Using Tools for Quality Improvement

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What's wrong with this picture?

Lessons Learned

- There is too much data…
- Don’t get distracted from all the noise – focus on the core findings
- Set priorities – you can not do everything!
- Communicate clearly – tell folks what is important!
- Slow down… understand before you act

Why Do We Use Data?

- **Standard LD.03.02.01**
- *The hospital uses data and information to guide decisions and to understand variation in the performance of processes supporting safety and quality.*
- **Elements of Performance for LD.03.02.01**
    1. Leaders set expectations for using **data** and information to improve the safety and quality of care, treatment, and services.
    2. Leaders are able to describe how **data** and information are used to create a culture of safety and quality.
    3. The hospital uses processes to support systematic **data** and information use.
    4. Leaders provide the resources needed for **data** and information use, including staff, equipment, and information systems.
    5. The hospital uses **data** and information in decision making that supports the safety and quality of care, treatment, and services. (See also NR.02.01.01, EPs 3 and 6; PI.02.01.01, EP 8)
    6. The hospital uses **data** and information to identify and respond to internal and external changes in the environment.
    7. Leaders evaluate how effectively **data** and information are used throughout the hospital.

Why Do We Use Data?

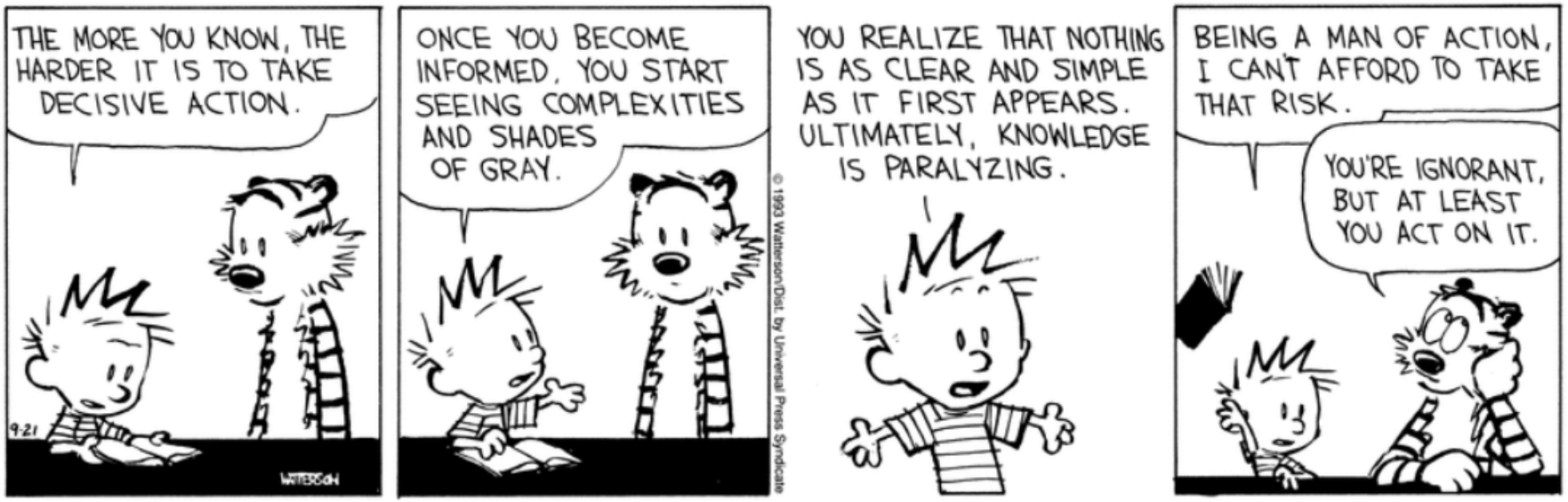
- Regulatory Standards & Expectations
  - Have a well-developed question BEFORE data collection.
  - Data needs to be STABLE and (statistically) PREDICTABLE.
  - To Identify Opportunities for Improvement.
  - Identify Changes that lead to Improvement.
  - Sustain Improvement once we have made it.

Barriers To Putting Data Into Action

- Don’t even know where to get data / info
- Collecting the wrong data
- No one is interested in it
- Paralysis by analysis
- Incorrect interpretation of data
- Too complex to understand
- Defensiveness

Incorrect Interpretation of Data

Too Complex to Understand



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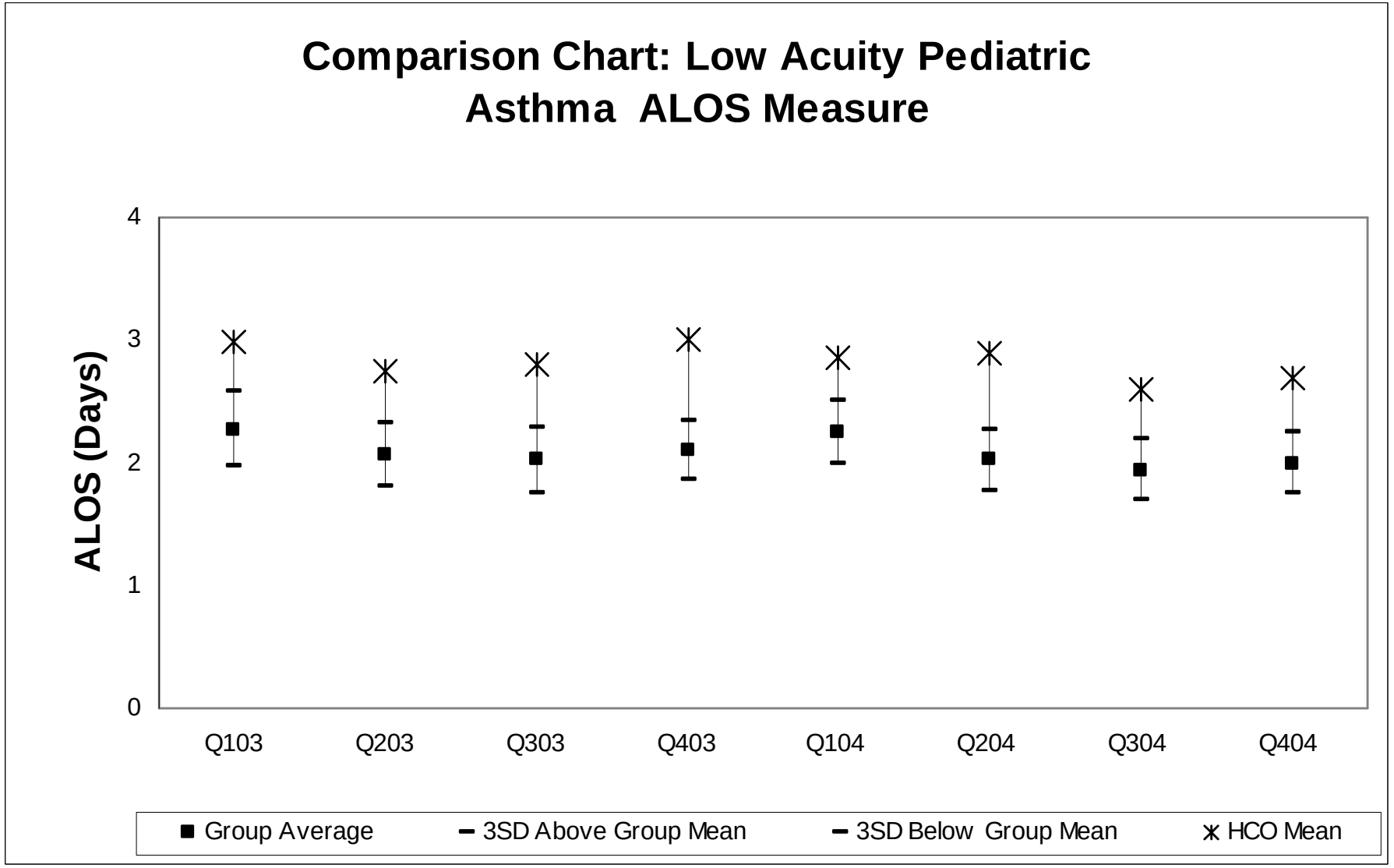
TCH Asthma Care Initiative in 2005



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Stages of Coping with Data

- ***Stage I***: “The data are wrong….”

TCH Asthma Care Initiative in 2005

- Over 200 Asthma Action Plans
  - 25% of inpatients received AAP
- Oxygen weaning strategies ranging from 5 minutes to 24 hours prior to discharge
- Beta agonists:
  - No weaning protocol or dose delivery protocol
  - 20% of patients received MDI treatments

Stages of Coping with Data

- ***Stage I***: "The data are wrong…."
- ***Stage II***: "The data are right, but it's not a problem…"
- ***Stage III***: "The data are right, it's a problem, but it's not my problem…"
- ***Stage IV***: "The data are right, it's a problem, it's my problem…"

- IHI – Take the Journey to "Jiseki"

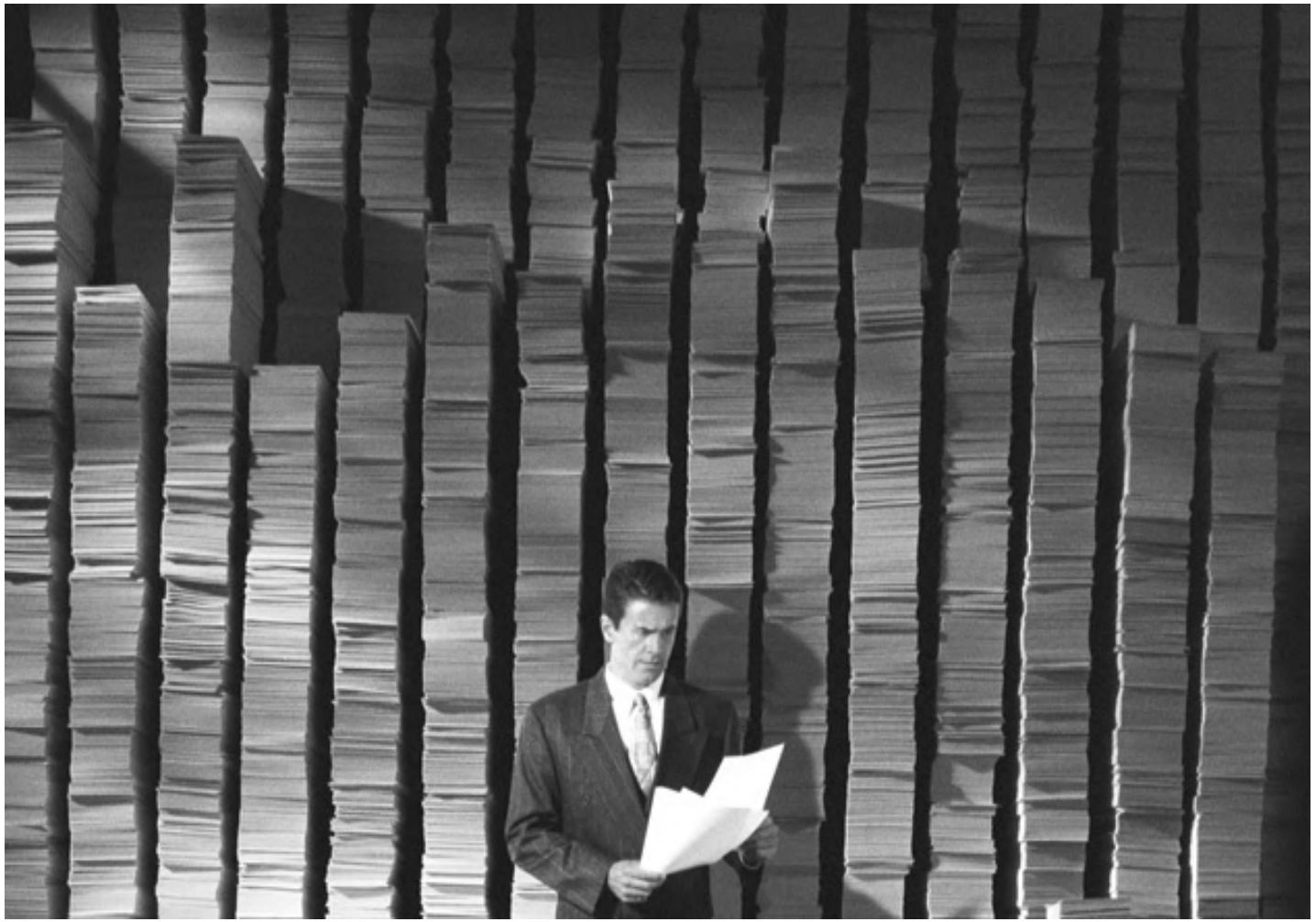
Value Data

In God We Trust,

All Others Bring Data.

W. Edwards Deming

How Do We Make Sense of Data?



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Quality Improvement Tools

What do you see?

Pessimist:
Glass is half empty!

Optimist:
Glass is half full!

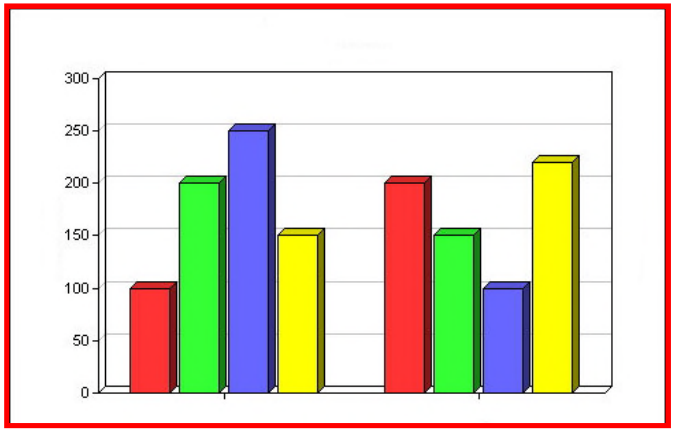
Know-it-all:
Glass is FULL!
Half Air & Half Water!

Quality Improvement Practitioner:
VOC: Customer only needs this much water.
Our capacity is larger than it needs to be!

Purpose of QI Tools

"If the only tool you have is a hammer, you will see every problem as a nail."

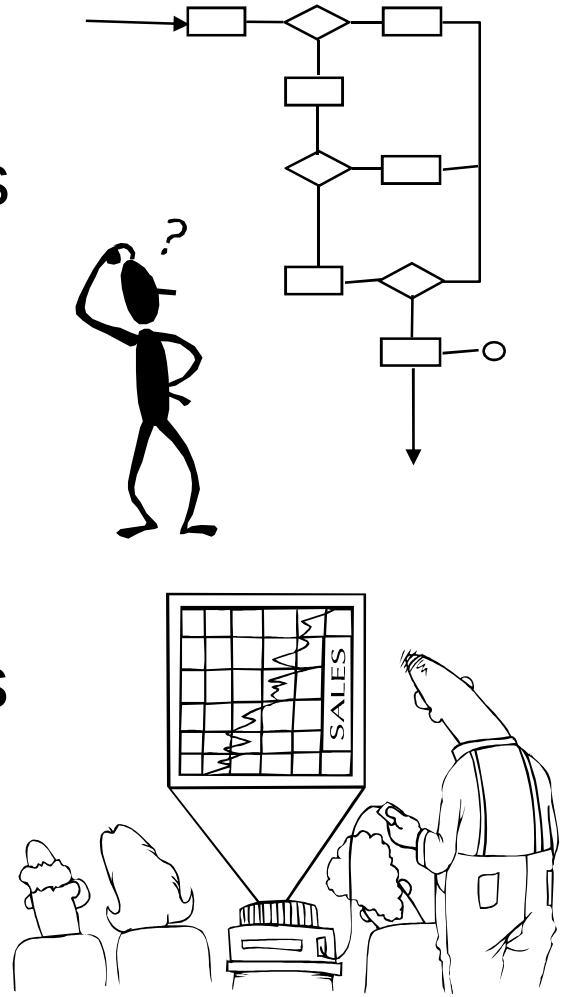
Abraham Maslow, 1966



Row	AGE	ED-LEVEL	SMOKING ST>	EXERCISE	WEIGHT	SERUM-CHOL	SYSTOLIC
1	27	2	1	1	120	193	126
2	18	1	0	1	145	210	120
3	32	2	0	0	118	196	128
4	24	2	0	1	162	208	129
5	19	1	2	0	106	188	119
6	56	1	0	0	143	206	136
7	65	1	2	0	160	240	131
8	36	2	1	0	215	215	163
9	43	1	0	1	127	201	132
10	47	1	1	1	132	215	138

Purpose of QI Tools

- Describe and improve processes
- Evaluate process or output variation
- Assist with decision-making
- Analyze data in a variety of ways
- Display information



Types of QI Tools

Quality Improvement Tool Selection Matrix

NOTE: E=Expanding F=Focusing	Tool	E/F	1 Charter & Plans	2 Customer Needs	3 Current State	4 Oppor-tunities	5 Root Causes	6 Changes	7 Do It	8 Monitor	9 Stan-dardize	10 Learnings
Project Planning & Implementing Tools	ACORN test	F	●									
	Arrow Diagram	F	●					●	●		●	
	Balanced Scorecard	F	●	●	●			●	●	●		
	Barriers & Benefits Exercise	E						●	●		●	●
	Check List (generic)	F	●						●	●	●	
	Contingency Diagram	E							●		●	
	Continuum of Team Goals	F	●							●		●
	Flowchart (generic0	E/F	●	●	●	●	●	●	●	●	●	●
	Force-Field Analysis	E						●	●		●	●
	Gantt Chart	F	●					●	●		●	
	Matrix Diagram (generic)	F	●	●				●	●		●	●
	Meeting Evaluation	F	●	●	●	●	●	●	●	●	●	●
	Mind Map	E	●	●	●	●	●	●	●		●	●
	Operational Definitions	F	●	●	●	●	●	●	●	●	●	●
	Plan-Do-Study-Act Cycle	F	●	●	●	●	●	●	●	●	●	●
	Plan-Results Chart	F								●	●	●
	Potential Problem Analysis	E/F						●	●		●	
	Presentation	F	●	●	●		●		●	●	●	●
	Process Decision Program Chart	E/F						●	●		●	
	Project Charter	F	●	●	●	●	●	●	●	●	●	●
	Project Charter Checklist	F	●									
	Relations Diagram	E/F	●	●		●		●			●	
	Stakeholder Analysis	E/F	●	●				●	●		●	
	Storyboard	E/F	●	●	●	●	●	●	●	●	●	●
	Table (generic)	E/F	●	●	●	●	●	●	●	●	●	●
	Tree Diagram	E	●	●	●	●	●	●	●	●	●	●
	Two-dimensional chart (generic)	F	●	●	●	●		●	●	●	●	●
	Wordsmithing	E/F	●	●	●		●	●			●	●
Idea Creation Tools	Affinity Diagram	E/F	●	●	●	●	●	●			●	●
	Benchmarking	E/F	●			●		●				
	Brainstorming	E	●	●		●	●	●			●	●

Divergent & Convergent Tools

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Purpose of QI Tools

However, you don't have to use EVERY tool for every problem.

Basic Decision Making Toolbox

Histogram

Pareto Chart

Scatter Diagram

Run Chart

Control Chart

Definitions

Distribution - Tendency of large numbers of observations to group themselves around some central value with a certain amount of variation or "scatter" on either side

Variation - Any quantifiable difference between individual measurements; such differences can be classified as being due to common causes (random) or special causes (assignable)

Definitions

Discrete Data – (Attribute) Data that is qualitative, rather than quantitative. (i.e. Color, Type, Characteristic, yes/no, location, etc.)

Continuous Data – (Variable) Data that is quantitative, rather than qualitative. (i.e. length, time, age, weight, volume, etc)

Definitions

Measures of Central Tendency - relates to the way in which one dimensional quantitative data tend to cluster around some value

Arithmetic mean, Median, Mode, Geometric mean, Harmonic mean, Weighted mean, Truncated mean, Midrange, Midhinge, Trimean, Winsorized mean.

Average - a measure of the "middle" or "typical" value of a data set

Measures of Central Tendency

“The Average”

Average Length of Stay

Average Age

Average Cost

Average Throughput Time

Average Turnover Time

Average Time to Admission

Etc.

What Constitutes an “Average”?

Mean – The mathematical average of a group of measurement values.

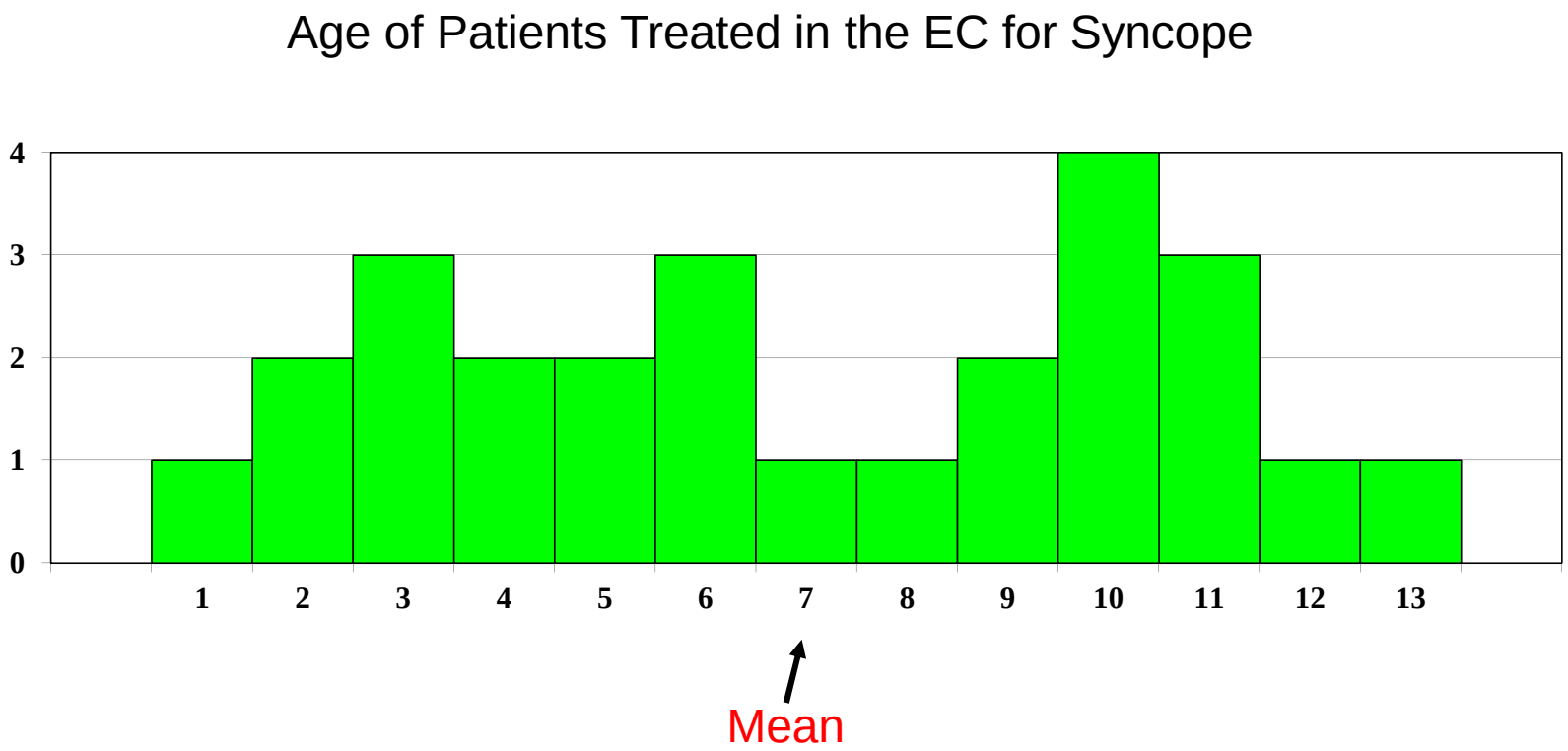
Median – The middle of a group of measurement values when arranged in numerical order.

Mode – The most frequently occurring value in a group of measurements.

“If I stick my right foot in a bucket of boiling hot water and my left foot in a bucket of freezing ice water, on the average, I’m pretty comfortable.”

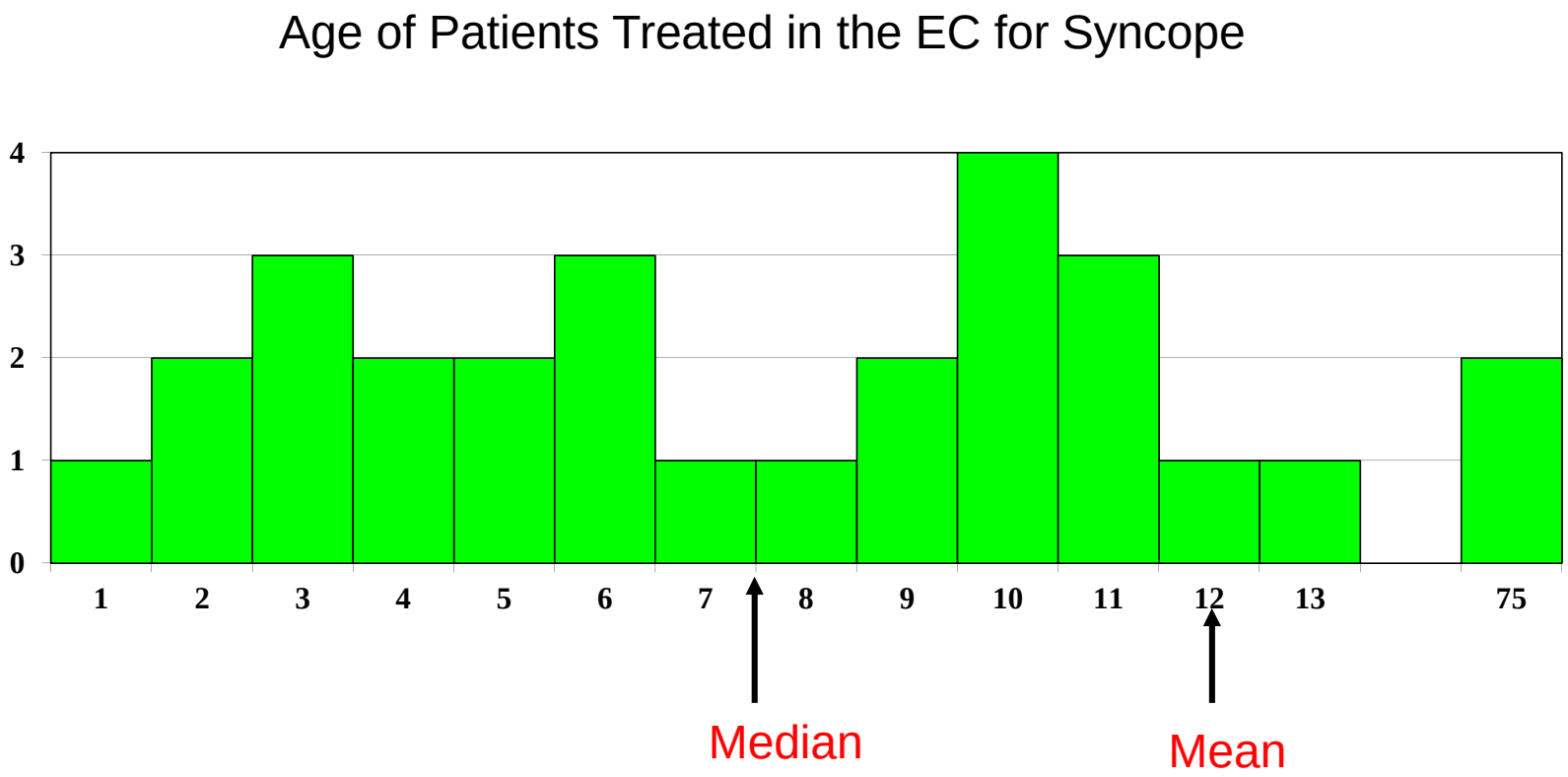
Author Unknown

Definition of “Average”



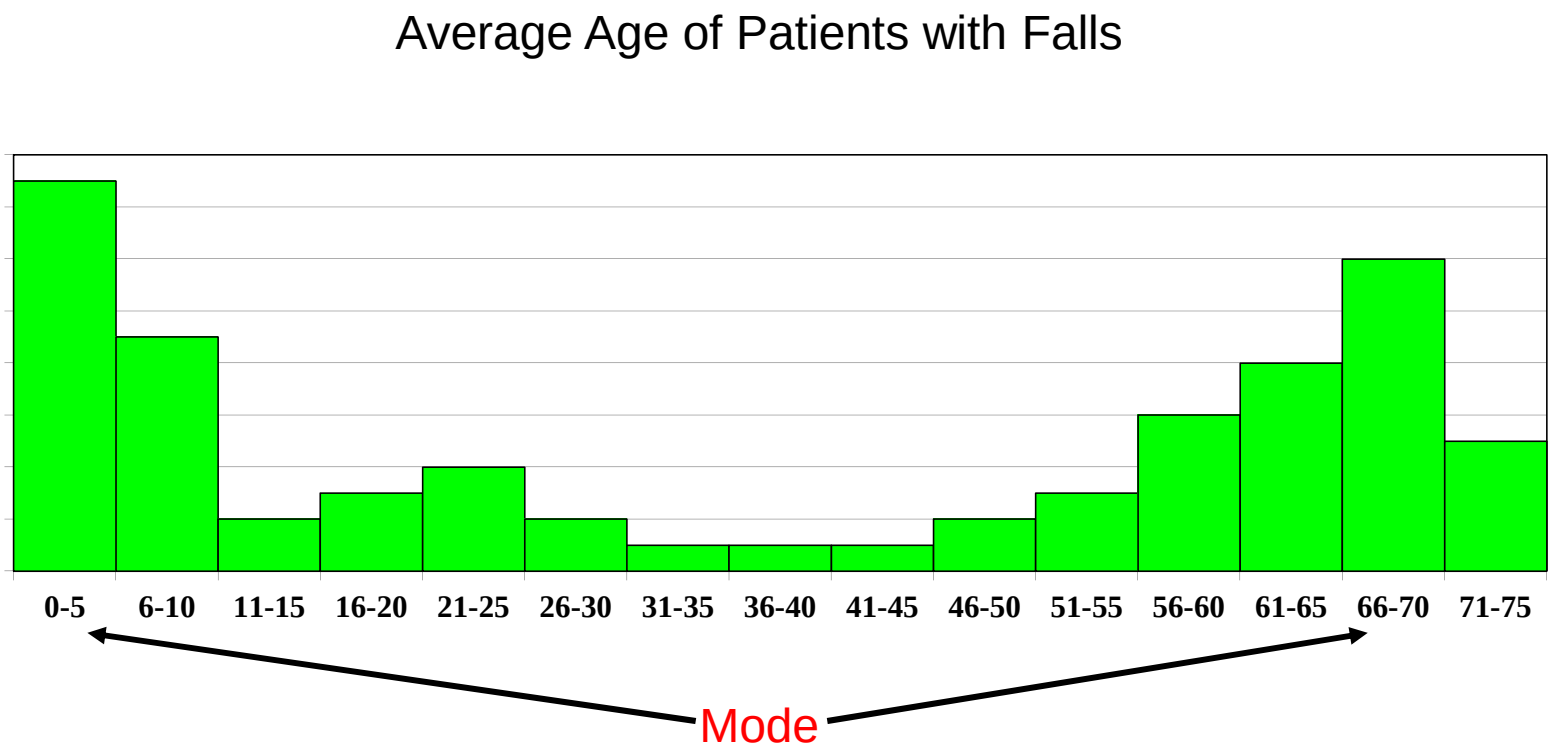
- Mean – The mathematical average of a group of measurement values.

