

# Statistical Process Control (SPC)

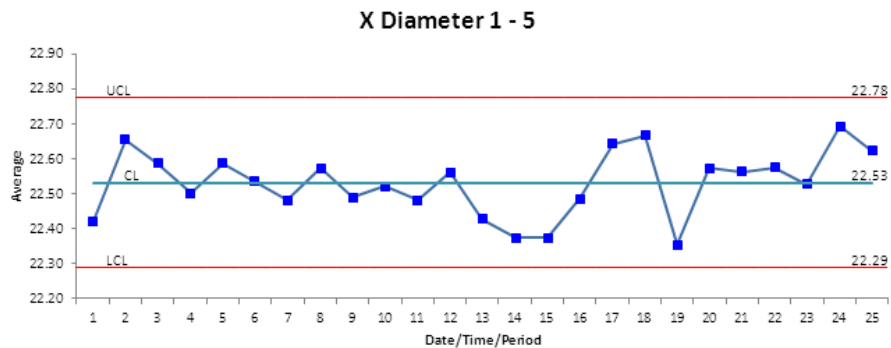
Can Be Applied To Anything Measured Using Numbers

**Goal:** To Make A Process Behave the Way We Want It to Behave

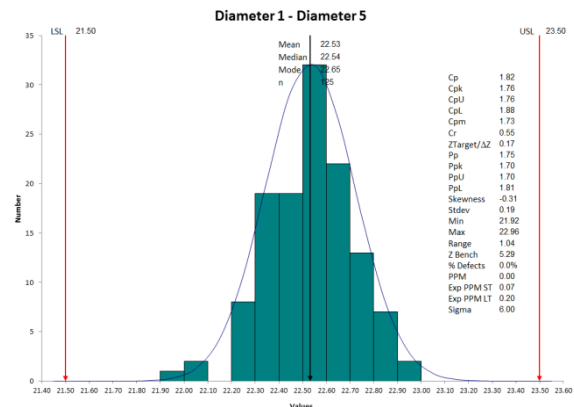
**Reality:** It's impossible to control a process without tools.

**Key Tools:**

➤ **Control Chart**



➤ **Histogram**



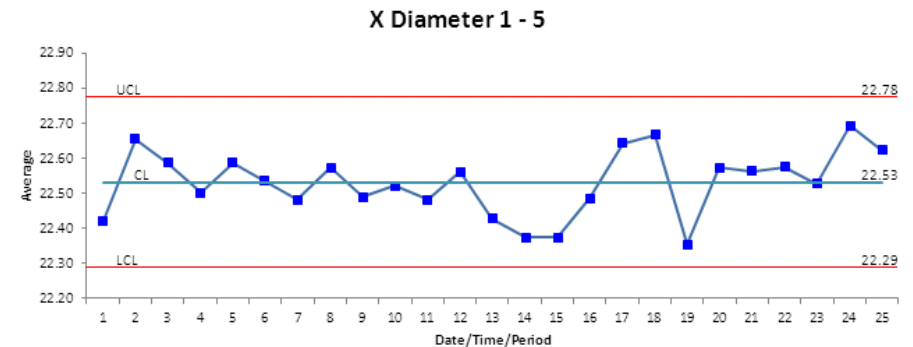
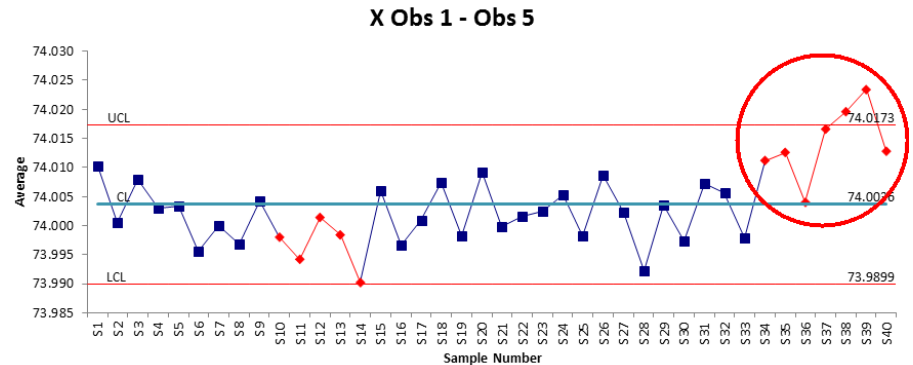
# SPC in a Nutshell

