

# Control Charts and Stability Analysis

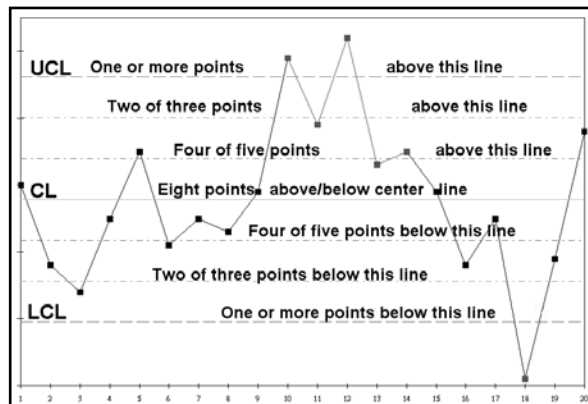
## Analyze Stability Using Control Charts

A stable process produces predictable results consistently. It is in statistical control and shows variation due to common causes.

An unstable process is out of statistical control and shows variation due to special causes.

### Common Stability Rules Identifying Unstable Conditions:

An unstable (i.e., out of control) condition can either be a point, set of points or trend in your data.



Control limits (1, 2, and 3 sigma lines) and stability rules are used to determine unstable conditions.

### Types of Control Charts

Attribute Charts for Counted Data	Variable Charts for Measured Data
defects, errors, injuries, etc.	length, weight, depth, time, etc.
c chart p chart u chart np chart	XmR Chart (Individual Moving Range Chart) XbarR Chart XbarS Chart

### Other Control Charts

- EWMA and Cusum charts for small shifts in a process
- g charts and t charts for rare events
- Levey Jennings standard deviation chart - used in healthcare labs

Choosing the Right Control Chart - see other side

## Control Chart Tools in the QI Macros

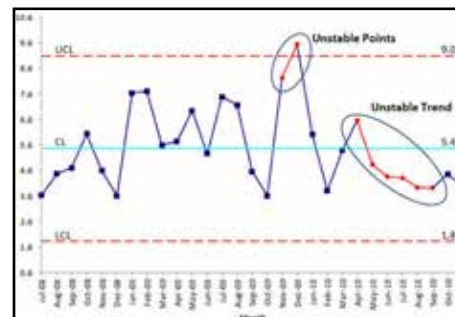
### Capability Suite of Six Charts

Use the Capability Suite or the X Chart Templates to Evaluate:

- Process Stability using Control Charts
- Process Capability using Histogram with Cp Cpk, Capability Plot, Values Plot
- Data Normality using Probability Plot



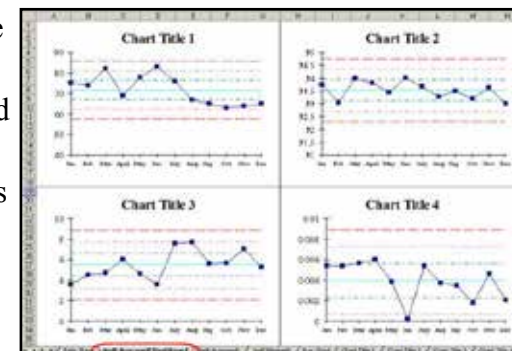
### Create Control Charts Using the QI Macros Menu



1. Just select your data and the chart you want from the QI Macros menu. If you don't know which chart, the **QI Macros Control Chart Wizard** can select the correct one for you.
2. QI Macros draws the chart and does all the calculations for you.
3. Use the Chart Menu to Add Data, Stair Step Limits, Target Lines, etc.

### Control Chart Dashboard

1. Input up to 25 data sets into one worksheet.
2. Create a control chart dashboard with one click.
3. Add new data and refresh charts each period.
4. Rolling dashboards: add new data and only show the most recent X points on the chart.



Learn More at: [www.qimacros.com/control-chart/](http://www.qimacros.com/control-chart/)

## Using the Control Chart Wizard

The **QI Macros Control Chart Wizard** will analyze your data and choose the correct control chart for you.

1. Just click and drag over your data to select it.
2. Then click on the **QI Macros Menu** and **Control Chart Wizard**.



## QI Macros Chart Menu

**Automates Chart Updates:**

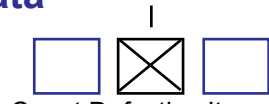
- Add New Data, Target Lines, or Text to a Point.
- Add Stair-Step Control Limits to Show a Process Change.
- Ghost or Delete points.
- Analyze Stability, Recalculate Control Limits
- Show/Hide Sigma Lines
- Remember Chart Format

## Choosing The Right Control Chart Yourself

### Defect Data



**Defective**



Count Defective Items?

**np Chart**

**Sample Size**

**Constant**  
• defects/100

**QI Macros Sample Data**

Sample	Defects	Sample Size = 50
S1	12	
S2	15	
S3	8	

Defective? Yes/No

**p Chart**

**Varies**  
• wrong orders/orders  
• medication errors  
• infections/patient days

Sample	Defects	Sample Size
S1	12	100
S2	8	80
S3	6	80

**Attribute (counted)**  
integer: 1,2

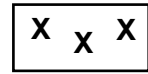
- Defects
- People
- Events

How many defects?

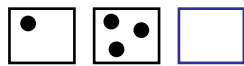
**c Chart**

**Constant**  
• injuries/month  
• Patient falls/month

Pinholes
9
9
5



**More than one defect per item**



Count Number of Defects Per Item

**u Chart**

**Varies**  
• errors/orders  
• components/assemblies  
• Patient falls/days

Roll Number	Defects in Dyed Cloth	50 Sq Meters
R1	14	10
R2	12	8
R3	20	13

Rates or Ratios?

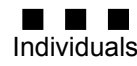
**Services & Manufacturing**

**XmR Individuals**

**1**  
• length or weight per item  
• time/project  
• cost/project  
• infections/1000 patient days

Batch Number	Viscosity
B1	33.75
B2	33.05
B3	34.00

**Cycle Time**



Individuals

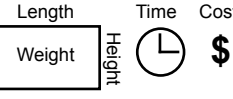
**Variable (Measured)**  
decimal: 1.3



Sub-groups

**XbarR**

**2-5**  
• diameters, lengths  
• tensile strength  
• resistance



Length

Time

Cost

Weight

Height



Sub-groups

**XbarS**

**6-25**  
• diameters, lengths  
• tensile strength  
• resistance

**Samples used to analyze large runs of product**

Sample	Obs 1	Obs 2	Obs 3	Obs 4	Obs 5
S1	74.030	74.002	74.019	73.992	74.008
S2	73.995	73.992	74.001	74.011	74.004
S3	73.988	74.024	74.021	74.005	74.002

**Variable Data**

**Manufacturing**

To automate these charts, try the QI Macros for Excel. **Download a FREE 30 day trial at:** [www.qimacros.com](http://www.qimacros.com)

**QI Macros Control Chart Wizard**  
The QI Macros can analyze your data and select and run the right control chart for you.