Common and Special Cause Variation

Data Science for Quality Management: Understanding Process Variation

with **Wendy Martin**

Learning objective:

Differentiate between Common Cause and Special Cause Variation

Common Causes of Variation

- Processes exhibit inherent variation.
- This variation is created by the sum of many small sources of variability.

Common Causes of Variation

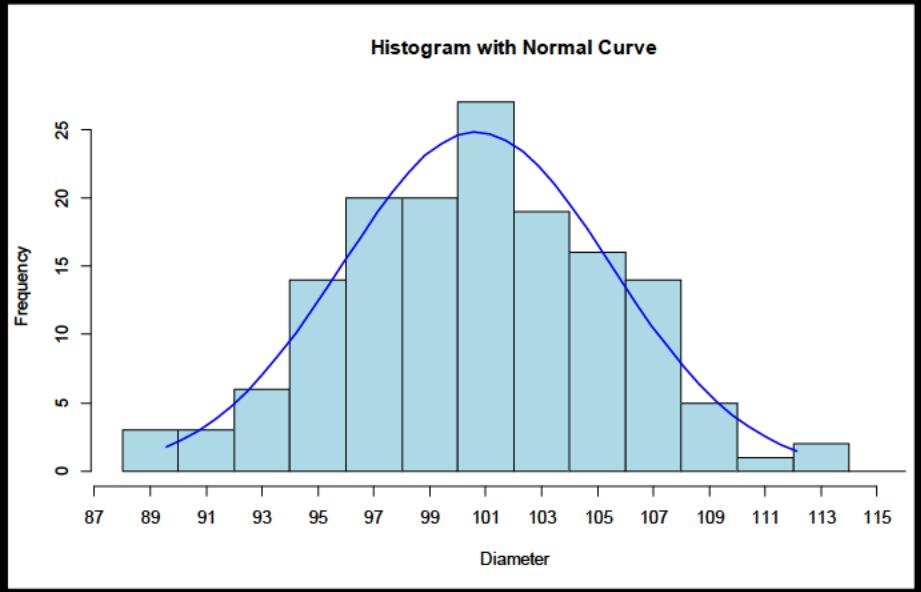
- These sources of variability produce an observable distribution in the characteristics studied during the short time period.

Common Causes of Variation

- Assume that there are 150 consecutive items taken from a process.
- Assume that these 150 items may be modeled with a normal distribution, with an estimated mean and standard deviation.

Common Causes of Variation

- Why are not these 150 consecutive items all the same?



Common Causes of Variation

- You cannot explain exactly why one item differs from another, and the variability often cannot even be measured.
- Although the items are not exactly alike, they do come from a common process, producing a distribution.

Common Causes of Variation

- The sources of variation that produce this distribution are referred to in Statistical Process Control as common causes of variability.

Special Causes of Variation

- Over time, changes in some variables can alter the distribution.
- These changes can appear unpredictably as changes in shape, spread, or the location of the distribution.

Special Causes of Variation

- The causes, which move or alter the common cause distribution, are known as special causes of variability.

Defining Process Control

- Where only common causes of variation are present, the processes are said to be in a state of statistical control.

Defining Process Control

- Processes affected by **both** common and special causes of variation are said to be out of statistical control.

Defining Process Control

Walter Shewhart (1931) wrote,

“...a phenomenon will be said to be controlled when, through the use of past experience, we can predict, at least within limits, how the phenomenon may be expected to vary in the future.”

