences per inspection unit

- It also follows the Poisson distribution

u Charts Introduction

- Each u value would be calculated as

$$u = \frac{c}{Unit\ Size}$$

The Case of the Incoming Ceramic Substrates

- The automotive assembly line employees have found that the number of engine problems has increased.
- They suspect that the problem may be in the engine control modules.

The Case of the Incoming Ceramic Substrates

- The electronics division reports that its processes have not changed.
- You are asked to investigate.

The Case of the Incoming Ceramic Substrates

- Upon reviewing the failure mode and effect analysis (an analysis that shows potential problems, their effects, and the associated risks), you find that the ceramic substrates could be a potential problem.

The Case of the Incoming Ceramic Substrates

- The substrate is the foundation on which an integrated electronic circuit is formed or fabricated.

- If a high number of nonconformities exist, failures can occur in the engine control modules.

- Dock audits have taken place for the past five months, but no one has analyzed the data.

The Case of the Incoming Ceramic Substrates

- The data are based upon the inspection of incoming shipments of ceramic substrates

- As each lot size varies from period to period, so do the number of inspection units

Step 1 — Select a Characteristic

- A standard procedure is used to audit the ceramic substrates for nonconformities

- Acceptance levels of the nonconformities have been clearly defined

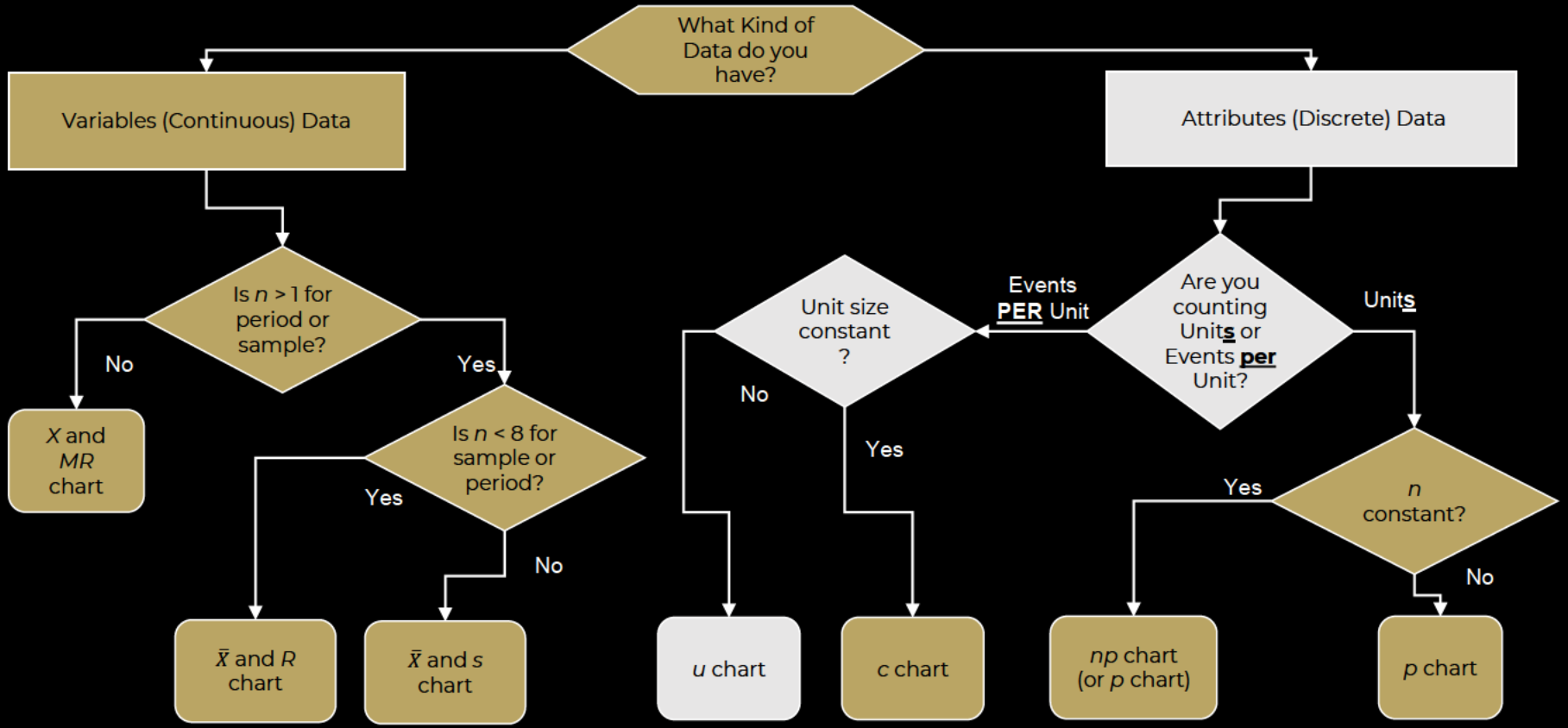
Step 2 — Select Sampling Plan

- Data have been taken on incoming boxes of ceramic substrates during dock inspection
- Because you are analyzing past data, your sampling plan has been defined
- You have 25 samples of five to nine boxes each. Each box contains the same number of substrates.

Step 3 — Select the Chart Type

- Because you are dealing with the number of occurrences and your sample size varies, you select the u chart

Step 3: Select the Chart



Step 4 — Collect Data

- The file shows the results of the dock inspection of incoming boxes of ceramic substrates

Step 5 — Generate Chart

In Rstudio

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spc.chart.attributes.counts.u.poissondistribution.simple( )
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Sample Statistics

- For each sample, u will be calculated as follows.

$$u = \frac{c}{n}$$

Centerline(s)

- The centerline for the u chart is the average number of observations per unit, calculated as

$$\bar{u} = \frac{c_1 + c_2 + \cdots + c_k}{n + n_2 + \cdots + n_k} = \frac{\sum c}{\sum n}$$

= 237/169 = 1.40

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:

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