Live Session 8

1. Welcome/Intro (including polls)
2. Control Charts (Process Behavior Charts)
3. Assignments for next 2 weeks
4. Wrap up and Feedback

Improve

Description:
Develop potential solutions, select best solution, pilot solutions, measure results, document new process.

Key Concepts:
Discover y= f(x)

Project:
Implement a solution, run a pilot, evaluate the results, complete a hypothesis test.

Tools:
Affinity diagram
Fishbone cause/effect diagram
Pareto
Control charts
Hypothesis testing
Process map
Solution selection matrix

Control

Description:
Implement process changes and controls. Verify expected performance was achieved, monitor performance to sustain new levels.

Key Concepts:
Xbar/R and ImR control charts, Different control charts applicable to different processes, time series forecasting methods predict future performance.

Project:
Utilize an appropriate control chart and /or time series forecasting method

Tools:
Control charts
Time series analysis
Operational definitions
Process map
Sigma Quality Level (SQL)

Week 8 → **Week 9**

Control Charts (Process Behavior Charts)

All processes have variation.
Control charts help you see the type of variation in your process
One of the most common use of control charts is to monitor a process

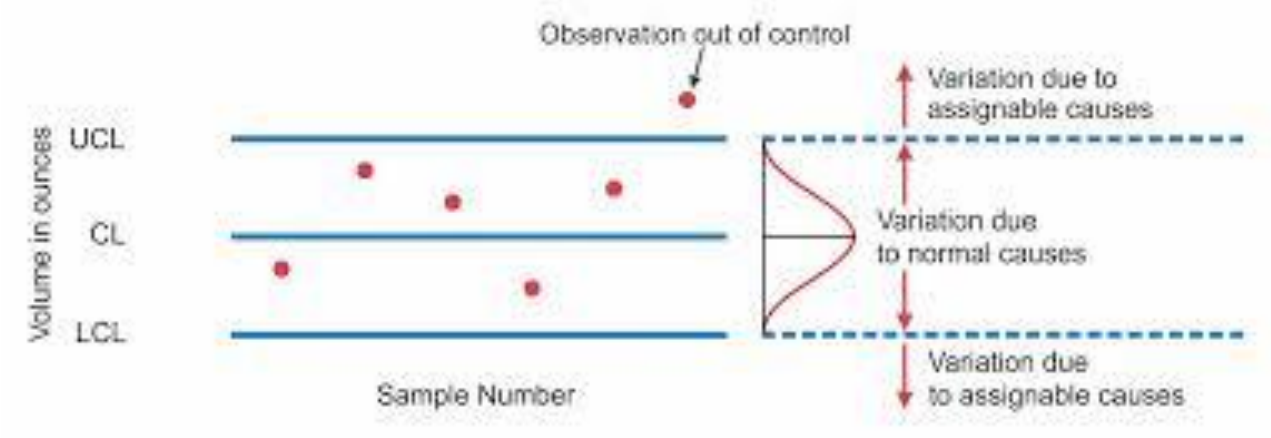
Common cause: predictable, routine, stable; noise
Special cause: unpredictable, unstable, out of control; a signal

If a control chart indicates special cause variation, something needs fixing/investigating

What are some common cause and special cause variations in your processes?

Control Charts (Process Behavior Charts)

Elements of a control chart:



Centerline = average

Control Limits:

UCL (upper control limit) LCL (lower control limit)

y = your metric, process output

x = your subgrouping plan (usually time)

When a process is “in control” does this mean that it’s a good process?
Give an example to explain

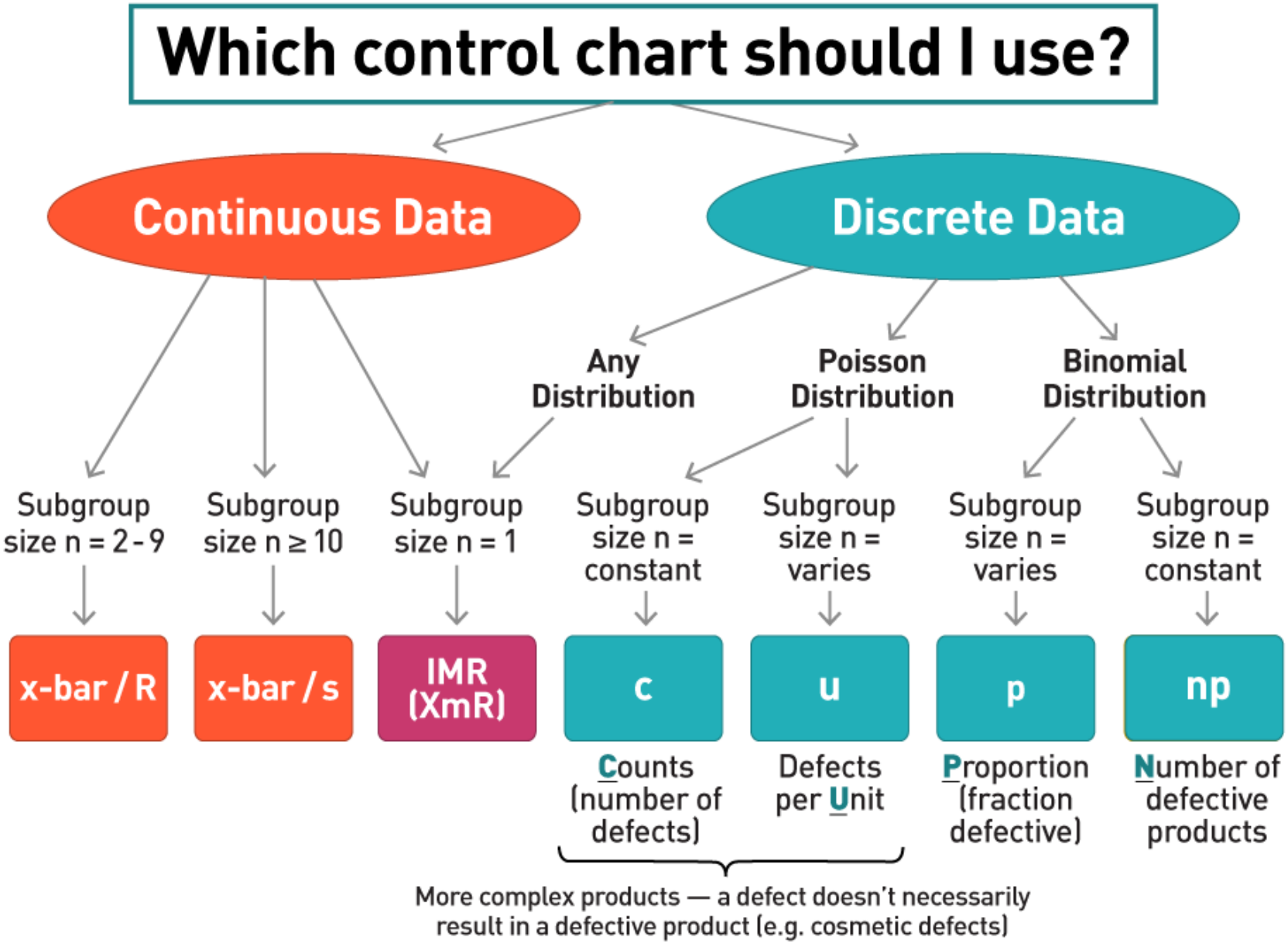
Control Charts (Process Behavior Charts)