**Reality:** Every Process Varies

**Goal:** Reduce Variation in Products and Services

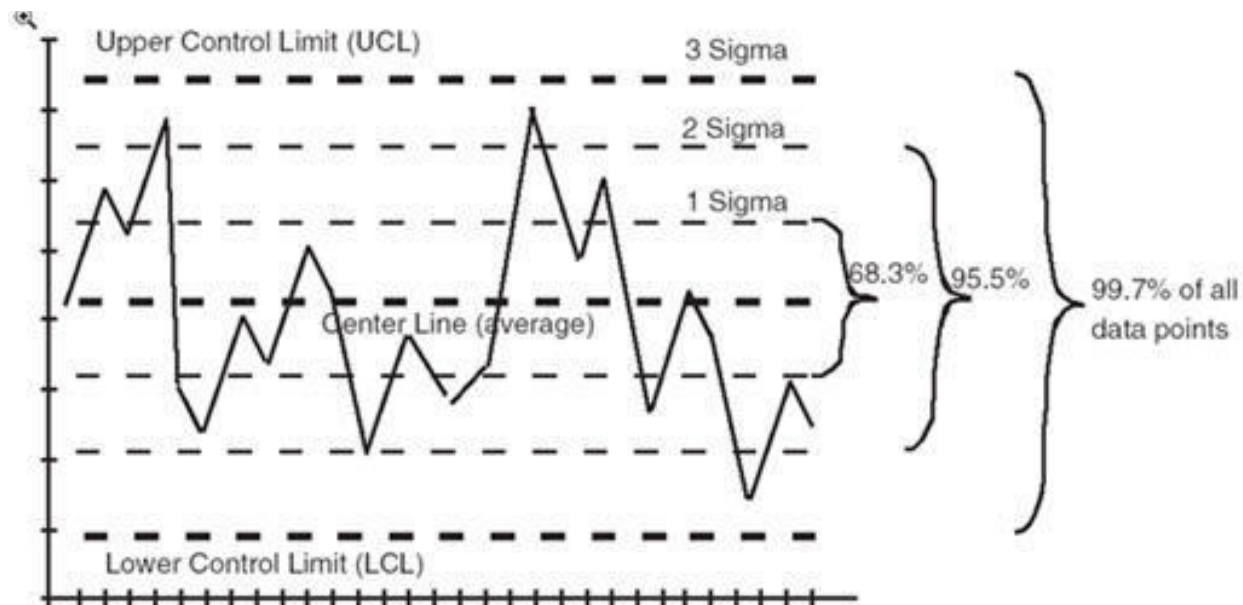
## Types of Variation

- **Special Cause Variation**  
(something changed)
- **Common Cause Variation**  
(normal variation)



# SPC in a Nutshell

It's possible to calculate statistical limits for *any* type of data and *any* pattern of variation.



Using these “control” limits, it's possible to create rules to detect special causes of variation whenever a process shifts.

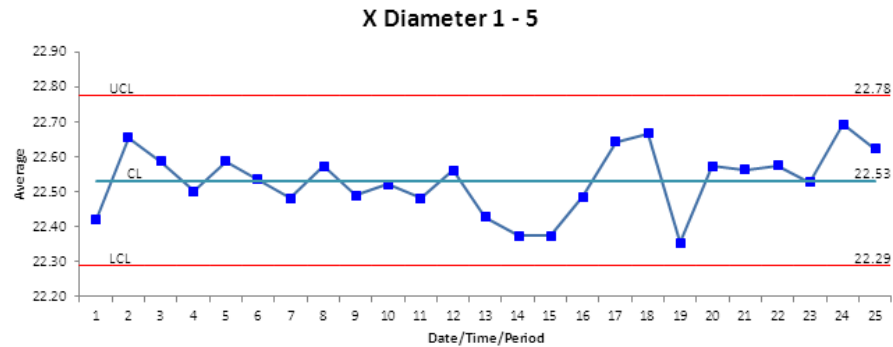
# SPC in a Nutshell

## Most Common Types of Data

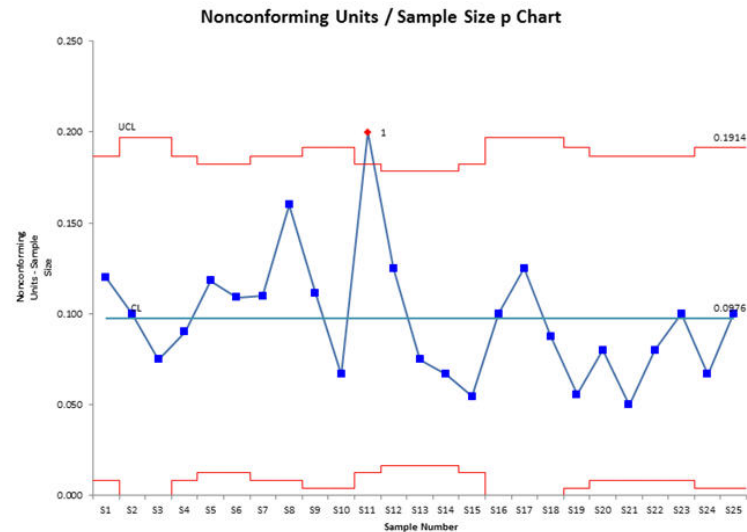
- **Averages** of measured or counted data (X, c, np, p, u charts)
- **Ranges between measurements** (XmR, XbarR charts)
- **Percentages** (i.e., ratios – XmR, np, p, u charts)
- **Individual numbers** (XmR chart)

# Control Chart Limits

Most control charts have “straight” UCL & LCL lines



XbarR, XbarS, p, and u can have “stair step” limits when the sample size varies

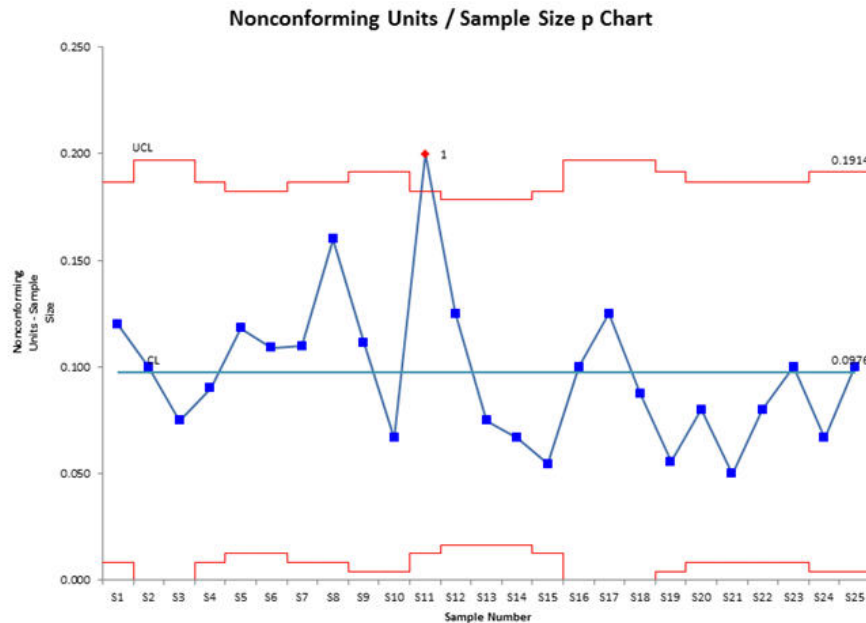


# Control Chart Rules

## Detect Special Causes

### One Point above the UCL or below the LCL

- Should only happen 3 times out of 1,000 points (99.7%)
- So, if there's a one point out of 20, investigate the special cause using 5 Whys?

