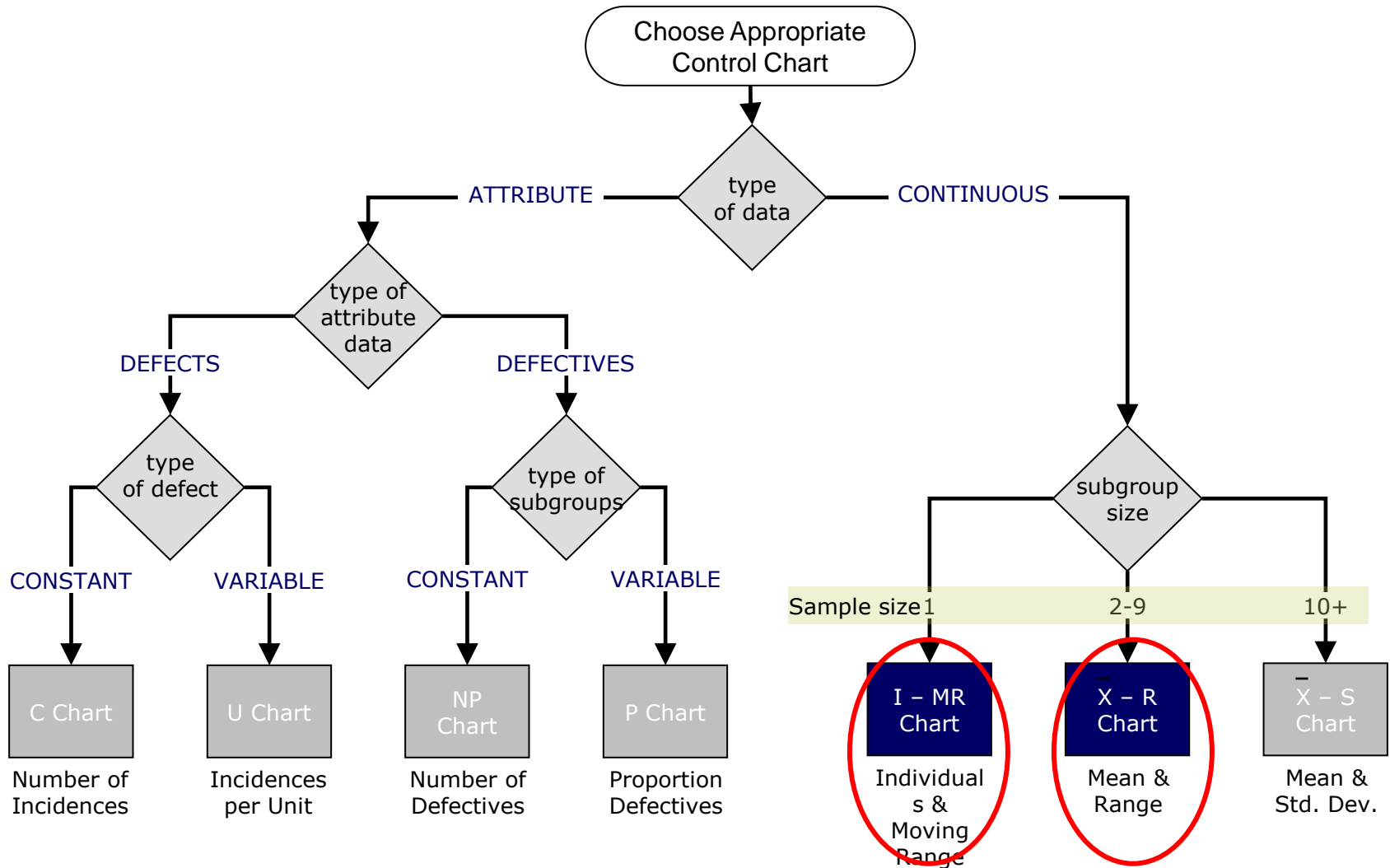


## Individual Moving Range (I-MR) Charts

### The Swiss Army Knife of Process Charts



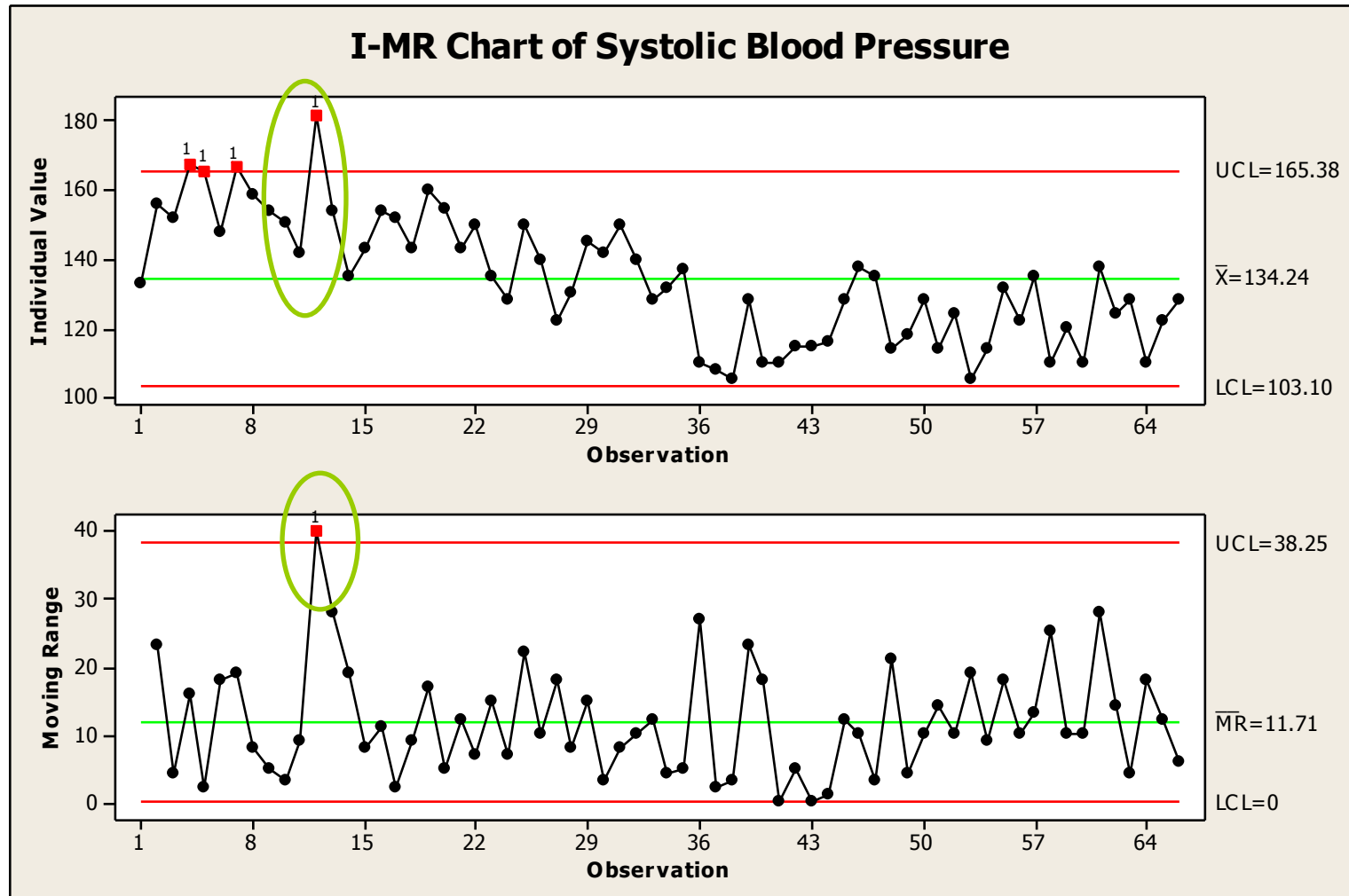
# SPC Selection Process



# Individual Moving Range (I-MR Chart)

- Control charts for variables data
- Monitors the process over time
- Individual Chart
  - Plots each measurement as a separate data point
  - Each data point stands on its own (subgroup size = 1)
- Moving Range Chart
  - Uses a default value of 2, which means each data point plots the difference (range) between two consecutive data points as they come from the process in sequential order
  - There will be one less data point in the Moving Range chart than the Individual chart

# Sample Individual Moving Range Chart



- Control charts for variables data
- Monitors the process over time
- The distribution does not have to be approximately normal
- Based on the average of a series of observations, called a subgroup
- Monitors the variation between observations in the subgroup over time
- The larger the subgroup, the more sensitive the chart will be to shifts, providing a Rational Subgroup can be formed



What is a rational subgroup?

