Measurement as a Process, The Big 5 Aspects of Data

Data Science for Quality Management: Data and Measurement

with **Wendy Martin**

Learning objectives:

Describe the process of measurement
Demonstrate and recall the big five (5) aspects of data

Data Costs Money

We must make data both

- Efficient and
- Effective

How Do We Make Data Efficient and Effective?

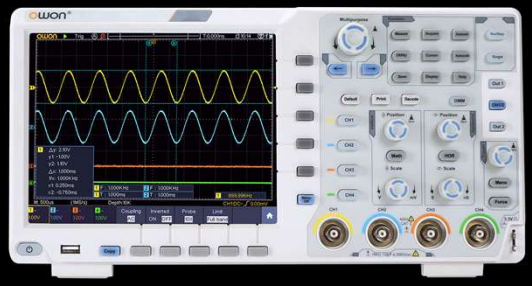
Make certain that the measurement process itself is effective:

- Capable
- Acceptable

Measurement and Data

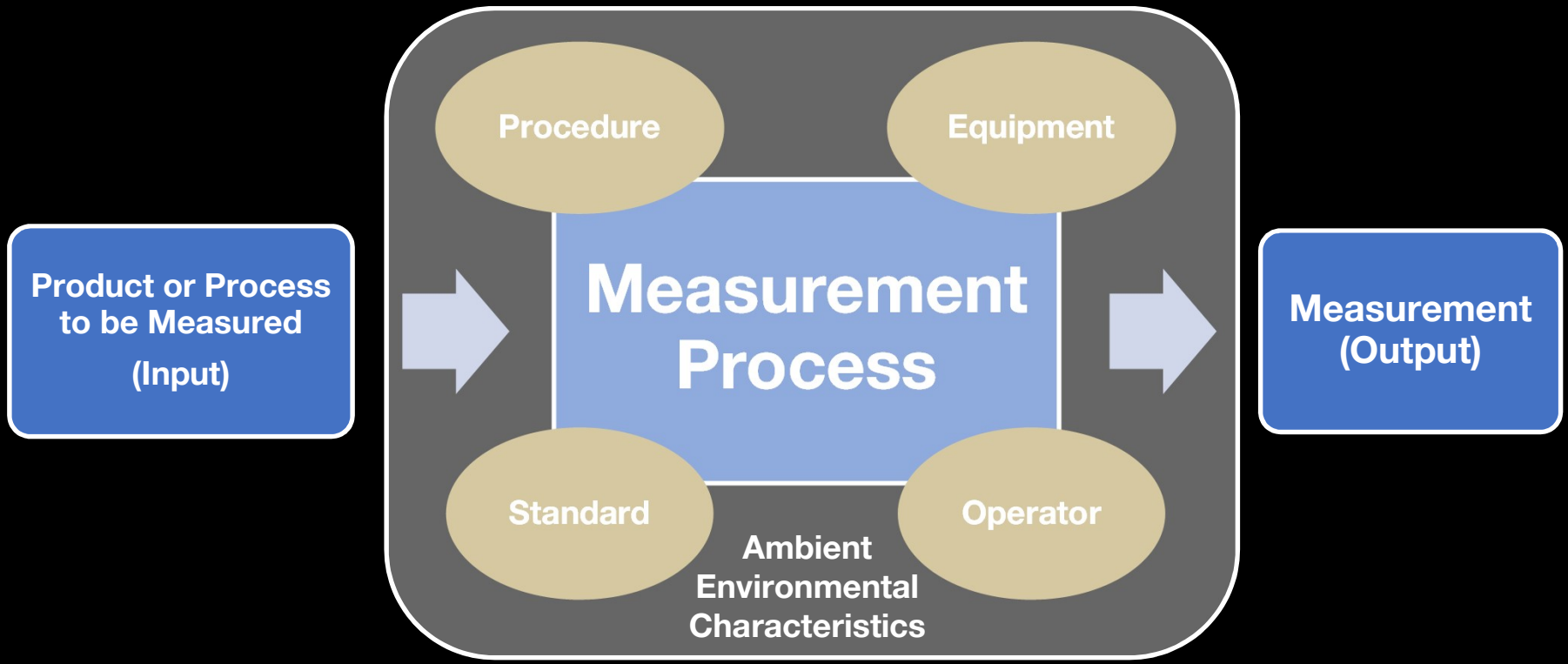
How do we study, record and communicate an event? We assign numbers.