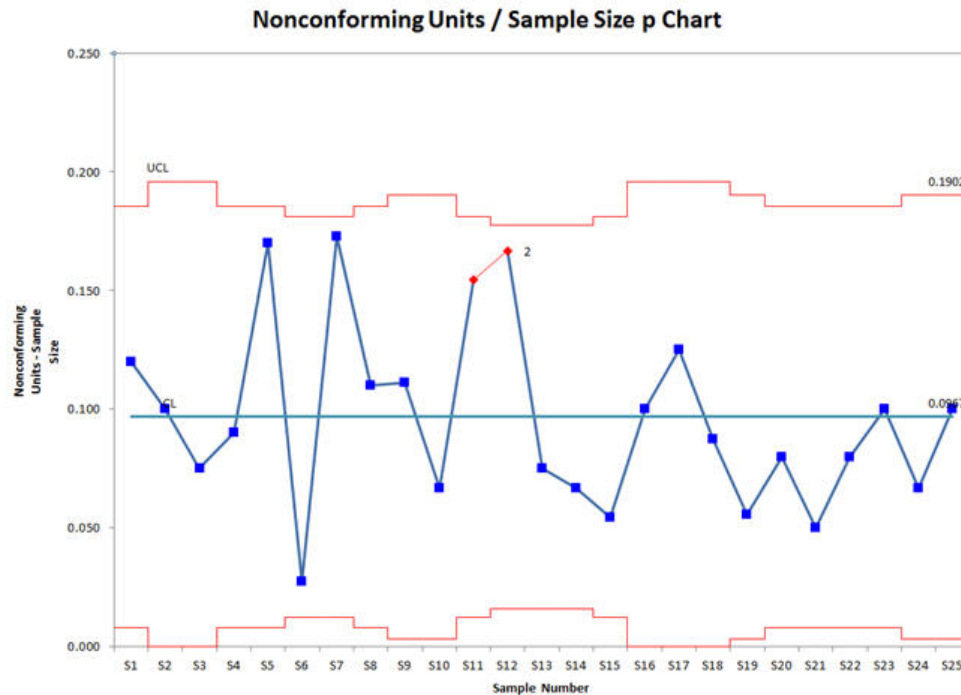


# Control Chart Rules

## Detect Special Causes

### Two-of-Three Points above 2 Sigma or below -2 Sigma

- Should only happen 0.3% of the time
- So, investigate the special cause using 5 Whys?

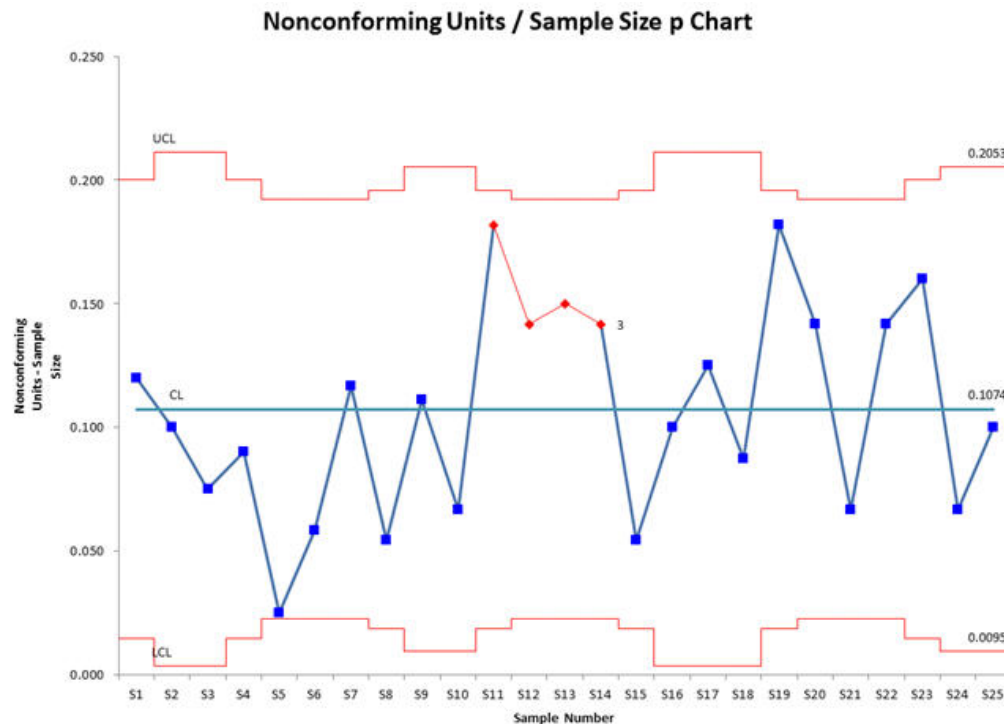


# Control Chart Rules

## Detect Special Causes

### Four-of-Five Points above 1 Sigma or below -1 Sigma

- Should only happen 0.3% of the time
- So, investigate the special cause using 5 Whys?