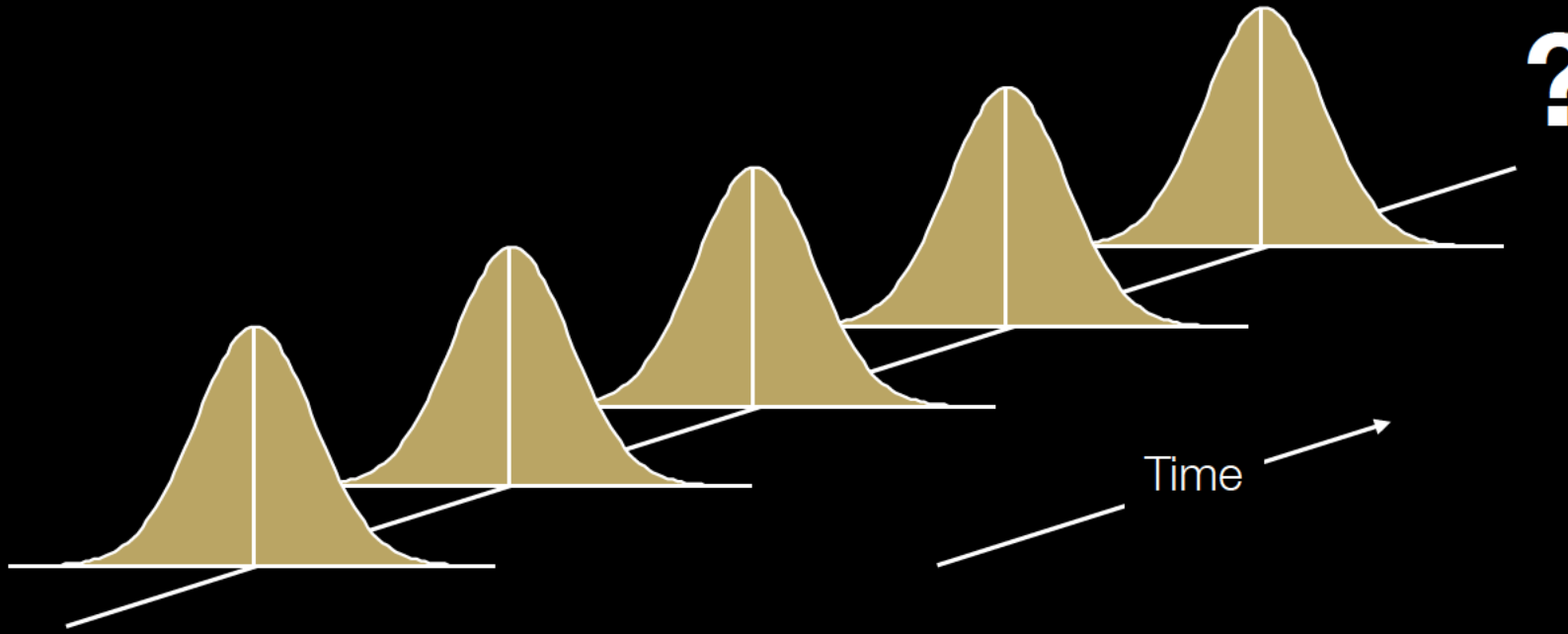
Predictability

- Process output affected only by common causes of variation is stable and predictable.

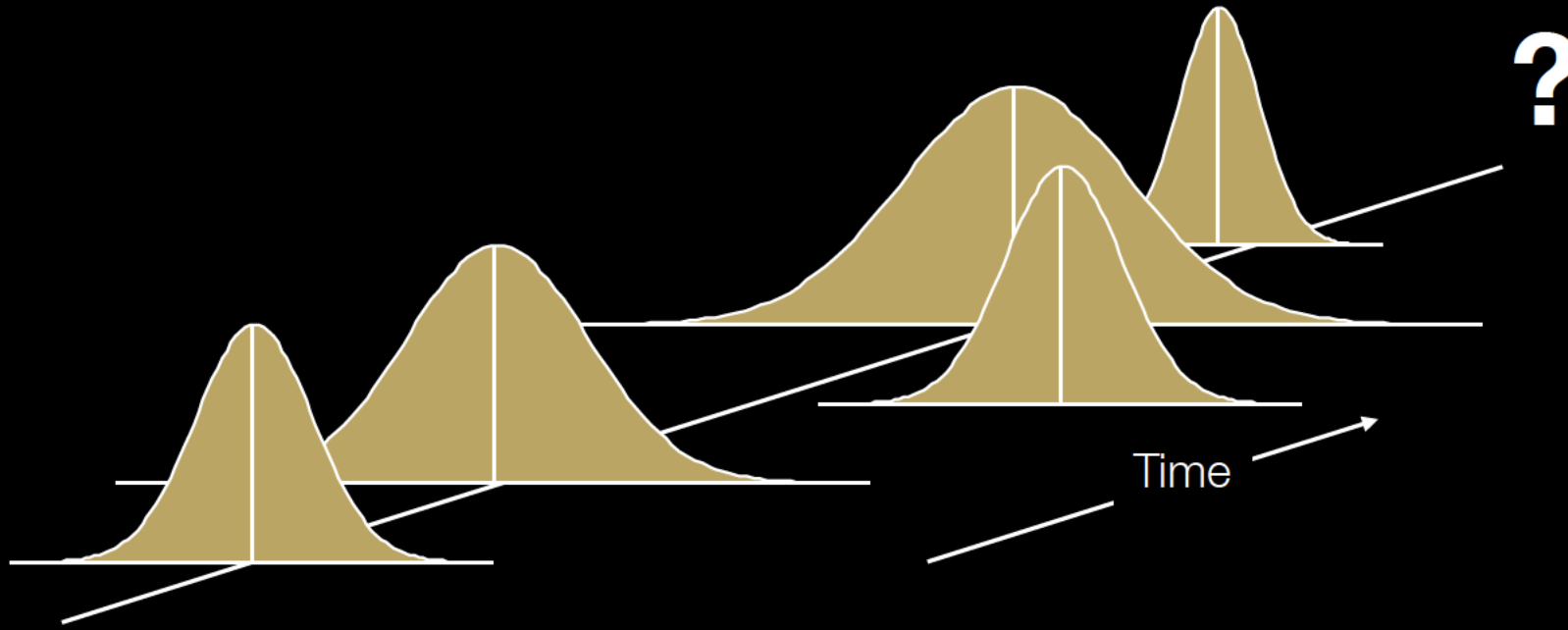
Predictability

- Process output affected by common and special causes of variation is unstable, and therefore by definition, unpredictable.

A Process Affected by Only Common Causes of Variation



A Process Affected by Special Causes of Variation



Special Causes Can Be Good or Bad

- Countermeasures must be implemented against detrimental special causes.
- Beneficial special causes should be incorporated into the process; that is, be made common to the process.

Special Causes Can Be Good or Bad

- The function of a control plan is to implement these countermeasures.

Elimination of Special Causes Causing Negative Effects

- The ***good*** news is that if you observe a special cause of variation which has a negative effect on the process, and fail to implement an effective countermeasure, you usually get a second chance.

Elimination of Special Causes Causing Negative Effects

- The ***bad*** news is that if you observe a special cause of variation which has a negative effect on the process, and fail to implement an effective countermeasure, you usually get a second chance!

“Special causes of variation left alone and unattended become common to the process!”

- Dr. W. Edwards Deming

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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