- **Measurement** is the *process*
- **Data** is the *output*



1.5	1.3	1.6	1.5
1.6	1.4	1.2	1.3
1.2	1.7	1.3	1.2
1.4	1.4	1.1	1.7

Measurement as a Process



Common Myths of Measurement

The measurement system MUST be effective (capable) if it:

- Is expensive
- Has a digital readout
- Uses radiation
- Is made in Switzerland
- Is only used by a Supervisor
- Has a recent calibration sticker

Measurement as a Process

As in any process, measurement systems must demonstrate:

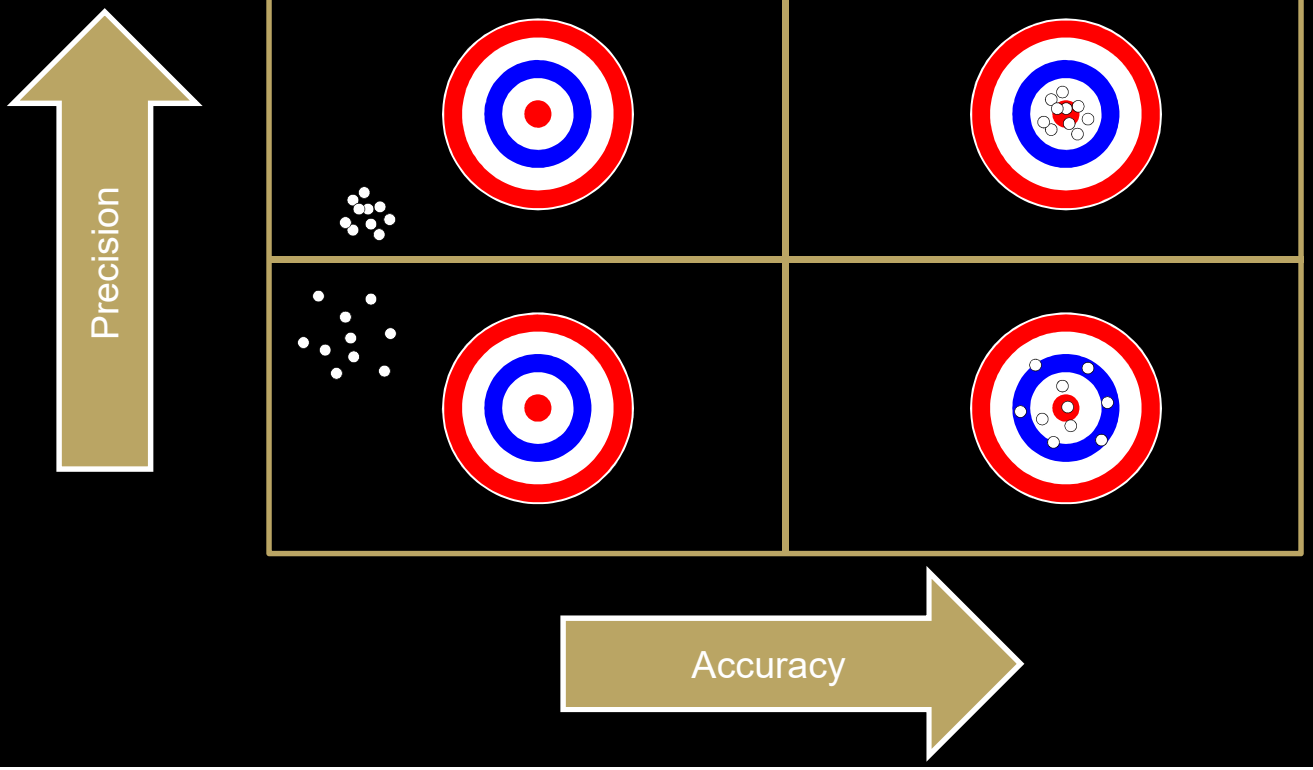
- Stability through time, or control
- The ability to generate reliable, or repeatable and reproducible measures
- The ability to generate valid measures

Measurement as a Process

Reliability in measurement is a measure of the Precision of the device / method

Validity in metrology is a measure of the Accuracy of the device / methods

Precision vs. Accuracy



Tools for Understanding Data

Once the measurement process is found to be capable and acceptable (more on this later), we can begin to analyze the generated data