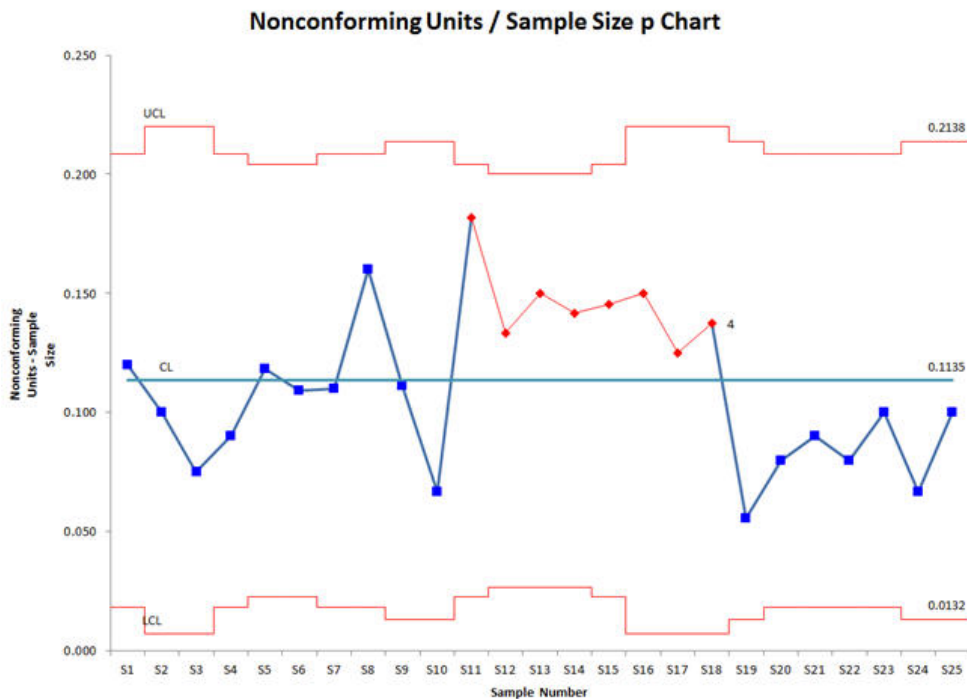


# Control Chart Rules

## Detect Special Causes

### Eight Points above below center line (average)

- Should only happen 0.3% of the time
- So, investigate the special cause using 5 Whys?

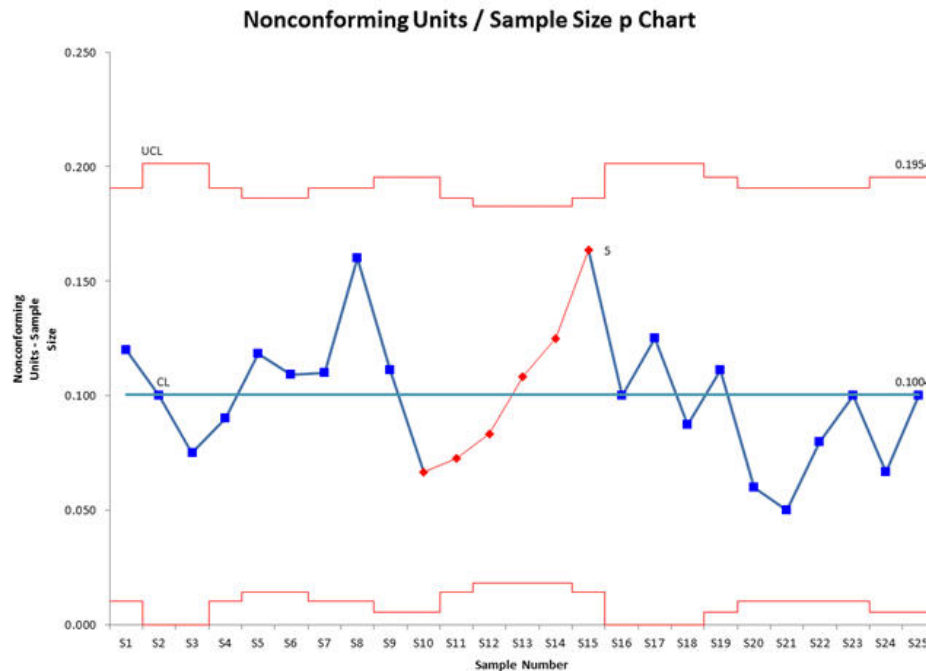


# Control Chart Rules

## Detect Special Causes

### Trend of 6 points increasing or decreasing

- Should only happen 0.3% of the time
- So, investigate the special cause using 5 Whys?

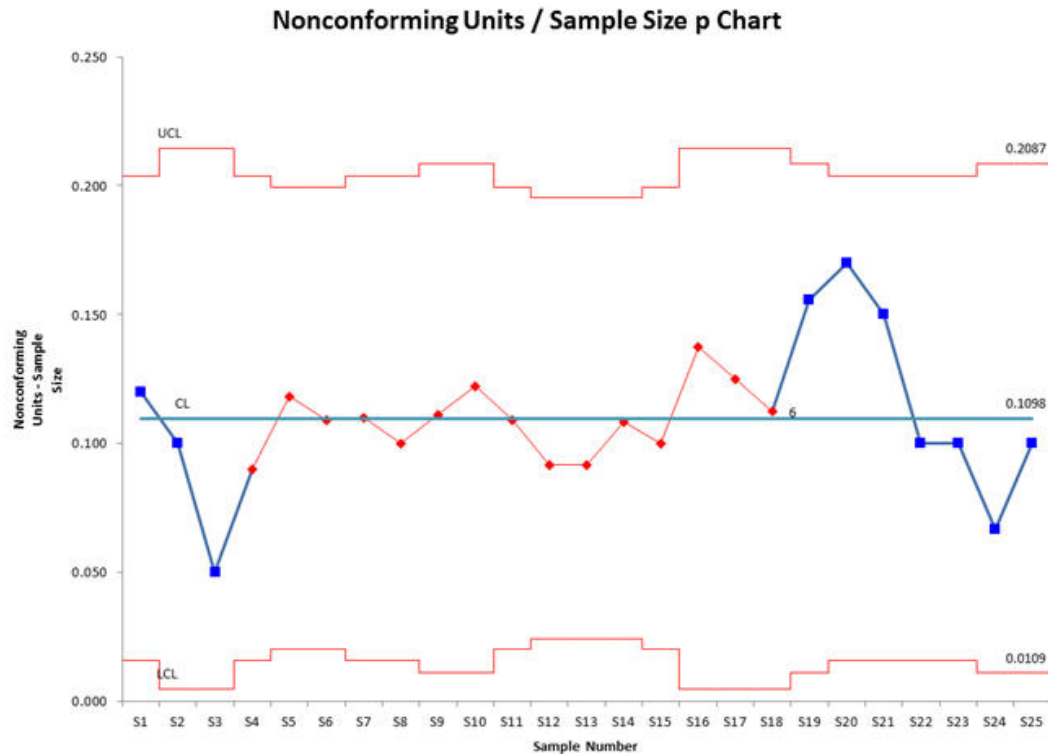


# Control Chart Rules

## Detect Special Causes

### 15 points “hugging” the center line (inside 1 Sigma)

- Should only happen 0.3% of the time
- So, investigate the special cause using 5 Whys?

