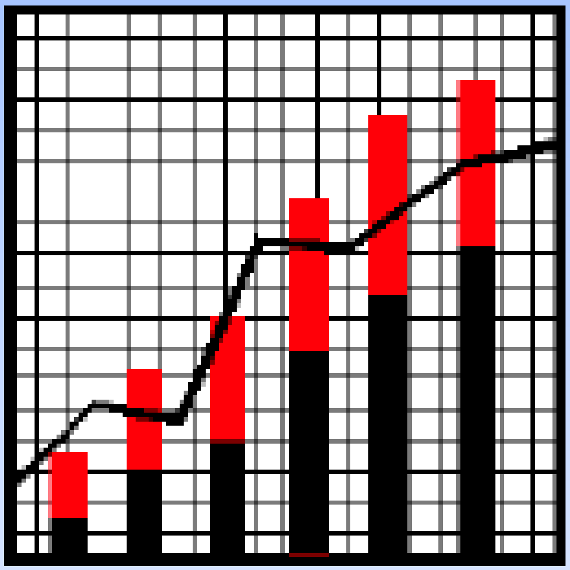
V. How to Measure Improvement



Introduction: Statements about Data

- Data are crucial to determine whether change has occurred
- The project aim and data need to be closely related
- A comprehensive understanding of the data elements is key:
  - Data illustrate variation in a process
  - It is important to understand how the data have been generated
- Data should be sufficient to show change
- Avoid collecting data that does not contribute to the aim
- Data may reveal unintended consequences after a process change

Statements about Data: Collection

- Clarify data collection goals:
  - What are we trying to measure?
  - Will the data reflect improvement?
  - Does it match the aim & goal?
- Utilize clinical value compass for prompts for categories of measurement
- Brainstorm to generate lists of measures
- Determine the key outcome measures

Statements about Data: Collection

- Develop operational definitions of data elements and procedures for data collection
- Determine how the variables will be measured
- Determine where and how the data will be obtained:
  - Who will collect?
  - How will data be recorded?
  - Who will analyze?
- Perform a reality check:
  - Does a trial of the collection procedure(s) and analysis work?
  - What data can you reasonably and affordably get in real time?

Variation in a Process

- Variation exists in any process
- Variation in a process is due to ***Common Causes*** and ***Special Causes***
- Distinguishing between ***Common Cause*** and ***Special Cause*** variation helps us select appropriate action for improvement

Common Cause Variation

- Is inherent in every process
- Is random and is due to regular, natural, or ordinary causes
- Produces processes that are said to be “in control” or stable
- Requires process change to improve

Common Cause Variation Example

If you measured the amount of time that you spent each day at a particular traffic light, you would find common cause variation with some days waiting for the full 50 second cycle, some days with no wait at all and the remaining days somewhere in between. If you wanted to reduce the average amount of time that you wait at this intersection each day (i.e. improve the process), then you would need to take steps to change the process (e.g. change the route, alter your speed as you approach the traffic light, etc.).

Special Cause Variation

- Affects only some outcomes in a process
- Is due to irregular or unnatural causes that are not inherent in a process
- Produces processes that are said to be “out of control” or unstable
- Needs to be recognized and analyzed before the process can be improved
- Indicates that something has changed in the process which can be a positive thing or a negative thing depending on the situation at hand

Special Cause Variation Example

If one day you came upon a 5 car accident in the intersection and had to wait for 45 minutes at the traffic light, this would be considered special cause variation (i.e. outside the normal variation that is inherent in the process). The required action in this case would be to remove the accident (i.e. address and eliminate the special cause) before starting to work on reducing the average time spent at the light each day.