Tools for Understanding Data

There are many tools to help us understand what data are telling us, including

- Probability and statistics; to quantify and summarize data
- Control charts; to determine if a process is stable

Tools for Understanding Data

- Experimental design; to allow us to identify root causes of a problem so we can eliminate it; or to identify and properly manipulate Special and Common Causes of Variability to improve optimize the process output

Big 5 Aspects of Data

Location

Spread

Shape

Time Sequence

Relationship

5 Aspects of Data

Location

Spread

Shape

Time Sequence

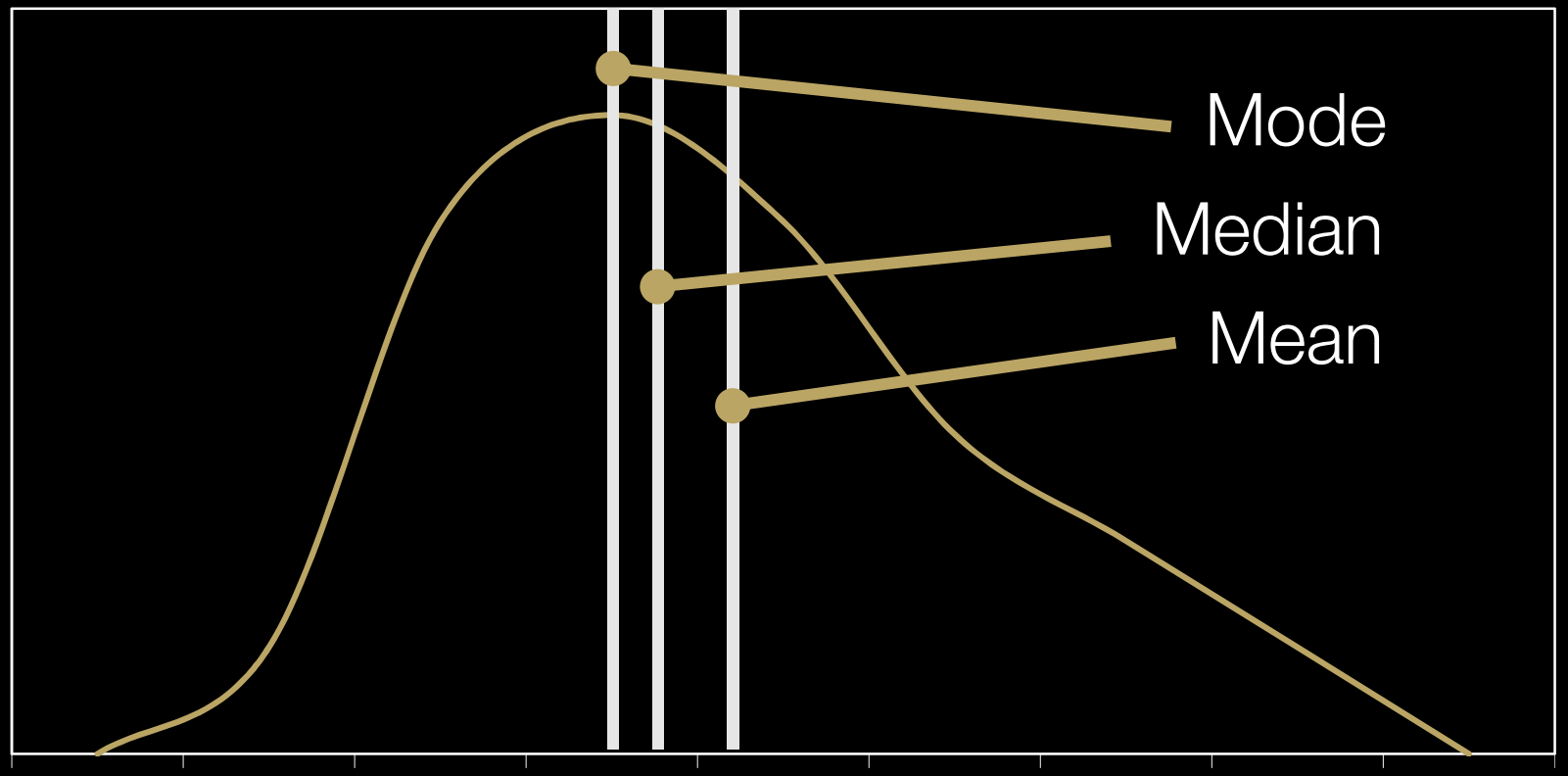
Relationship

Measures of Location

Measures of location, sometimes called measures of central tendency, describe a middle or central point or tendency of a distribution.