Definition of “Average”



- Median – The middle of a group of measurement values when arranged in numerical order.

Definition of “Average”



- Mode – The most frequently occurring value in a group of measurements.

Welcome to Quality Medical Center

- The Quality Medical Center (QMC) Management Team is proud of their system of metrics.

- They monitor a wide variety of indicators and carefully compare the averages for these indicators to performance targets on a regular basis.

- They are confident that this process provides them with accurate information of the status of key processes and enables them to make effective management decisions.

But, is this confidence founded?

Let's look at several scenarios.

- QMC has an innovative new treatment plan for a chronic medical condition with one therapeutic session per day.

- The QMC target for inpatient therapeutic sessions is 8.

- The upper and lower thresholds for this indicator are 9 sessions and 7 sessions respectively.

What are the Consequences?

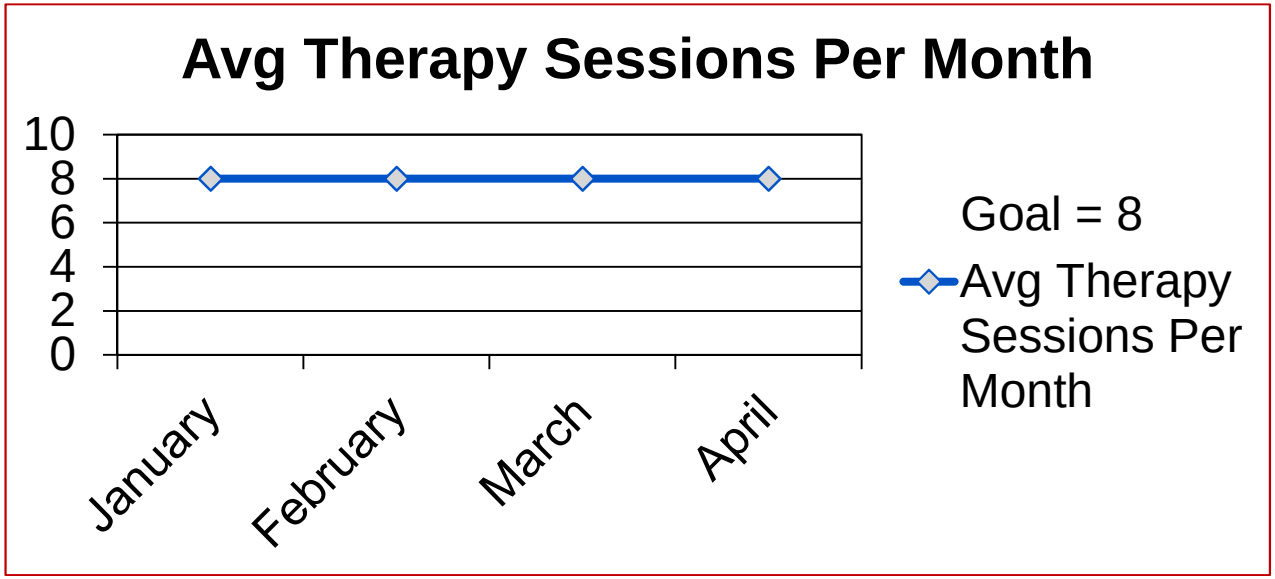
Based on agreements with the third party payors:

- If inpatient days exceed 9 the hospital reimbursement for those days will be denied.

- If therapeutic sessions are less than 7 there is a greater chance of unplanned readmission, which again will lead to decreased reimbursement.

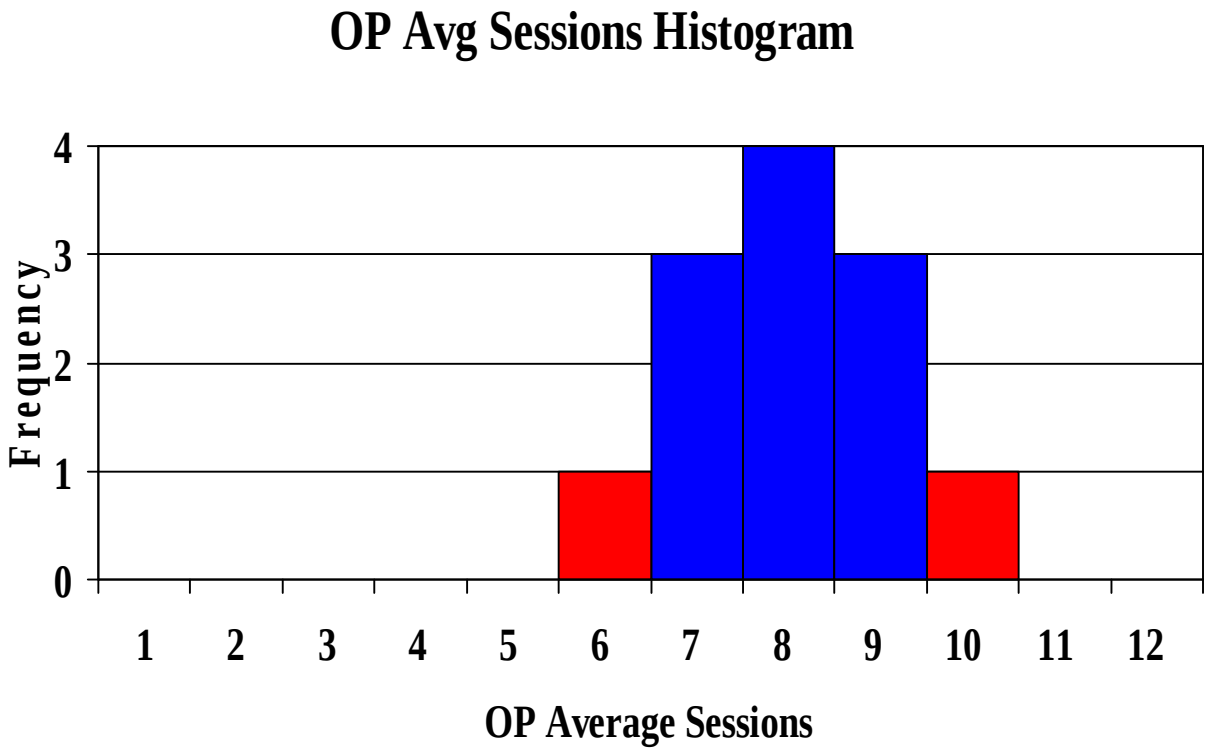
But, is this confidence founded?

- Their monthly reports to the hospital executives consistently report an average of 8 sessions.



So they are consistently on target…. Right?

Scenario #1: Best Case Scenario
“See, I told you so!”



Average:	8.0
Percent Within Standard:	83%

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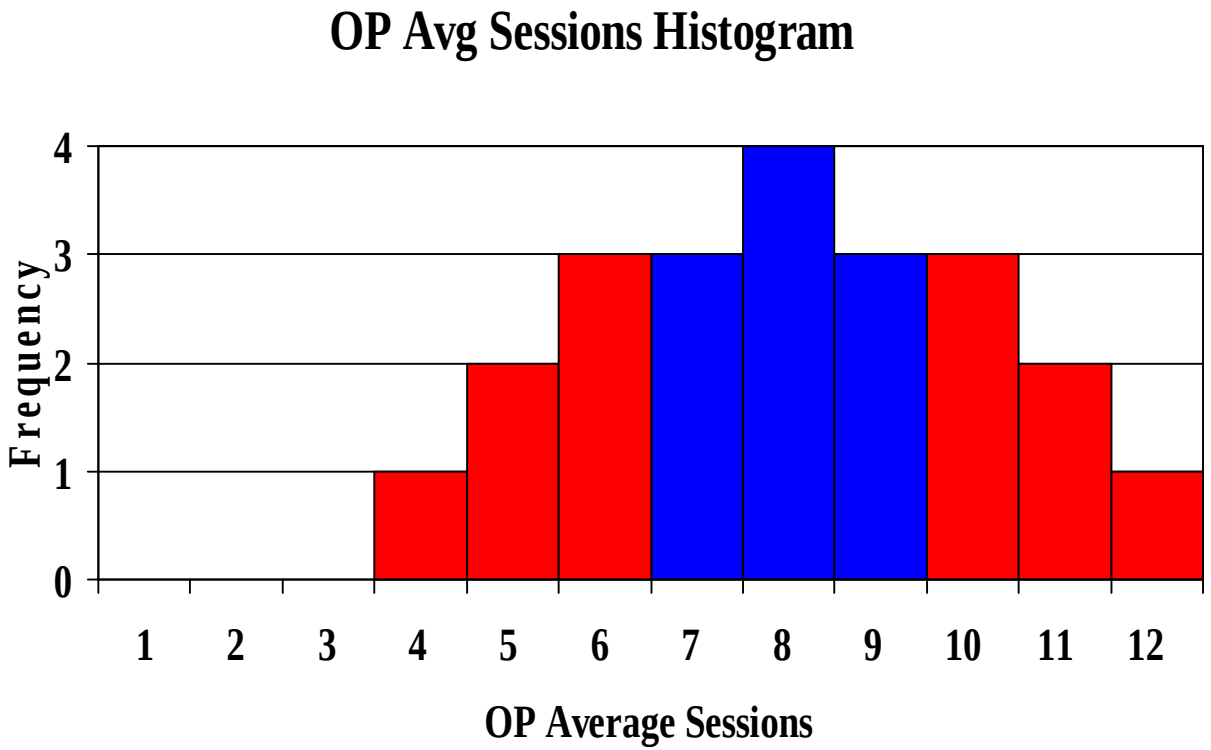
Scenario #2: What happens when the distribution “widens-out”?



Average: 8.0

Percent Within Standard: 45%

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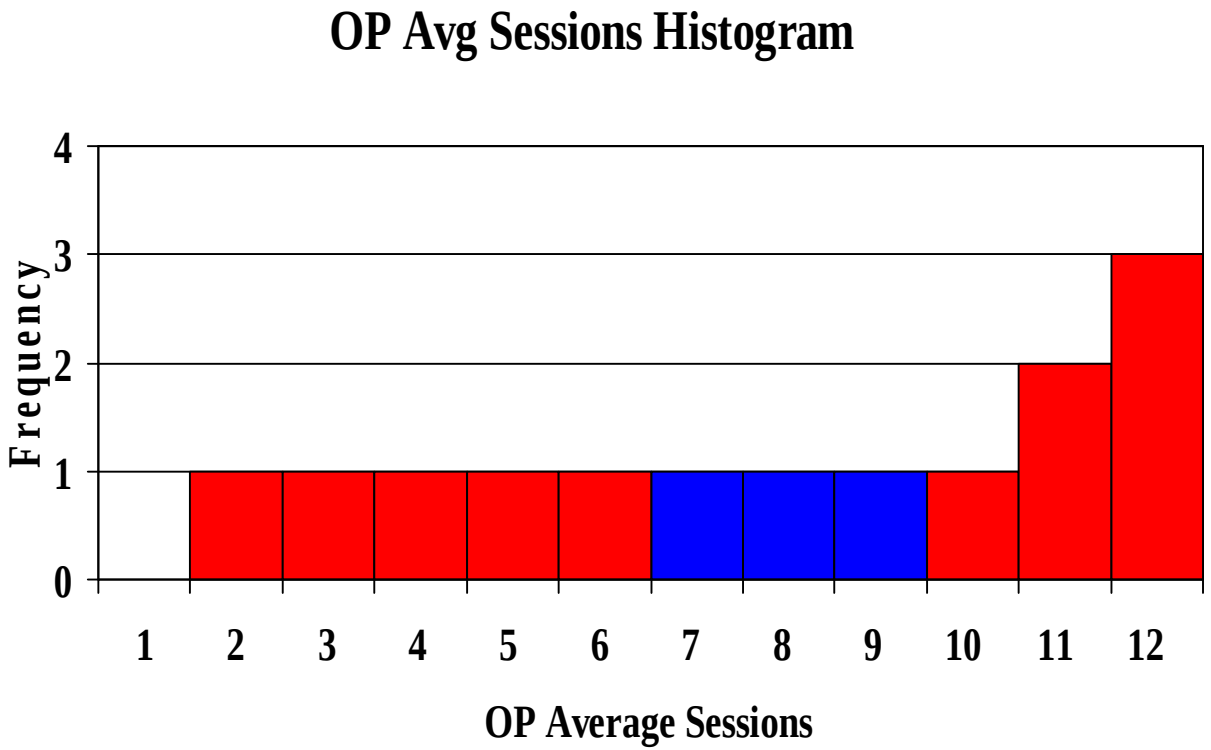
Scenario #3: A Skewed Distribution



Average: 8.0

Percent Within Standard: 21%

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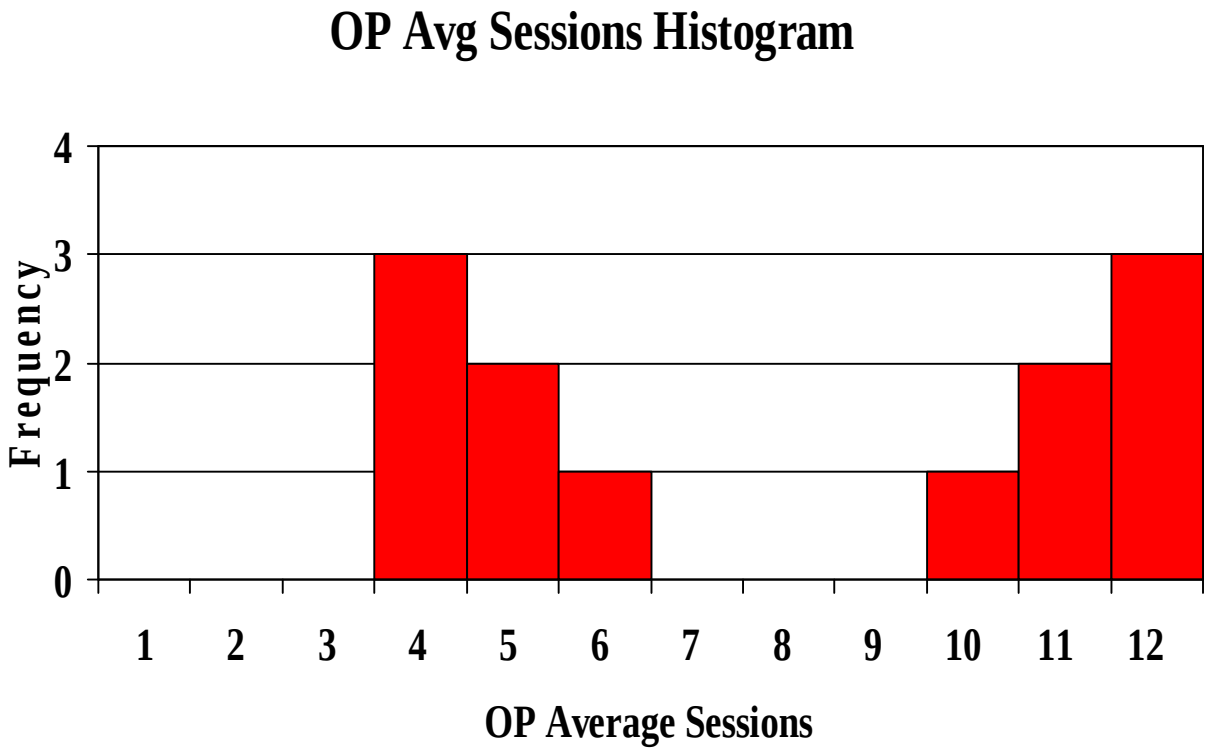
Scenario #4: “What do you mean we missed the target altogether?”



Average: 8.0

Percent Within Standard: 0%

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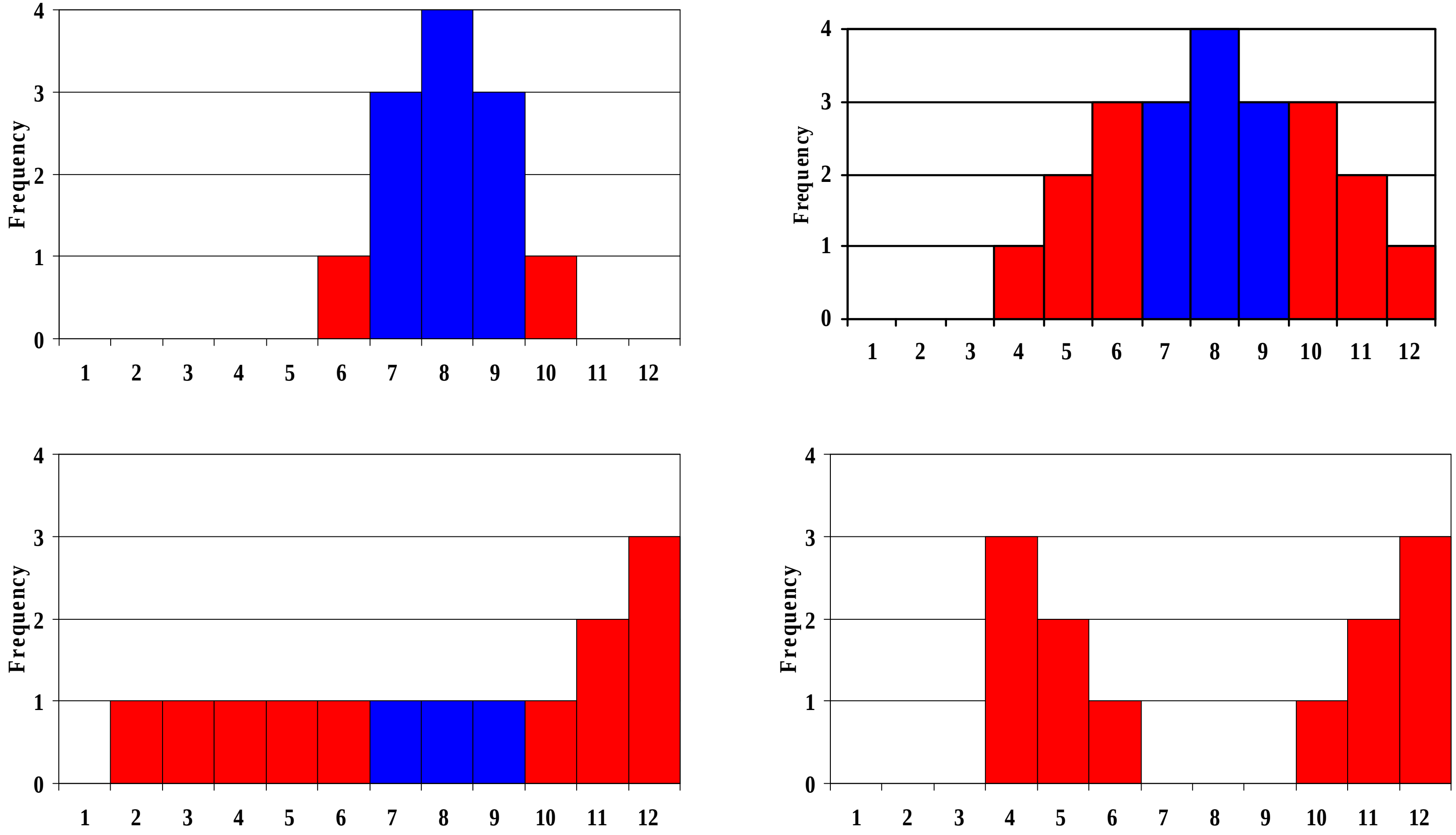
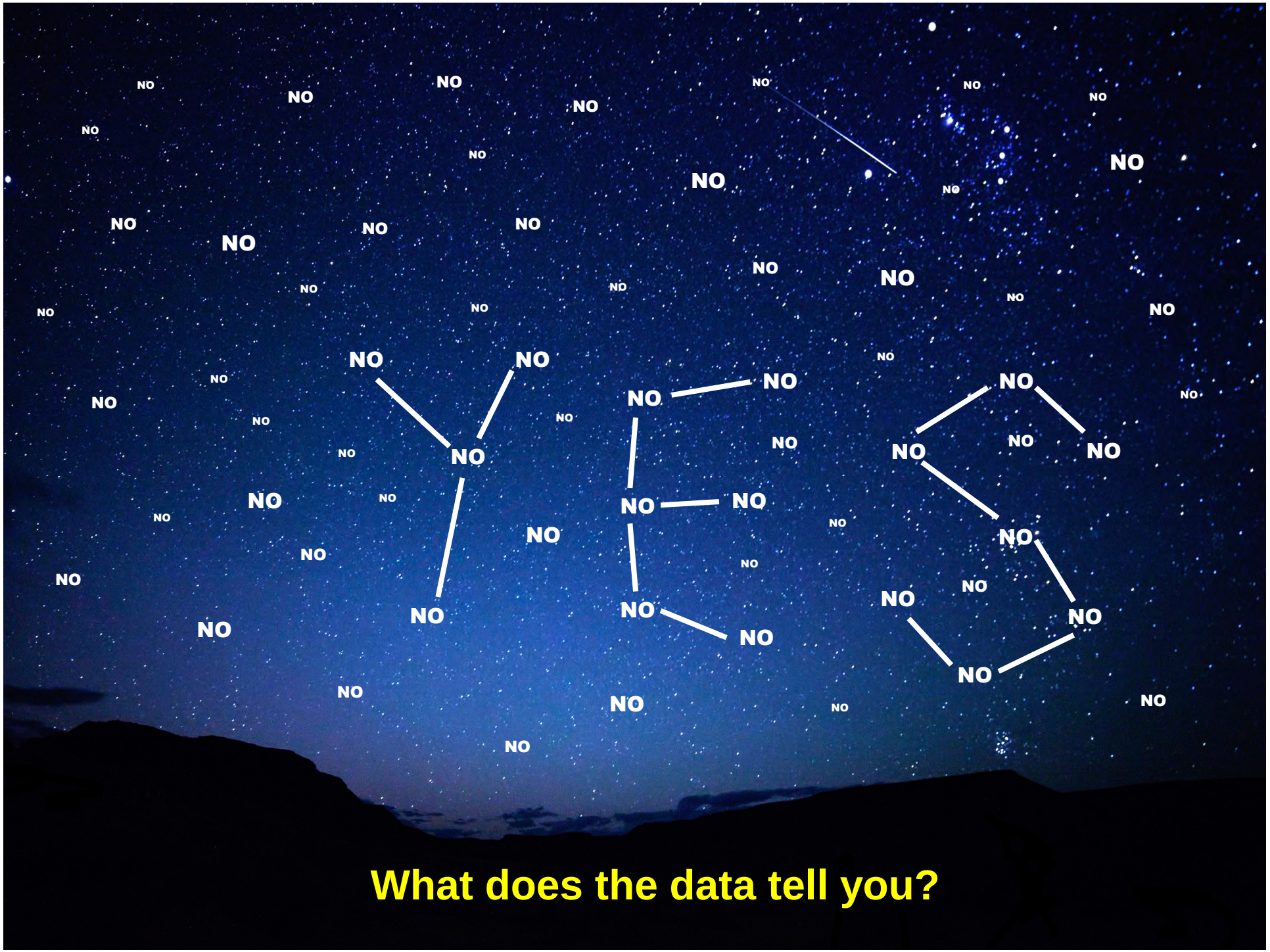
With only the average, there's no way to determine "what really happened."



“Do not put your faith in what statistics say until you have carefully considered what they do not say.”

William W. Watt

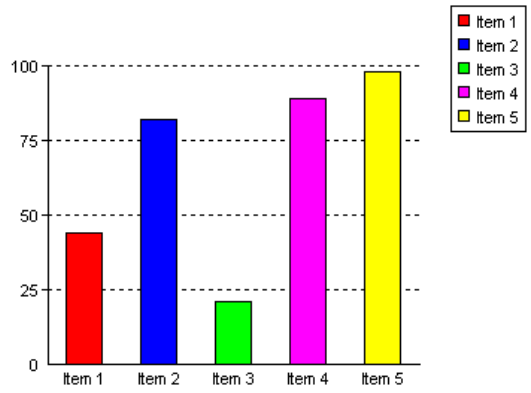

NO
What does the data tell you?

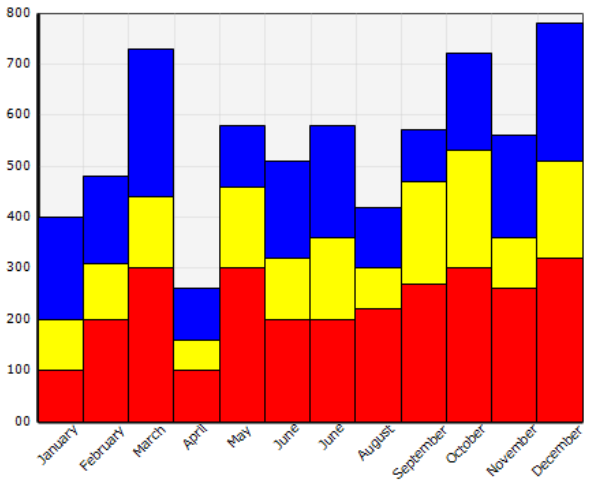
“There are three kinds of lies: lies, damned lies, and statistics.”

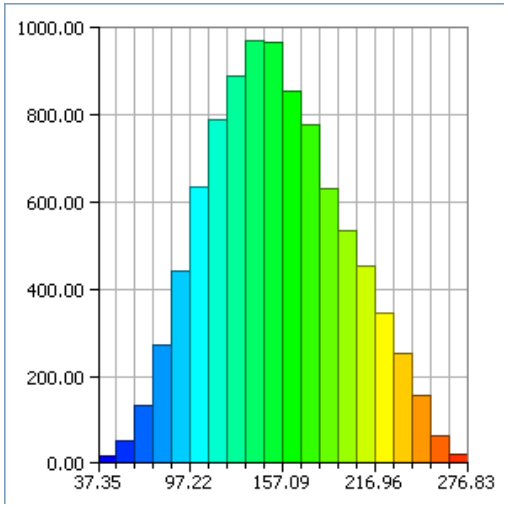
Mark Twain

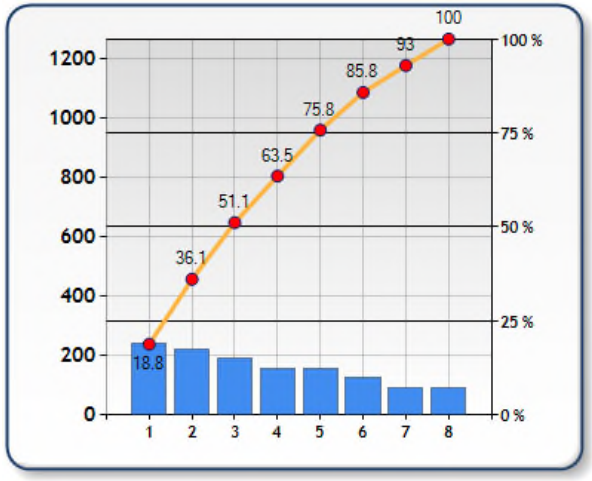
Basic Decision Making Tools

- Bar Charts









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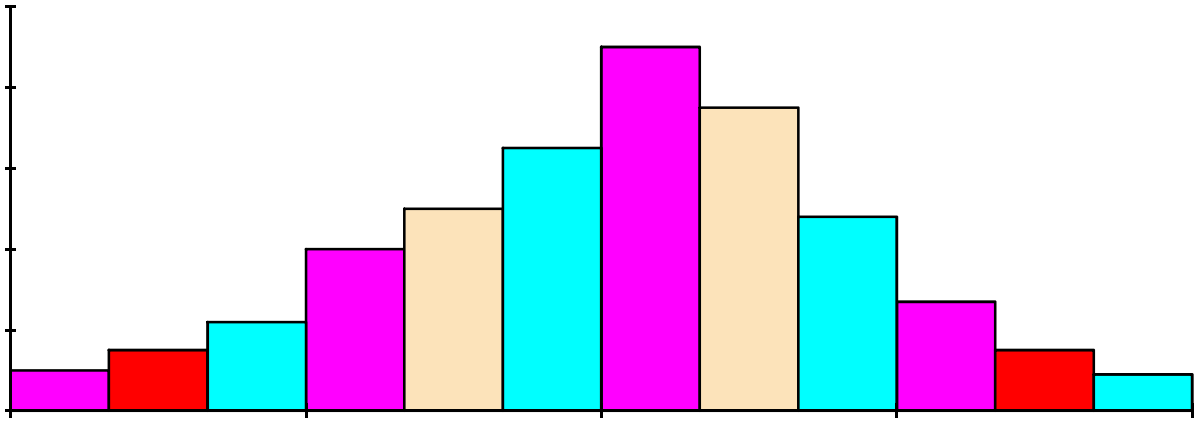
Basic Decision Making Tools

Histogram

What is a Histogram?