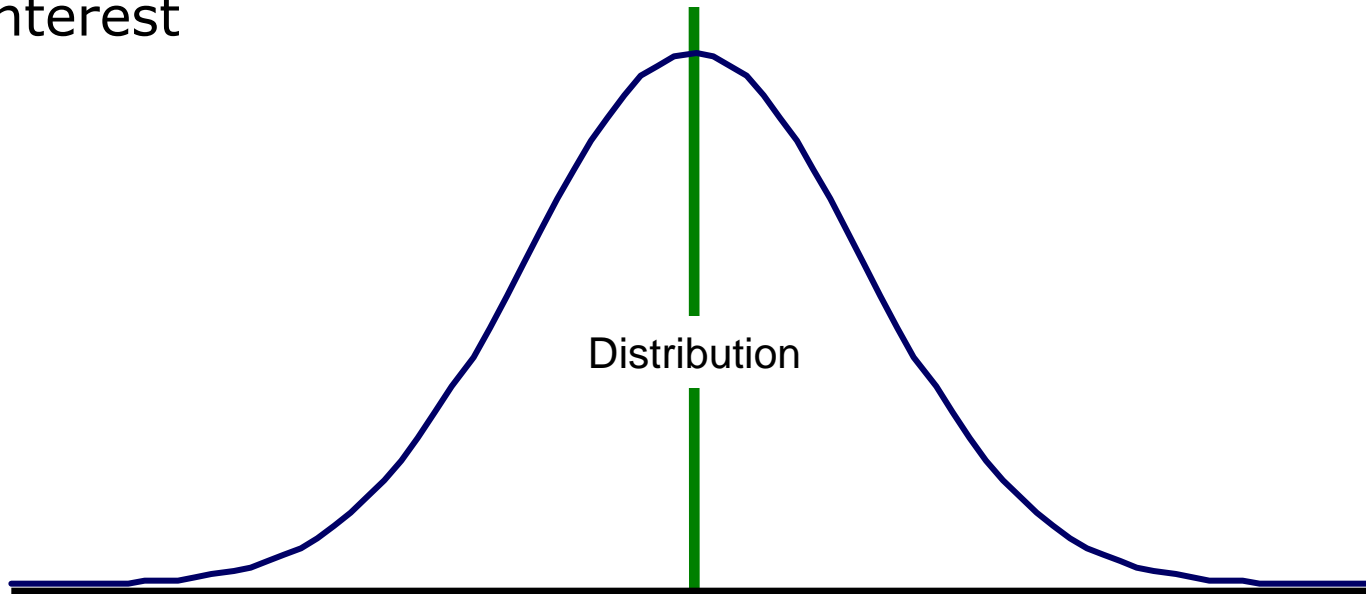
# What is it and where does it come from?

## ❑ Rational Subgroup

- ✓ Items which were produced under the same conditions
- ✓ When possible, formed by using consecutive units
- ✓ Each subgroup's statistics are compared to the control limits, and patterns of variation between subgroups are analyzed