- Mean, Median, Mode

Measures of Location

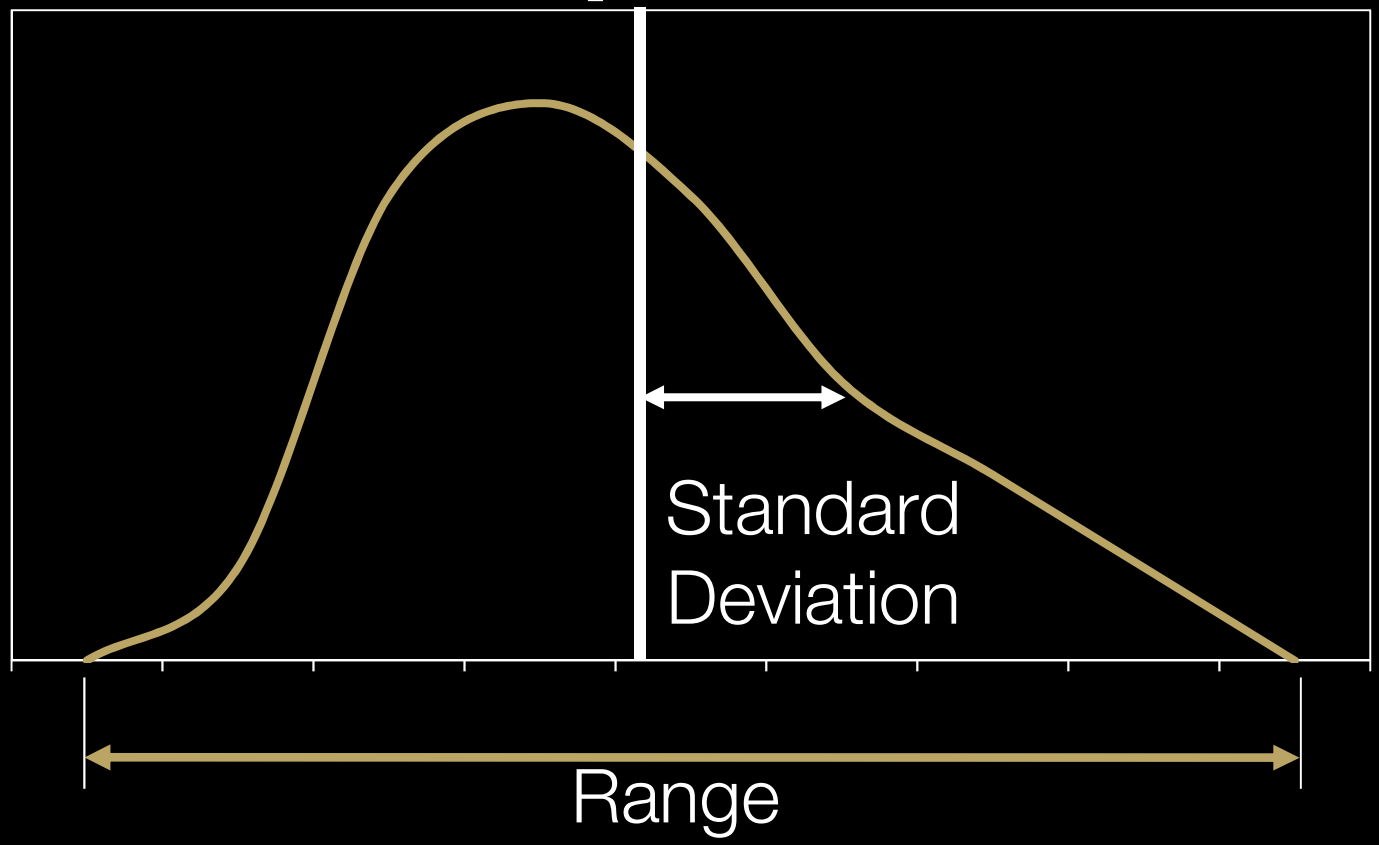


Measures of Spread

Measures of dispersion reflect the variation or spread in a data set or distribution. Some of the common measures of dispersion are:

- Range, Standard Deviation, Variance

Measures of Spread



Measures of Shape

Measures of shape reflect the type of distribution sampled. There are two measures:

- Skewness
- Kurtosis

Skewness

Skewness is concerned with the symmetrical nature of the distribution, and is the degree of departure from symmetry of a distribution.