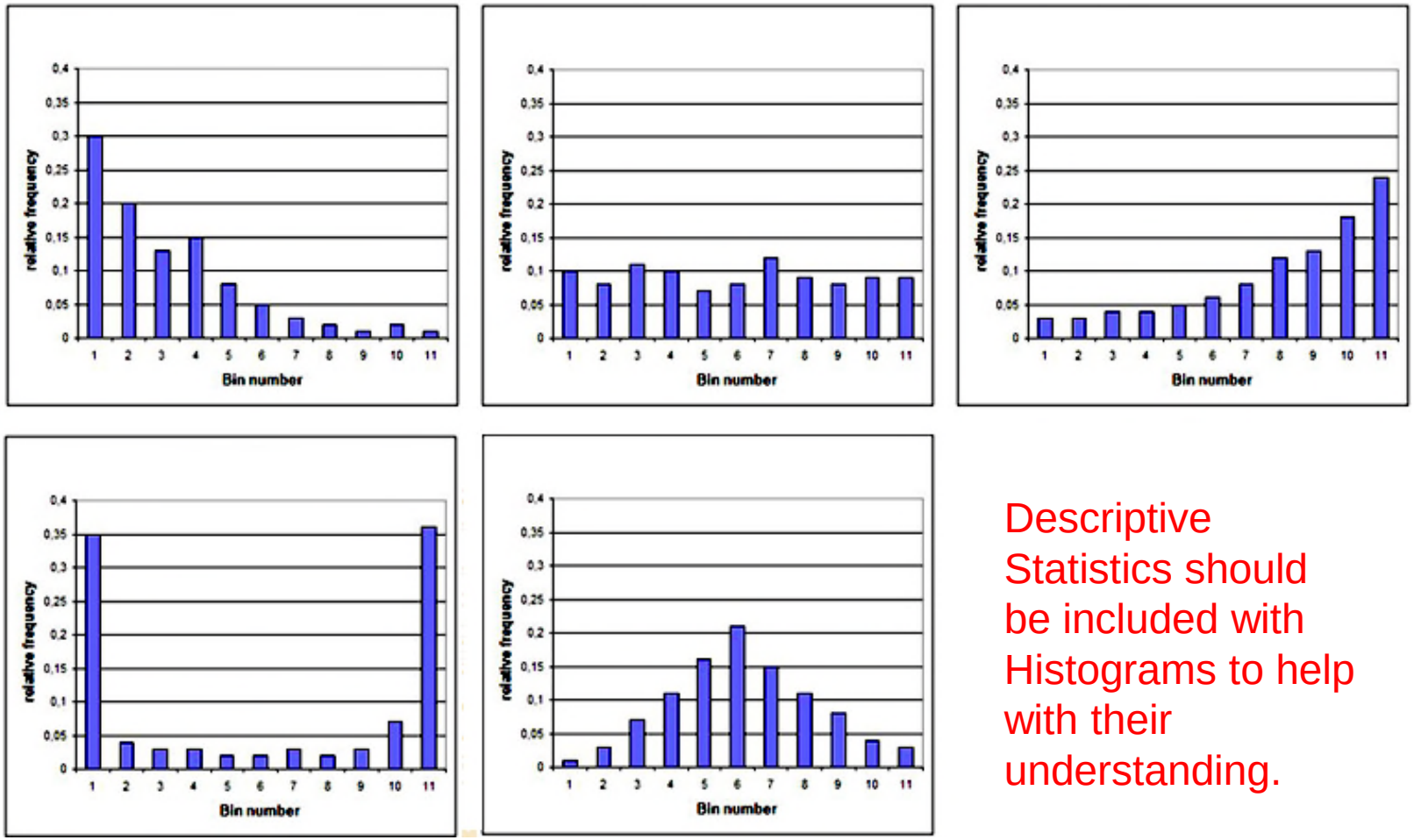


- A bar graph that shows the distribution of CONTINUOUS data
- A snapshot of data taken from a process

When are Histograms used?

- Summarize large data sets graphically
- Compare process results to specification
- Communicate information to the team
- Assist in decision making

Data Distributions

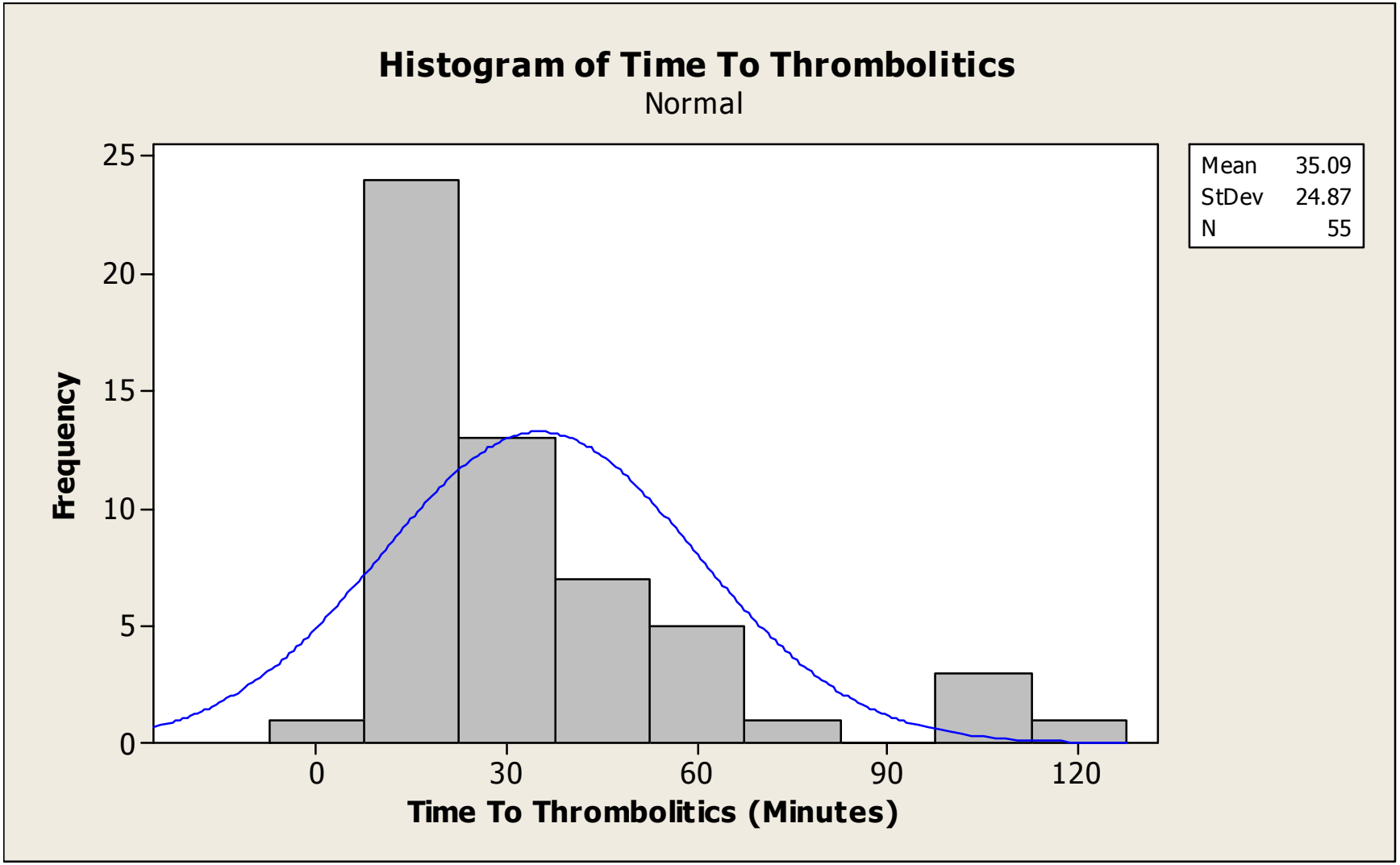


Descriptive Statistics should be included with Histograms to help with their understanding.

Descriptive Statistics

Wait Time (Hours)	
Mean	5.39
Standard Error	0.06
Median	5.45
Mode	5.95
Standard Deviation	0.73
Sample Variance	0.54
Kurtosis	0.18
Skewness	-0.40
Range	4.30
Minimum	2.95
Maximum	7.25
Sum	808.40
Count	150.00

Distribution



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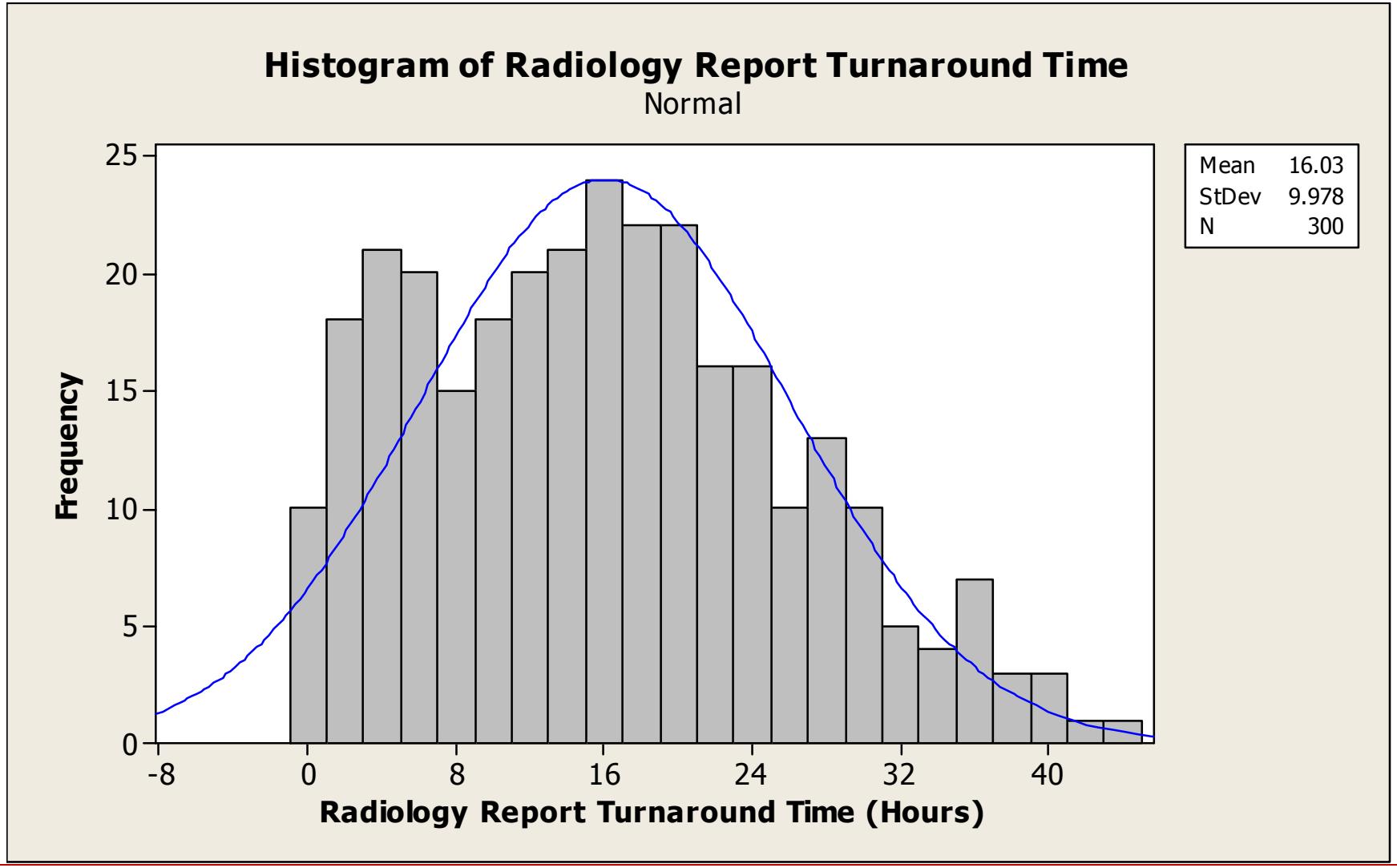
Distribution



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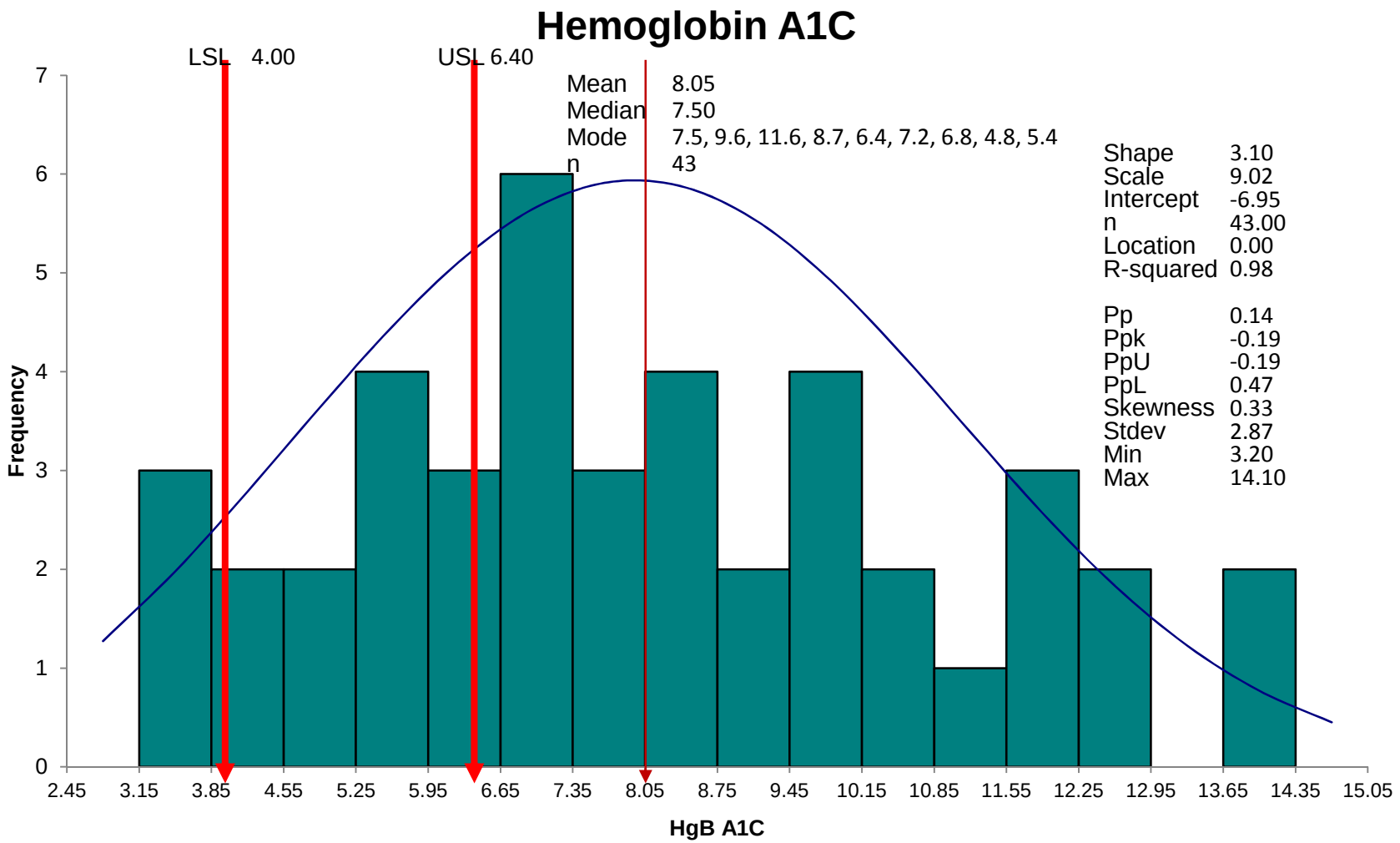
Distribution



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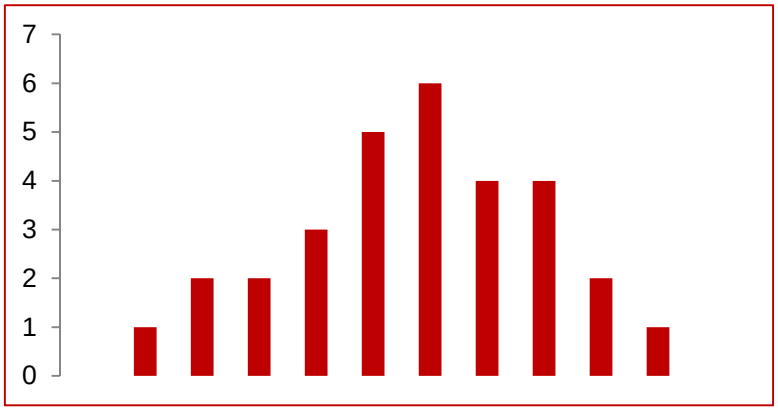
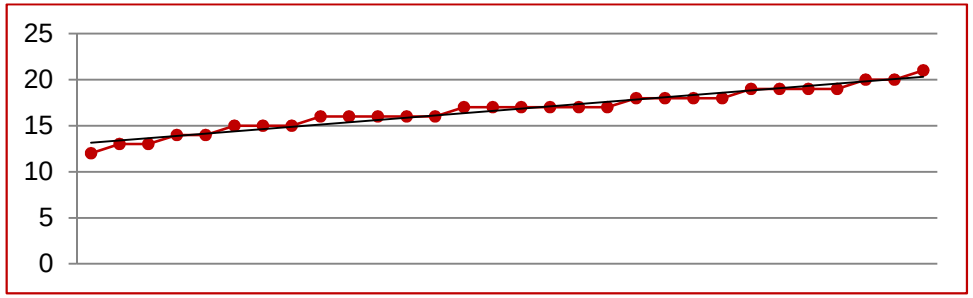
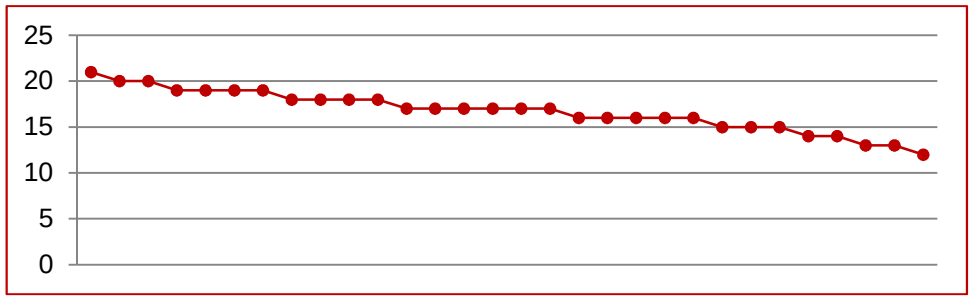
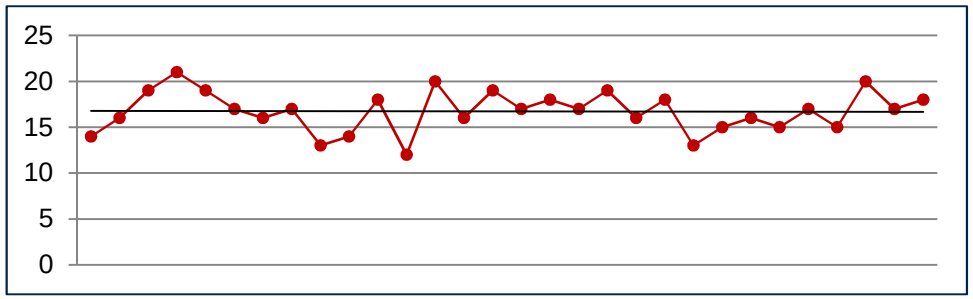
Histogram Analysis

- Histograms are a snapshot in time and show “distribution”.
- They do NOT show trends over time.









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Histogram

What Have People Used Histograms For?

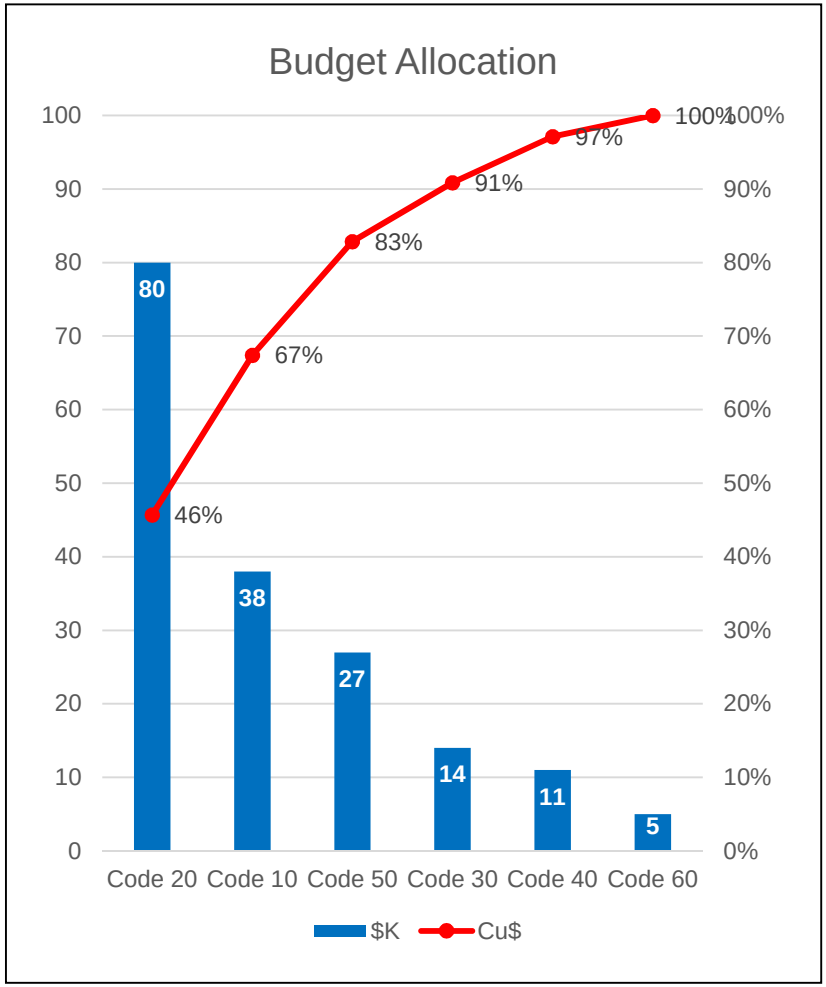
- Time to complete a type of lab test.
- Minutes waiting time.
- Cost per case
- Length of Stay
- Age of all unplanned readmits
- Length of time to respond to STAT Requests from ED for radiology
- Number of sessions of therapy attended before premature termination of therapy.

Basic Decision Making Tools

Pareto Chart

What is a Pareto Chart?

- Bar chart arranged in descending order of height from left to right
- Bars on left relatively more important than those on right
- Separates the "vital few" from the "useful many" (Pareto Principle)
- 80/20 Rule
  - 80% of the gain from 20% of the categories



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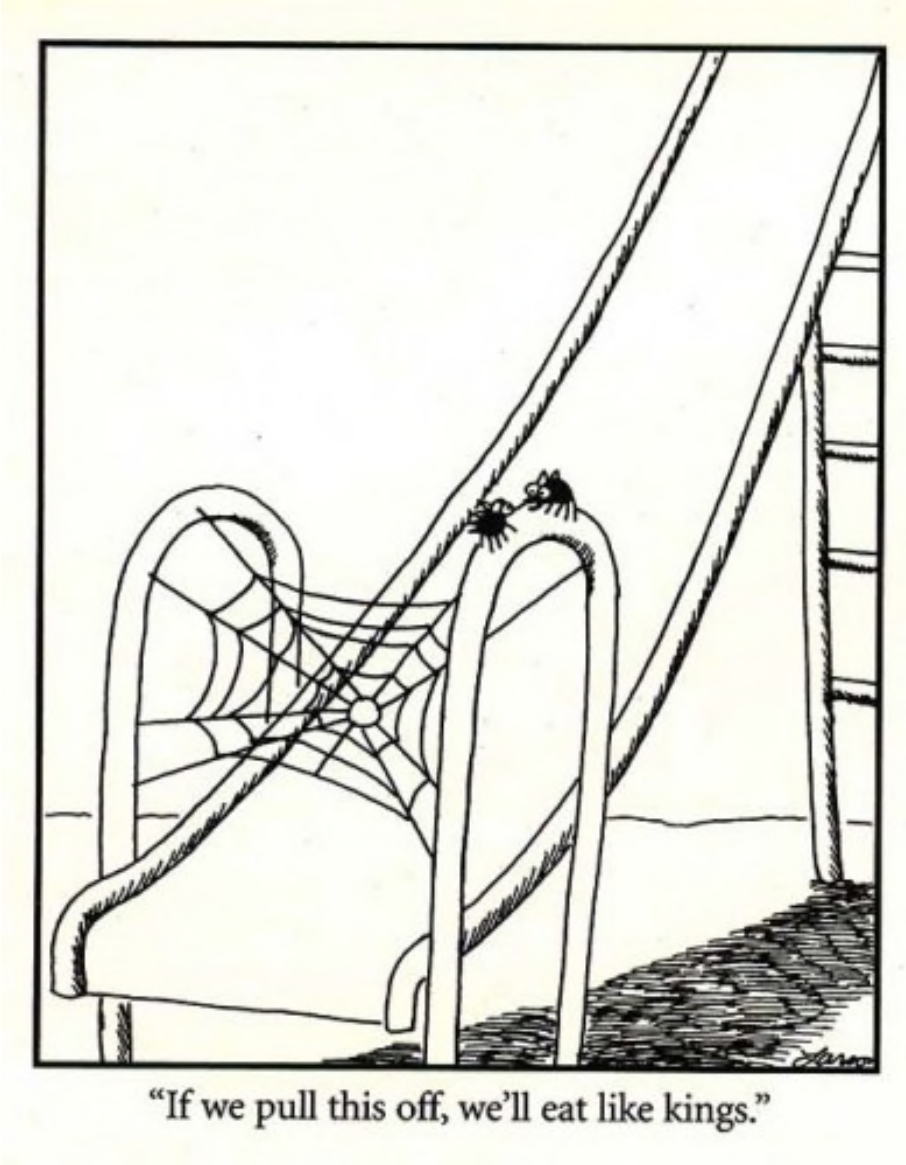
Why use a Pareto Chart?

- Breaks big problems into smaller pieces
- Displays causes or problems in priority order
- Identifies most significant factors
- Shows where to focus efforts
- Allows better use of limited resources

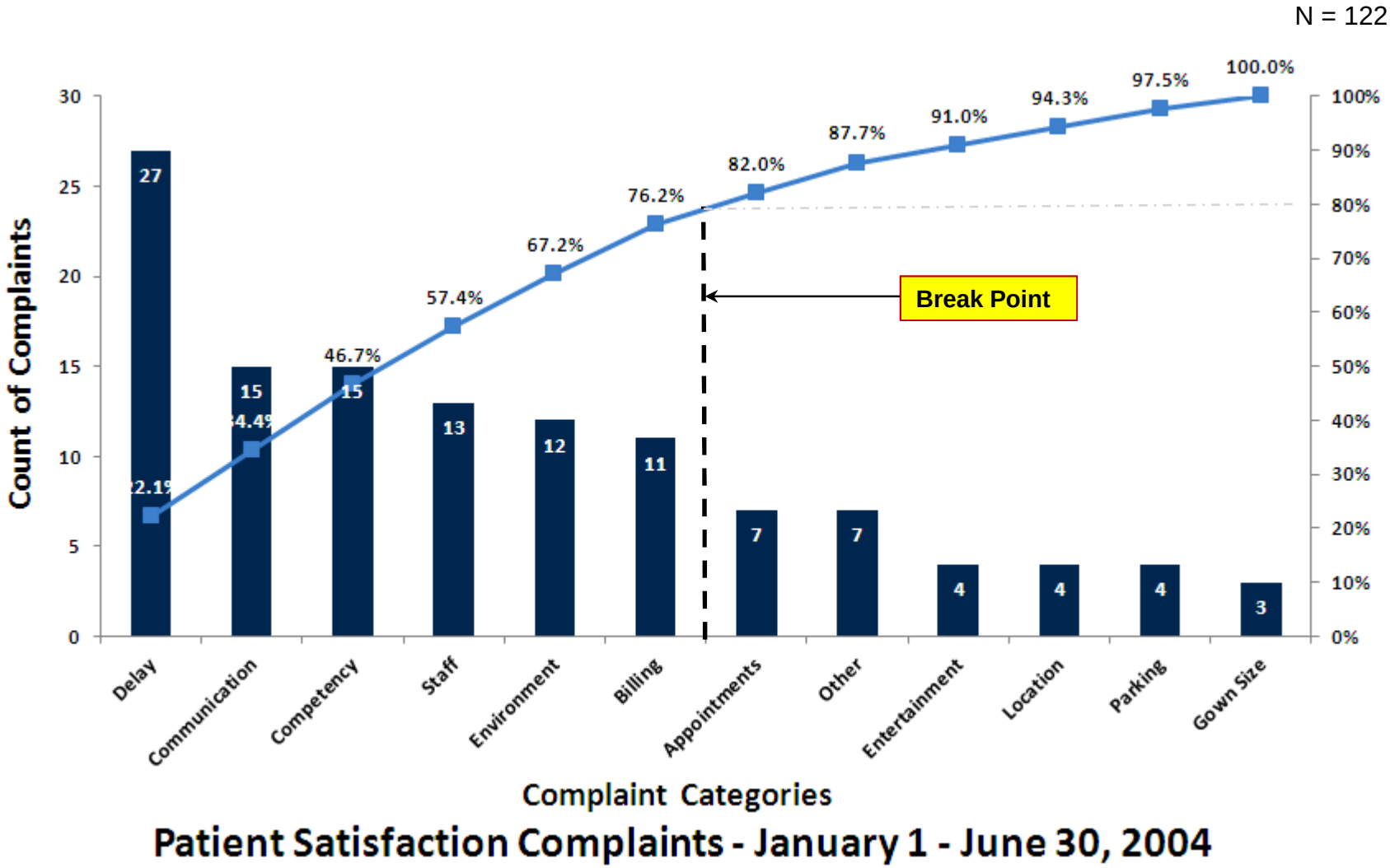
Why use a Pareto Chart?