Out-of-Control Signals➔ means special cause variation

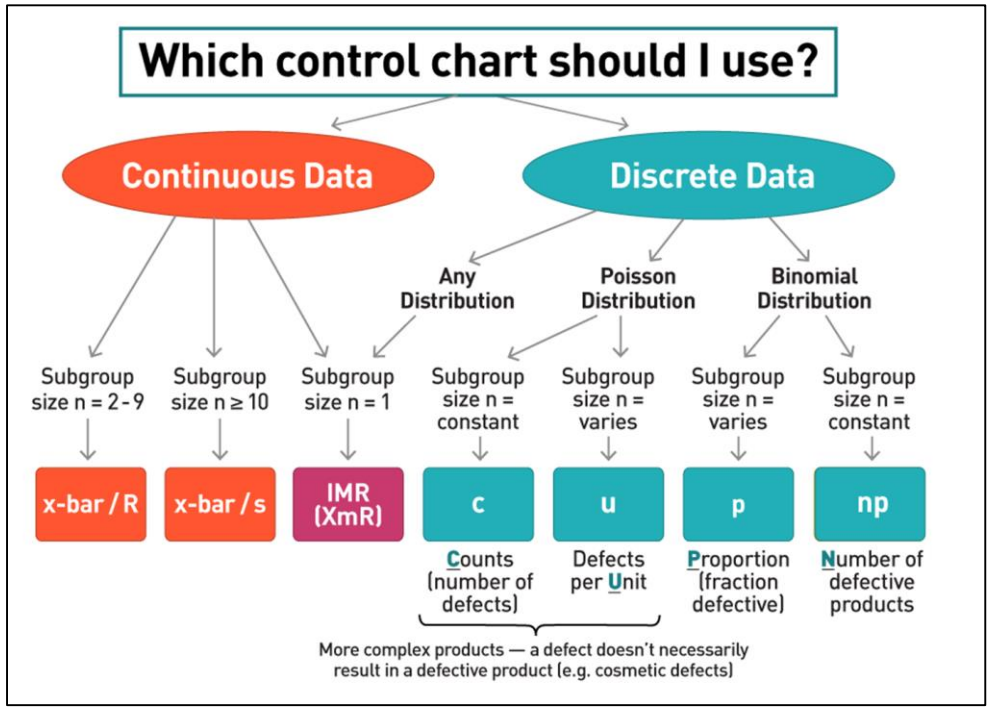
One or more points outside control limits
Also, data patterns inside control limits

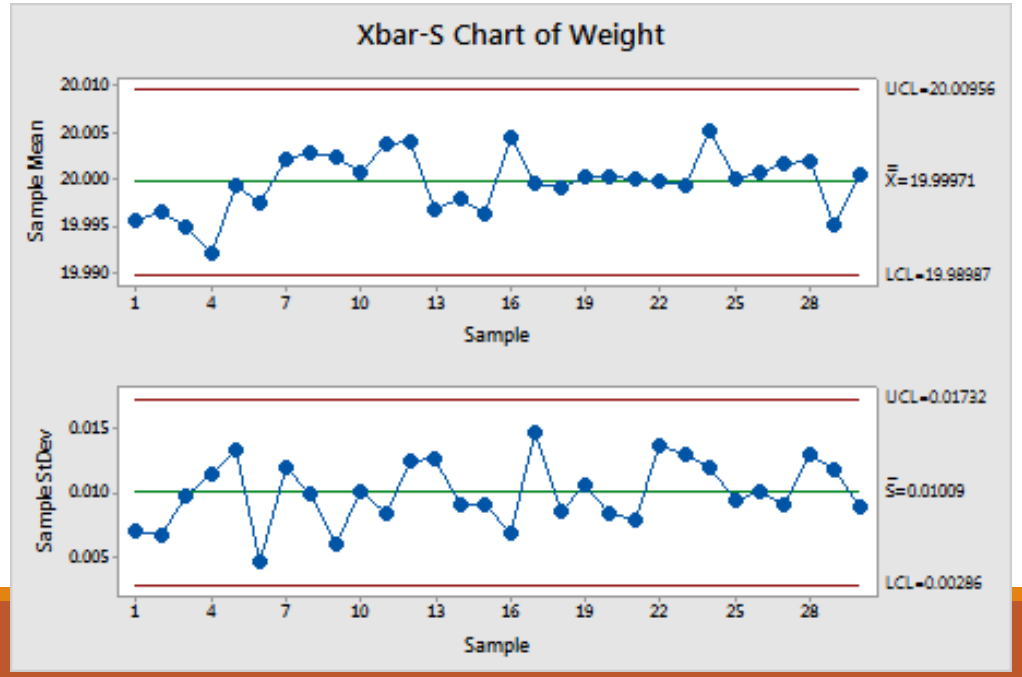
- Seven or more consecutive points above/below centerline
- Look for patterns forming
- E.g., consecutive points all above; all below; repeatedly alternating above and below

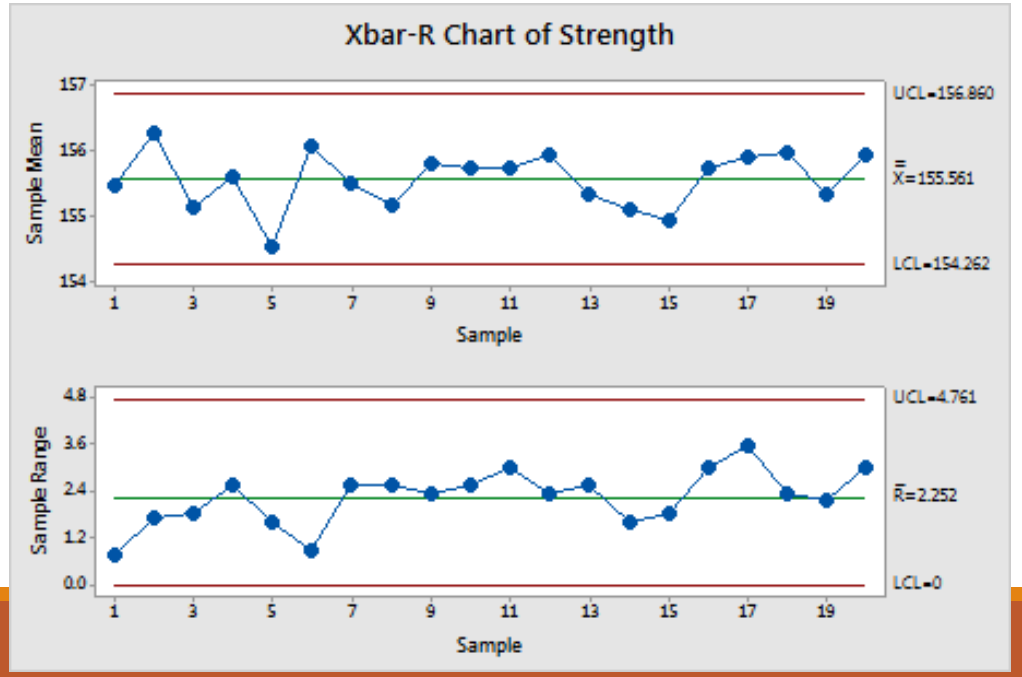
Random variation desirable
Pattern indicates a change in the process