Skewness

Basically measures “lopsidedness.”

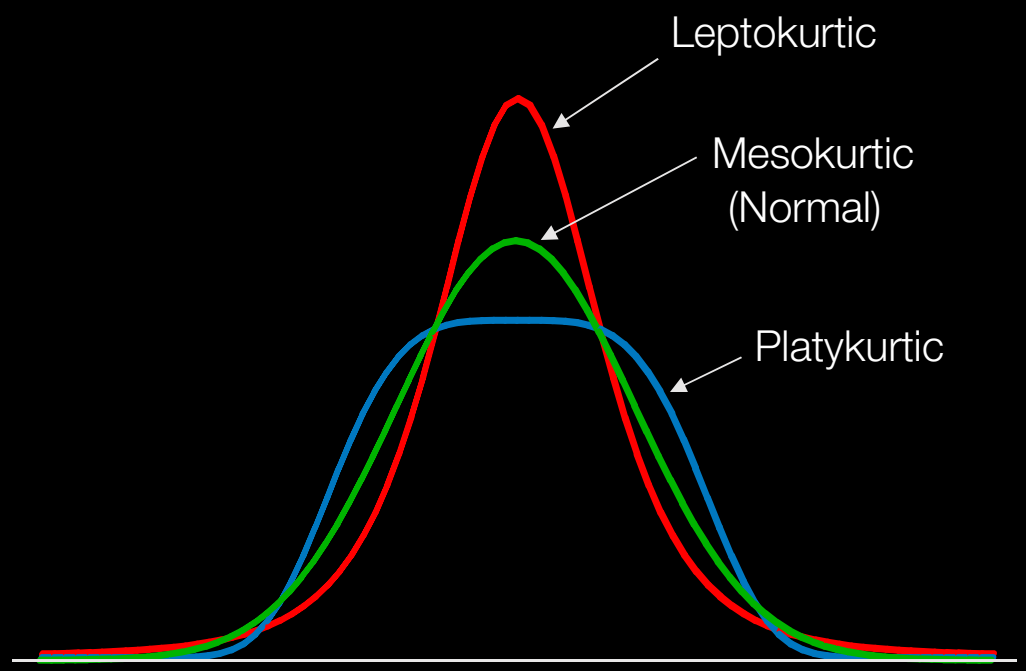
Symmetric distributions have zero skewness.

