

WEEK 10

DATA COLLECTION



AND

ANALYSIS

# Statistical Process Control

- It is used to monitor whether processes are different from those developed by Shewart (1963).



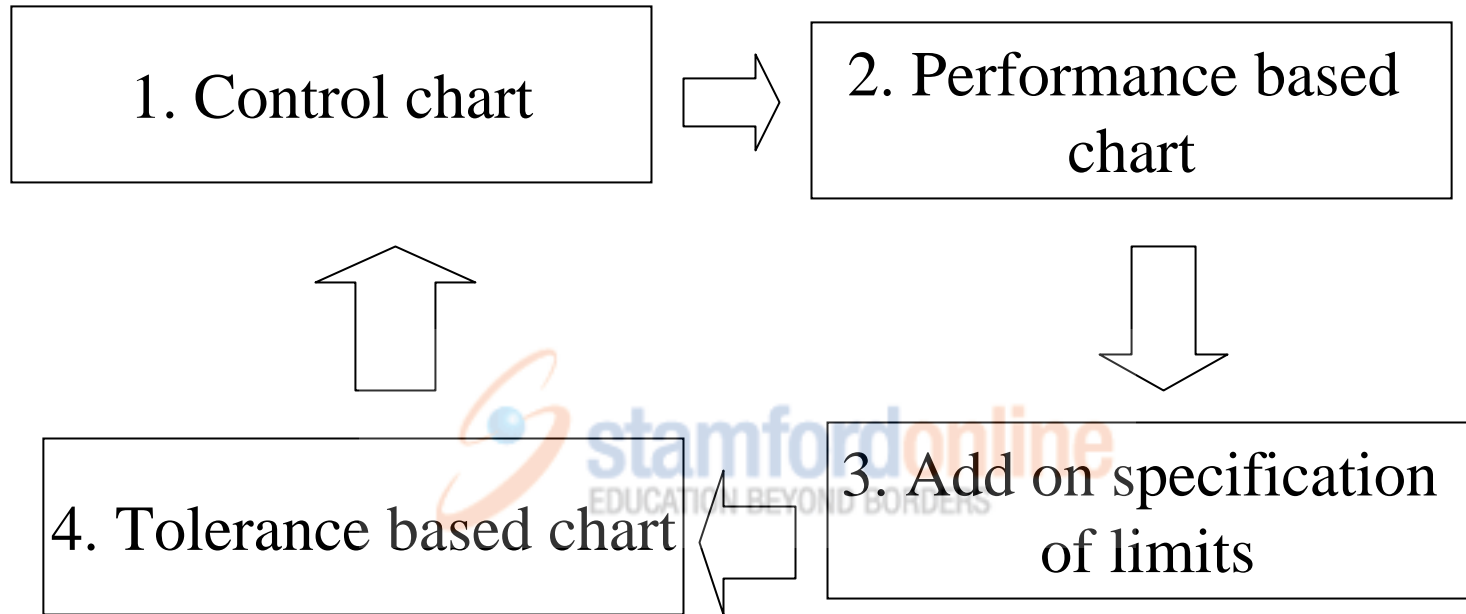
The application of statistical techniques to determine whether a process is delivering what the customer wants.

# Four main uses of SPC

1. To achieve process stability;
2. To provide guidance and understanding on how the process may be improved by the reduction of variation and to keep it reduced;
3. To assess the performance of a process;
4. To provide information to assist in management decision making.



# Development of SPC

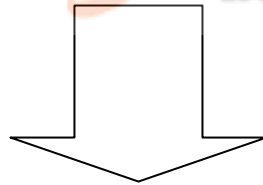


# Variation of Outputs

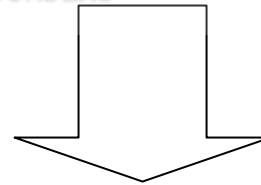
No two products are exactly alike because the process used to produce them contains many sources of variation.

Performance Measurement

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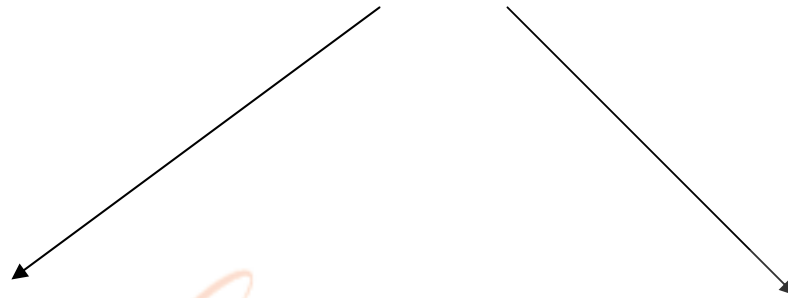
Variables



Attributes

# Variables

Service or product characteristics, such as weight, length, volume or time, that can be measured.