Which control chart should I use?
Continuous Data
Discrete Data
Any Distribution
Poisson Distribution
Binomial Distribution
Subgroup size n = 2 - 9
Subgroup size n ≥ 10
Subgroup size n = 1
Subgroup size n = constant
Subgroup size n = varies
Subgroup size n = varies
Subgroup size n = constant
x-bar / R
x-bar / s
IMR (XmR)
c
u
p
np
Counts (number of defects)
Defects per Unit
Proportion (fraction defective)
Number of defective products
More complex products — a defect doesn't necessarily result in a defective product (e.g. cosmetic defects)

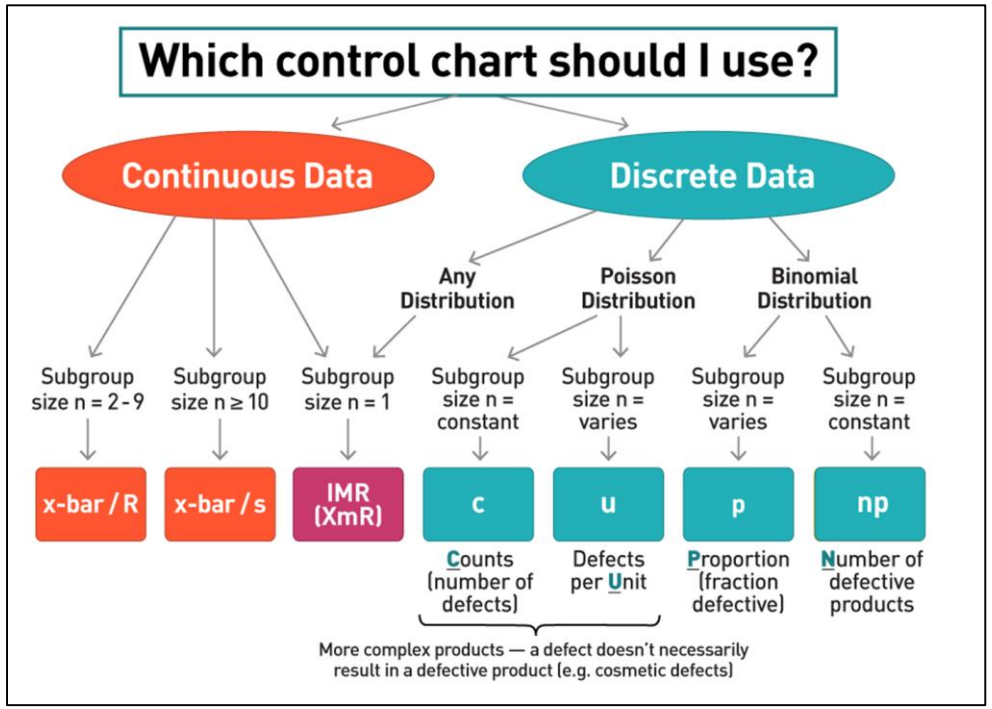
1. What type of data is measured in these charts?
2. Why was the chart chosen?
3. What can we say about the process variation for each chart?
4. Would you investigate further? Why or why not?