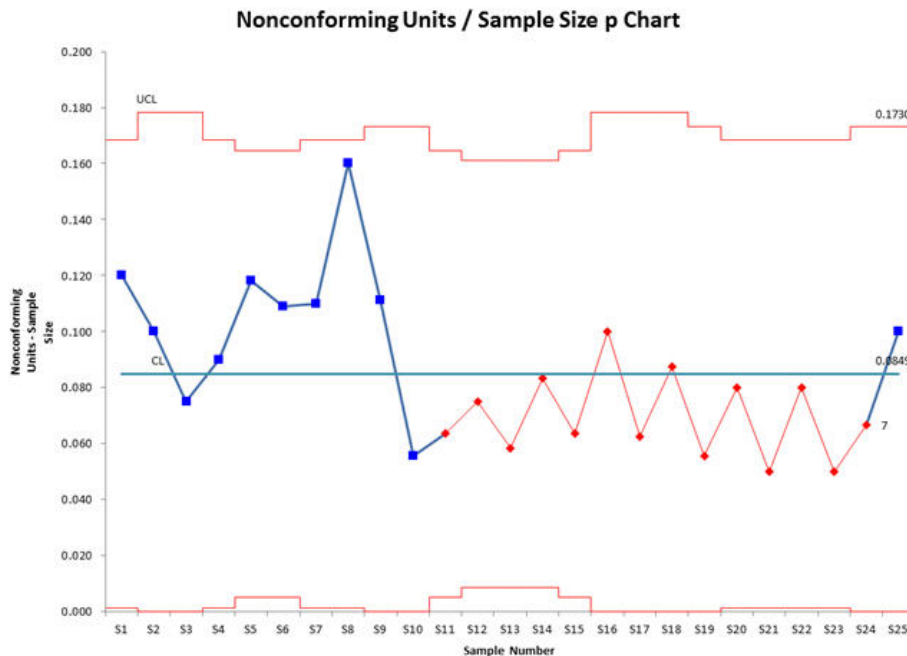


# Control Chart Rules

## Detect Special Causes

### 14 Points alternating up and down

- Should only happen 0.3% of the time
- So, investigate the special cause using 5 Whys?

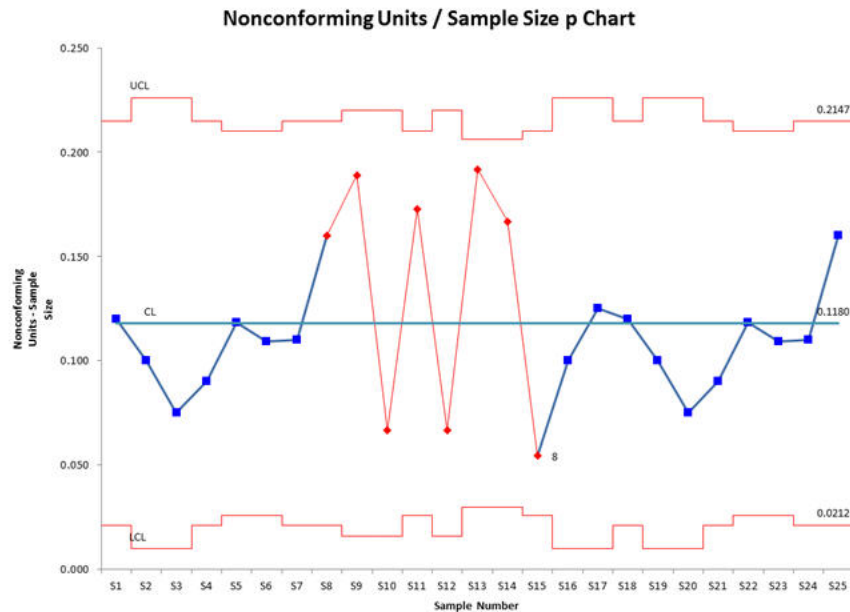


# Control Chart Rules

## Detect Special Causes

### 8 Points in a row above 1 sigma or below -1 sigma

- Should only happen 0.3% of the time
- So, investigate the special cause using 5 Whys?



# Ask Why 5 Times

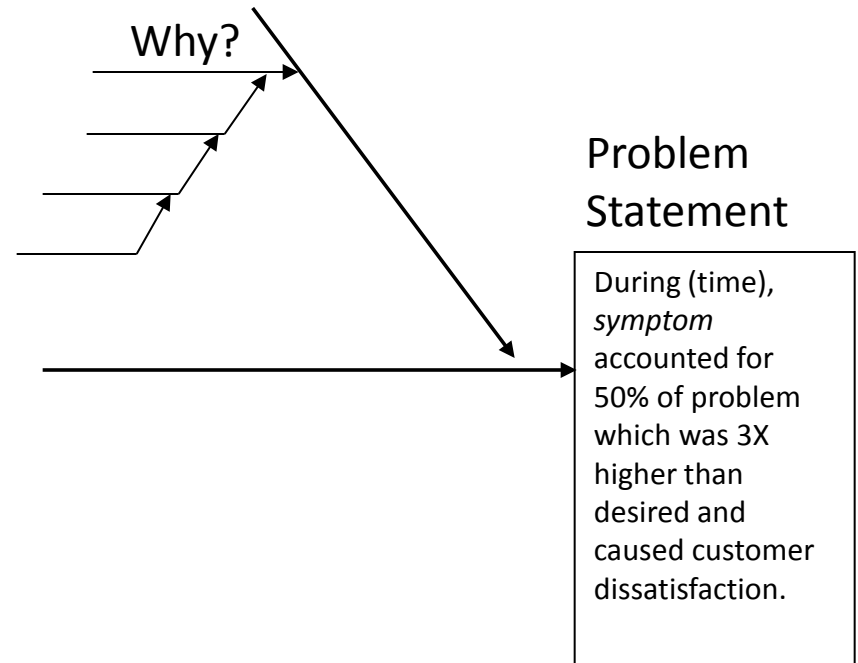
- Keep going until your answer to why is:
  - I don't know
  - I don't care
  - The answer sounds silly.