Most people trying to start an improvement try to tackle ALL of the problems at one time rather than breaking it down into manageable pieces.



"If we pull this off, we'll eat like kings."

Pareto Chart Construction



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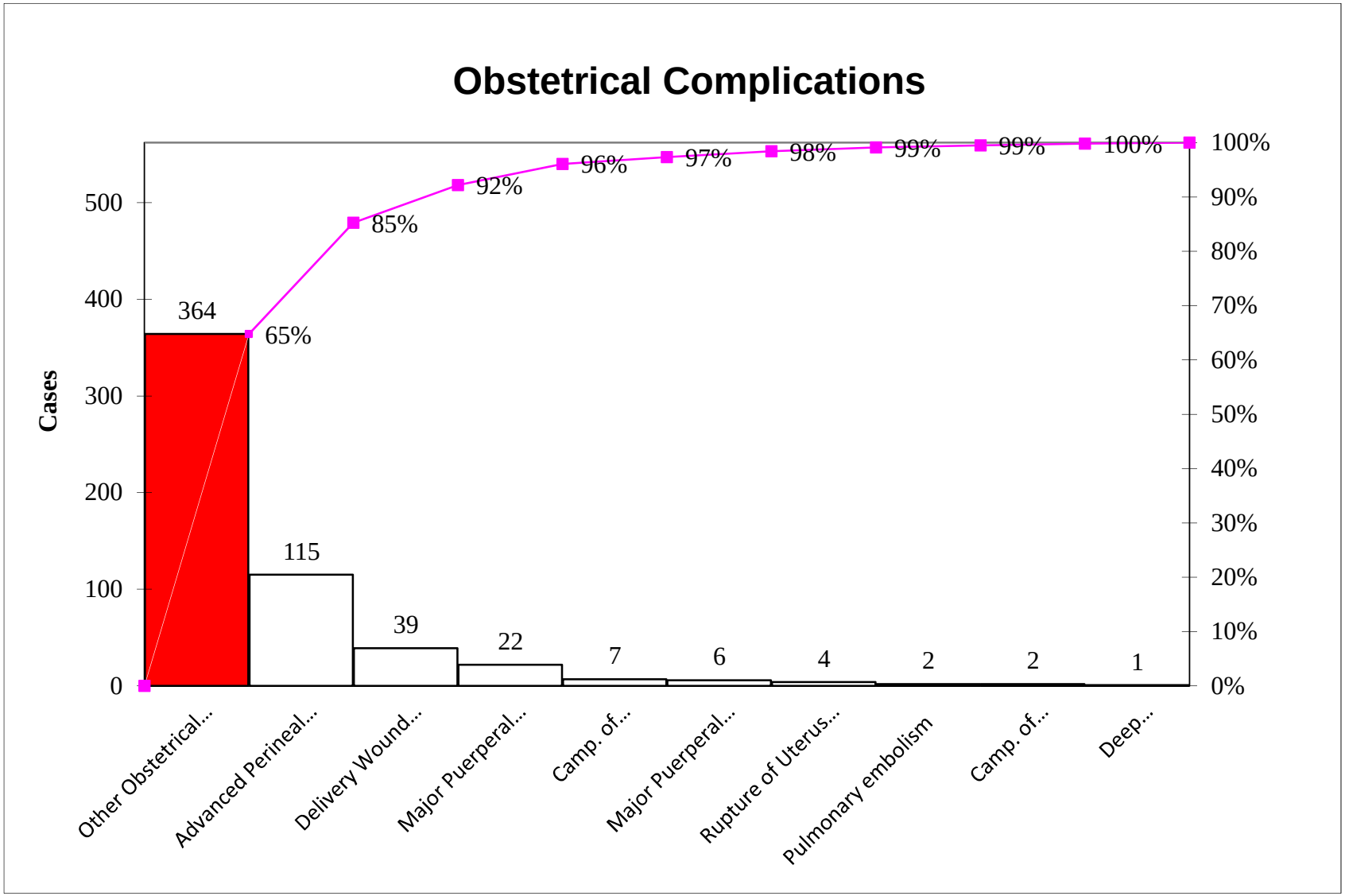
Pareto Chart



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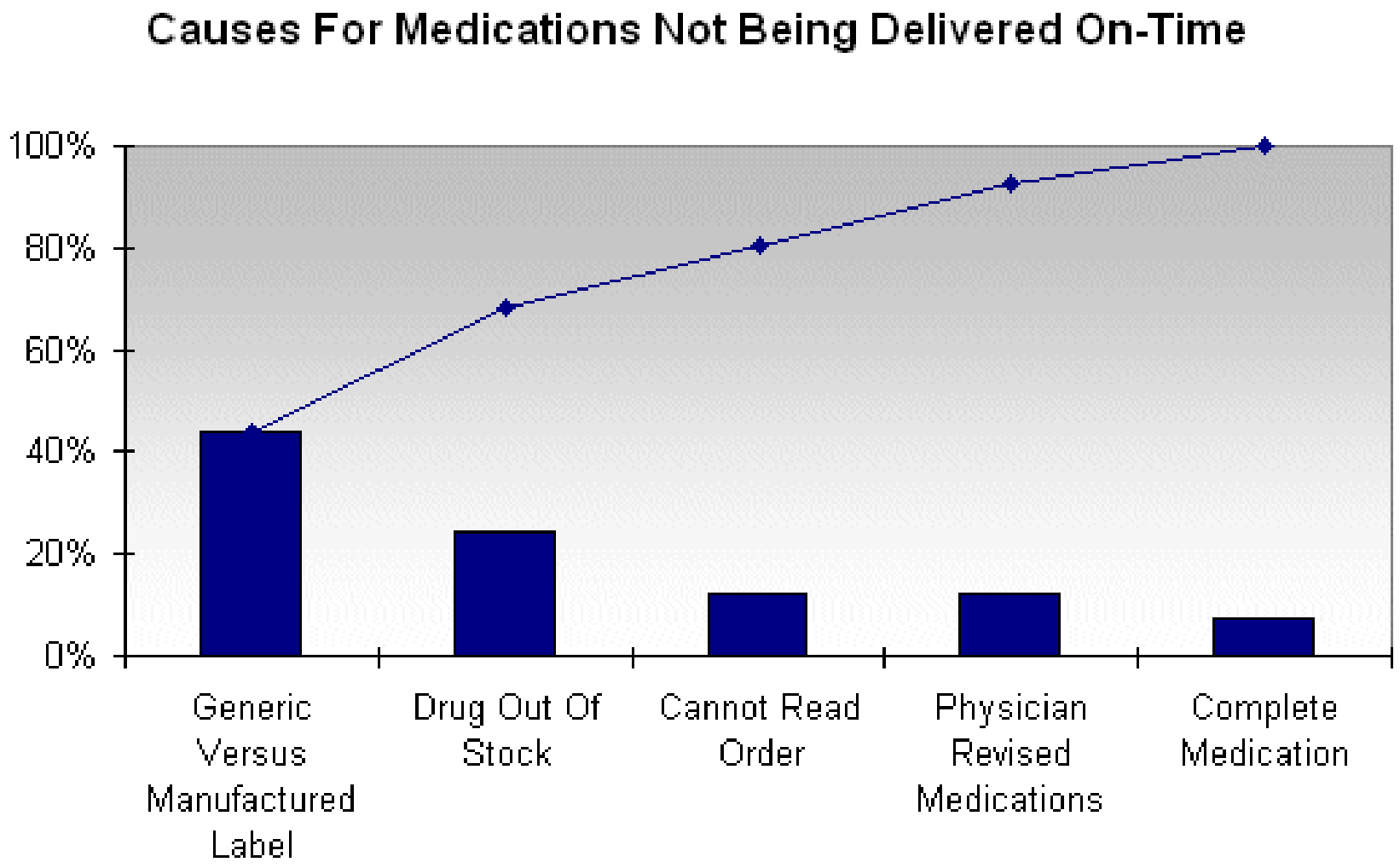
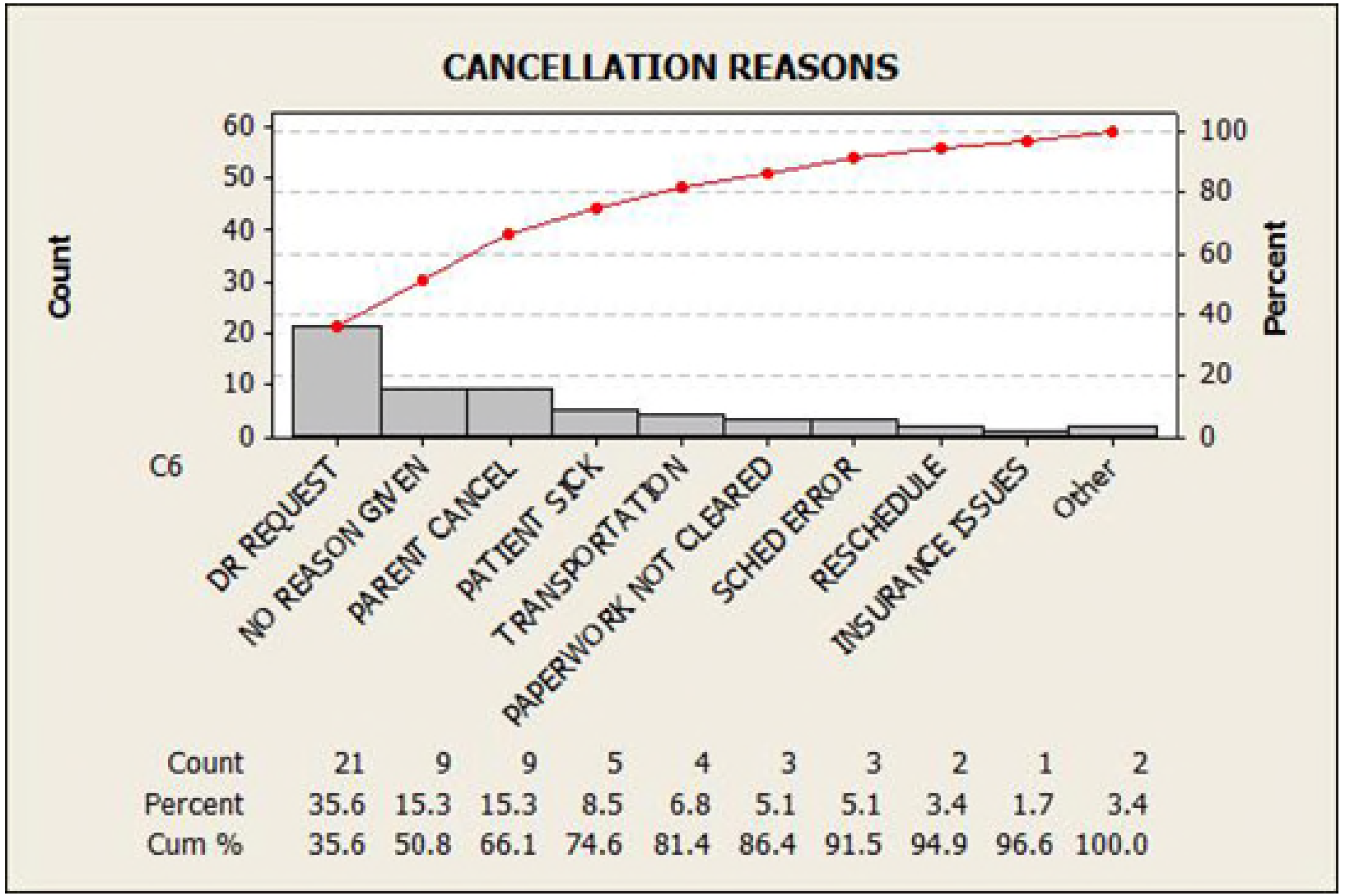
Pareto Chart



Pareto Chart



Count	21	9	9	5	4	3	3	2	1	2
Percent	35.6	15.3	15.3	8.5	6.8	5.1	5.1	3.4	1.7	3.4
Cum %	35.6	50.8	66.1	74.6	81.4	86.4	91.5	94.9	96.6	100.0

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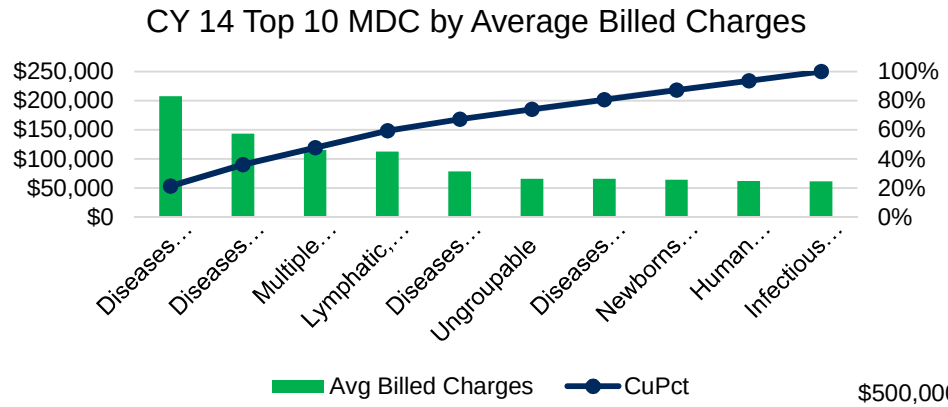
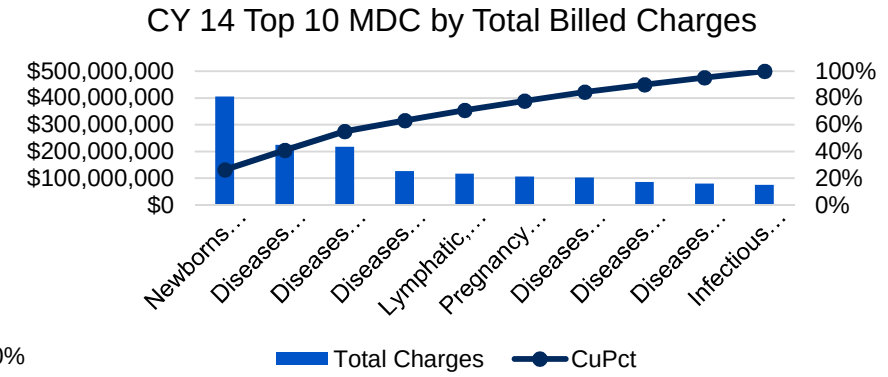
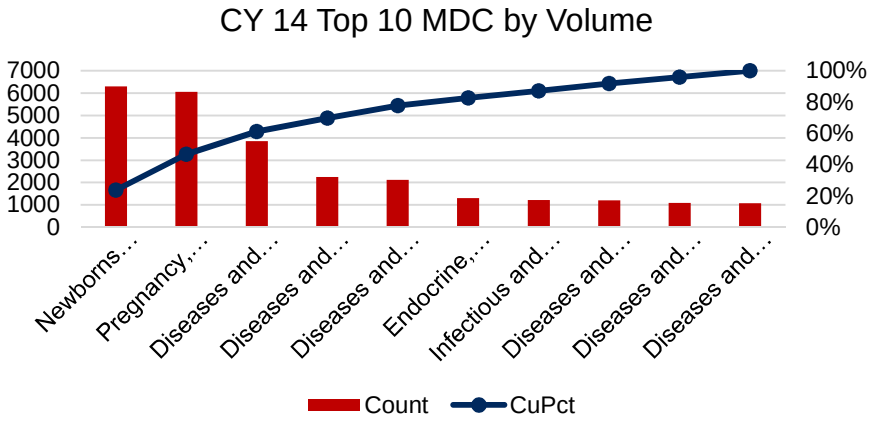
Pareto Chart







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Pareto Chart

What Have Others Used Pareto For?

- Sources of referrals to home care
- Reasons for same day surgery cancellations
- What customers called most about in Managed Care Organizations (what benefits)
- Causes of readmission
- Reasons for patients switching physicians
- Hospitals with most unplanned C-sections
- Causes of falls, needlesticks, med errors
- Reasons for Monday phone calls
- Reasons for delays (Discharge, etc)

Basic Decision Making Tools

Scatter Diagram

What is a Scatter Diagram?

A graph of paired data points plotted on a table that helps identify the possible relationship between the changes observed in two different sets of variables.

Why use Scatter Diagrams?

- Supplies the data to confirm a hypothesis that two variables are related.
- Provides both a visual and statistical means to test the strength of a potential relationship.
- Provides a good follow-up to a Cause and Effect Diagram to find out if there is more than just a consensus connection between causes and the effect.

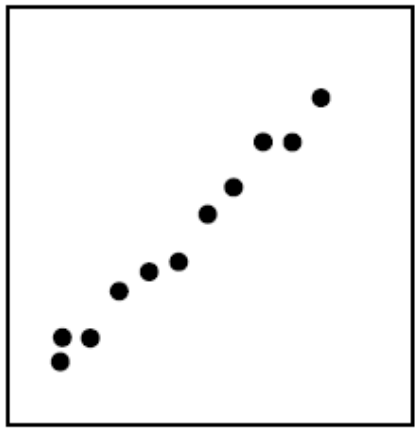
Why use Scatter Diagrams?

"Watch what happens when I do this."

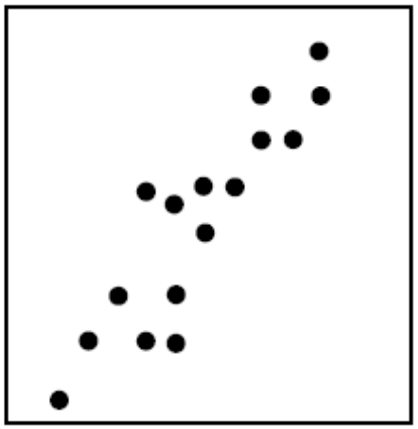
Interpreting Scatter Diagrams

- Strong Positive Correlation: An increase in y may depend on an increase in x.
- Moderate Positive Correlation: If x is increased, y may increase somewhat.
- No Correlation: There is no demonstrated connection between training experience and session ratings.
- Moderate Negative Correlation: As x is increased, y may decrease somewhat.
- Strong Negative Correlation: A decrease in y may depend on an increase in x.
- Non-Linear or Curvilinear: May increase or decrease alternately to create an arch or sigmoid curve

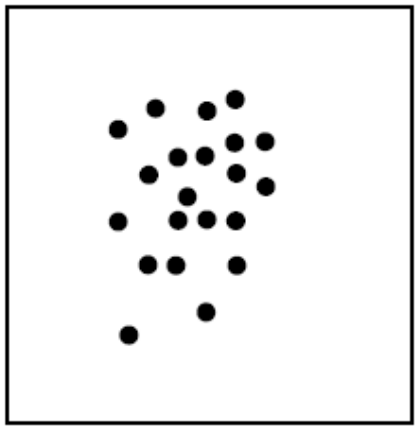
Scatter Diagram Correlation



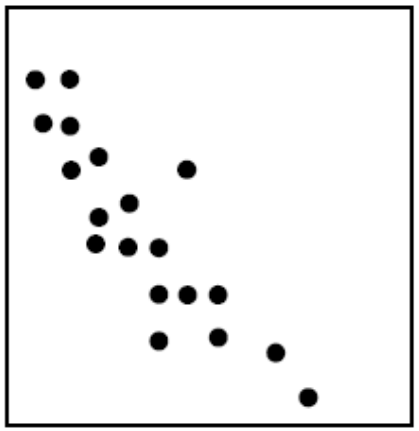
Strong positive correlation



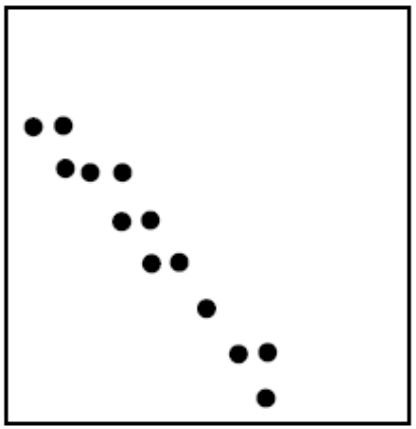
Moderate positive correlation



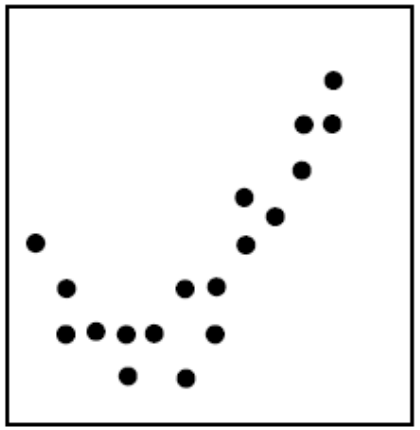
No correlation



Moderate negative correlation

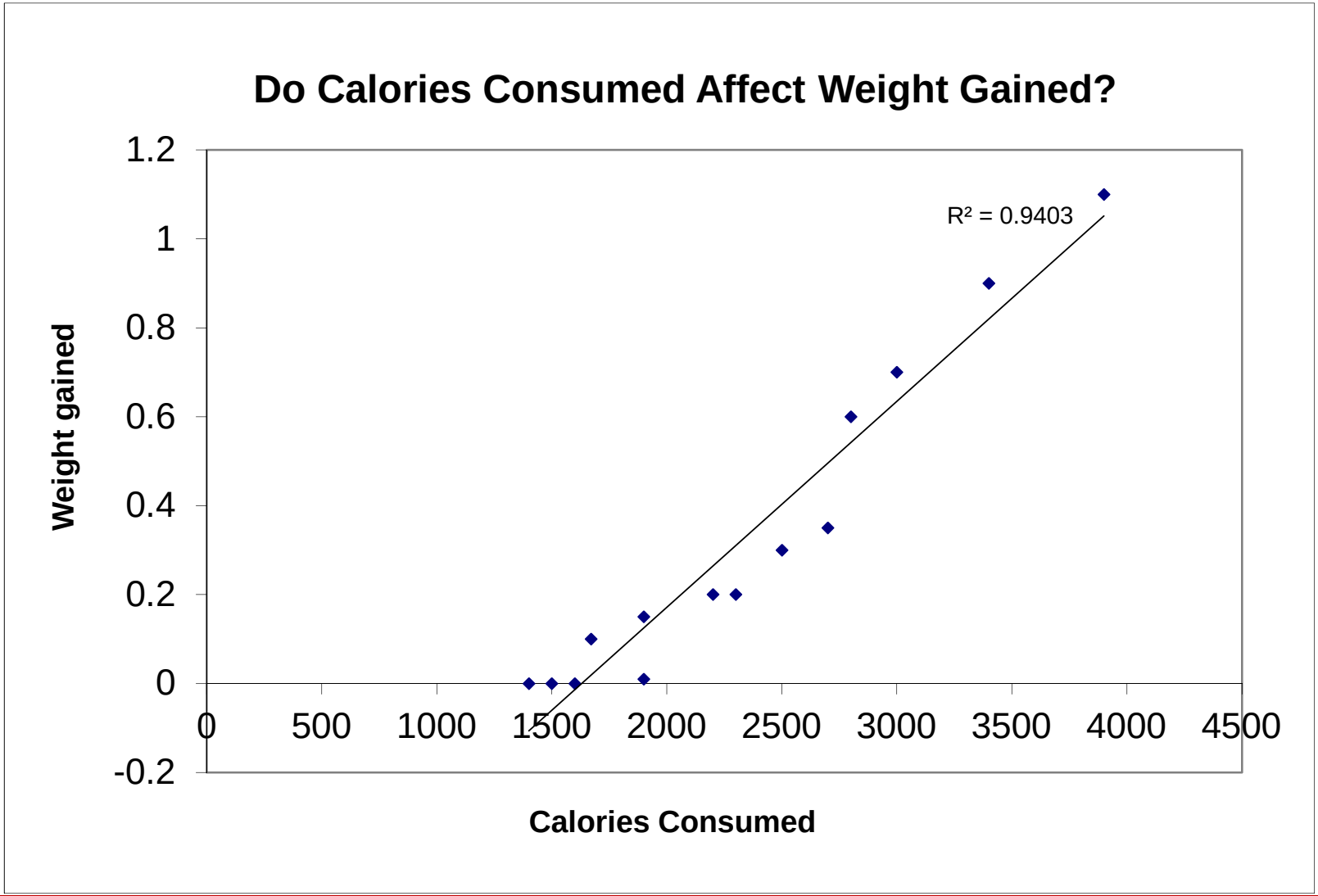


Strong negative correlation

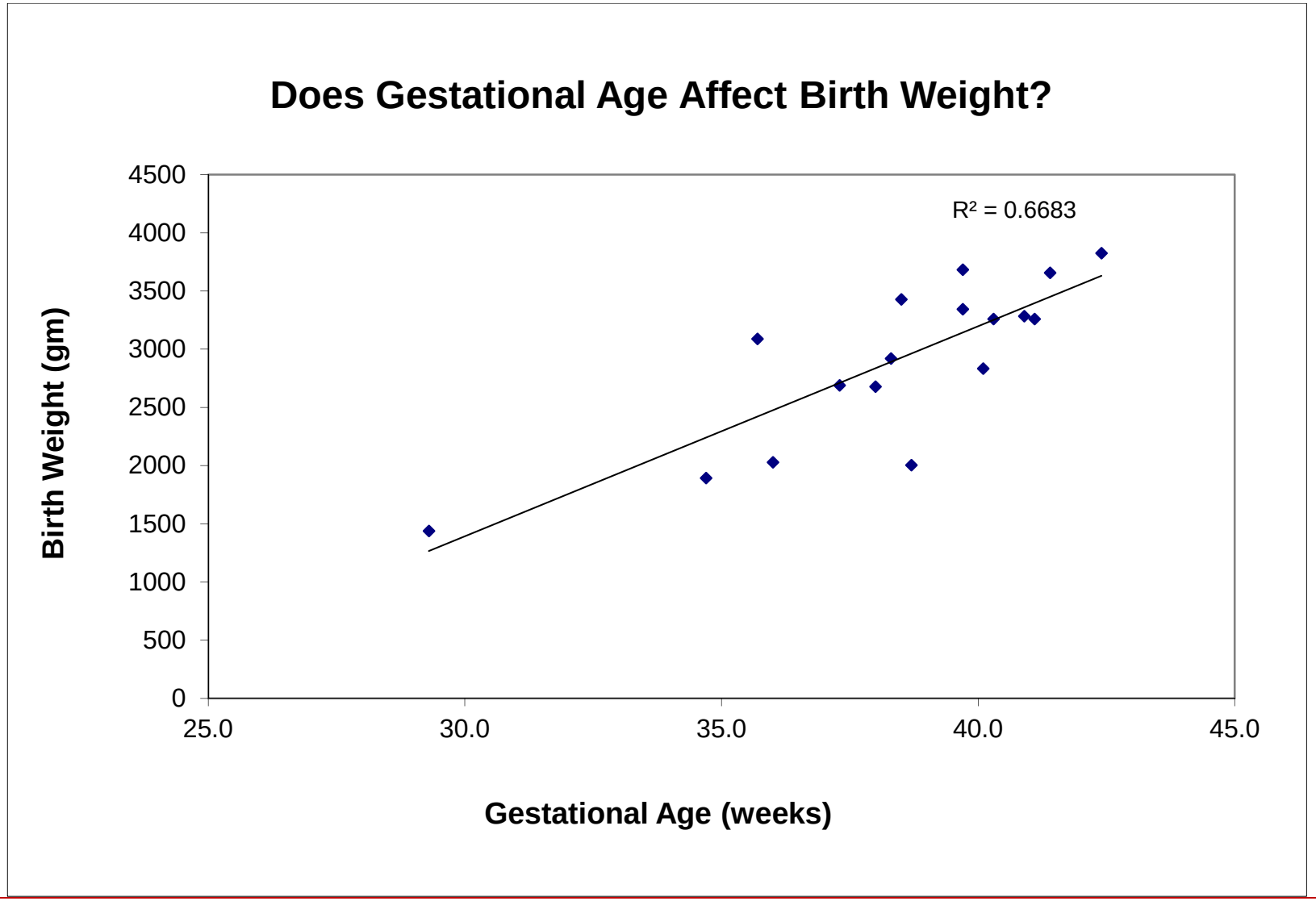


Curvilinear relationship

Scatter Diagram Example



Scatter Diagram Example



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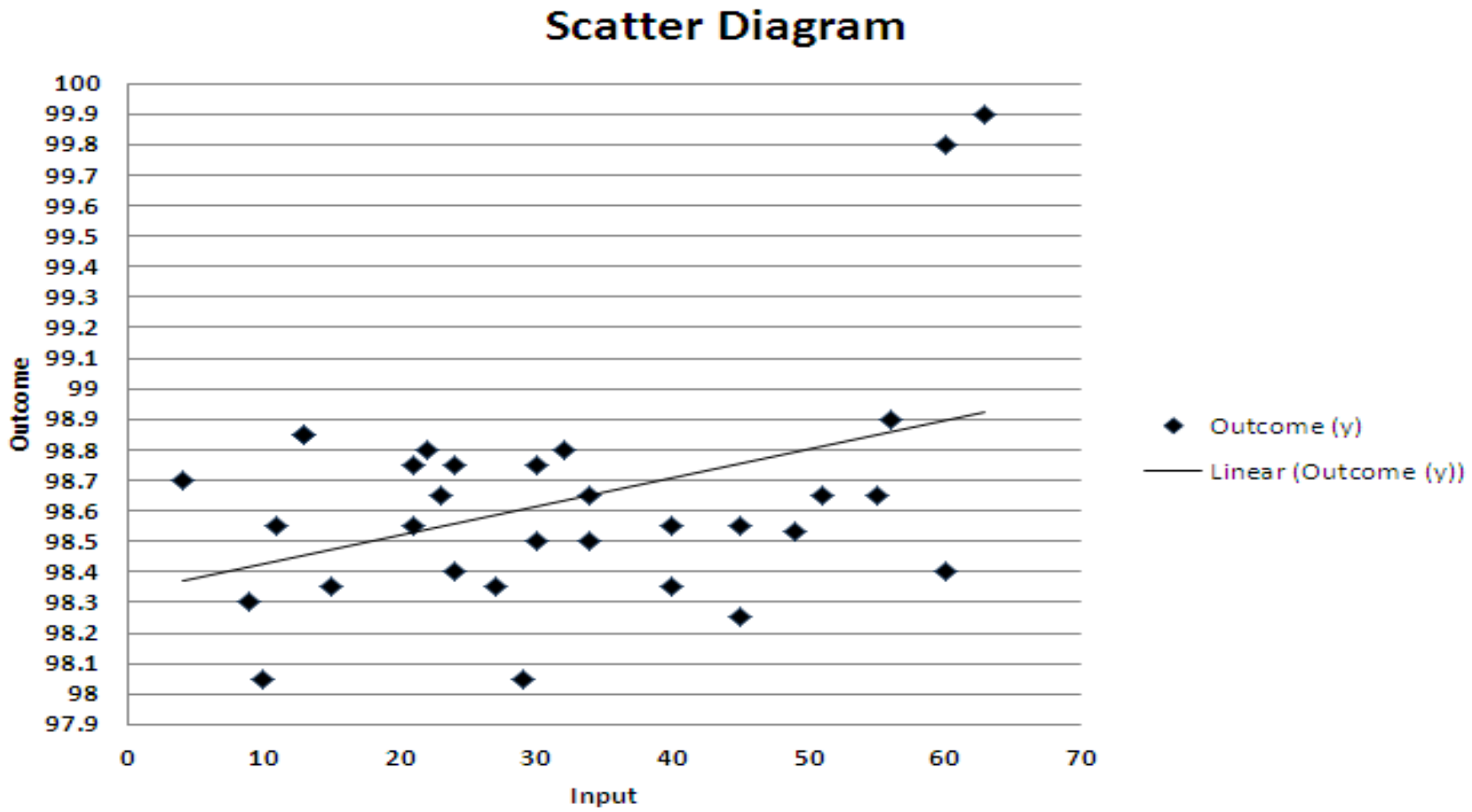
Scatter Diagram Example

Is there a correlation?