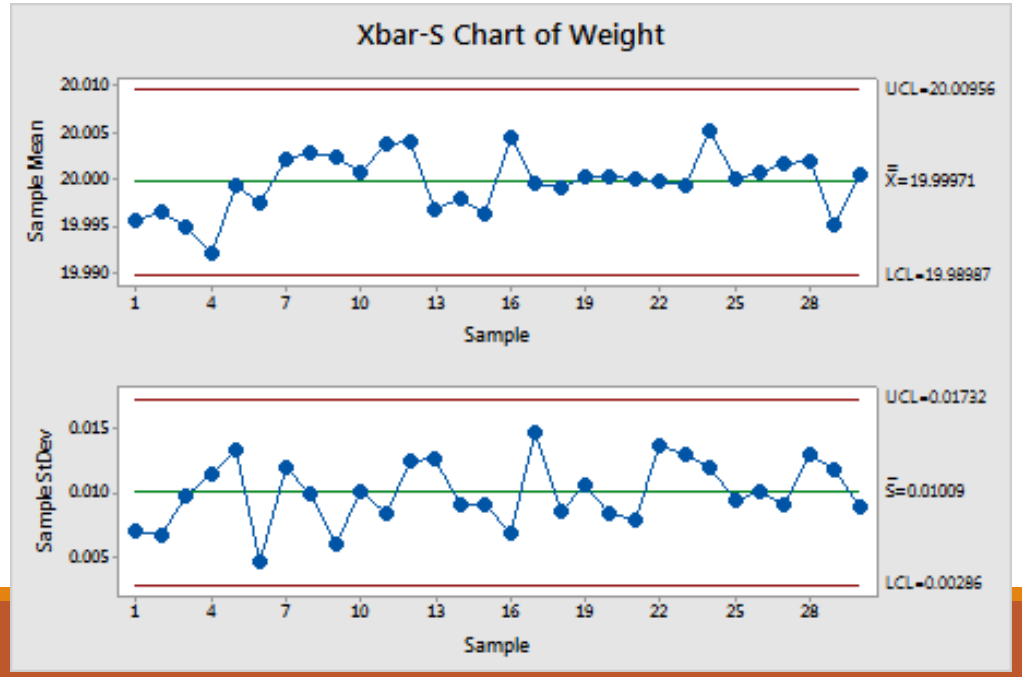


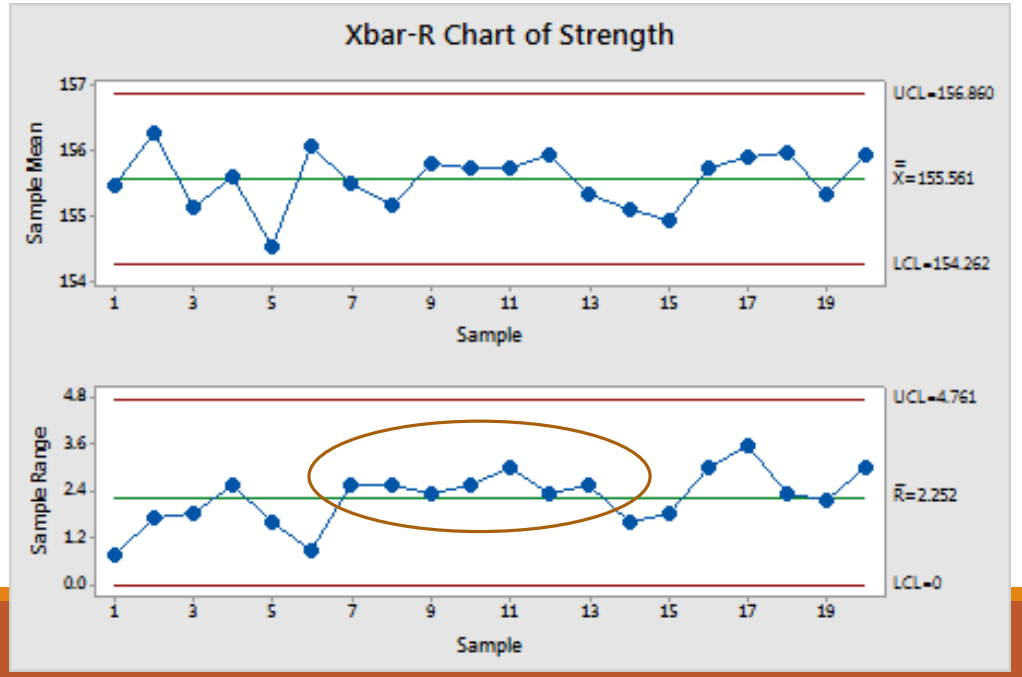




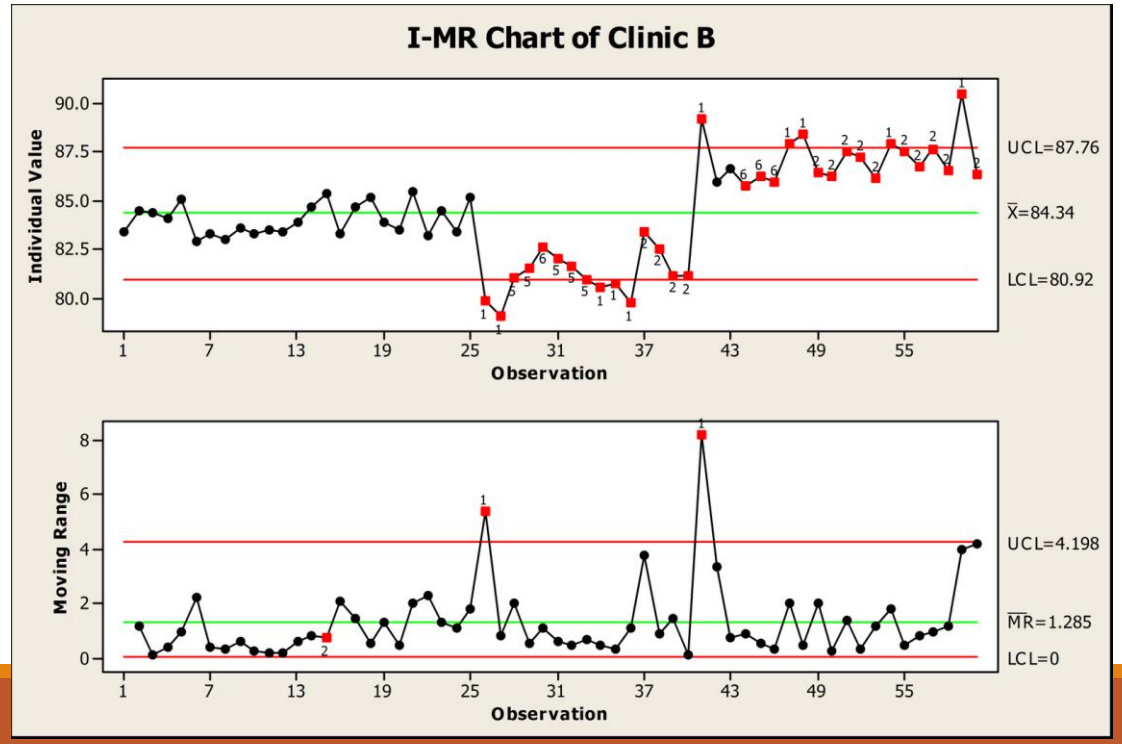
1. What type of data is measured in these charts? Continuous data
2. Why was the chart chosen? Subgroup size
3. What can we say about the process variation for each chart? Xbar-R seems to have an out of control condition
4. Would you investigate further? Why or why not? Yes – investigate to see what may have changed

