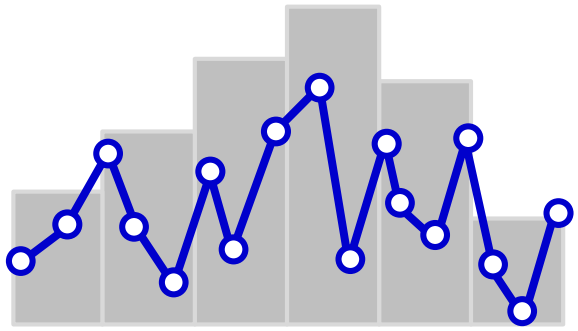
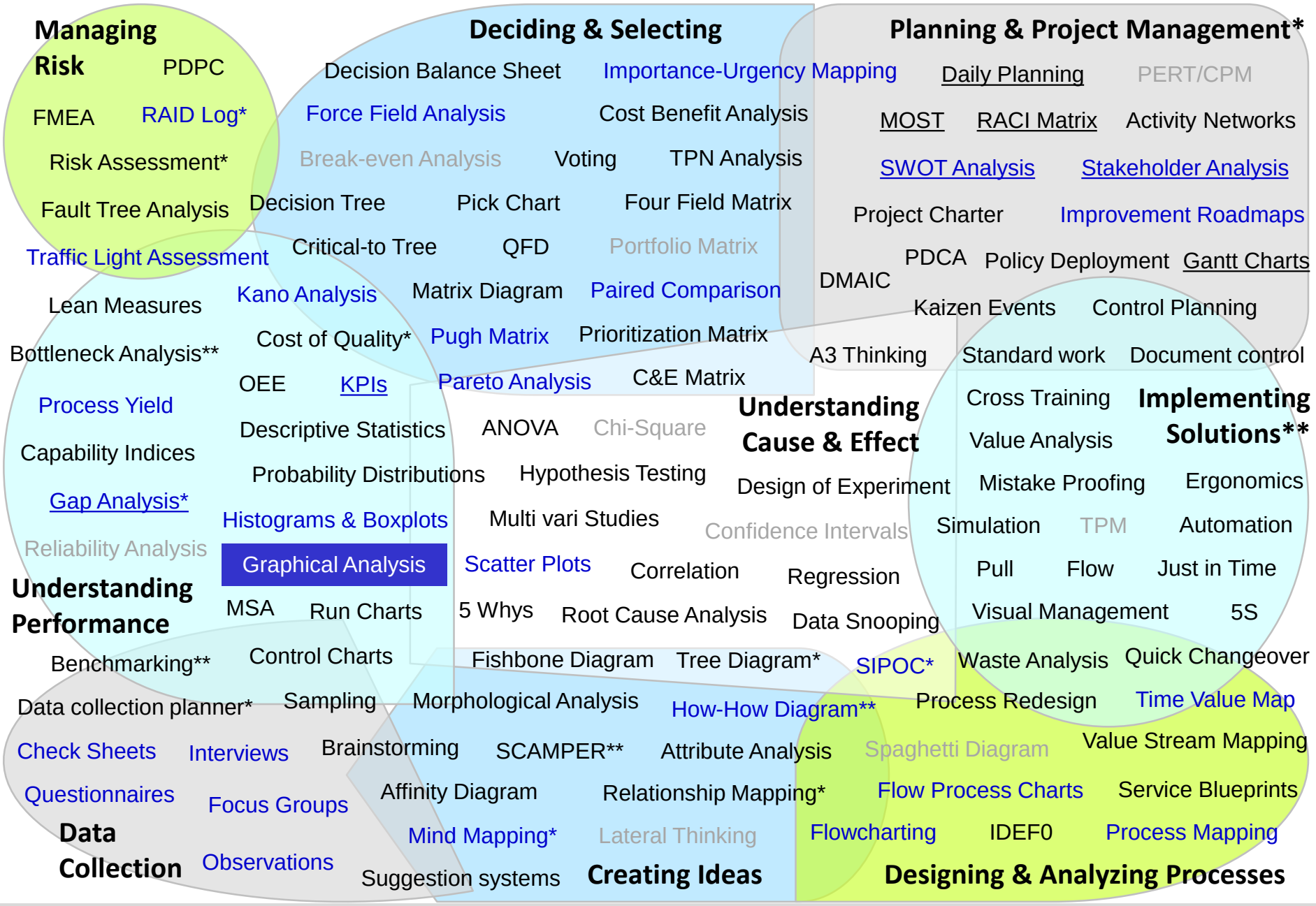
Continuous Improvement Toolkit