## ❑ Picture a Stable Distribution

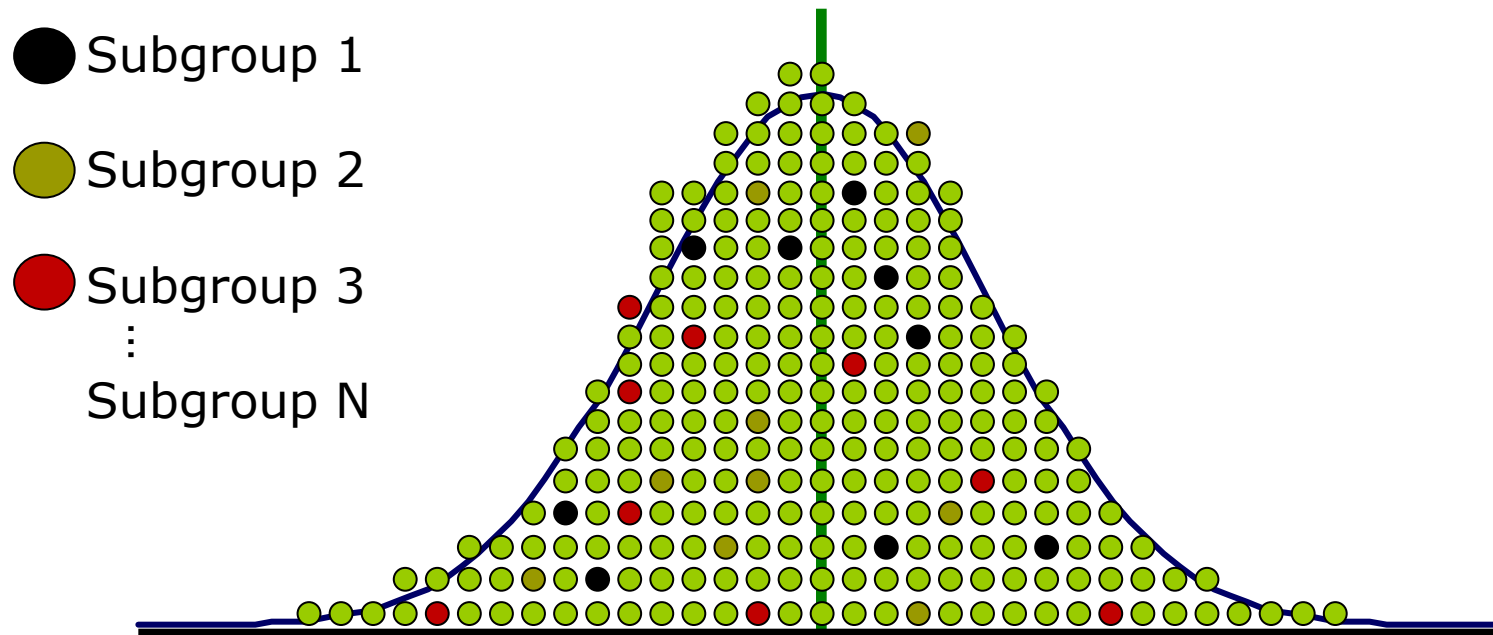
- ✓ A group of objects containing