Positively skewed

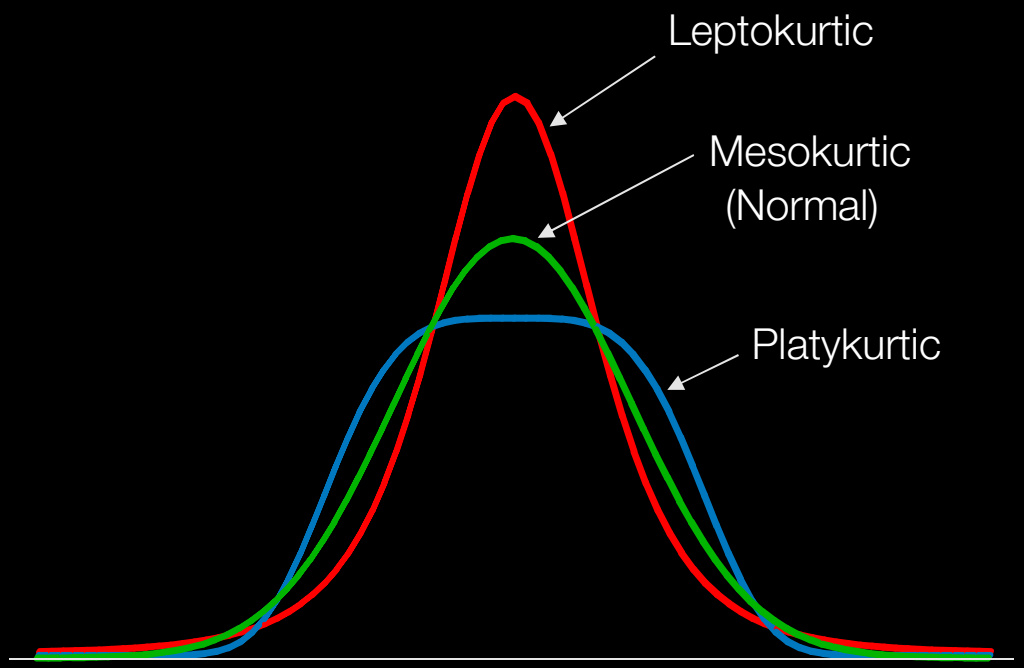
Negatively skewed

Kurtosis

Kurtosis is concerned with the peakedness of the distribution.



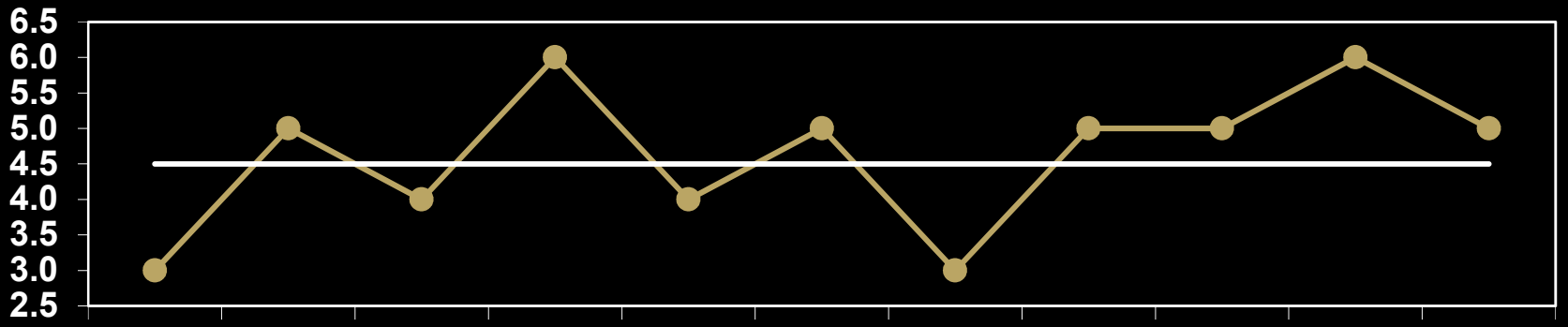
Kurtosis

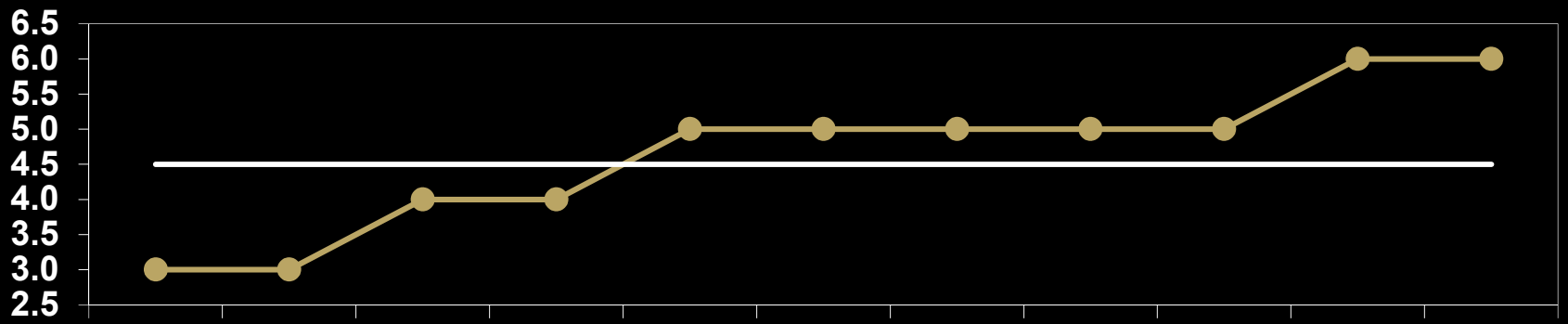


Time Sequence

Time ordered data indicates the stability of the process through time.