# Five Whys – Fishbone Diagram

Diagnose special causes using 5 Whys?

- Why did *process, machines, materials, etc.* cause the problem?
- Why did *answer 1* cause problem?
- Why did *answer 2* cause answer 1?
- Why did *answer 3* cause answer 2?
- Why did *answer 4* cause answer 3?
- Why did *answer 5* cause answer 4?

Process/Methods



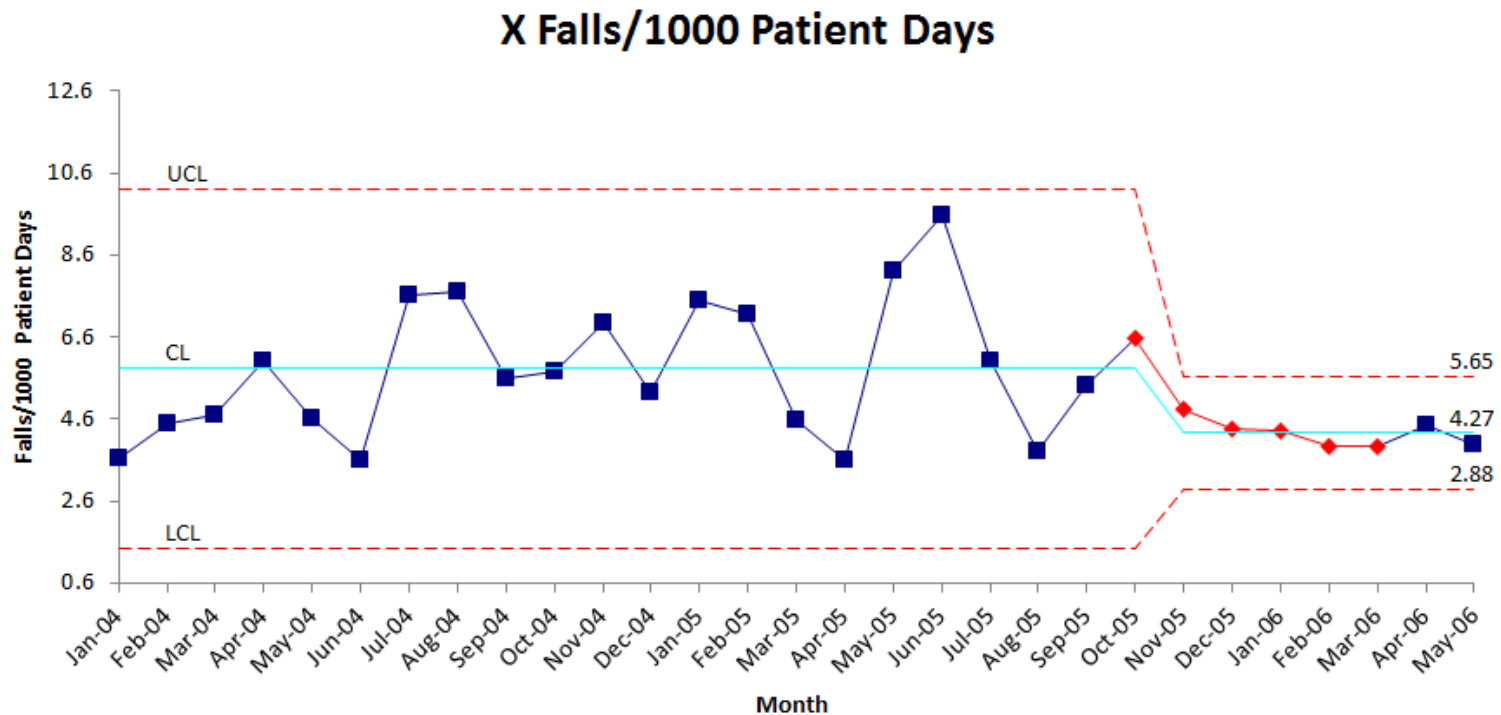
Check your logic:

Answer 2 causes Answer 1 causes Problem

# Reducing Variation

Once the *special causes* have been eliminated, then and only then is it possible to focus on reducing *common cause* variation

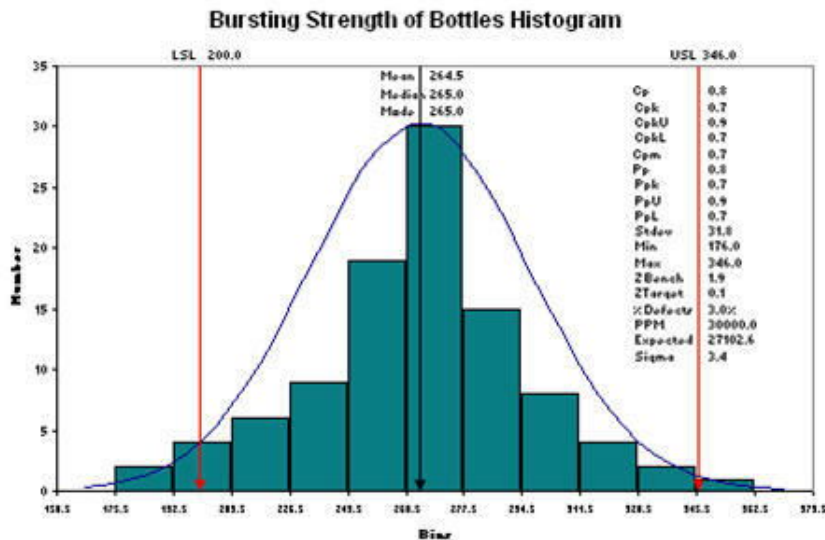
- Use Root Cause Analysis to eliminate common causes of variation