Graphical Analysis

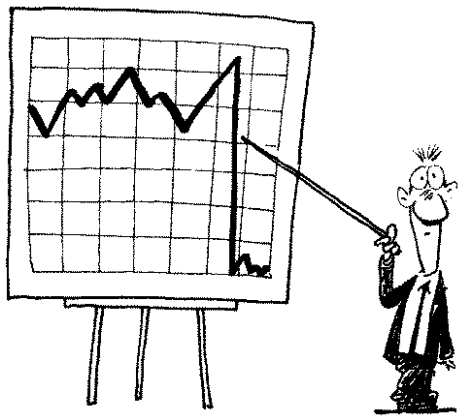


The Continuous Improvement Map



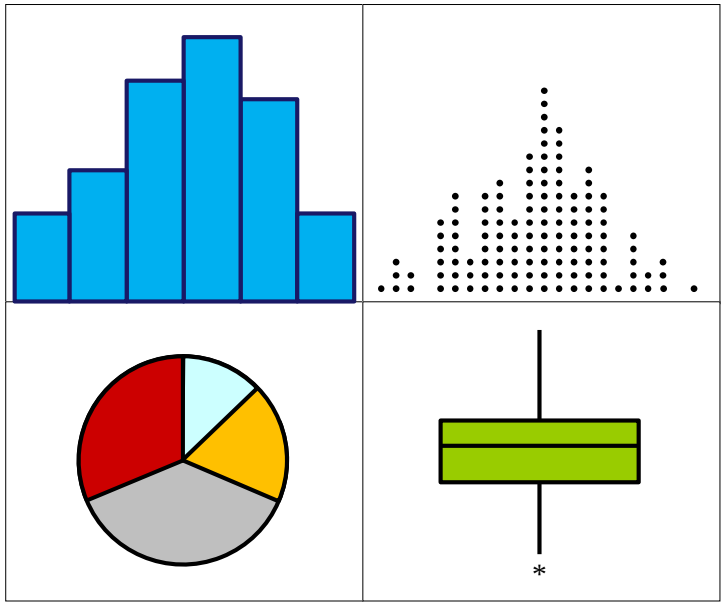
- Graphical Analysis

- Statistic is the science of describing, interpreting and analyzing data.
- **Statistics may be:**
  - **Graphical:**
    Makes the numbers visible.
  - **Inferential:**
    Makes inferences about populations from sample data.
  - **Analytical:**
    Uses math to model and predict variation.
  - **Descriptive:**
    Describes characteristics of the data (location and spread).



- Graphical Analysis

- Graphs truly show that a picture is worth **a thousand of words**.
- A long list of data is usually not practical for conveying information about a process.
- One of the best ways to analyze any process is to **plot the data**.
- Many graphical tools are available which can generate graphs quickly and easily.



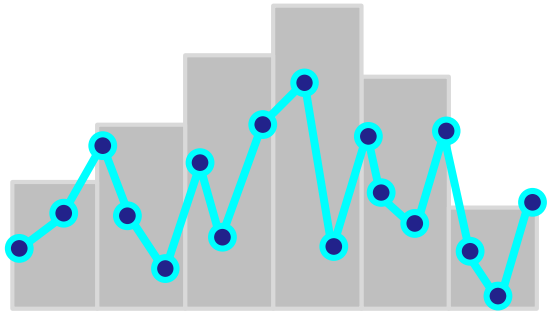
- Graphical Analysis

Benefits:

- Allows to learn about the nature of the process.
- Enables clarity of communication.
- Helps understanding sources of variation in the data.
- Provides focus for further analysis.