a characteristic of interest



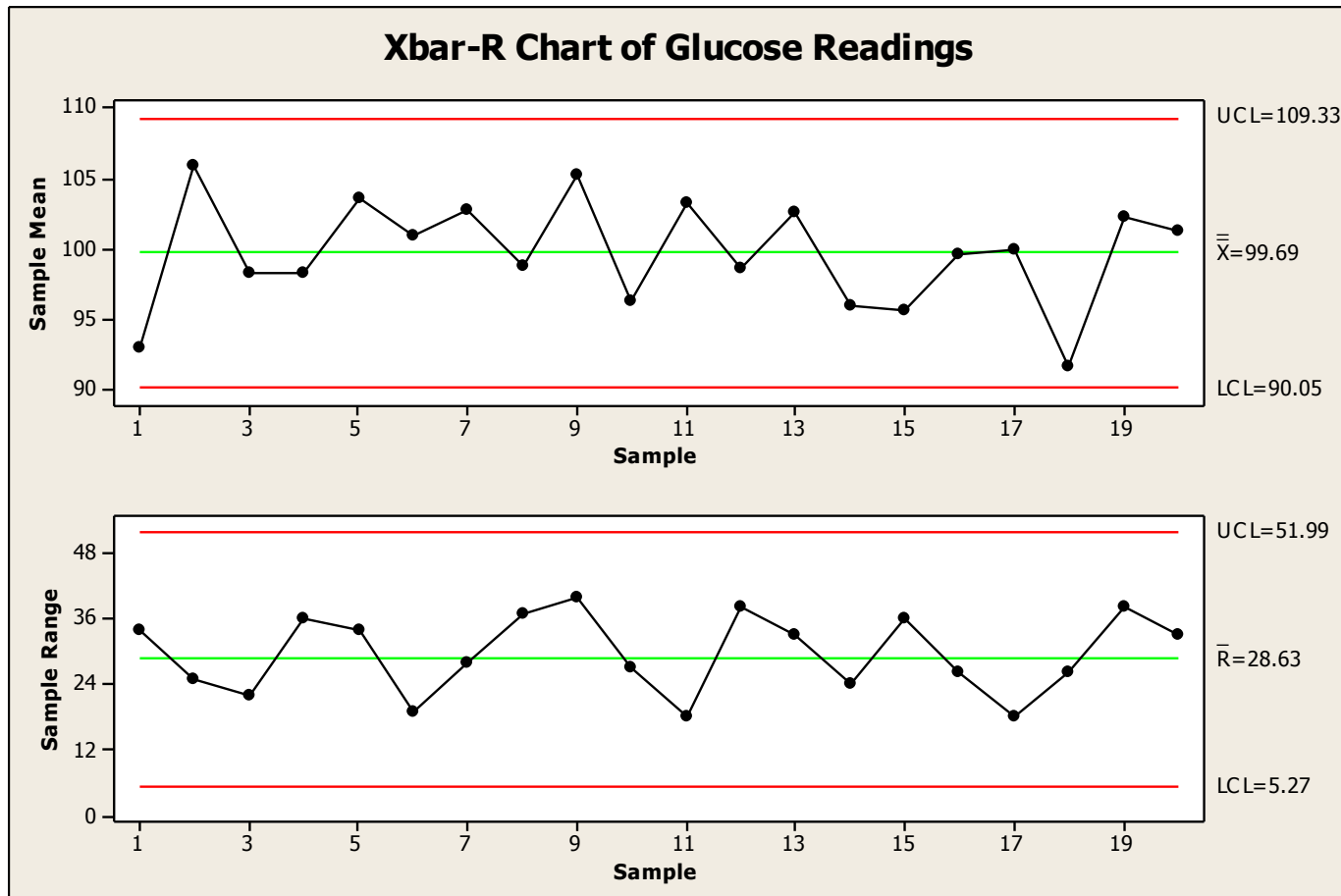
# Where do Subgroups Come From?