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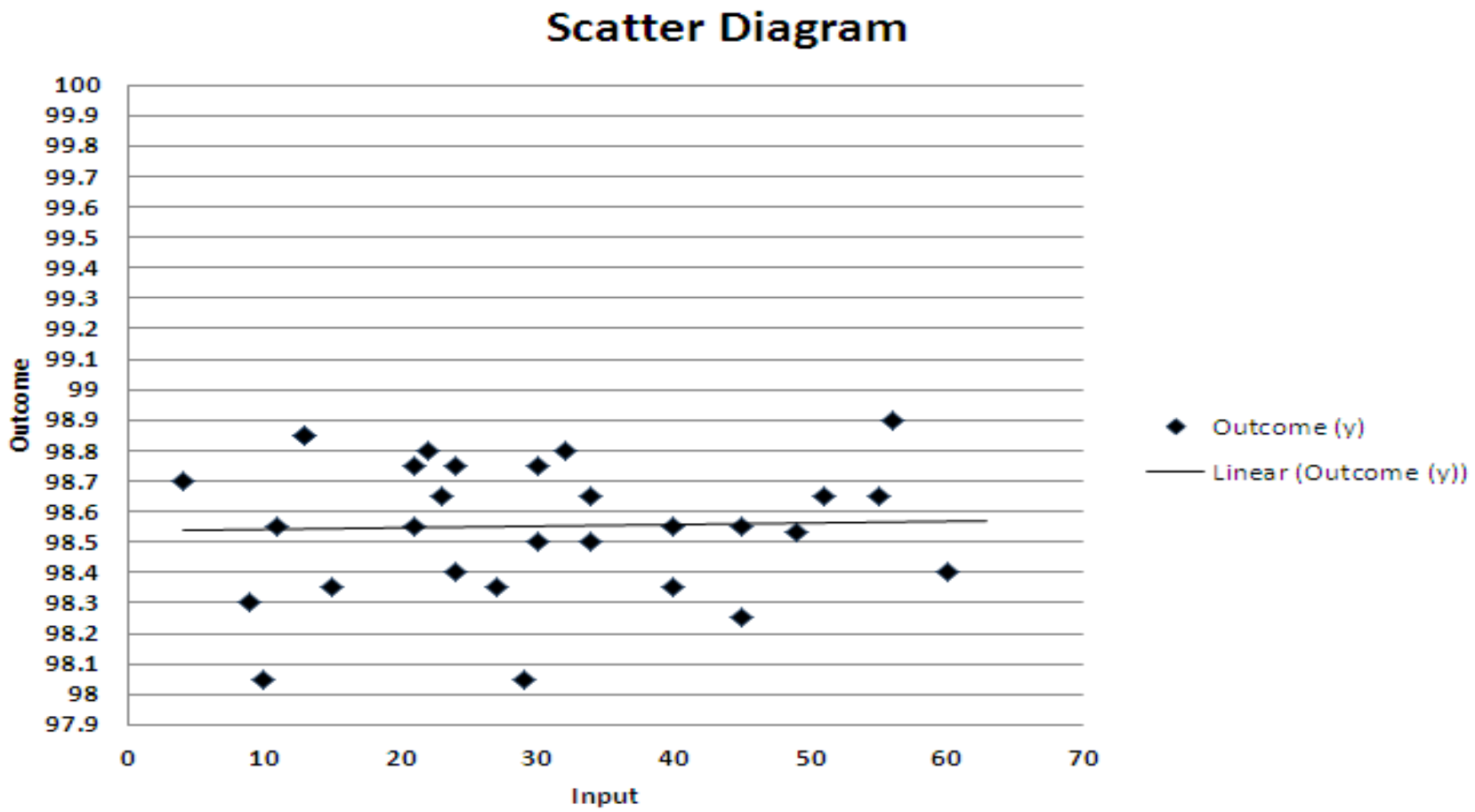
Scatter Diagram Example

Beware of False Correlation



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Scatter Diagram

What Have People Used Scatter Diagrams For?

- Following are paired samples (X, Y)
  - (amount of Pitosin given, length of labor)
  - (amount of drug given, pain rating)
  - (minutes treatment given, mobility rating)
  - (rating on a particular question, overall customer satisfaction rating)
  - (age, length of stay)
  - (# phone orders, rate of late prescription fills)
  - (volume of work, proportion of errors)

Basic Decision Making Tools

Understanding Variation

Basic Decision Making Tools

Variation

Variation - Any quantifiable difference between individual measurements; such differences can be classified as being due to common causes (random) or special causes (assignable)

Variation: A change in data, characteristic or function caused by one of four factors: common causes, special causes, tampering or structural variation.

- American Society for Quality

Common vs Special Causes of Variation

Common Causes

- Also called Chance causes of variation.
- Inherent in the process, affect all data points.
- Must focus on improving the process to decrease common cause variation.
- The “background noise” of the process.
- All processes manifest some degree of Common Cause variation.

Special Causes

- Also called Assignable causes of variation.
- Result from some factor unique to a data point.
- Focus on removing special causes to bring process into statistical control.

Neither type of variation is “good” or “bad” in itself!

COMMON CAUSE

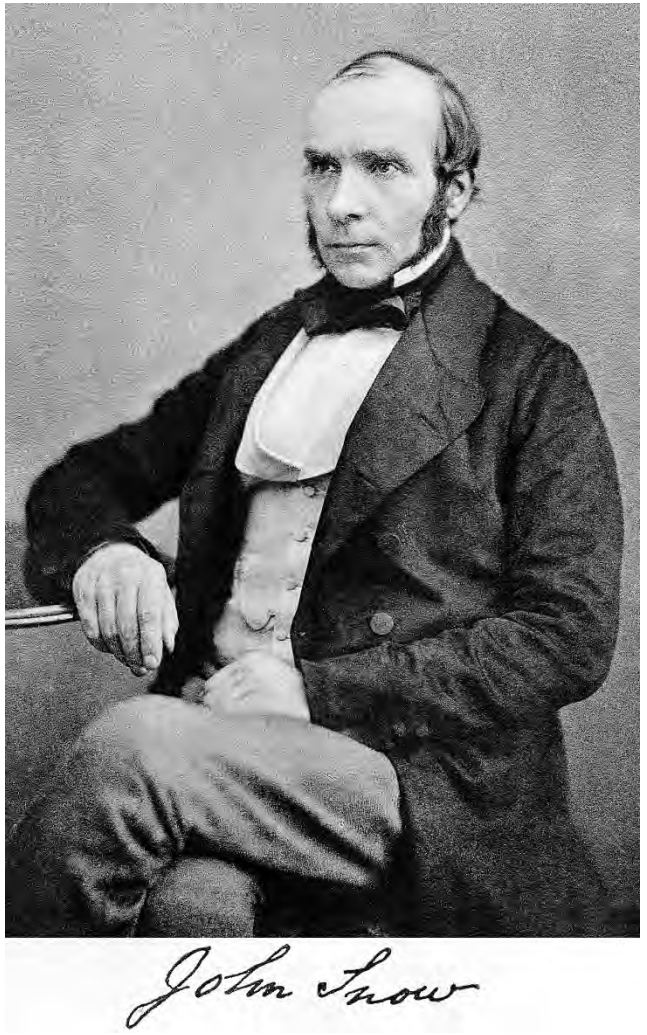
- Only tells you that a process is stable and predictable within certain limits
- However, it may be functioning at an unacceptable level!

SPECIAL CAUSE

- Usually undesirable when you did not plan for it.
- Can also be a “signal” that a planned change was effective.

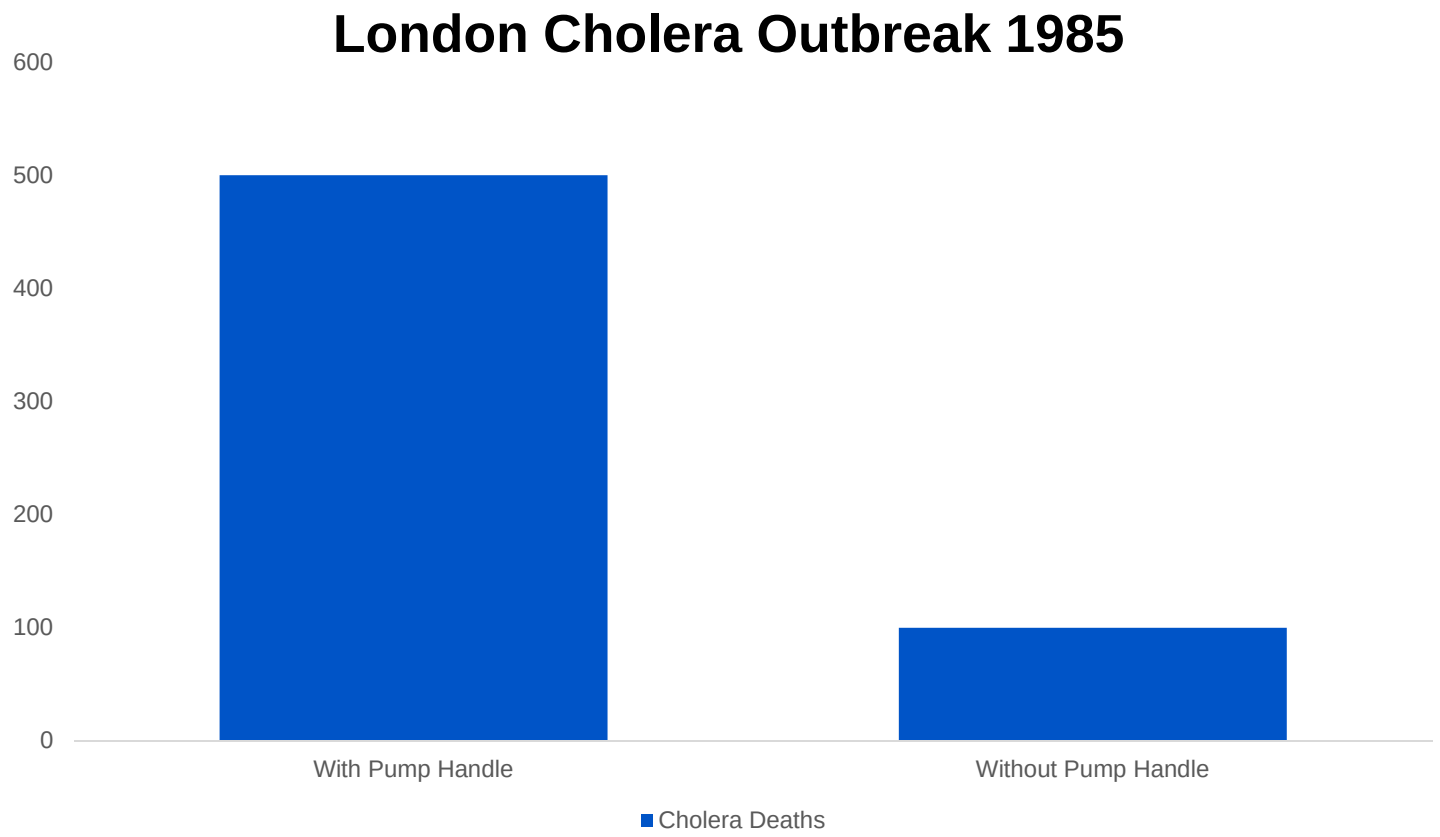
Using Data Over time

In 1854, Dr. John Snow (father of modern epidemiology) plotted the location of the deaths from a Cholera epidemic on a map of London, and observed that most deaths occurred among those who lived near the Broad Street water pump. He came to the conclusion that they were sharing a contaminated water source. He had an idea to take the handle off of the pump so no one could use it. After he had the handle removed, the epidemic ended.



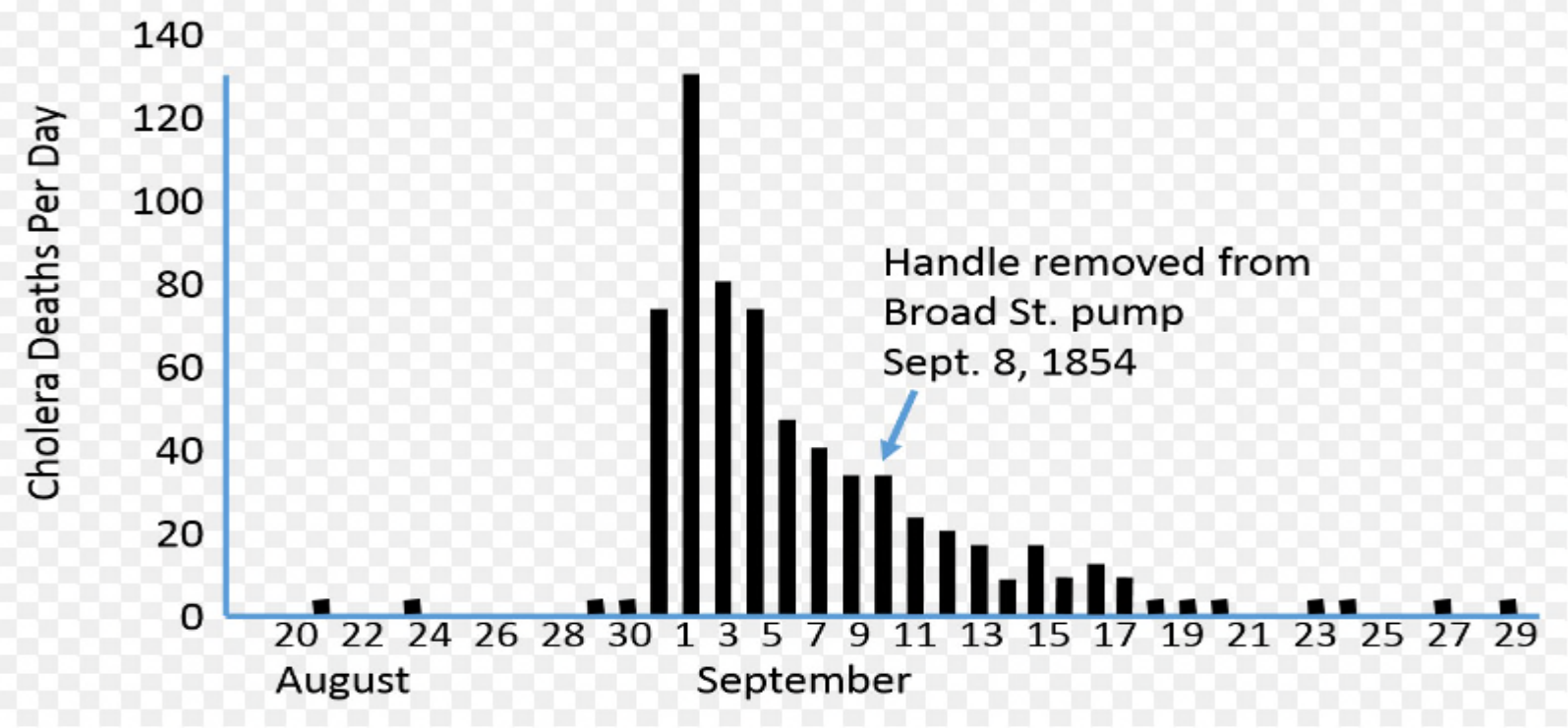
Using Data Over time

If you do a t-Test, you are going to find a significant difference before and after his intervention.



Using Data Over time

But what happens if we look at the data over time with what we know today? There are very few deaths before September first, then we see a dramatic leap once the epidemic begins. But then they begin tapering off. Now after looking at the data over time, how sure are we that removing the pump handle REALLY made the critical difference?



Basic Decision Making Tools

Run Charts

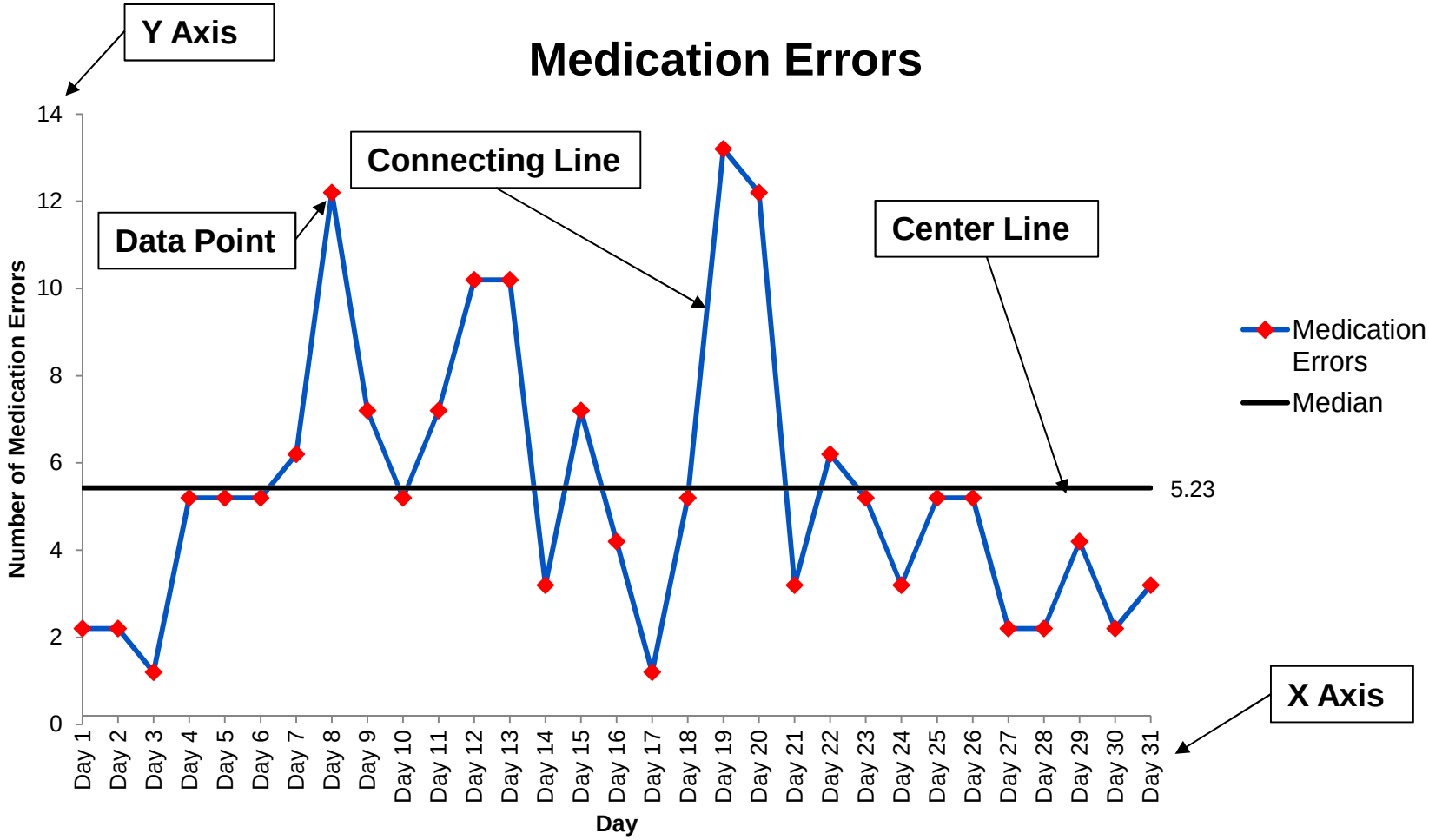
What is a Run Chart?

A line graph of data points plotted in chronological order that helps detect special causes of variation.

What is a Run Chart?

- A running record of process behavior ***over time***.
- Requires no statistical calculations.
- Shows process behavior at a glance.
- Can detect ***some*** special causes.
- Time sequence is plotted on horizontal axis.
- Measure of interest is always plotted on the vertical axis.
- Center Line is the ***mean*** or ***median*** score.

Run Chart


Y Axis
Medication Errors
Connecting Line
Data Point
Center Line
Number of Medication Errors
14
12
10
8
6
4
2
0
5.23
Medication Errors
Median
X Axis
Day 1
Day 2
Day 3
Day 4
Day 5
Day 6
Day 7
Day 8
Day 9
Day 10
Day 11
Day 12
Day 13
Day 14
Day 15
Day 16
Day 17
Day 18
Day 19
Day 20
Day 21
Day 22
Day 23
Day 24
Day 25
Day 26
Day 27
Day 28
Day 29
Day 30
Day 31
Day

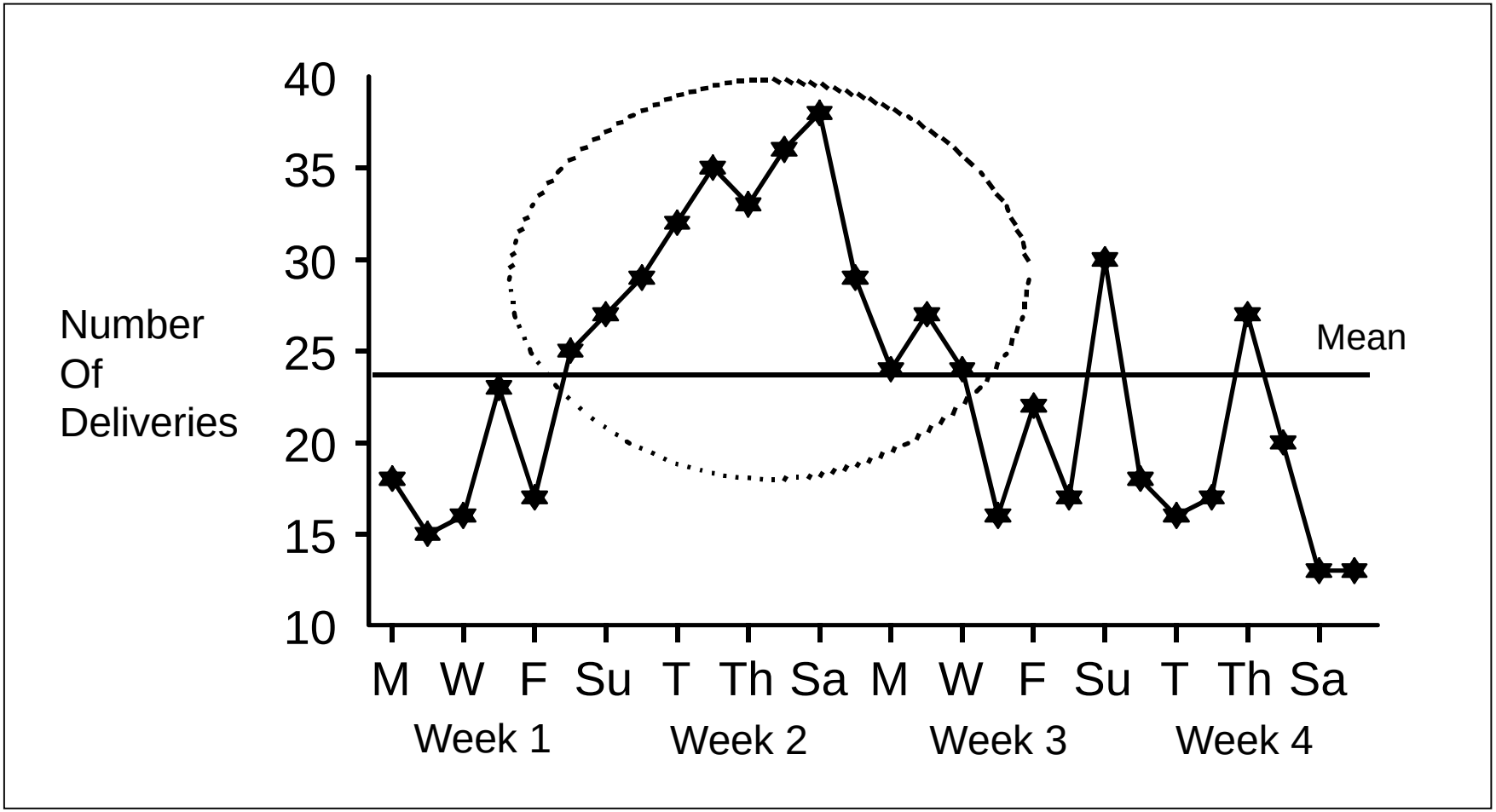
Why use Run Charts?