General Ways To Look At Data

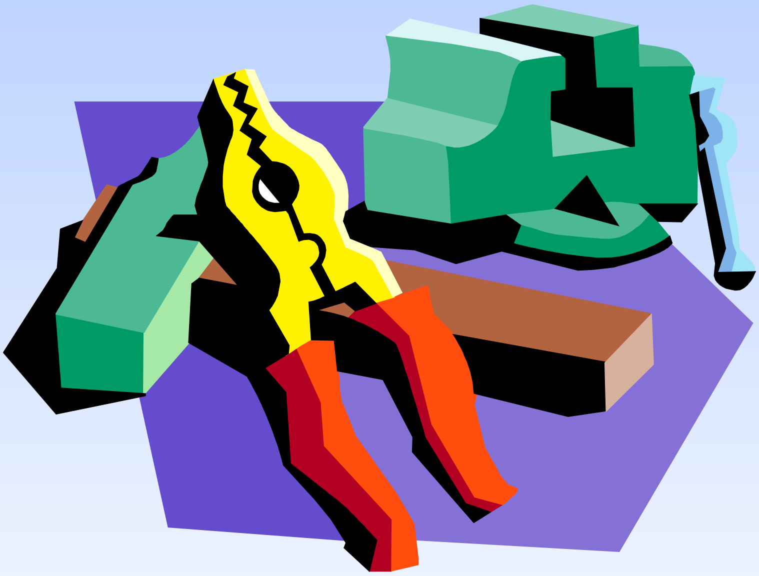
Static Approach to Measurement

- Average
- Maximum value
- Minimum value
- Fails to show if getting better, getting worse or staying the same within the time period in question

Dynamic Approach to Measurement

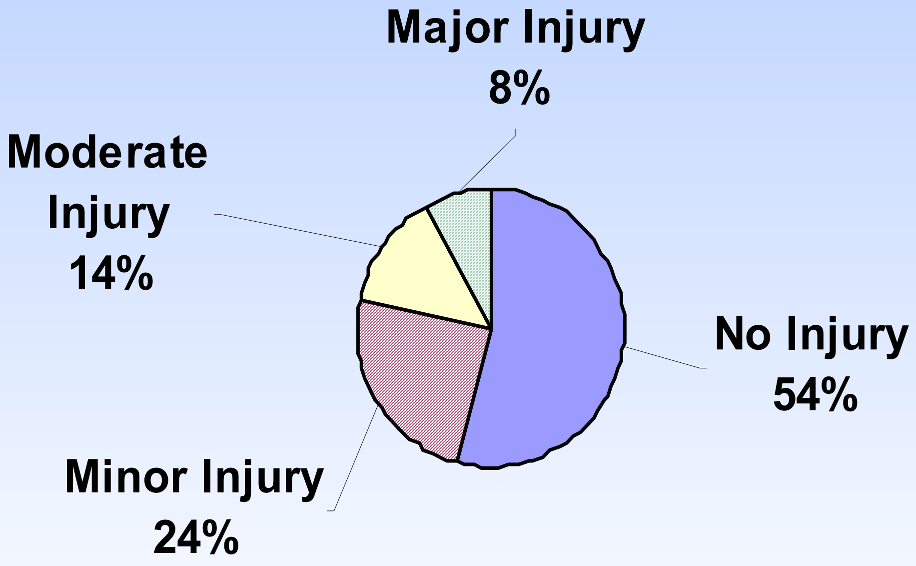
- Look at values over time using graphical display with control charts or run charts
- Easier to identify trends
- Helps identify the correct approach to improving the process by identifying the type of variation in the process (common cause vs. special cause)

MEASUREMENT TOOLS



Pie Chart

- Example of static measurement
- Used to show proportions of the whole at a snapshot in time
- Pie charts do not lend themselves to reading absolute magnitudes of the total or the individual components
- Pie charts cannot show flow of progress through time but can illustrate relative changes in the proportion of the components