Subgroup:

- A subset of the distribution of interest



# Sample Xbar-R Chart





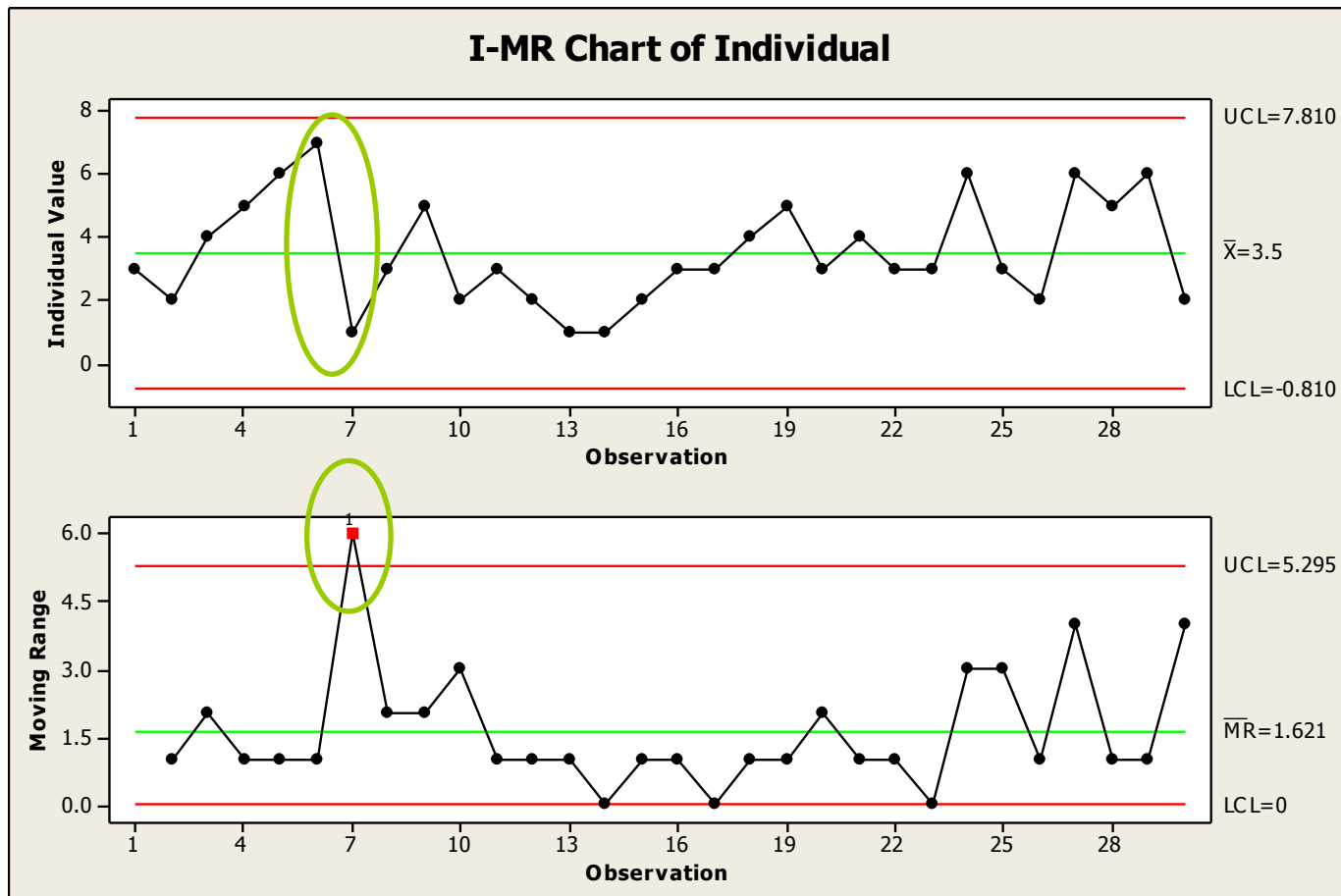
# When to Use I-MR/Xbar-R

- I-MR
  - When you have a limited number of individual measurements
- Xbar-R
  - When you can collect measurements in groups (subgroups) of between two and ten observations
- For subgroup sizes greater than ten
  - Use Xbar / Sigma charts
- Must have data that is time-ordered

- Always look at the Range chart first
  - Control limits on the I-MR are derived from the change in range (moving range)
  - The control limits on the Xbar-R chart are derived from the average range
  - If the Range chart is out of control, then the control limits on the Individual and X-bar chart are meaningless.
- Look for out of control points
  - Special causes must be eliminated
  - There should be more than five distinct values plotted
  - No single value should appear more than 25% of the time

# I-MR Chart

- Looking at the moving range chart, what does the out of control point tell you?



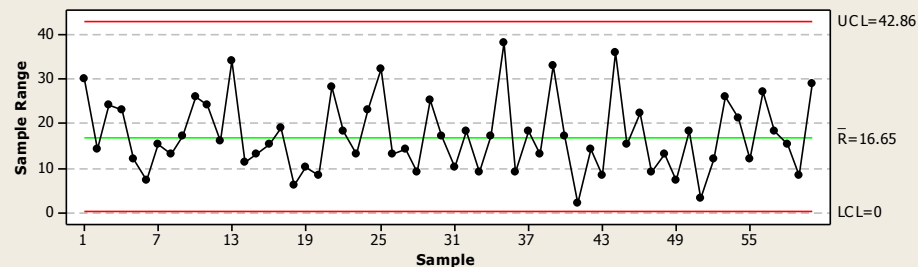
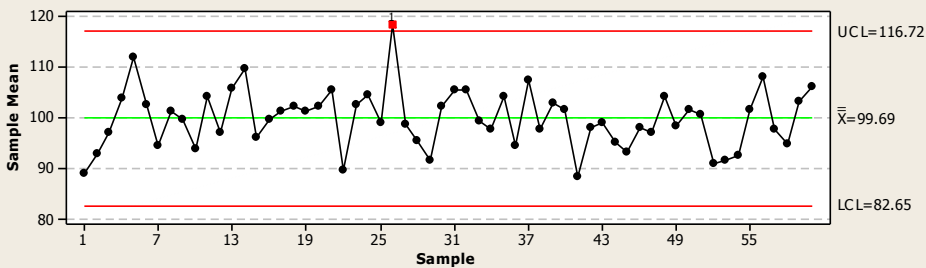
- Average charts become more sensitive to process changes as the subgroup size is increased