- Communicate process performance
- Analyze data for patterns
- Assess process stability
- Understand process variation
- Monitor process performance

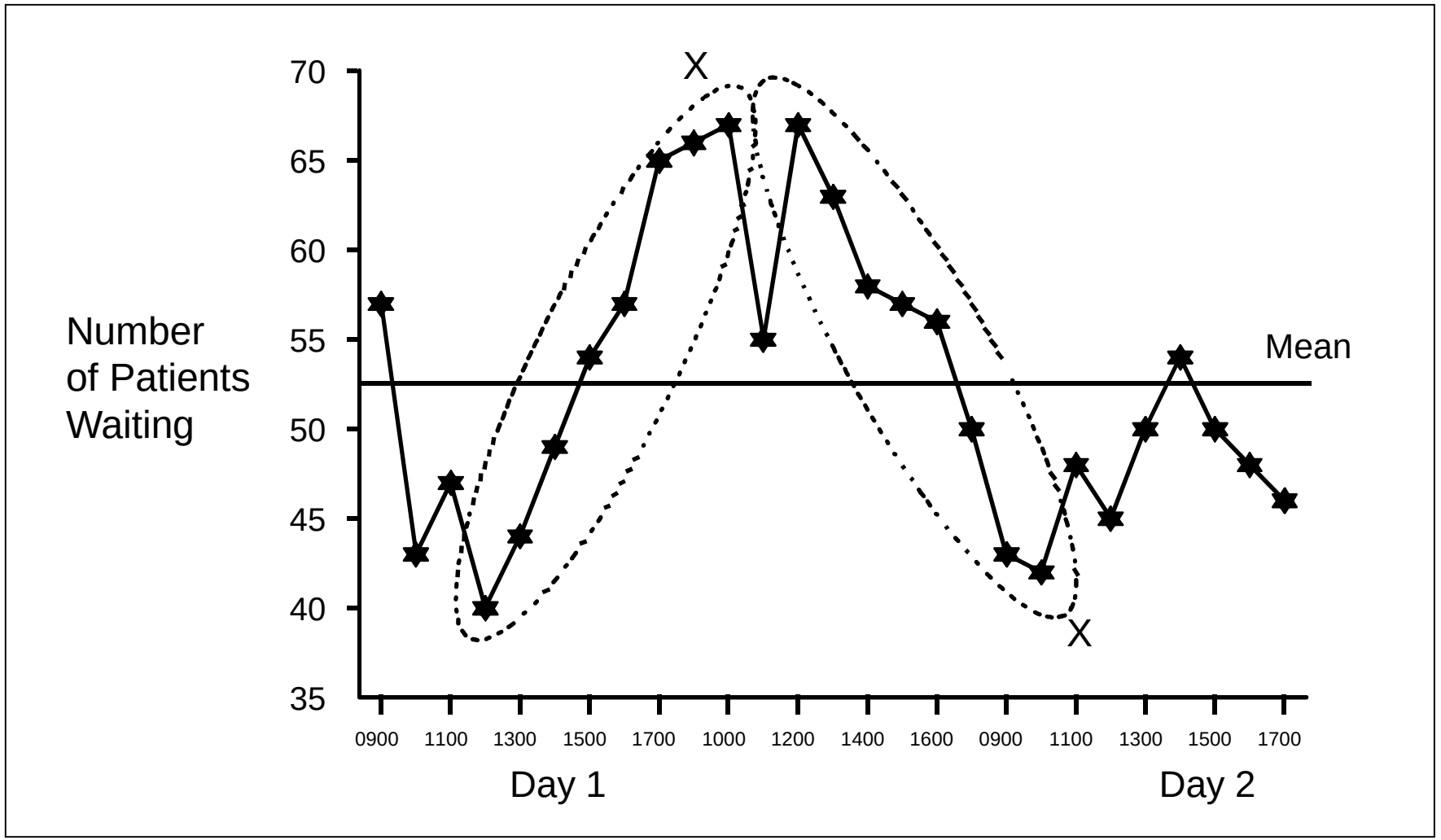
Interpreting Run Charts

- Signals of Special Cause Variation
- **Shift:** 8 or more consecutive data points on the same side of the centerline
- **Trend:** 6 or more consecutive ascending or descending points
- **Repeating Patterns**

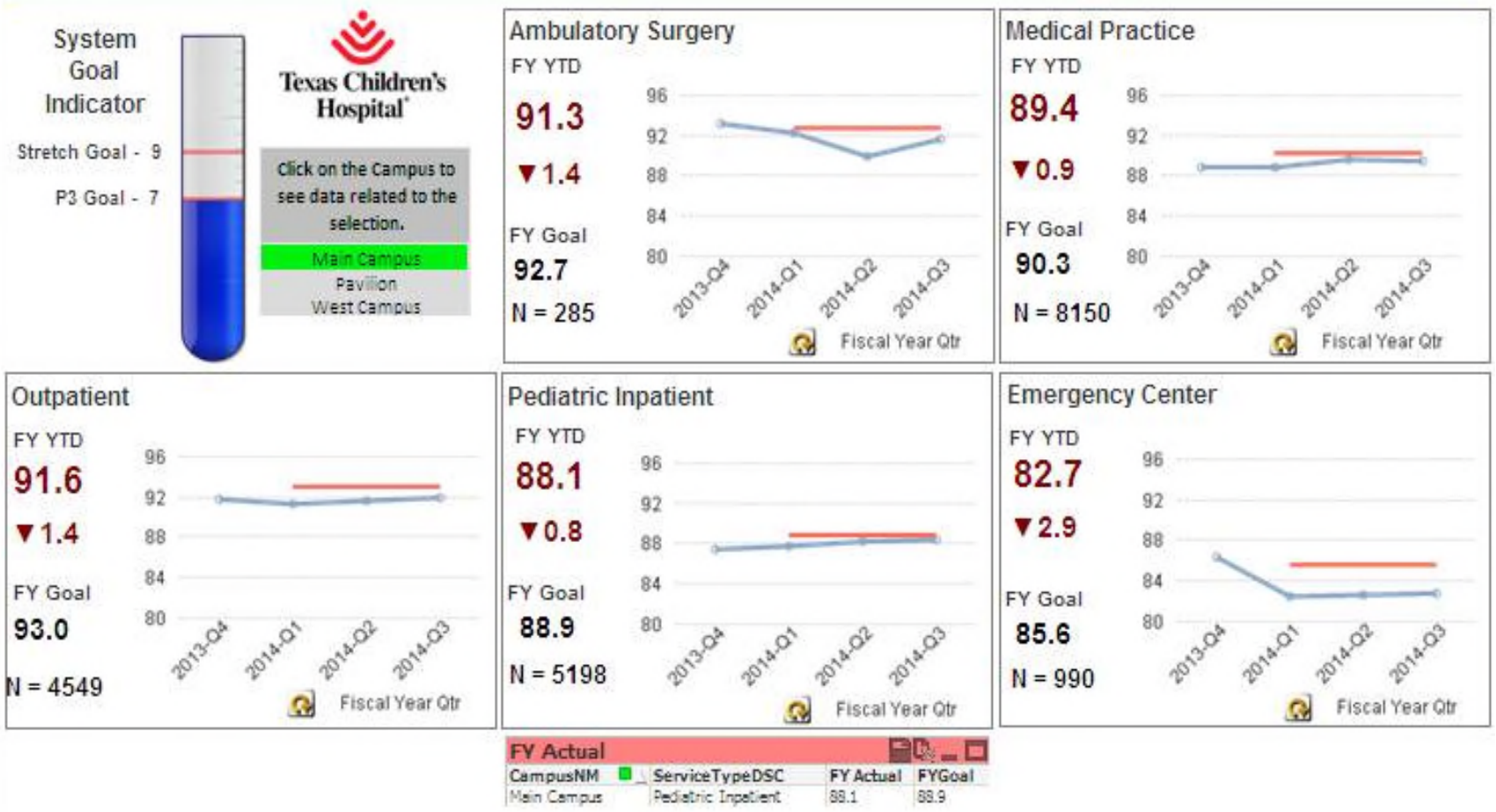
Interpreting Run Charts: Shift



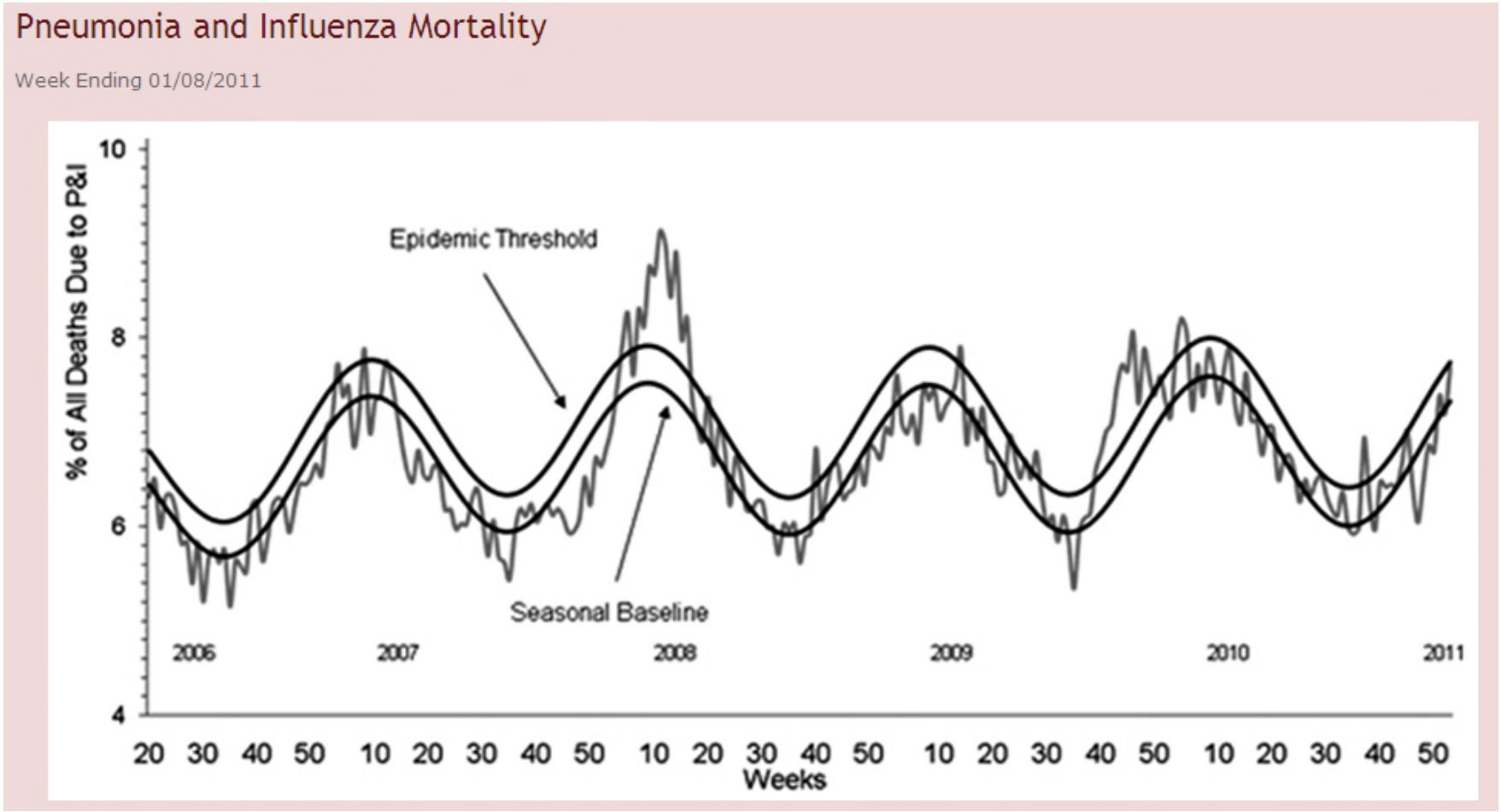
Interpreting Run Charts: Trend



Run Chart Drawbacks



Run Chart Drawbacks



Understanding Data

Basic Decision Making Tools

Control Chart

What is a Control Chart?

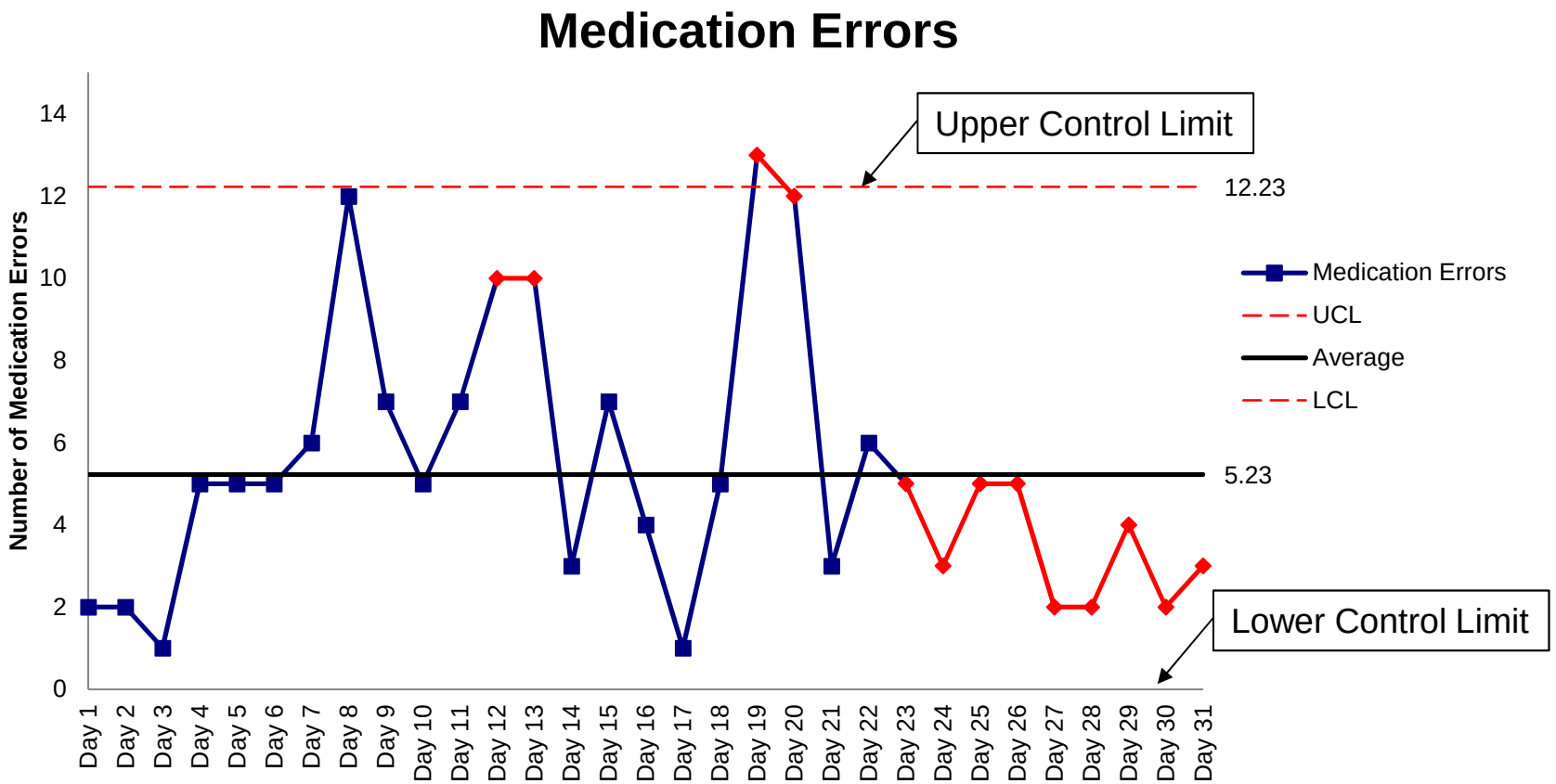
A statistical tool used to distinguish between process variation resulting from common causes and variation resulting from special causes.

When people do not understand variation

- See trends where there are no trends
- Blame and give credit to others for things over which they have little or no control
- Build barriers, decrease morale, and create an atmosphere of fear
- Never be able to fully understand past performance, make predictions about the future and make significant improvements in processes

Control Chart

Elements of a Control Chart



Why use Control Charts?

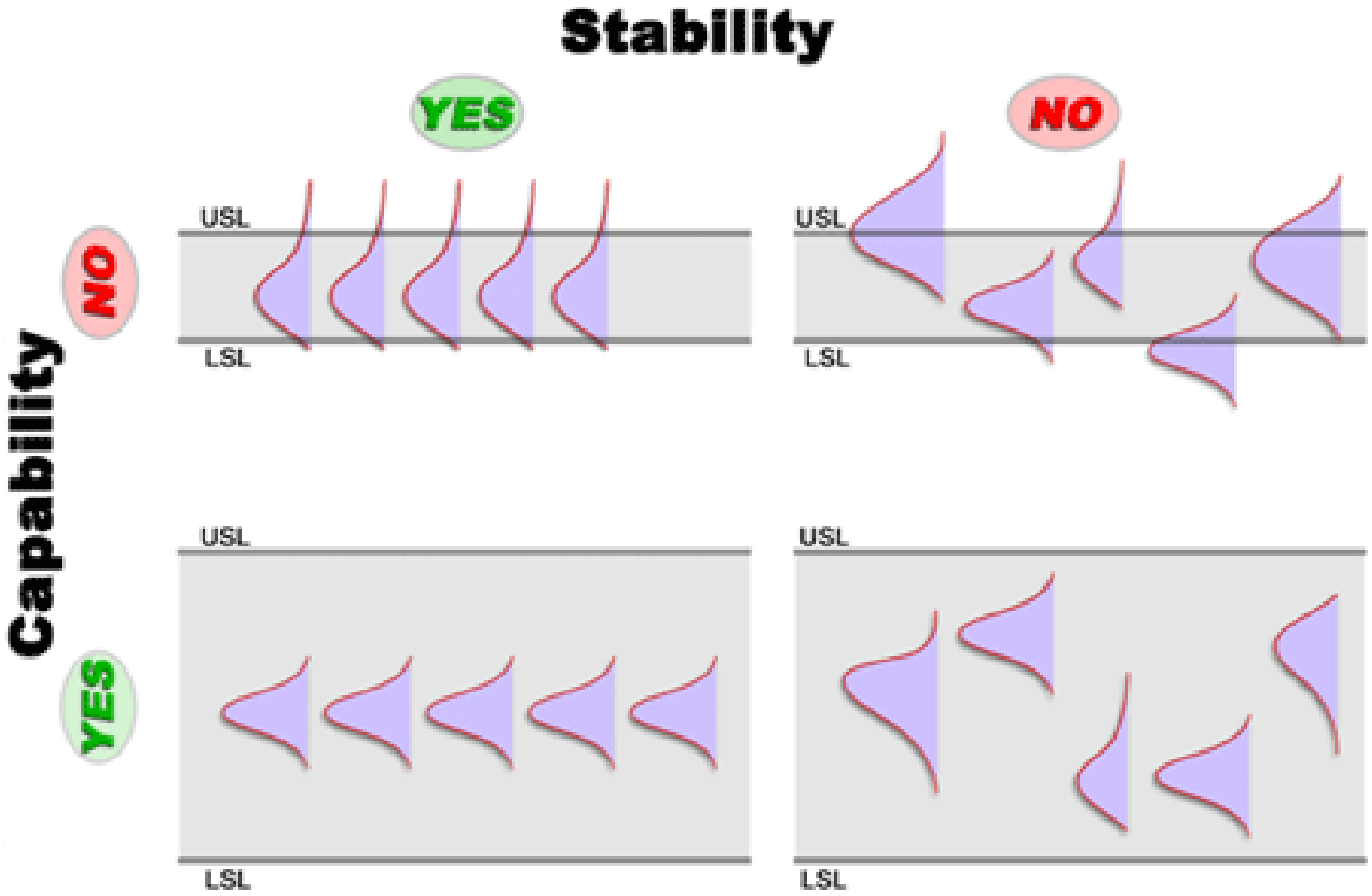
- Monitor process variation over time
- Differentiate between special cause and common cause variation
- Assess effectiveness of changes
- Establish the basis for determining process capability
- Communicate process performance

Why use Control Charts?

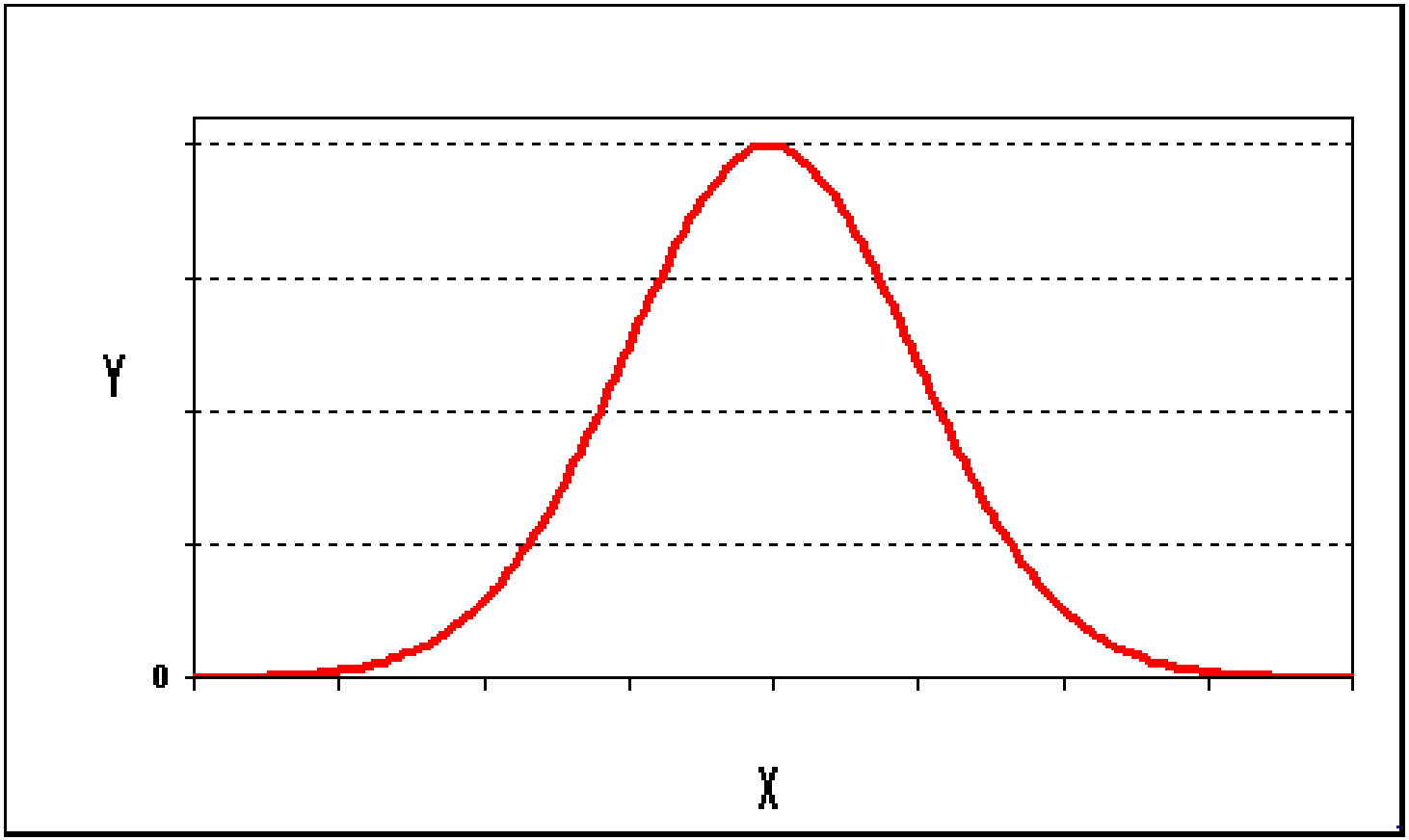
- **Stability**: A processes ability to produce predictable results consistently. Usually resulting in a relatively constant mean and variance.

- **Capability**: A processes ability to remain within the parameters or standards set forth by the customer.

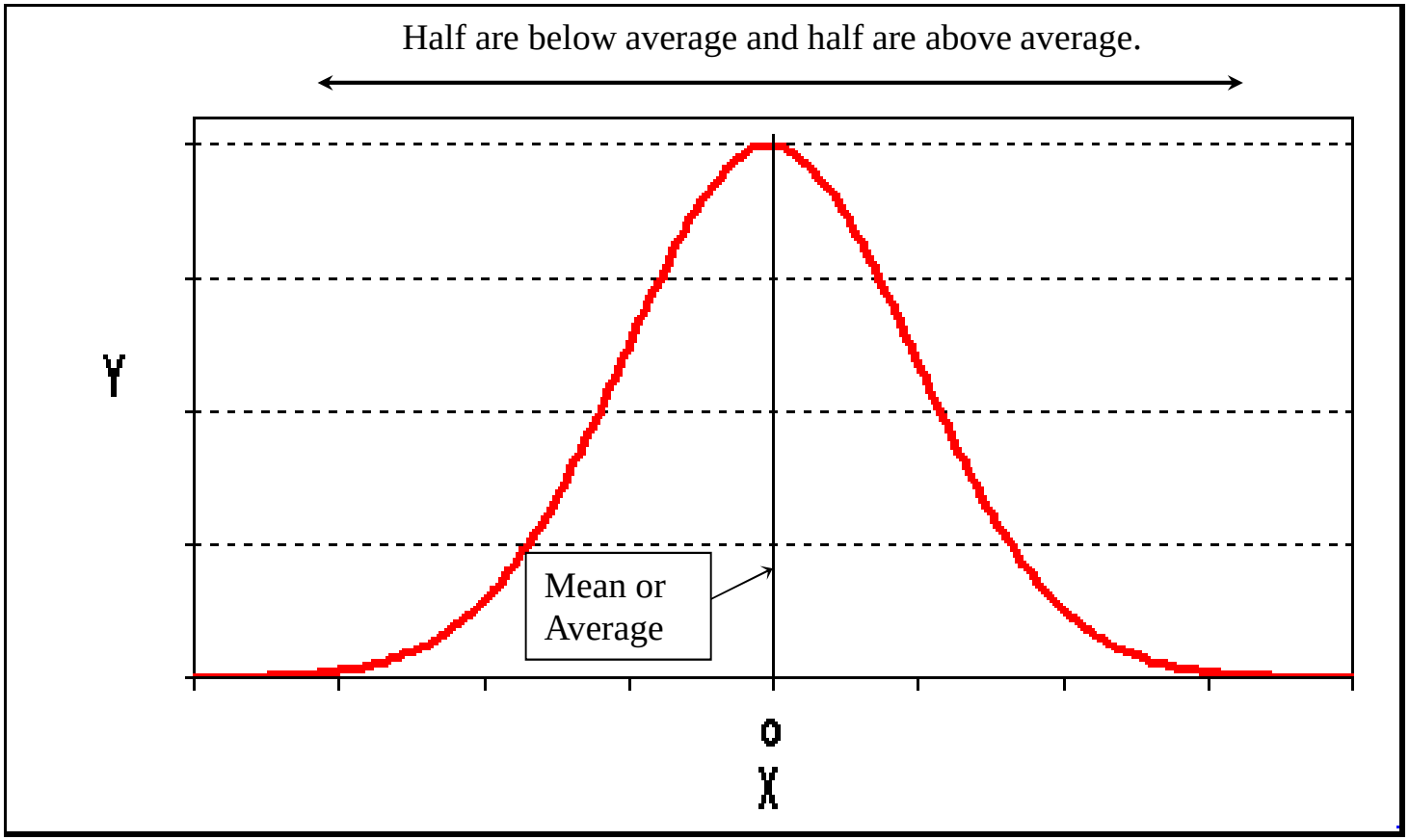
Why use Control Charts?