## Advantages

If a service or product misses its performance specifications, the inspector knows by how much

## Disadvantages

Such measurement typically involves special equipment, employee skills, etc

# Attributes

Service or product characteristics that can be quickly counted for acceptable performance.

## Advantages

Less effort and fewer resources are needed than for measuring variables.

## Disadvantages

Even though attribute counts can reveal that process performance has changed, they do not indicate by how much.



## **Typical special causes may be:**

1. Change in raw material
2. Change in machine setting
3. Broken tool or die or pattern
4. Failure to clean equipment
5. Keying in incorrect data

## Variable and attribute data:

1. Measurements may be labelled:

$x_1, x_2, x_3, x_4, \dots, x_n$

2. The arithmetic mean: Sum of observations divided by the total number of observations.



$$\bar{x} = \frac{1}{n} \cdot \sum_{i=1}^n x_i$$

3. Range:

Difference between the largest observation in a sample and the smallest.

Standard Deviation: Square root of the variance of a distribution

$$\sigma = \sqrt{\frac{1}{N} \sum_{i=1}^N (x_i - \bar{x})^2}$$

Normal Distribution

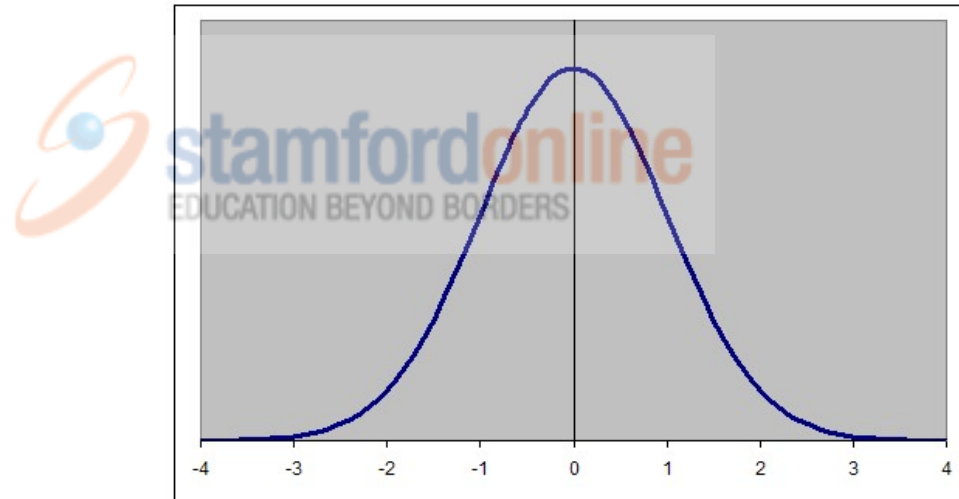


Figure 1 -- Standard Normal Distribution

# Common Causes

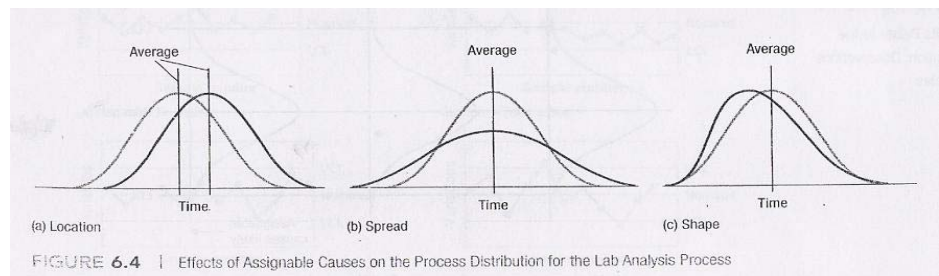


## Common Causes of Variation

The purely random, unidentifiable sources of variation that are unavoidable with the current process.

## Assignable Causes of Variation

Any variation-causing factors that can be identified and eliminated.



# Control Charts

- A time-ordered diagram that is used to determine whether observed variations are abnormal.

## Type I error

- An error that occurs when the employee concludes that the process is out of control based on a sample result that falls outside the control limits, when in fact it was due to pure randomness.

## Type II error

- An error that occurs when the employee concludes that the process is in control and only randomness is present, when actually the process is out of statistical control.

# Statistical Process Control Method (SPC)

Useful for both measuring the current process performance and detecting whether the process has changed in a way that will affect performance.



## Control Charts for Variables

- $\bar{R}$ -chart
- $\bar{x}$ -chart



## Control Charts for Attributes

- $\bar{p}$ -chart
- c-chart



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# Control Charts for Variables

- **R-chart**

A chart used to monitor process variability.

- **X-chart**

A chart used to see whether the process is generating output, on average, consistent with a target value set by management for the process or whether its current performance, with respect to the average of the performance measure, is consistent with past performance.

# Control Charts for Attributes

- **P-chart**

A chart used for controlling the proportion of defective services or products generated by the process.

- **C-chart**



A chart used for controlling the number of defects when more than one defect can be present in a service or product.

# Summary

- Statistical tools are very important because it enables us to measure and compare company performance.