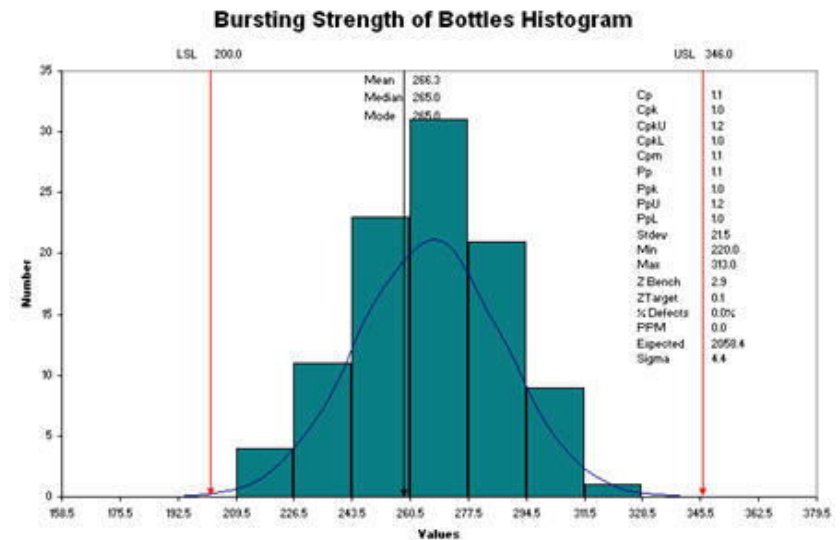


# Reducing Variation

Use Histograms to show reduction in variation and improvement in process capability (Cp and Cpk)



Before



After

# Statistical Process Control is Easy with the QI Macros for Excel Control Chart Wizard!

	A	B	C
7	Diameter 1	2	3
8	22.30	22.54	22.01
9	22.86	22.68	22.43
10	22.88	22.68	22.46
11	22.44	22.66	22.48
12	22.59	22.65	22.78

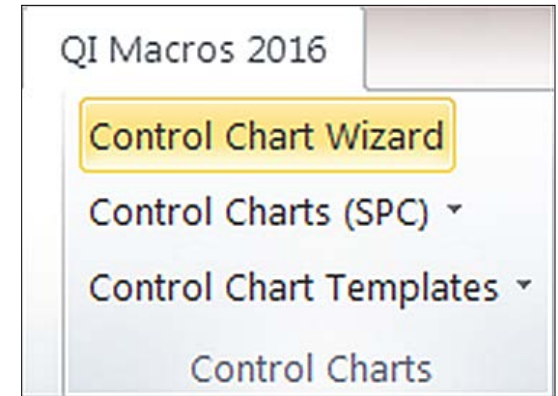
**Select Data**

Documents/QI Macros Test Data/AIAG SPC.xls

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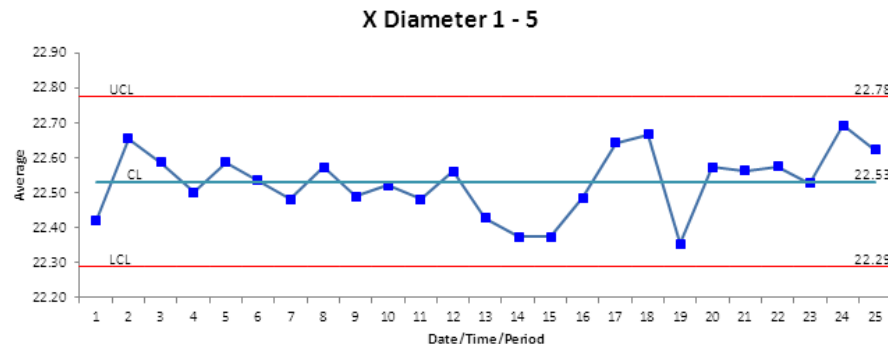


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**Click Menu**

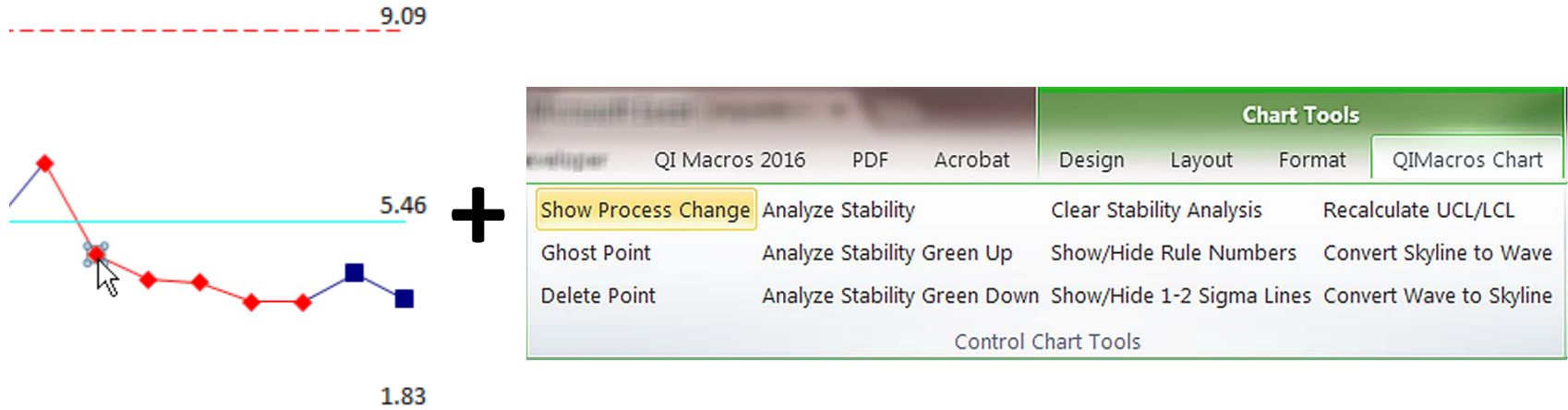
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**Control Chart**

# QIMacros

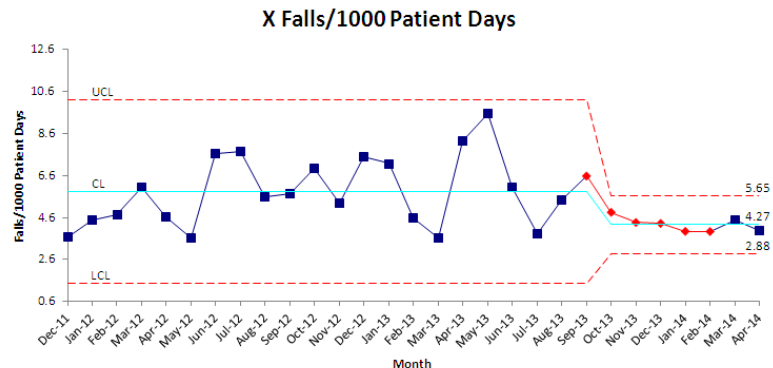
## Control Chart Menu!