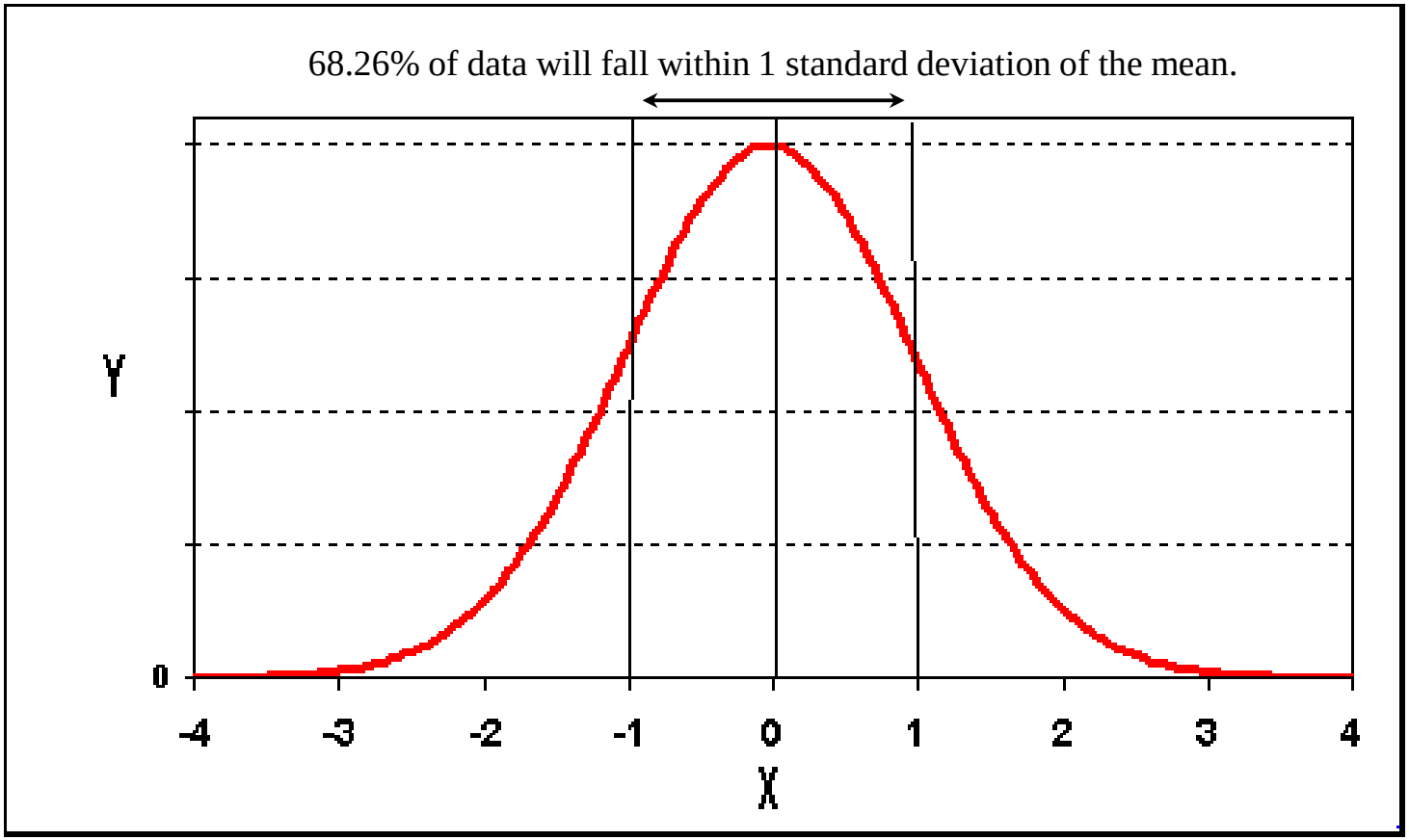
Standard Normal Distribution



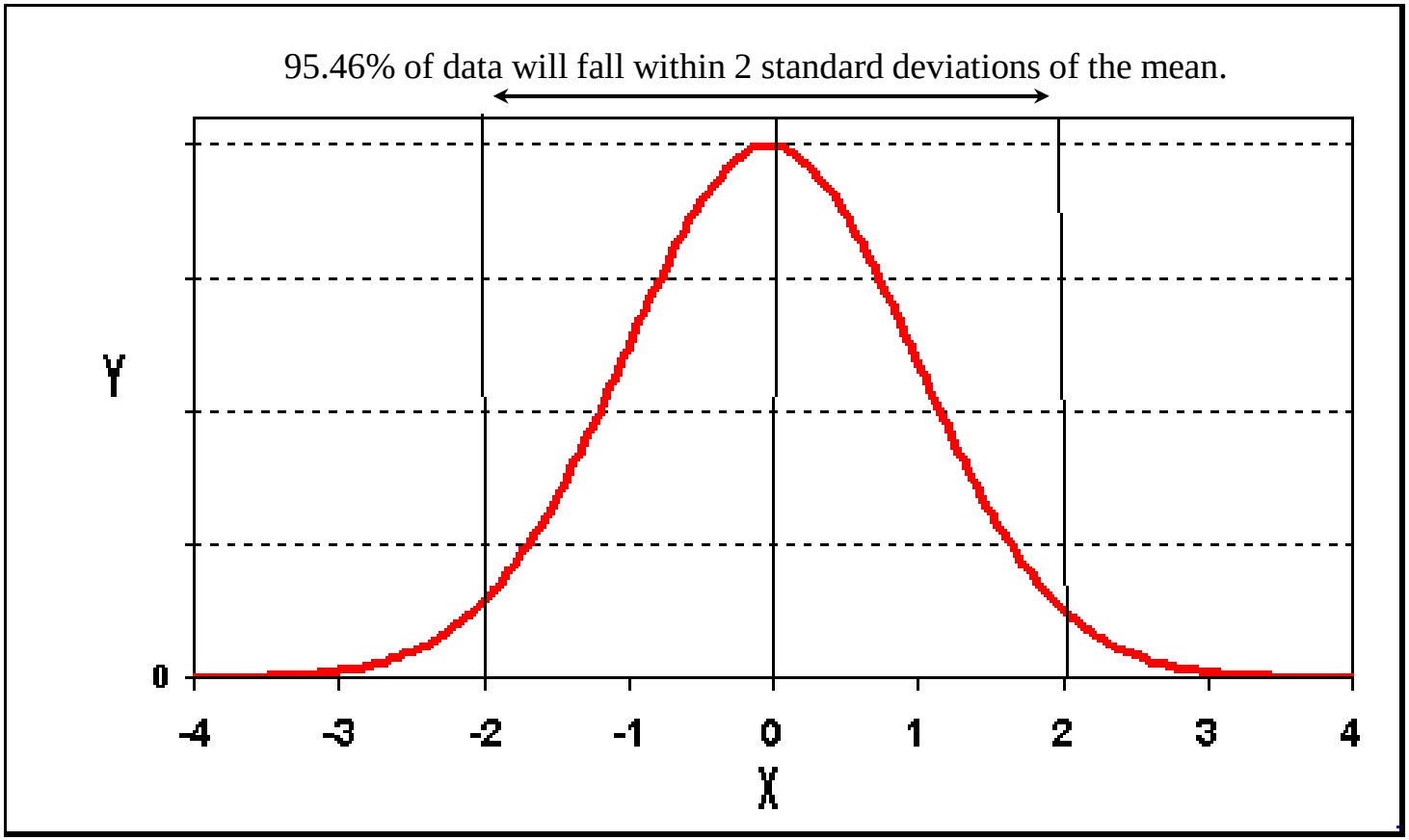
Mean or Average



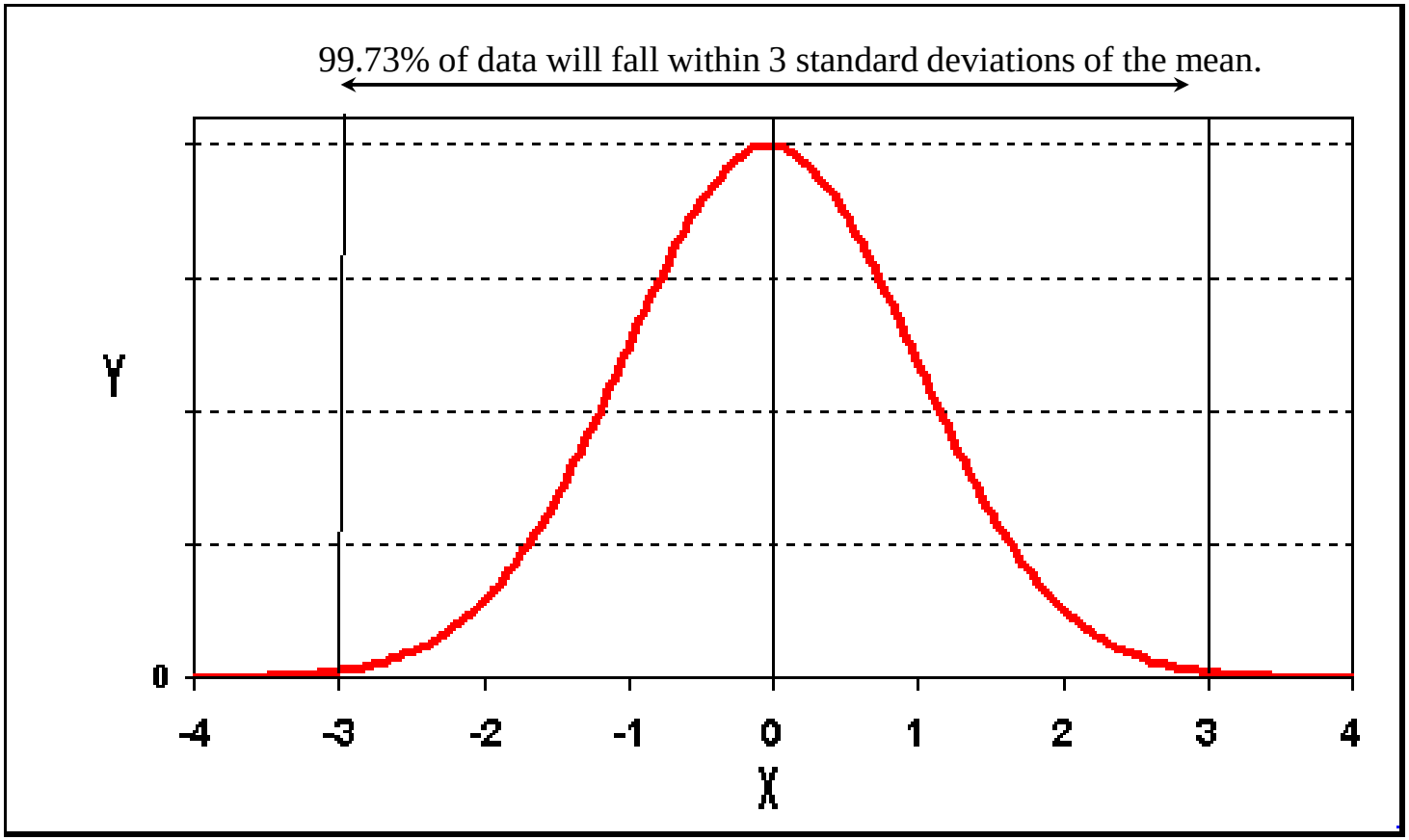
1 Standard Deviation



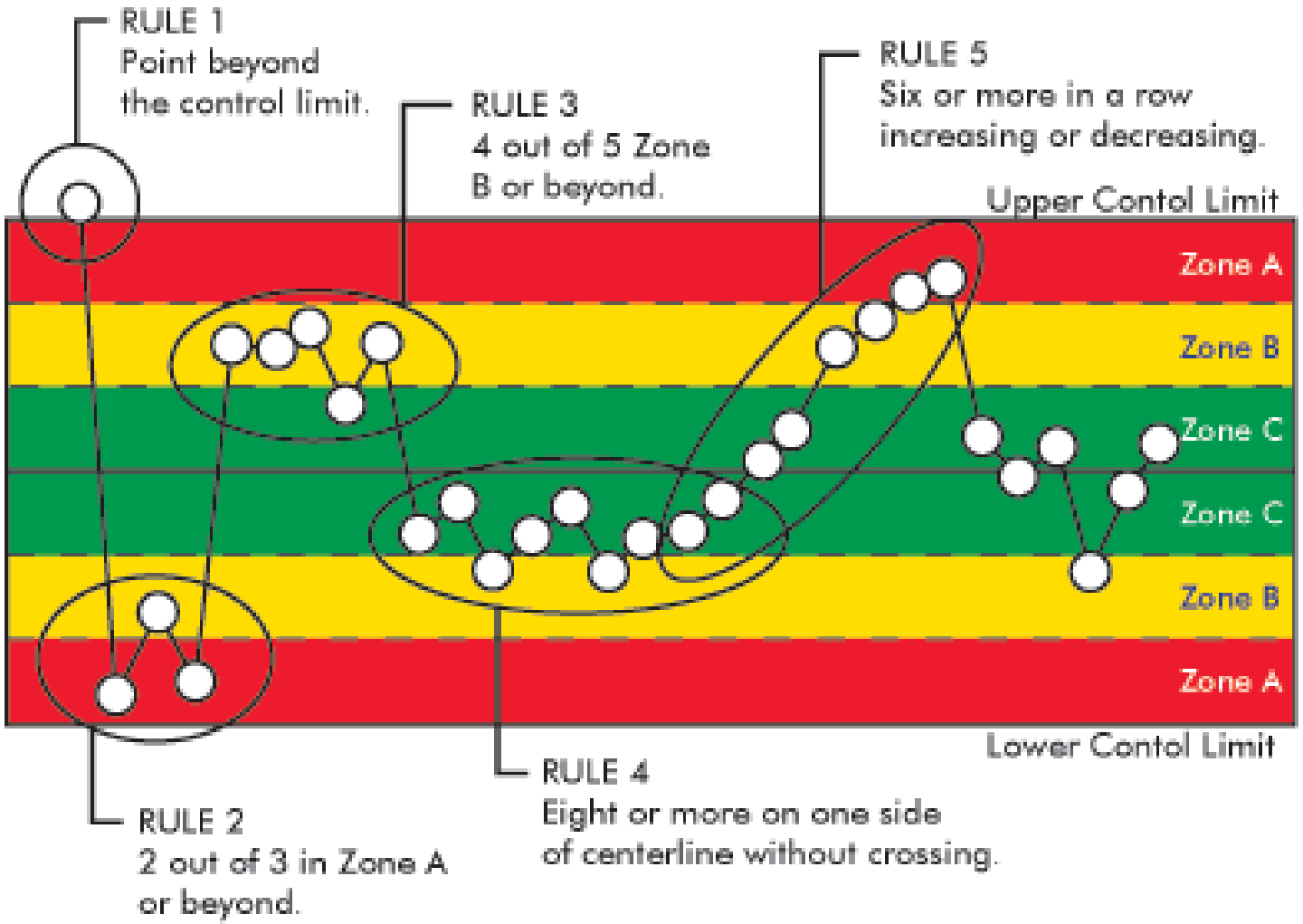
2 Standard Deviations



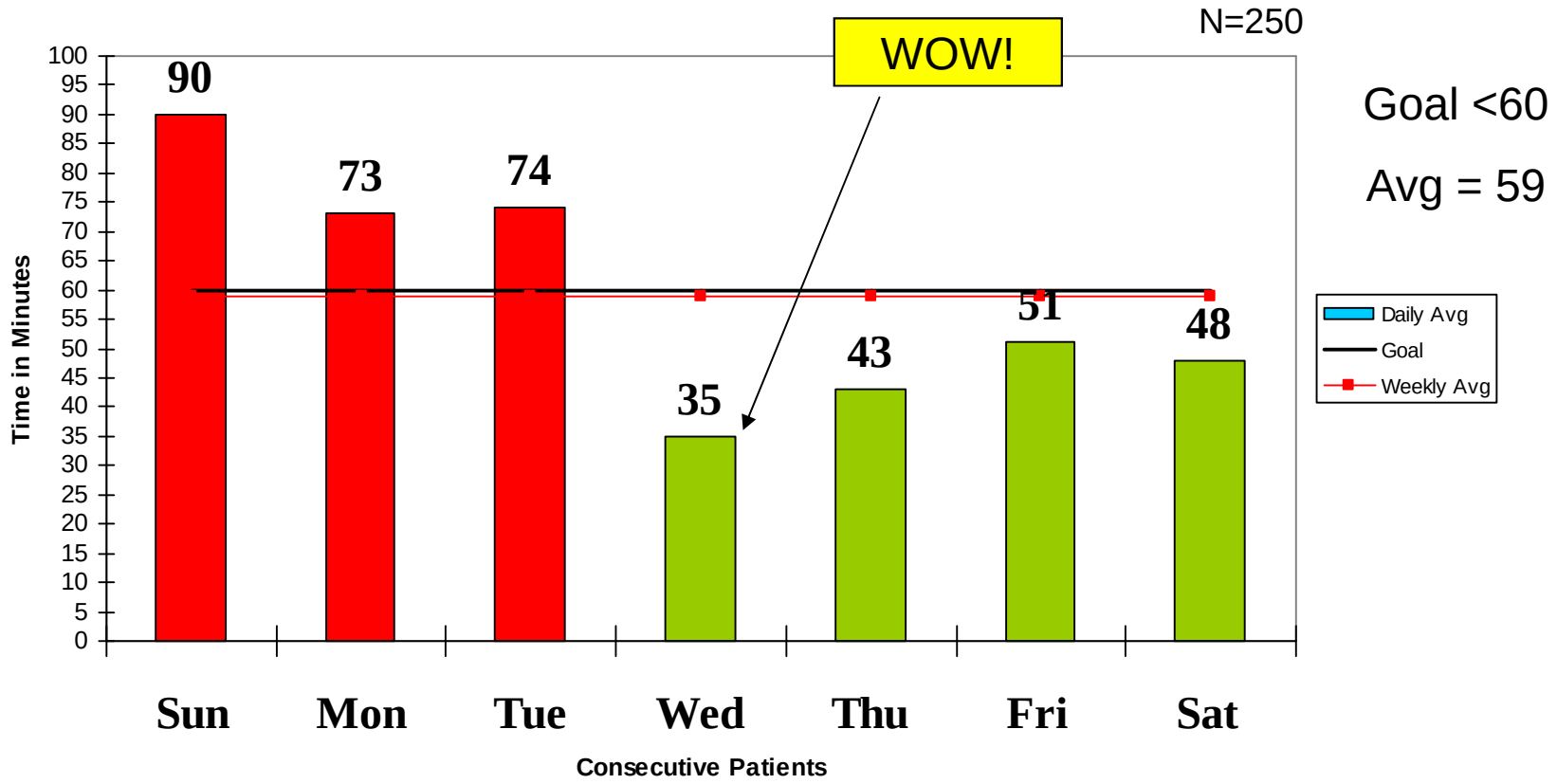
3 Standard Deviations



Tests for Special Causes



QMC ED Throughput Study
Patient Arrival to MD Exam



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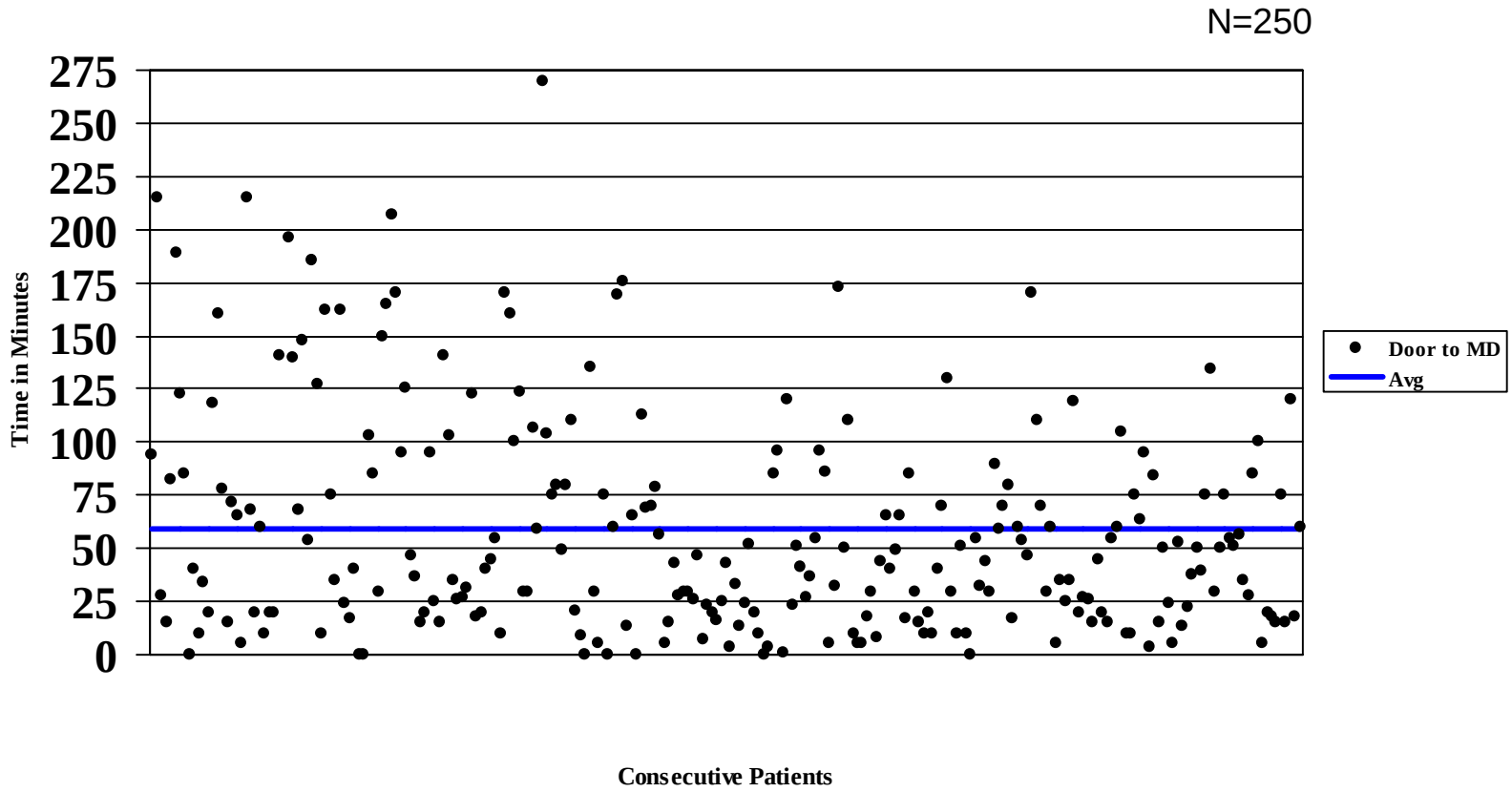
QMC ED Throughput Study
Patient Arrival to MD Exam



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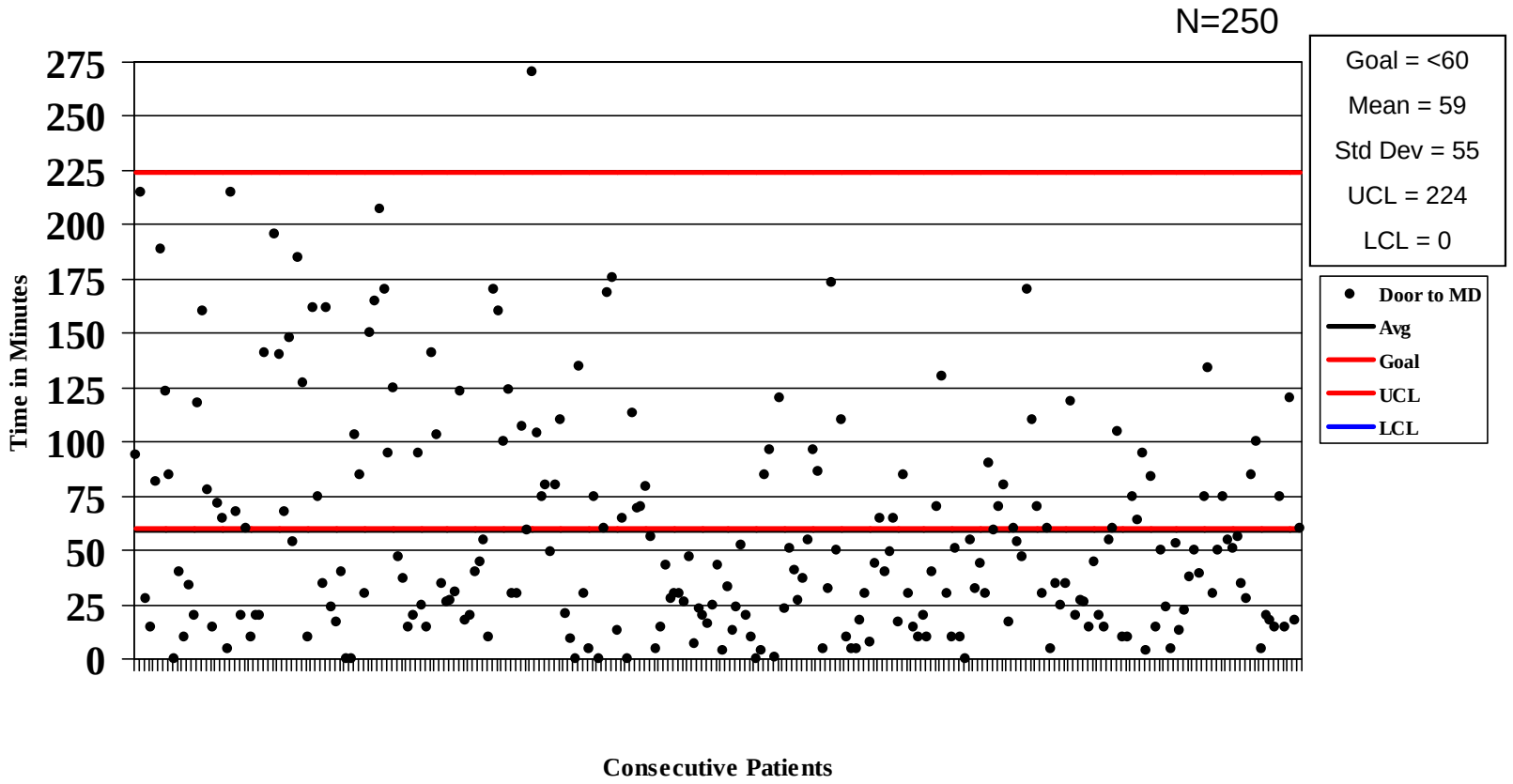
QMC ED Throughput Study
Patient Arrival to MD Exam



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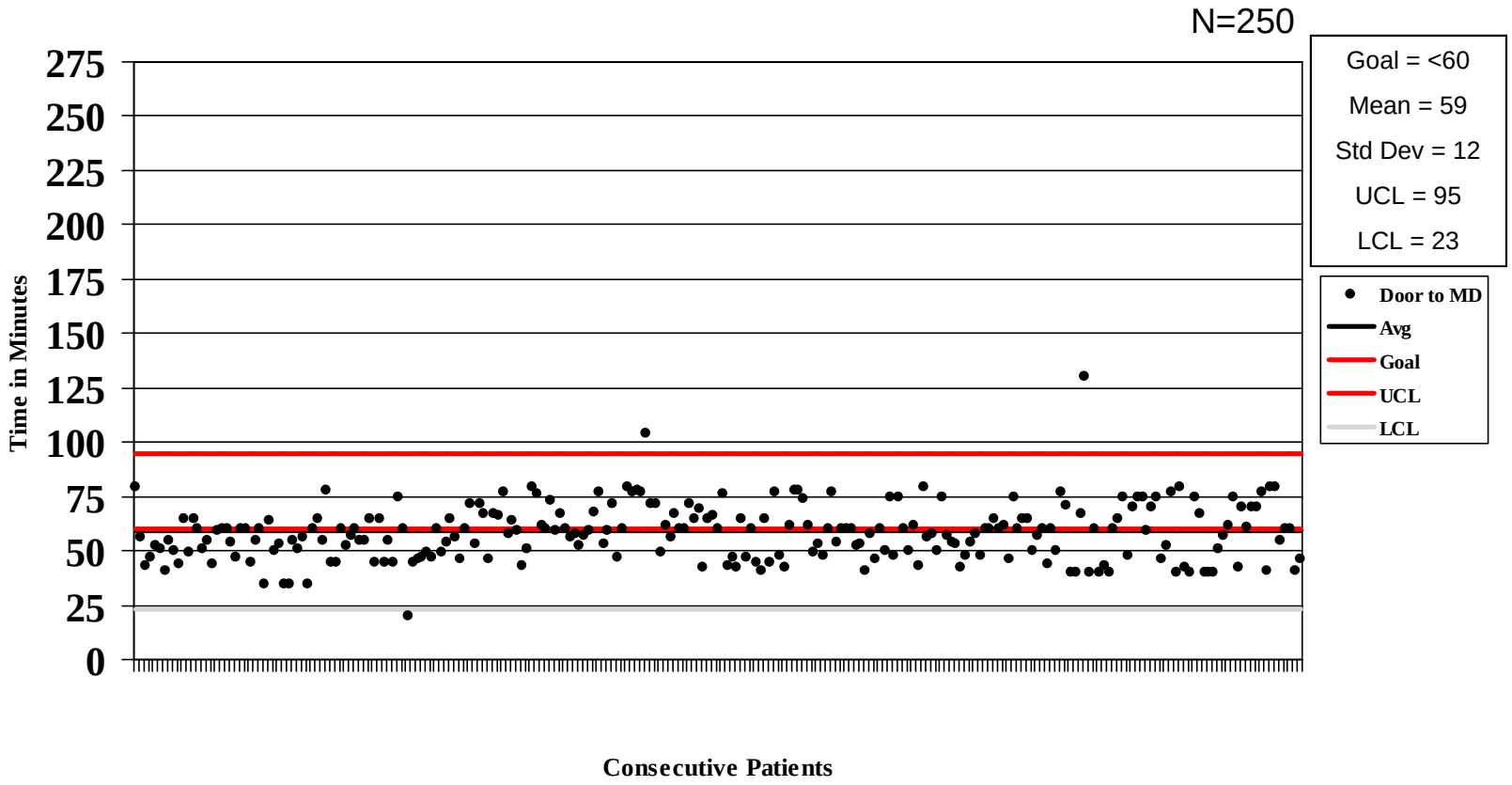
QMC ED Throughput Study
Patient Arrival to MD Exam



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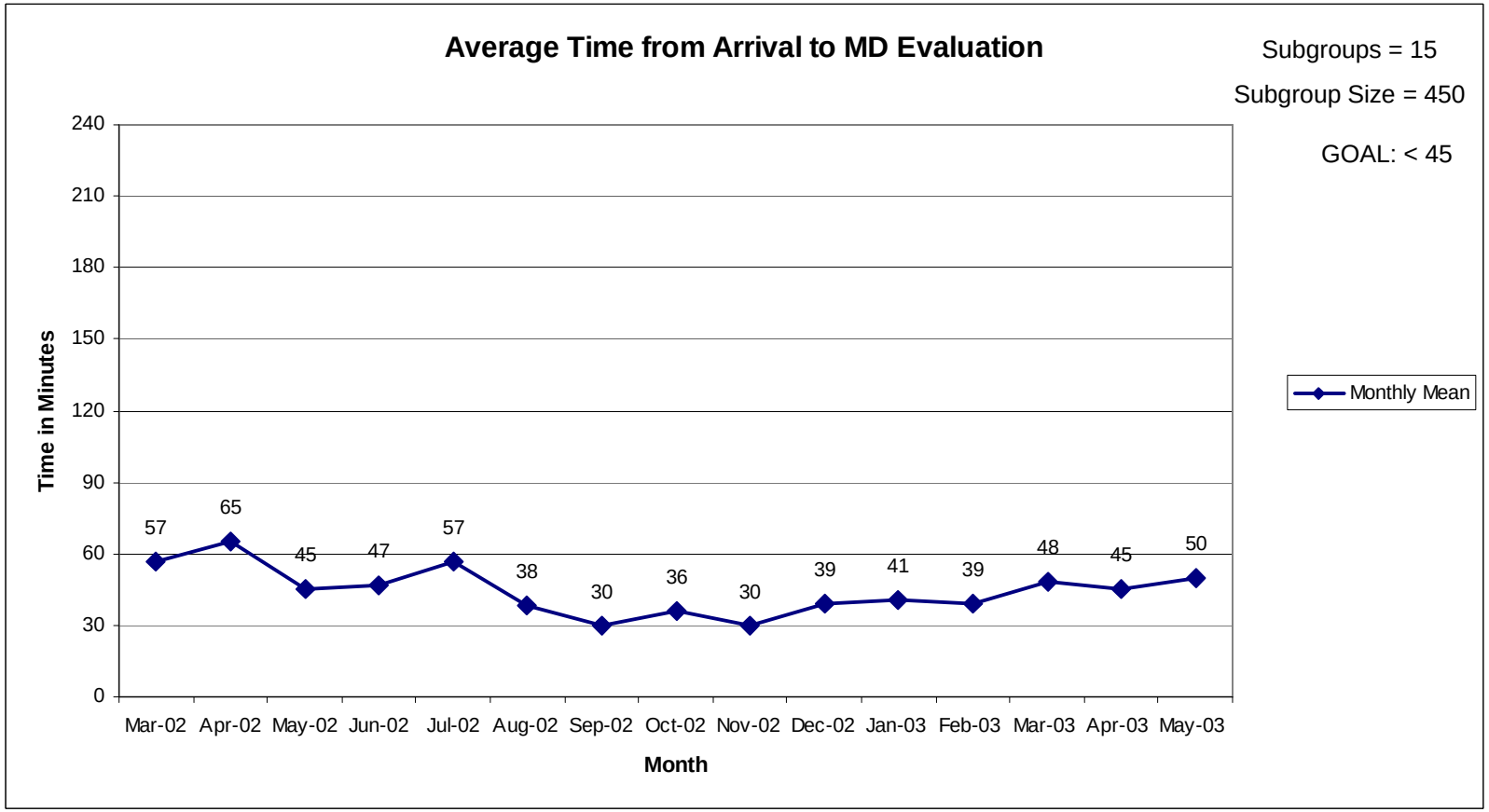
Control Chart Application (actual study)



