Creating a Control Chart

Data Science for Quality Management: Process Control and Control Charts

with **Wendy Martin**

Learning objectives:

Describe the 7 step process to create a control chart

Calculate and select sample size

Where Should the Data Be Collected?

- Select locations in the process where the characteristic is created, changed, or influenced
- Avoid the Error of Process Stream Effects

Where Should the Data Be Collected?

- One or More Stations, Fixtures, Dies, Suppliers, Mill Lots, etc. should not be combined (especially in the initial phases of analyzing the process for control)

Where Should the Data Be Collected?

- Combining data from multiple processes on a single control chart is referred to as a process stream effect

Where Should the Data Be Collected?

- It violates the concept of a rational subgroup and the good news is that it is almost always detected by the control chart if you pay attention.

How Often Should the Data Be Collected?

Frequently enough to:

- allow special causes to occur between samples; and
- allow the process owner(s) to take timely corrective action if necessary

How Often Should the Data Be Collected?

- Balance the cost of sampling with the cost of reacting or failing to react
- Sampling too infrequently leads to losses associated with time; e.g. making defective product unnecessarily

How Often Should the Data Be Collected?

- Sampling too frequently means wasted effort

- Sample more frequently in the beginning

Selecting An Appropriate Sample Size

- Sample size (n) can be calculated
- Sample size must be considered in conjunction with the cost of sampling and measuring / testing

Selecting An Appropriate Sample Size

- Example for a mean chart:

$$n = \left[\frac{(z_{\text{control limit}} + z_{\beta}) \times \sigma}{\Delta}\right]^2$$

Sample Size Calculation Example

- What is the minimum sample size required, if the process standard deviation is 1.0 or less, you would like to detect a 2-unit shift with no more than a 2.28% chance of missing it on a single random sample (draw), and you intend to use a typical standard error control limit of 3?

Sample Size Calculation Example

$$n = \left[\frac{(z_{\text{control limit}} + z_{\beta}) \times \sigma}{\Delta}\right]^2$$

Per the previous formula:

$n = (((3 + 2) \times 1)/2)^2 = 6.25$ or 7

Sample Size Calculation Example

In R Studio

```
> sample.size.mean.z.onesample()
```

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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