Click a Point

Click the Menu

=



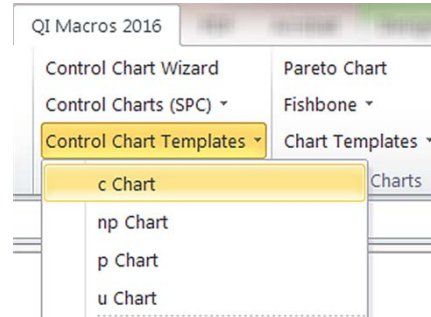
Change the Control Chart

# QIMacros

## Has Control Chart Templates!



Mouse

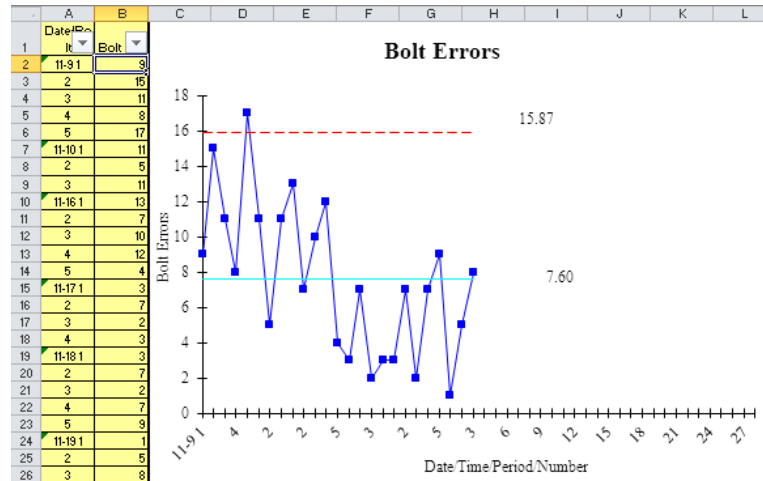


Click Menu



Date/Bolt	Bolt Errors
11-9 1	9
2	15
3	11
4	8
5	17
11-10 1	11
2	5
3	11

Data



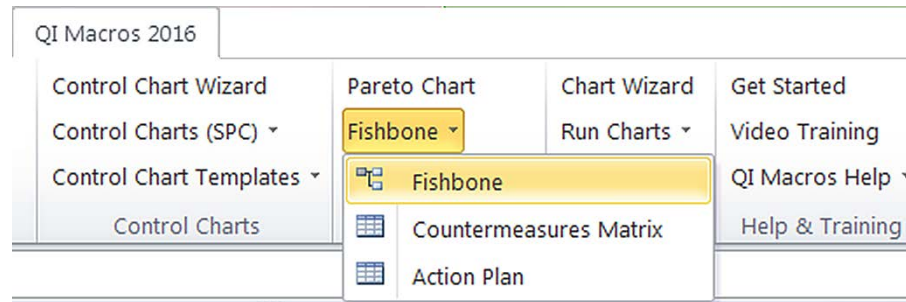
Control Chart Template

# QIMacros

## Has 5 Why & Fishbone Diagrams!



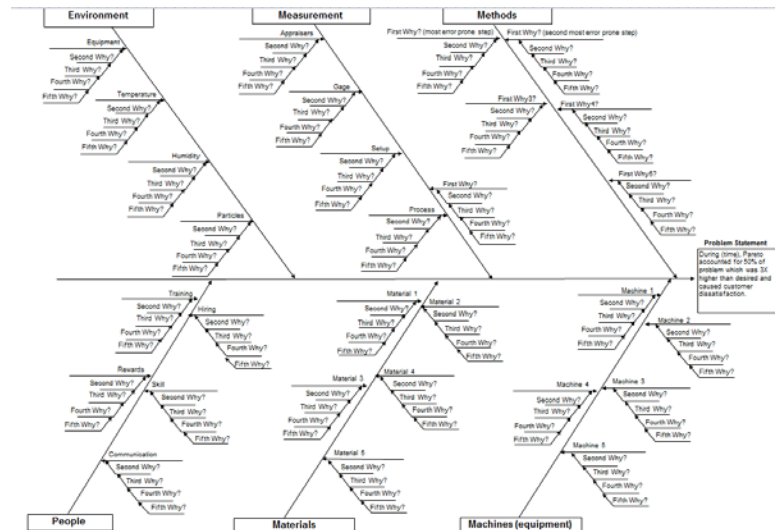
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Mouse

Click Menu

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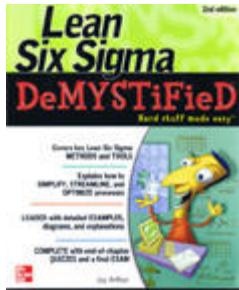
### 5 Whys and Fishbone Diagram

# QIMacros



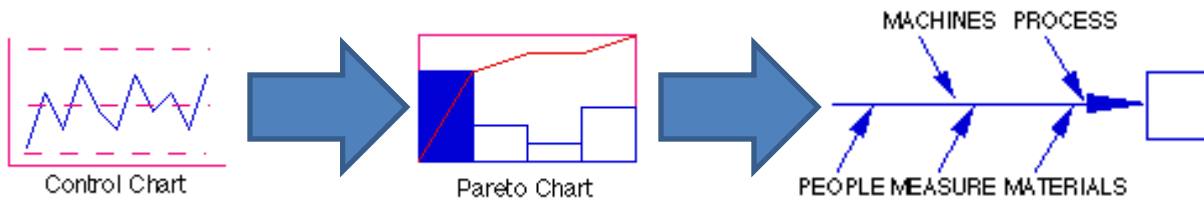
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Data Analysis & Projects