Time Sequence



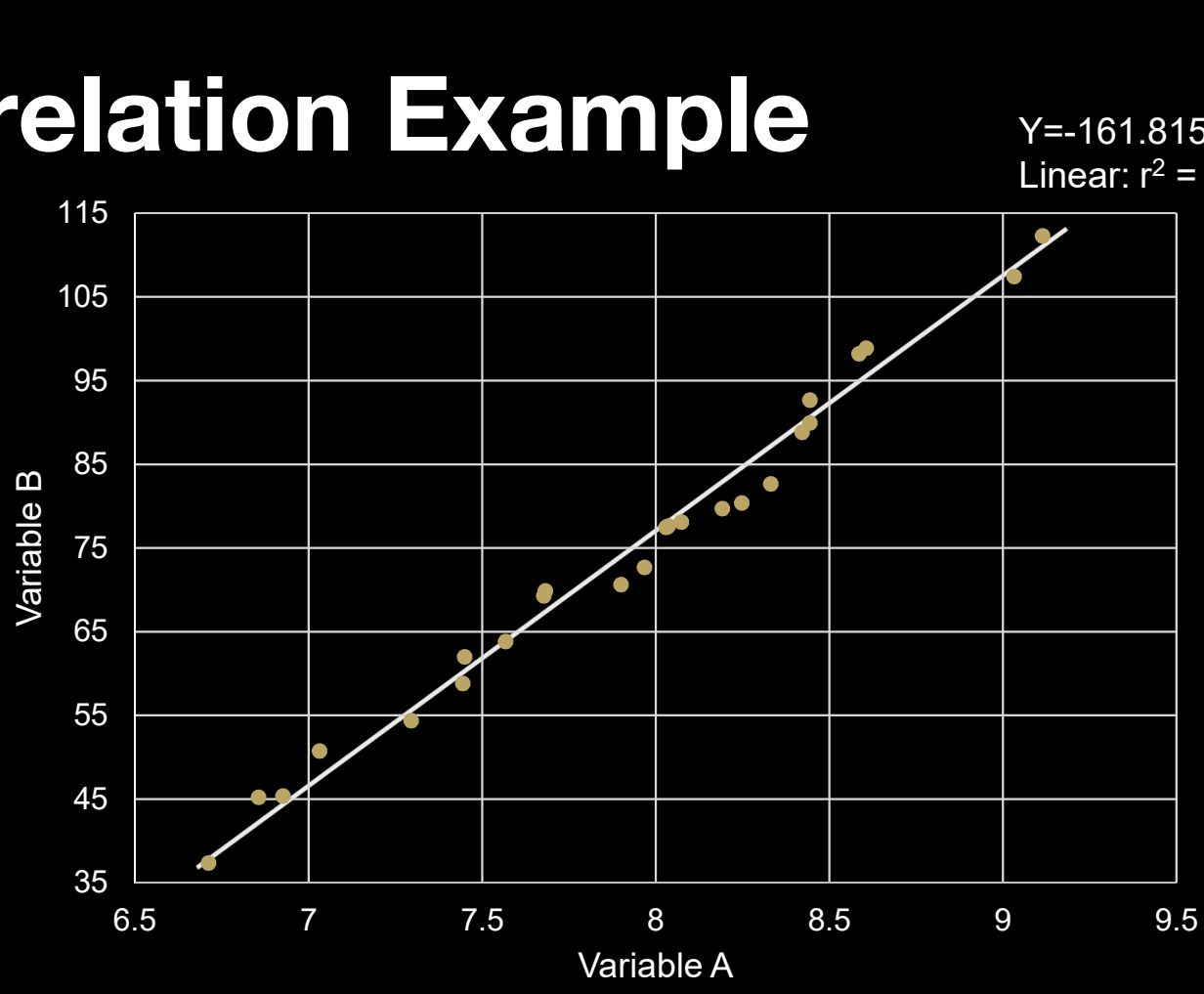


Measures of Relationship

Measures of relationship quantify the "strength" of the relationship between two variables.

- Correlation
- Association

Correlation Example



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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