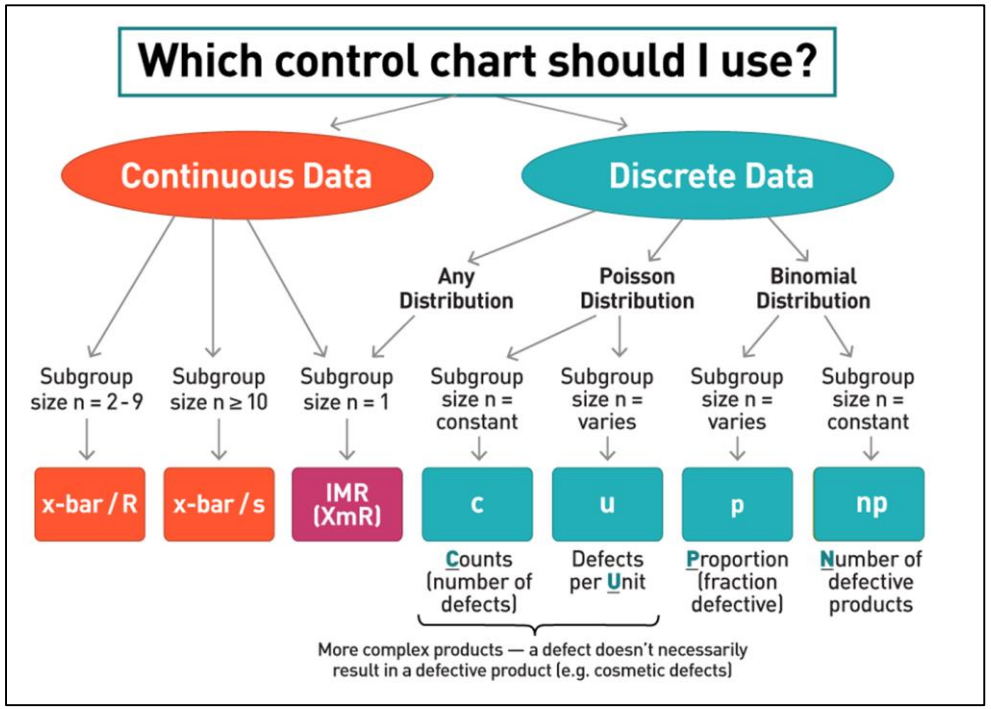




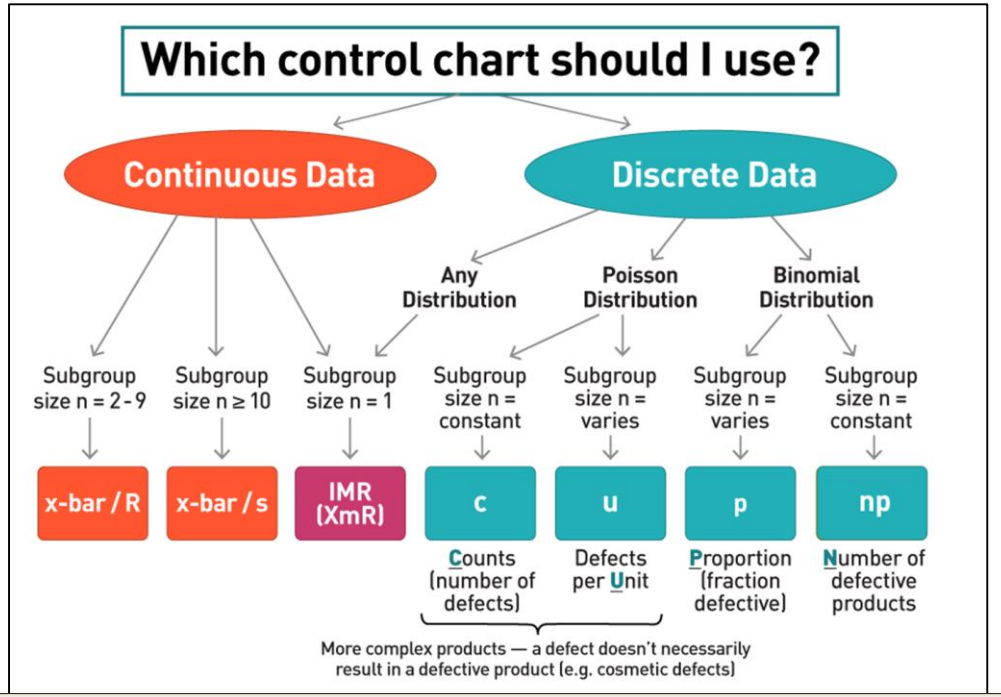


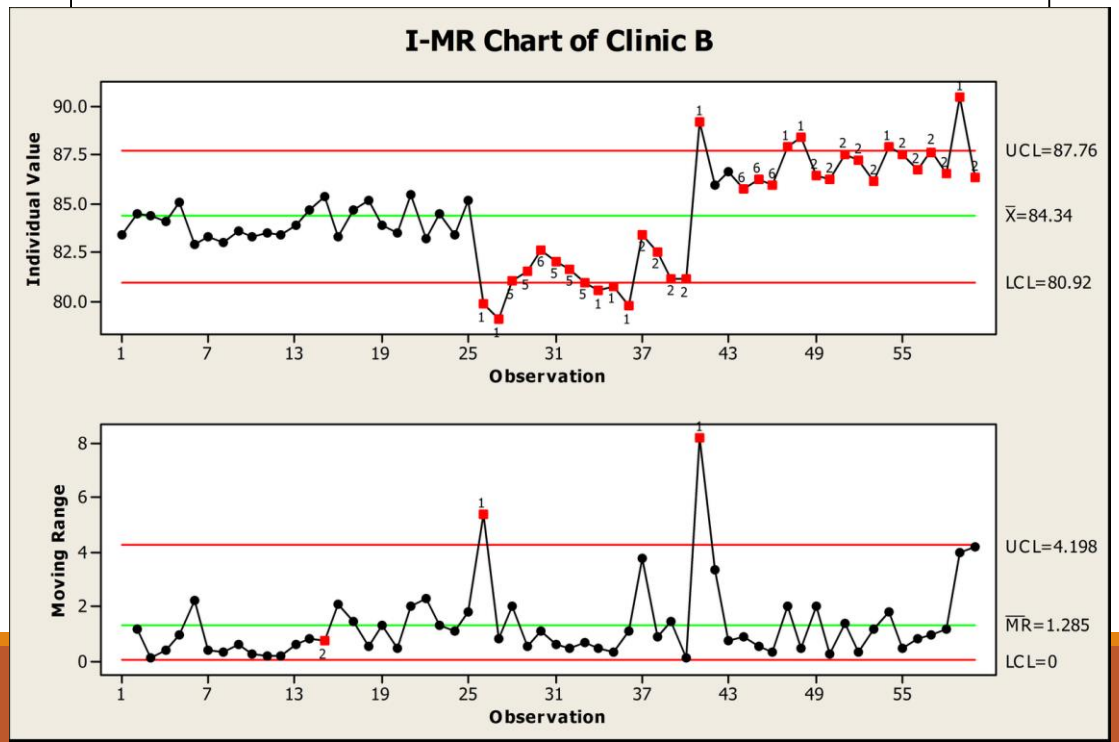
1. What type of data is measured in these charts?
2. Why was the chart chosen?
3. What can we say about the process variation for each chart?
4. Would you investigate further? Why or why not?