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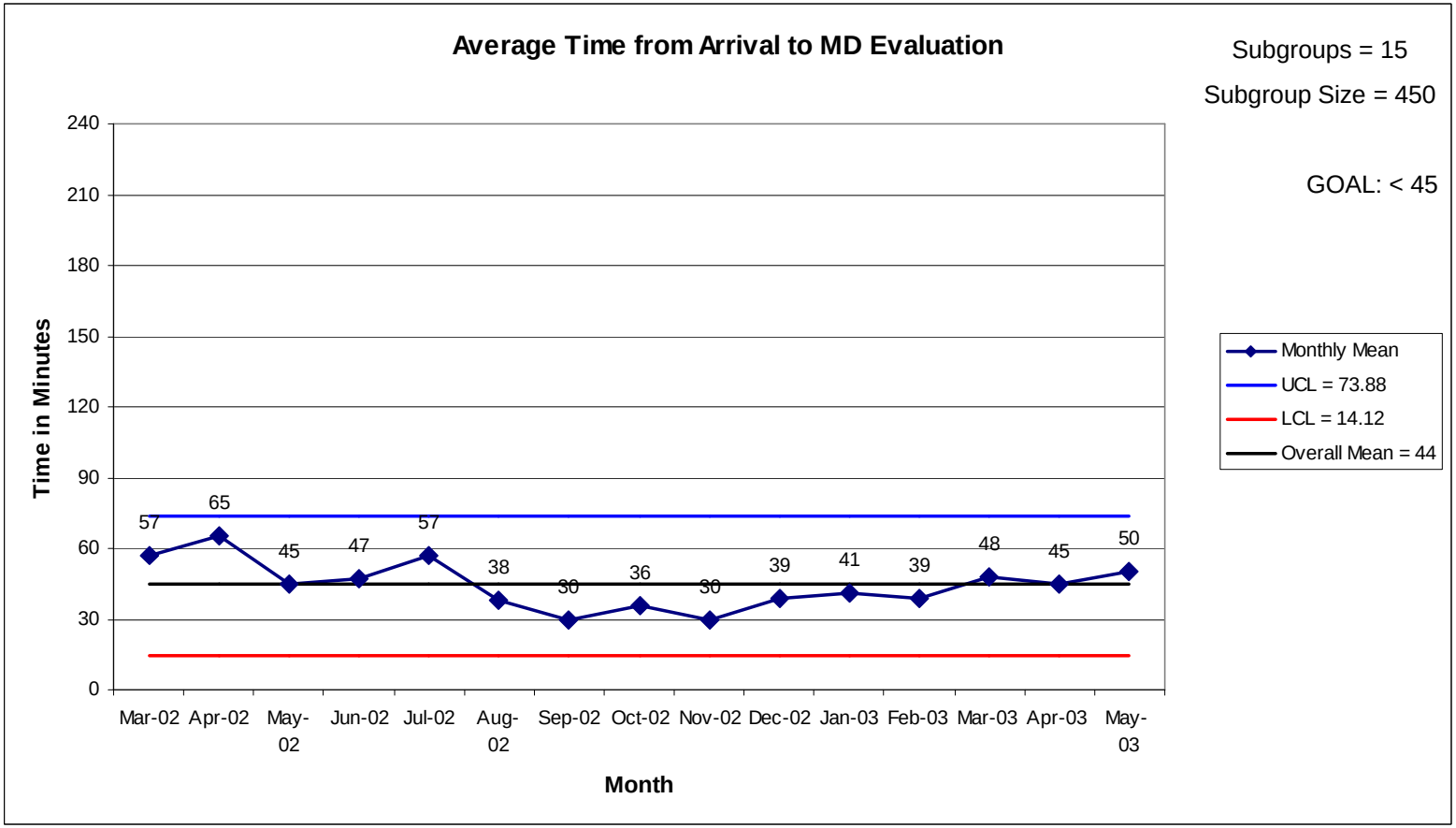
Control Chart Application (actual study)



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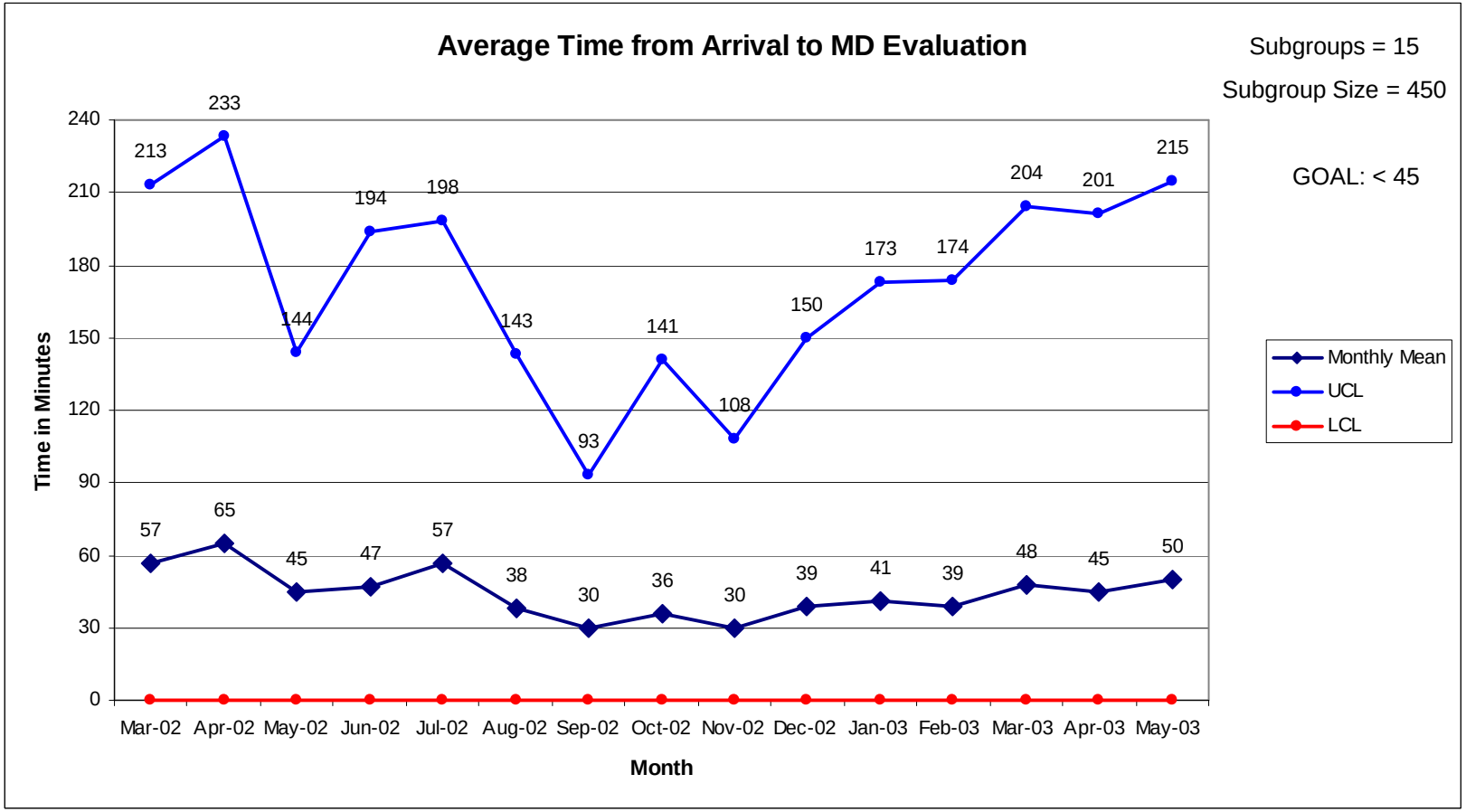
Control Chart Application (actual study)



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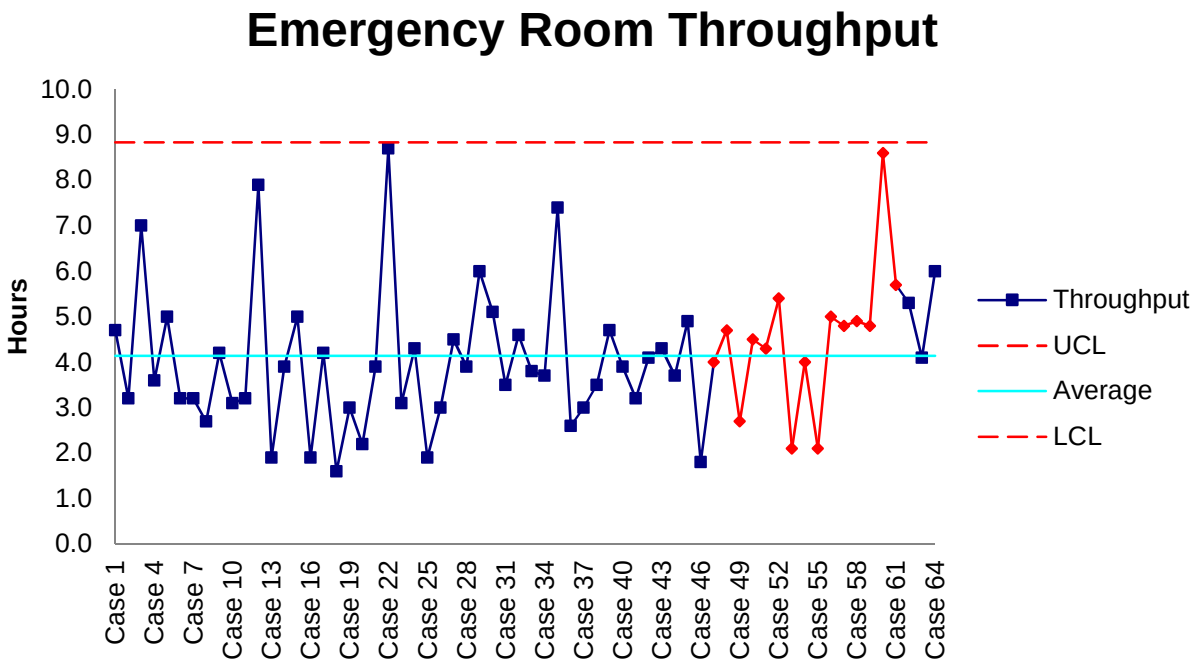
Where are Control Charts Used?

- In the beginning of a Quality Improvement Project during the Measure or Analyze Phase of a project to determine current process capability and benchmarking.
- In the middle during the Improve Phase of a project to determine effectiveness of an intervention.
- At the end in the Control Phase of a project to help sustain the gains.

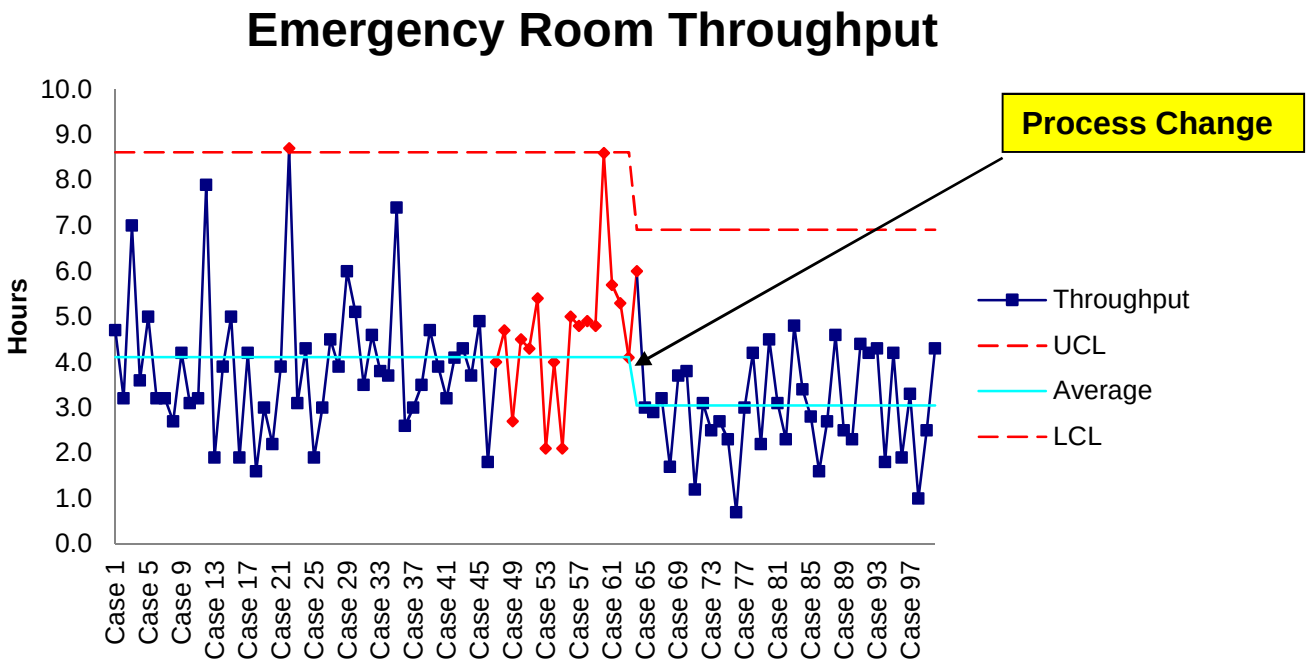
Data Display Tips

- Begin analyses with questions / hypotheses before ‘digging’ through data
- Plan data display with key stakeholders early in the process
- Limit the display to the points you need to make
- If possible, show benchmark data (internal / external)
- Publicize the results; post graphic displays in hallways and waiting rooms for staff / patients
- Compare outcomes to established targets / goals
- When appropriate, compare results grouped by demographics or other characteristics

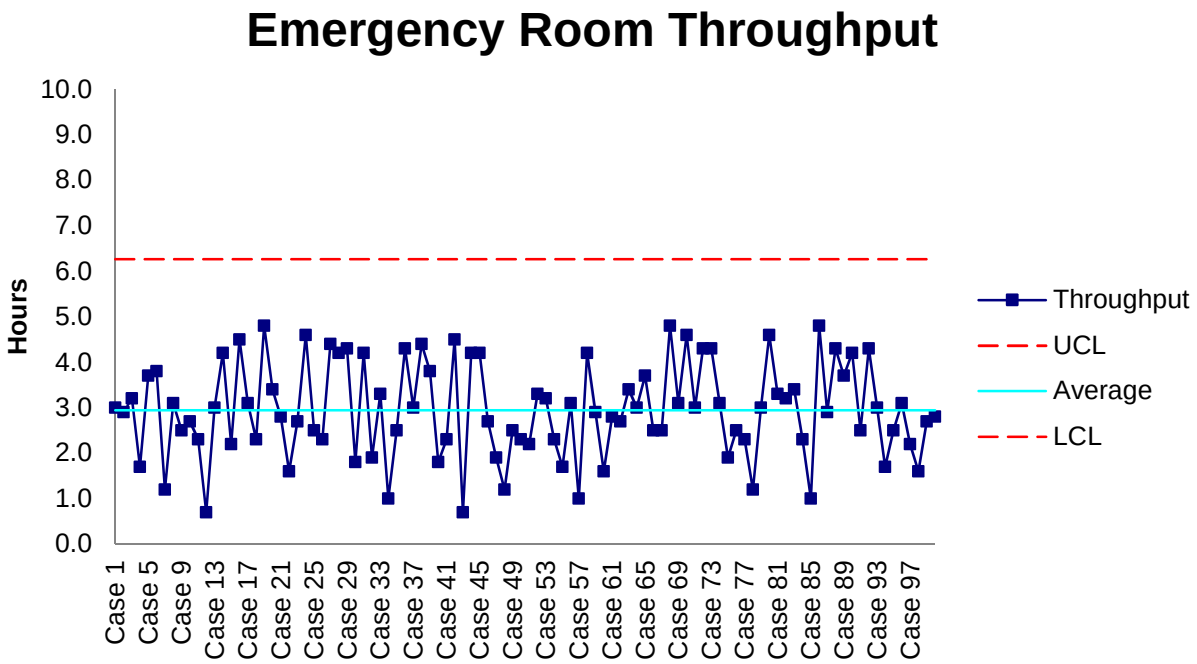
Baseline (Not in Control)



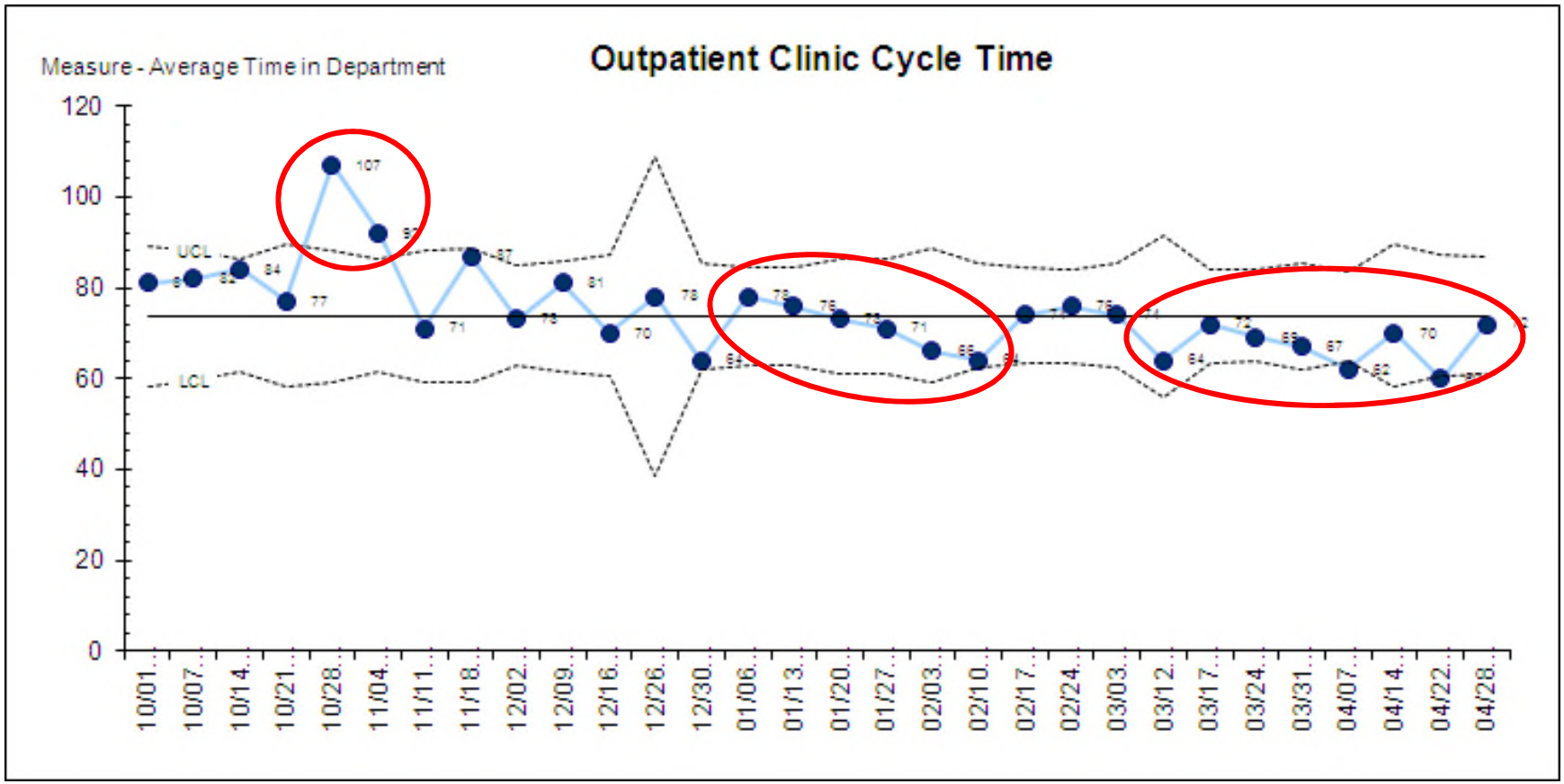
Improve (Making Progress)



Control (In Control)



Identifying Process Changes



X-Bar Chart

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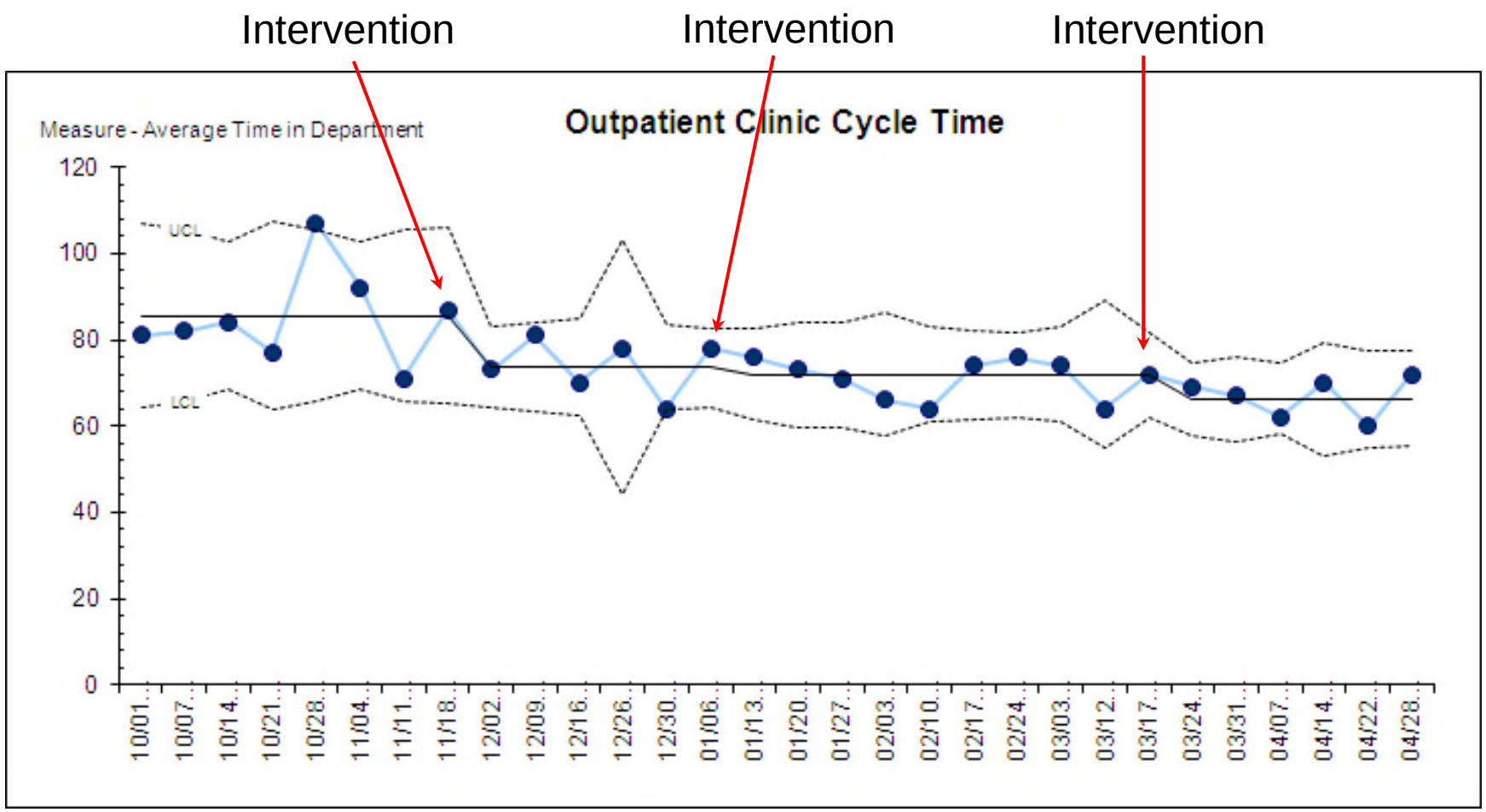
Identifying Process Changes



X-Bar Chart

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Control Charts

What Have People Used Control Charts For?

- Rates of infections, occurrences, falls, needle sticks
- Satisfaction rates
- HMO Enrollment, initial or repeat
- HMO Disenrollment
- Waiting times in reception
- Cost per member per month
- Time to treatment
- Cost per lab, cost per procedure
- Days between a “bad” occurrence (fall, infection, death, etc.)

Improve a common cause system by changing the process

- Identify and prioritize options to improve:
  - Pareto charts will identify the “vital few”
- Use your “PI methodology” (i.e., PDCA, DMAIC)
- Identify the Key Process Variables (KPVs)
  - KPVs are those aspects of a process that have a major impact on the measure of interest.
  - Get moving! Don’t wait for “perfect” plan.

How will you know your intervention is a success?

- A Special cause in the desired direction will signal that the old process is changed for the better.
- A Special cause in the wrong direction will indicate that your intervention was counterproductive.
- Continued common cause variation will indicate that your intervention did not help – but did not hurt either.

Cycle for Learning and Improvement

Four Questions/Phases that Must be Addressed

1. *What are we trying to accomplish?*
   a. Pareto Charts (what problem do we want to tackle)
2. *How will we know that a change is an improvement? (all improvement comes from change, but not all change leads to improvement)*
   a. Run Charts
   b. Control Charts

Cycle for Learning and Improvement

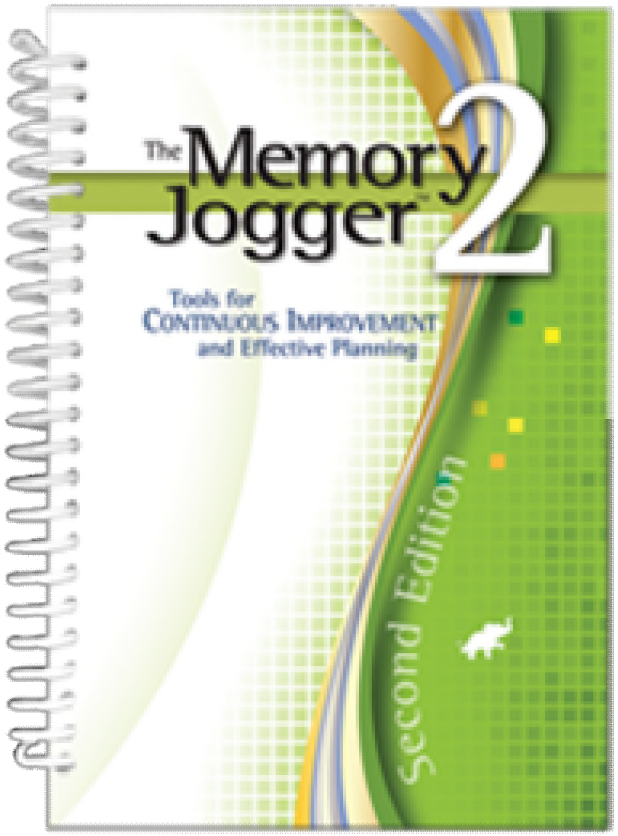
Four Questions/Phases that Must be Addressed

3. *What changes can we make that will lead to improvement?*
   a. Pareto Charts
   b. Run Charts
   c. Histograms
   d. Scatter Diagrams
   e. Control Charts
4. *P.D.S.A.*
   a. Run Charts
   b. Control Charts

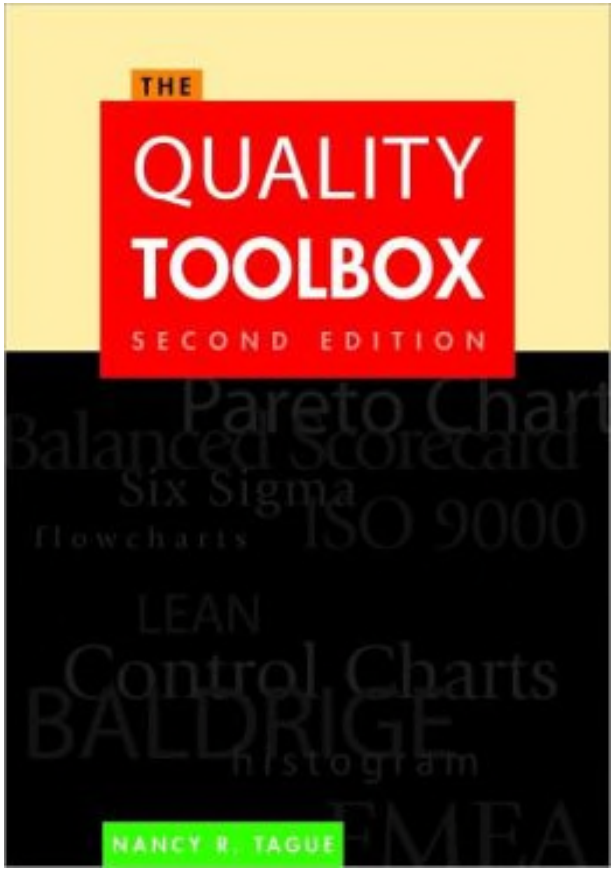
Summary

1. Explain the purpose and uses of various quality data displays
2. Interpret basic data quality charts
3. Describe measures of central tendency and other terms commonly used in the interpretation and communication of quality data
4. Understand common misconceptions and limitations that arise from reporting “averages”.
5. Understand the concepts Special Cause and Common Cause when interpreting data.
6. Identify tests used to determine special causes.
7. Interpret basic Run charts and Control Charts.
8. Explain the use of data throughout the PDSA process as described in select AQI projects

Resources



The Memory Jogger 2
- Goal QPC



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Using Tools for Quality Improvement

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