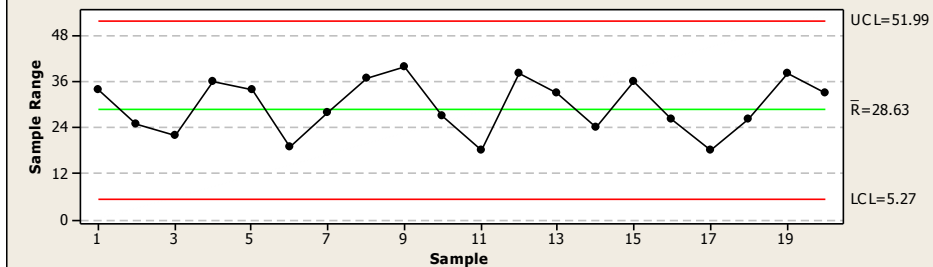
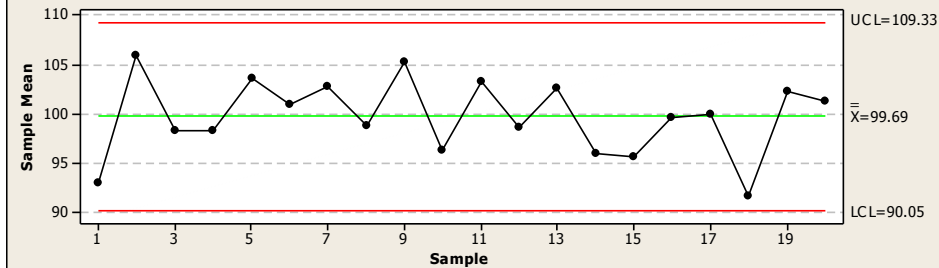
# Sensitive to Process Changes

- As the subgroup size increases the control limits of the range chart increase

Xbar-R Chart of Glucose Readings (Subgroup Size 3)



Xbar-R Chart of Glucose Readings (Subgroup Size 9)



- Range Chart
  - UCL – 42.86
  - LCL – 0

- Range Chart
  - UCL – 52.99
  - LCL – 5.27

- Individual/Xbar Charts
  - ❖ Interpret the points on the X-bar chart relative to the control limits and Run Tests
  - ❖ Look for out of control points
  - ❖ Look for obvious non-random behavior
- Averages in the Xbar Chart cannot be compared to requirements



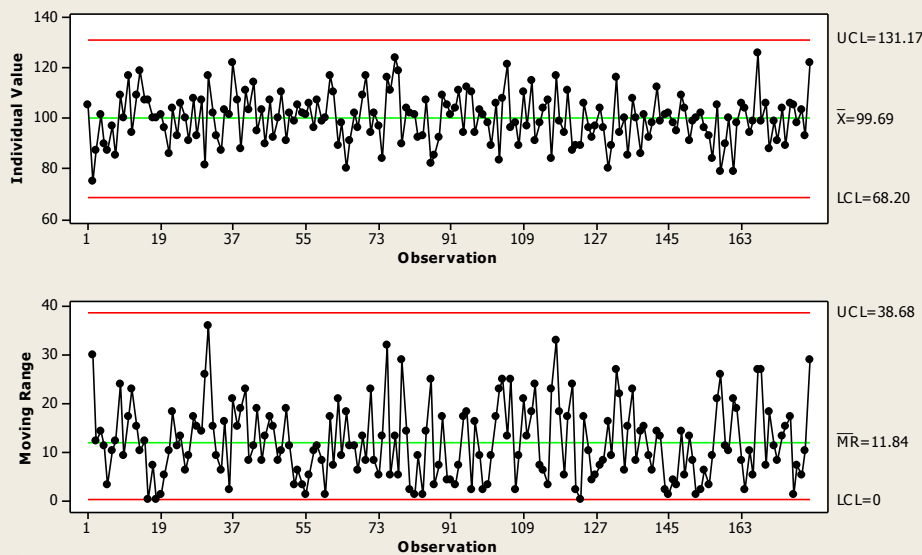
# Xbar-R Cannot Be Compared to Requirements

- Both charts use same data set
- Look at the control limits on the Individual and Xbar Charts