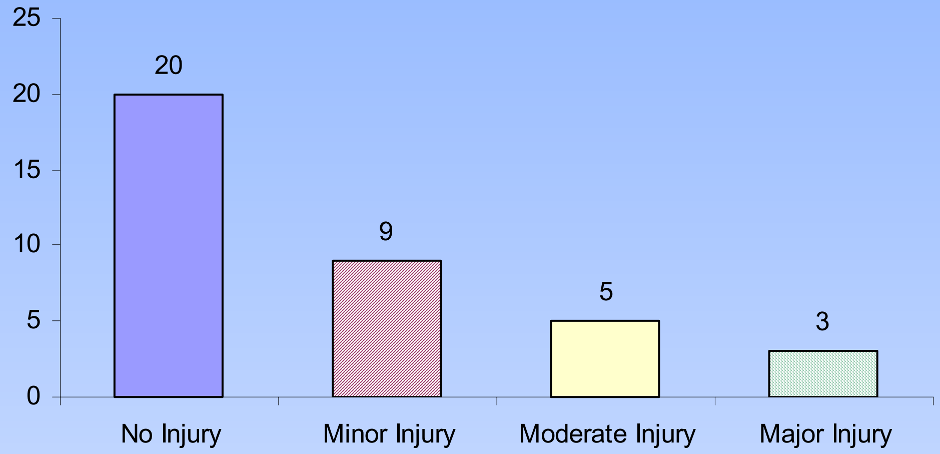


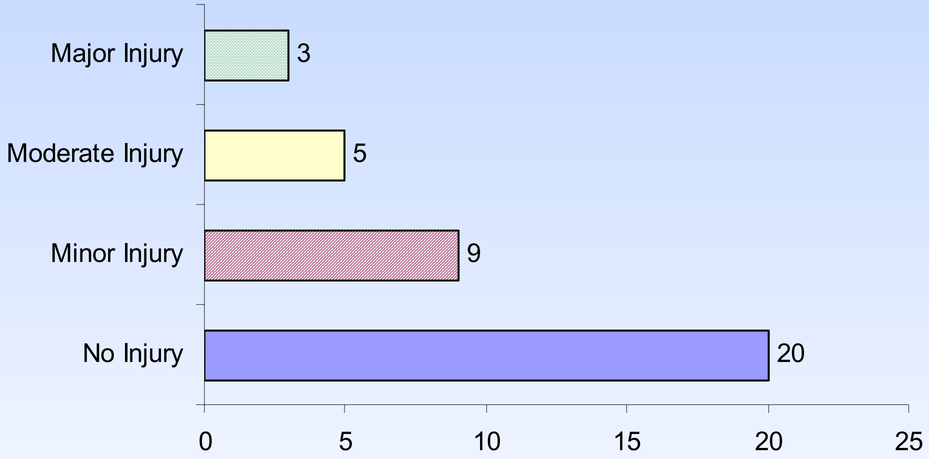
Bar Chart

- Example of static measurement
- A graphical comparison of several quantities in which the lengths of the bars represent the relative magnitude of the values
- A way of summarizing a set of categorical data
- Often used in exploratory data analysis to illustrate the major features of the distribution of the data in a convenient form
- Used to summarize nominal or ordinal data

Bar Chart

- Can be displayed horizontally or vertically and are usually drawn with a gap between the bars



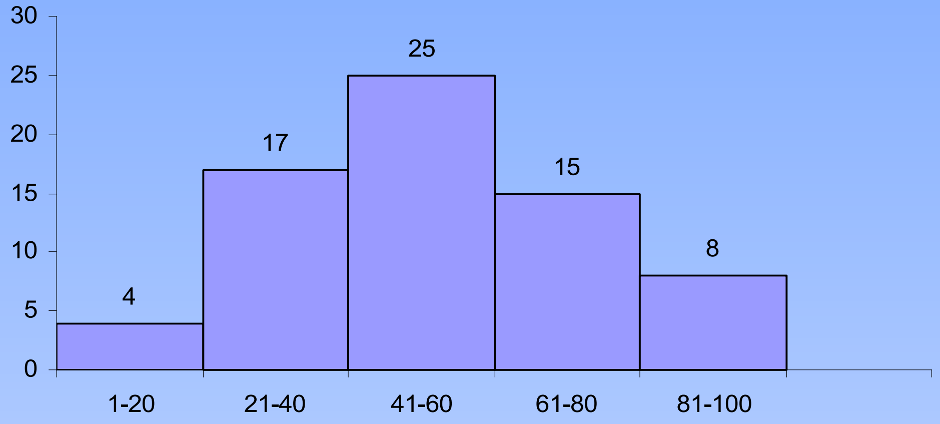


Histogram

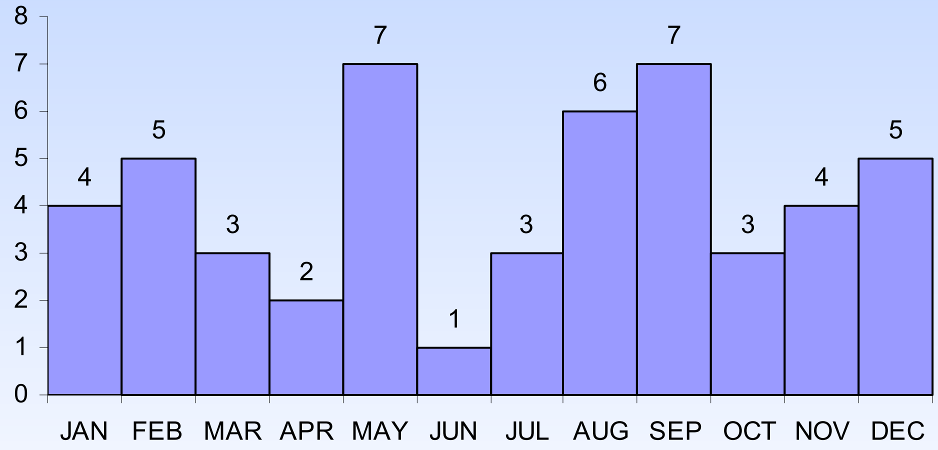
- Graphically shows the characteristics of the distribution of items in a given population or sample
- Used to identify the “shape“ of data and to summarize data that are numerical and measured on an interval scale (either discrete or continuous)
- Used in exploratory data analysis to illustrate the major features of the distribution of the data in a convenient form
- Generally helpful when dealing with large data sets (>100 observations)
- Helps detect any unusual observations (outliers) or any gaps in the data set