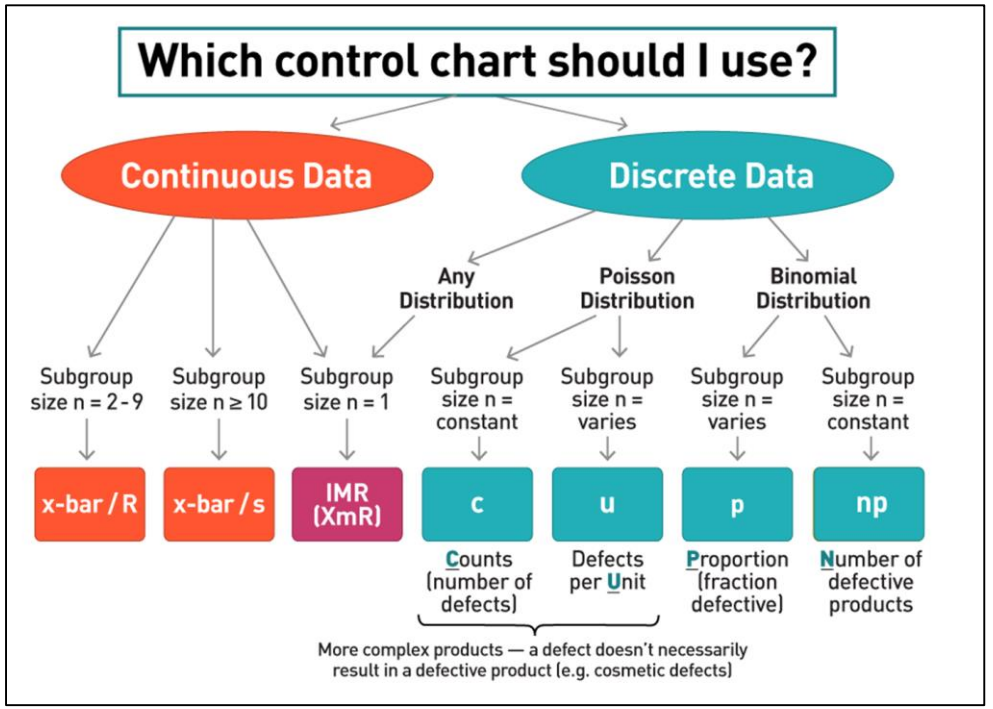


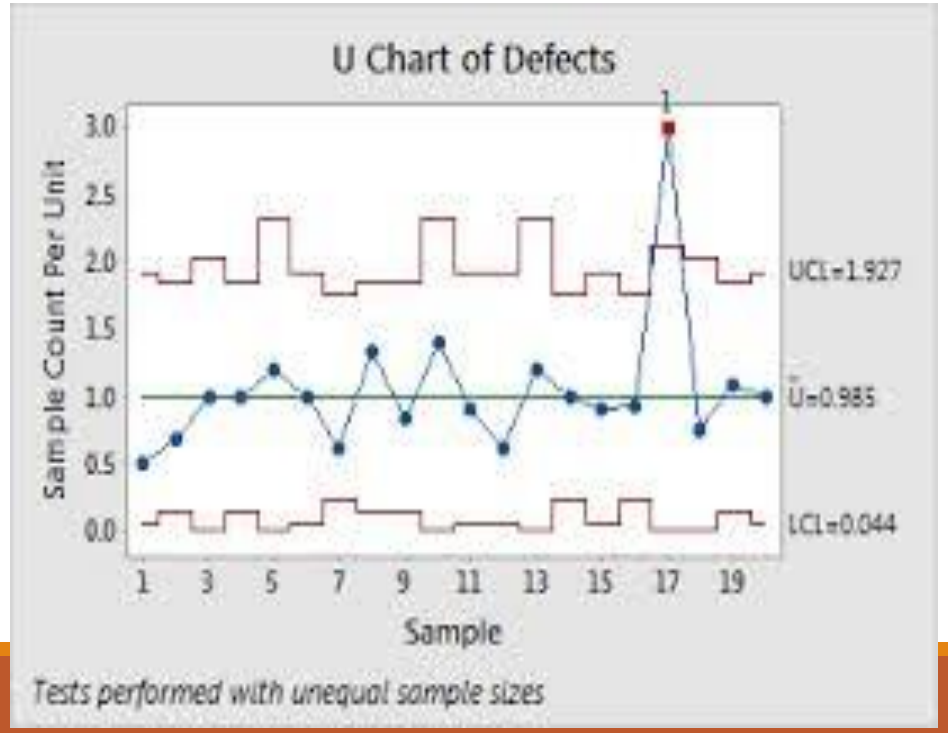
1. What type of data is measured in these charts? Continuous or discrete data
2. Why was the chart chosen? Individual values
3. What can we say about the process variation for each chart? Many out of control conditions
4. Would you investigate further? Why or why not? Yes – different working shifts or holidays? Something is different

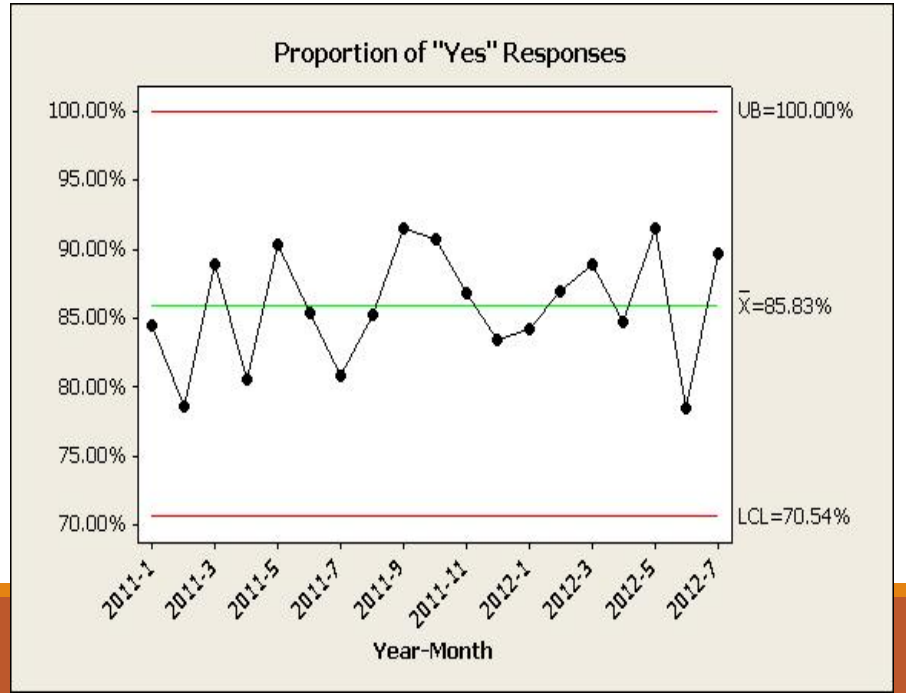




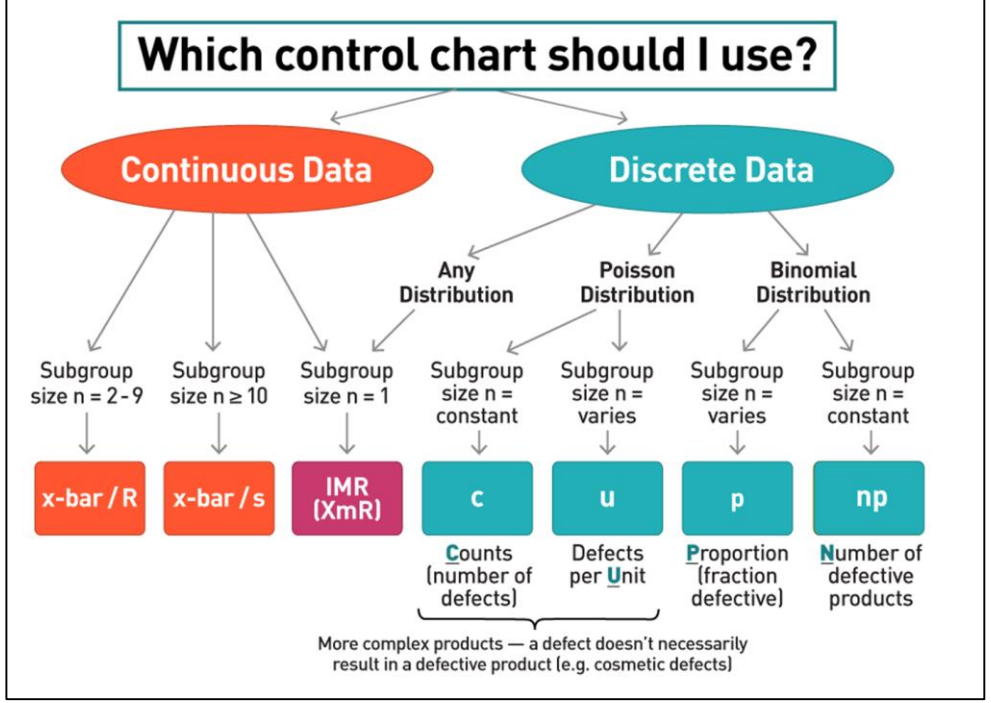
1. What type of data is measured in these charts?
2. Why was the chart chosen?
3. What can we say about the process variation for each chart?
4. Would you investigate further? Why or why not?