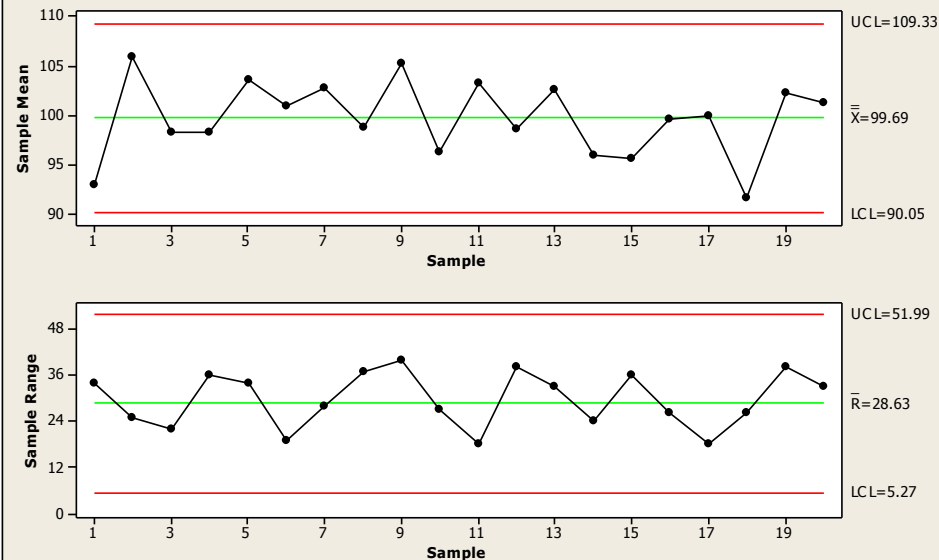
Individual Readings

Same Readings in Subgroups of 9

I-MR Chart of Glucose Readings



Xbar-R Chart of Glucose Readings



- UCL – 131.17
- LCL – 68.2

- UCL – 109.33
- LCL – 90.05

## *General Steps for Constructing I-MR Charts*

1. Select characteristic (critical “X” or CTQ) to be charted
2. Determine the purpose of the chart
3. Select data-collection points
4. Determine the measurement method/criteria
5. Drop the data into Minitab or other charting software



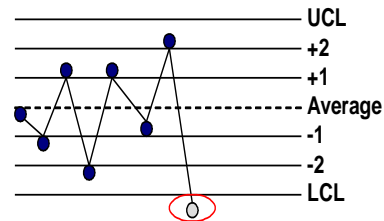


Questions?

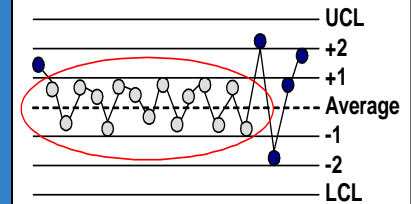


# Run Tests – Western Electric Rules

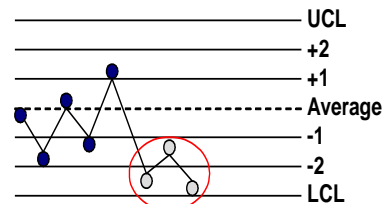
One or more observations occurring more than 3 Standard Deviations from the average, i.e. any points occurring above or below the Control Limits.



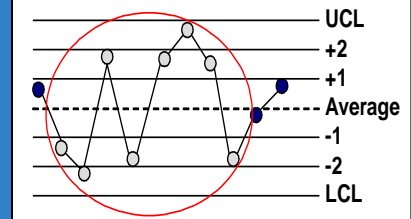
Fifteen consecutive observations occurring within one Standard Deviation from the average.



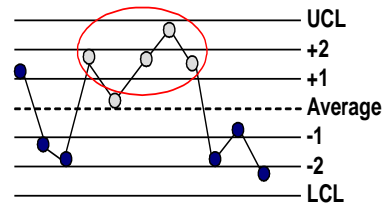
Two out of three consecutive observations, all on the same side of the average and occurring more than two Standard Deviations away from the average.



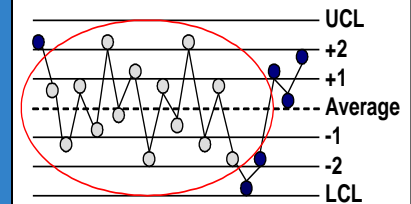
Eight consecutive observations that are more than one Standard Deviation from the average.



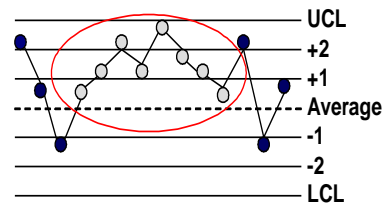
Four out of five consecutive observations, all on one side of the Center Line occurring more than one Standard Deviation from the average.



Fourteen consecutive observations that alternate up and down.



Eight consecutive observations on one side of the average.



Six consecutive observations that trend downward or upward.