Histogram

- Typically illustrates static measurement



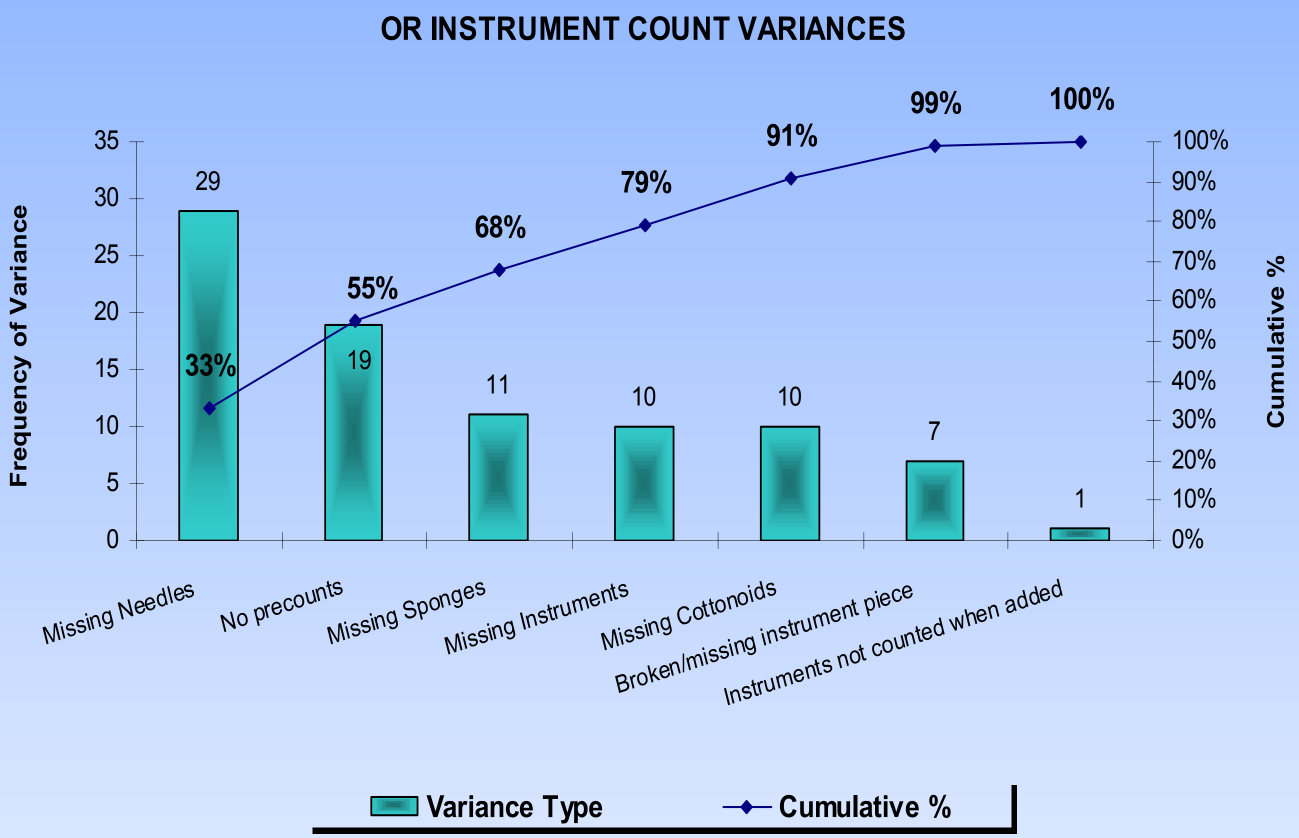
- Illustrates dynamic measurement if the categories are sequential dates. (However, a run chart may be a more effective method of data display in this case.)