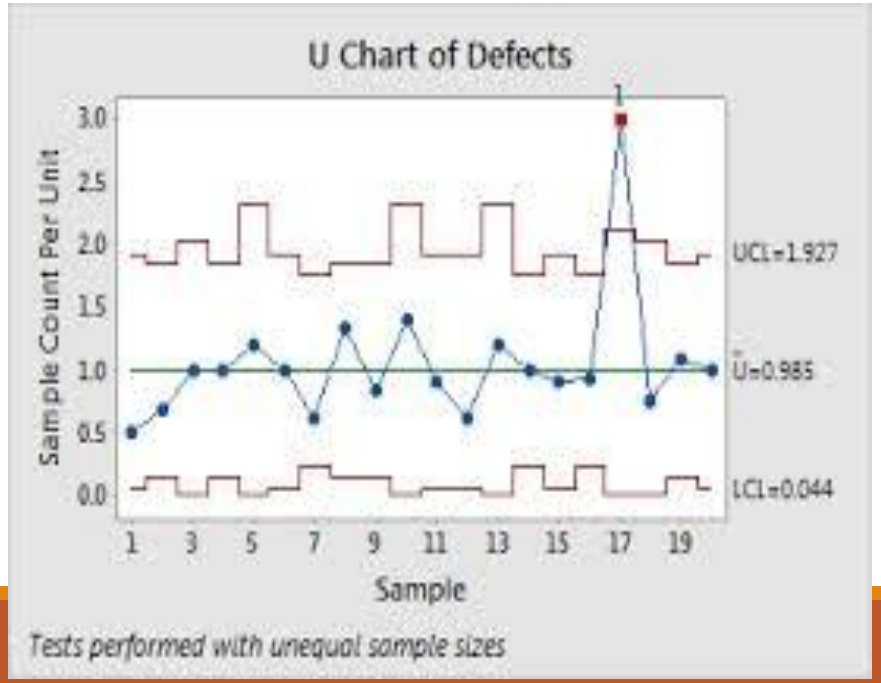


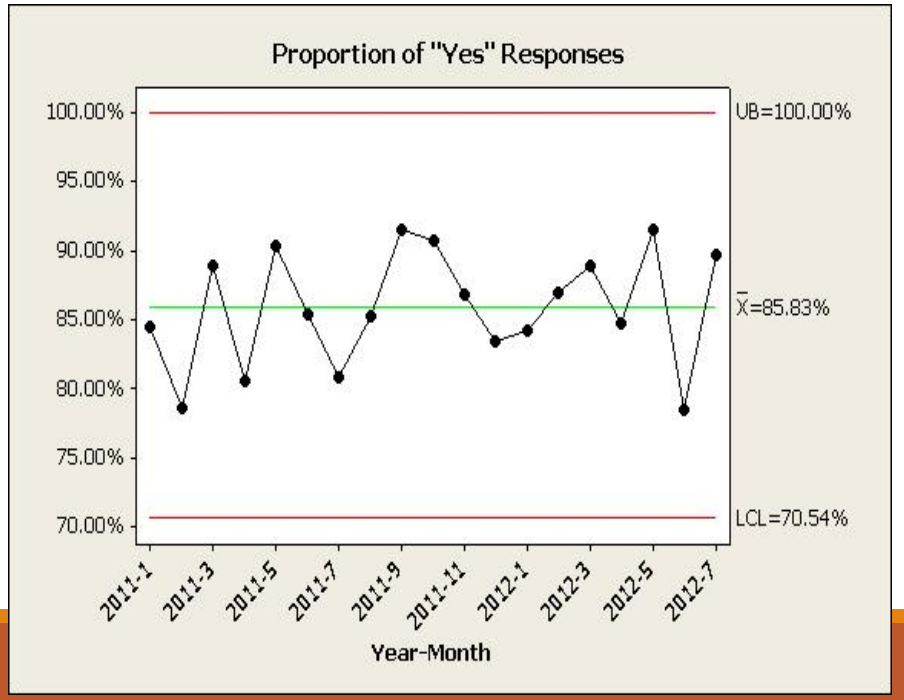




1. What type of data is measured in these charts?
   Discrete
2. Why was the chart chosen? U – defects per unit; P - proportion
3. What can we say about the process variation for each chart? U chart – out of control; P chart in control but very high variation.
4. Would you investigate further? Why or why not?
   Yes investigate outlier and causes for variability.







Control Charts (Process Behavior Charts)

Control Charts as a proactive tool:

Measurement System Analysis

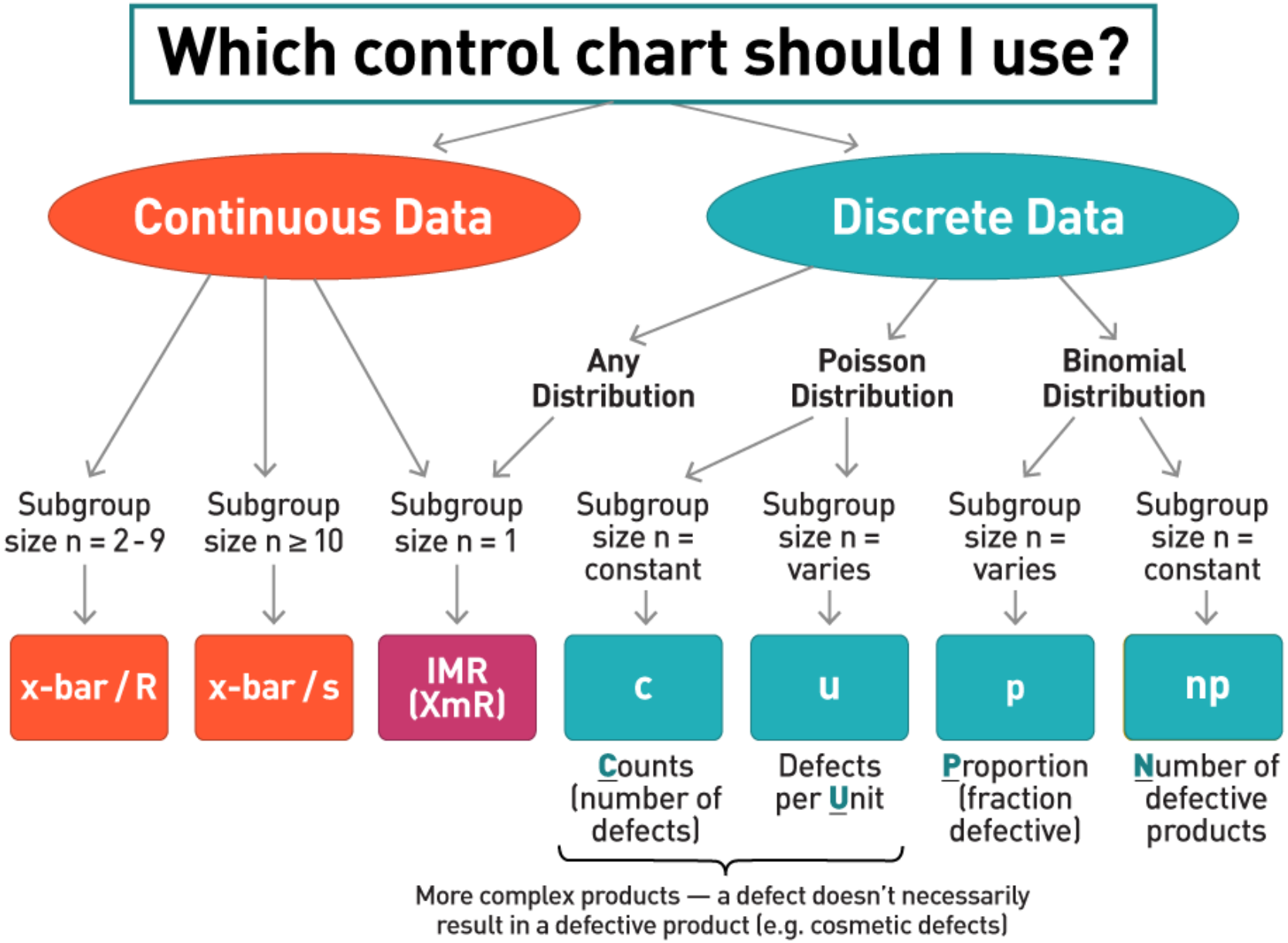
- Also referred to as Gauge R&R
- Useful in confirming that your measurement system is capable of measuring differences between items
- Similar to discrete tool (Kappa) used for peanut exercise
- You WANT to see your range in control and your x-bar chart out of control

Trends

- Is my process shifting?
- Is there a pattern in my data that needs investigating?

Rational Subgrouping

- Is there a difference between different factors in my process? i.e. shift, operator, product line, location…



How could you use Control Charts in your project?

1. What type of data would you want to monitor?
2. What's your plan for out of control data?
3. Which chart could you use?

Sample projects

Process Improvement Project
-Requirements-

The final submission should be 1 file, in slide format, created in PowerPoint.

It should include 2 parts:

1) ***Executive summary slide*** **– 1 slide Storyboard (specific requirements below).**

2) ***Back-up slides*** **– additional 5-15 slides (specific requirements pgs. 3-4). This is not a repeat/copy of your storyboard. The back-up slides should detail and support the content of your storyboard.**

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1) ***Executive Summary :: Storyboard*** (should be presented in 1 PowerPoint slide)

- Follow the DMAIC steps
- Include the problem statement and baseline
- Utilize **at least 5 different** tools/techniques (present relevant key tools to best tell your story).
- Be readable; summarize and condense exhibits where necessary
- Use arrows, call out boxes, and balloons to highlight questions and key learnings
- Display data/charts supporting your findings and conclusions
- Show results or expected results

Process Improvement Project
-Requirements-

2) *Back-up slides* - following the Storyboard include 5-15 slides containing the answers to the following questions.

DEFINE

•What is your goal? How will you know if you've been successful?

•Have clear operational definitions been established for your inputs and outputs?

•What is the process you're trying to improve? What are the current steps of the process?

MEASURE

•Include your Data Measurement Plan **or** Data Stratification Tree (see examples)

•What type of data did you collect (cost, cycle time, changeover time, yield, machine utilization, scrap, rework, defects, inventory)?

•Was that data continuous or discrete?

•Did you collect your own data or did you use existing data?

•How much data did you collect and why? What is your ideal sample size using the sample size formula? What is the risk if you collected fewer samples?

•How was your data collected? Describe the methods you used to collect it.

Process Improvement Project
-Requirements-

2) *Back-up slides continued:*

MEASURE (continued)

- Where could you have measurement error? How much measurement error do you have? What could you do to minimize your measurement error?

ANALYZE

- What tools did you use to analyze the data? Why?
- What is the data telling you? What did you discover?
- What is the SQL for the old and new process?

IMPROVE

- What solutions did you propose and/or implement? Did you successfully improve your process? What did you learn about your process?

CONTROL

- How will you use this information to “hold the gains” of your improvement or make the next round of improvements in your process?

Process Improvement Project
-Rubric-

Content Requirements	Possible Points
A) An executive summary is provided in the storyboard format including: Is the storyboard presented in 1 PowerPoint slide? Follows DMAIC? Are tools/graphs/charts used and clearly visible? Do they support findings and conclusions Are arrows, call-out boxes, etc. used to summarize, highlight questions and key learnings? Are expected results clear? And next steps noted?	5.0
B)Is it a cohesive presentation opening with the business process and problem statement? The back-up slides (5-15) detail and support the storyboard content.	2.0
C) Was the success measure clearly identified, operationally defined and baseline identified? (Was the data identified as continuous or discrete, includes SQL?)	3.0
D) Was the data measurement plan or data stratification tree included?	1.0
E) Was the data collection method identified?	1.0
F) Was there rationale for the sample size taken? Use of the formula? Is there any reference to measurement error and how to minimize?	1.0
G) Are at least 5 different tools and techniques clearly identified? Are the tools linked/ pertinent to the data analysis?	5.0
H) Does the data analysis clearly tie to the problem conclusion? Is the “discovery” clear to the reader?	2.0
Total	**20**

Next two weeks

1. Project Next Steps – Analyze/Improve Phases

Analyze tools
Begin identifying solutions to try
Plan pilot or implementation of solutions

2. Coursework BLT's:

8.7 Test Your Knowledge: Measurement System

8.8* Relate Control Charts to Your Project

9.9 Test Your Knowledge: Time Series Models

9.10* Relate Time Series to Your Project

3. Assignments:

Homework #5: *(worth 3 points)*
Three days after live session 8
Assignments and Deliverables folder on 2SU

- Complete Control Chart problems **#1-10 on pgs 114 -116** from the ***Understanding Variation*** Book.

Upcoming assignment:

Homework #6: *(worth 2 points)* Three days after live session 9
Assignments and Deliverables folder on 2SU

- Complete Time Series problems - **Excel data file**