Pareto Chart

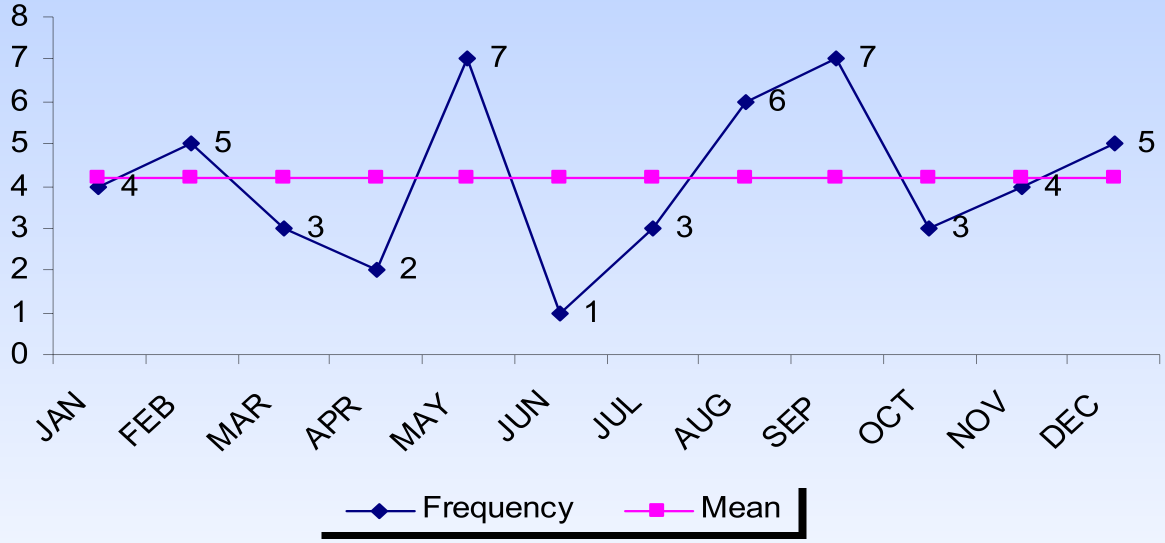
- Example of static measurement
- A bar chart with the bars sorted in order (high to low) and with a cumulative percentage line (see example)
- Illustrates relative frequency of the various occurrences or reasons
- Helps identify items of greatest importance or most problematic
- Can help guide teams in selecting which issue they want to work on first or where they might make the biggest impact
- Categories are listed on the X axis, frequency is on the left Y axis, and cumulative percentage is on the right Y axis
- Graph is named after the “Pareto Principle” which states that 20% of the sources cause 80% of any problem

Pareto Chart



Run Chart

- Example of dynamic measurement
- Displays data over time and can illustrate changes or variation in a process (i.e. special cause variation)
- Time on the X axis and measured characteristic on the Y axis
- Data and mean are shown on the graph



Run Chart (cont.)

- Used when not enough data points for a control chart
- Evidence of special cause variation includes
  - A run:
    - 7 or more points in a row on the same side of the mean if there are less than 20 data points
    - 8 or more points in a row if there are 20 or more data points
  - A trend: Data points steadily increasing or steadily decreasing with
    - 5 or more data points in a row if there are 5 - 8 total data points
    - 6 or more points in a row if there are 9 - 20 total data points
    - 7 or more points in a row if there are 21 - 100 total data points

Control Charts

- Example of dynamic measurement
- Same as run charts with the addition of upper and lower control limits
- Statistical principles are behind the calculation of the control limits and the interpretation rules
  - Developed by Walter A. Shewhart - early 1920’s (Bell Laboratories)
  - Commonly used in industry (particularly post-WW II Japan - W. Edwards Demming)
  - Recent application to healthcare
- Seven main types of control charts
  - Selection of appropriate type of chart depends on type of data being measured
  - Each chart type has its own formulas for calculating control limits
  - All types with same general components and interpretation rules (see example)

Control Chart Rules

- Distinguish common cause variation from special cause variation
- Based on probability that certain patterns would not occur by chance alone
- Most commonly applied rules:
  - One or more points outside the upper or lower control limits (see “A” on example chart)
  - Eight or more successive points on the same side of the mean (a run - see “B” on example chart)
  - Seven or more points in a row steadily increasing or decreasing (a trend - see “C” on example chart)

Control Chart Rules