- Graphical Analysis

- Different graphs can reveal different **characteristics** of your data:
  - Central tendency.
  - Dispersion.
  - The general shape for the distribution.



- Conclusions drawn from graphs may require verification through **advanced statistical techniques** such as significance testing and experimentation.

- Graphical Analysis

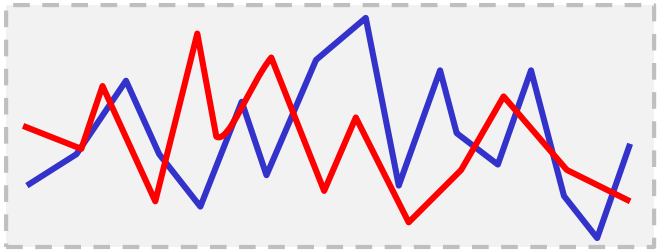
- Graphing the data can be utilized for both historical data and live data collection activities.
- You need to pick the right graphical tool as there are a lot of different ways to plot your data.
- If one graph fails to reveal anything useful, try another one.

Month	Machine 1	Machine 2	Machine 3
Jan	4,932	6,475	2,932
Feb	3,132	3,757	3,832
Mar	4,828	5,477	2,828
Apr	5,752	4,858	5,252
May	4,322	3,864	3,322
Jun	3,757	10,854	4,757
Jul	5,477	6,628	3,477
Aug	4,858	9,752	2,858
Sep	3,864	4,932	1,864
Oct	7,454	5,832	2,454
Nov	4,754	4,428	2,754
Dec	3,358	4,322	2,622

- Graphical Analysis

Line Charts:

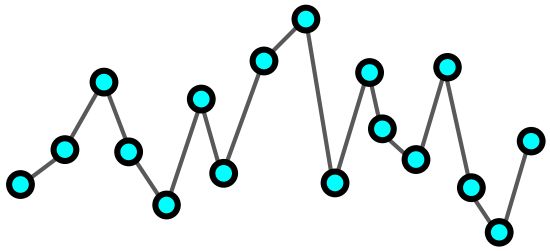
- One of the simplest form of charts.
- Useful for showing trends in quality, cost or other process performance measures.
- They represent the data by connecting the data points by straight lines to highlight trends in the data.
- A standard or a goal line may also be drawn to verify actual performance against identified targets.
- Time series plots, run charts, SPC charts and radar charts are all line charts.



- Graphical Analysis

Time Series Plots:

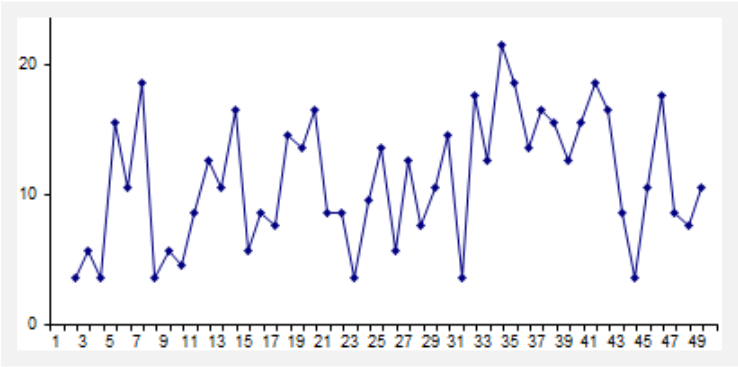
- Line charts used to evaluate behavior in data over a time interval.
- They can be used to determine if a process is stable by visually spotting trends, patterns or shift in the data.
- If any of these are observed, then we can say that the process is probably unstable.
- It requires the data to be in the order which actually happened.
- More advanced charts for assessing the stability of a process over time are run charts and SPC charts.



- Graphical Analysis

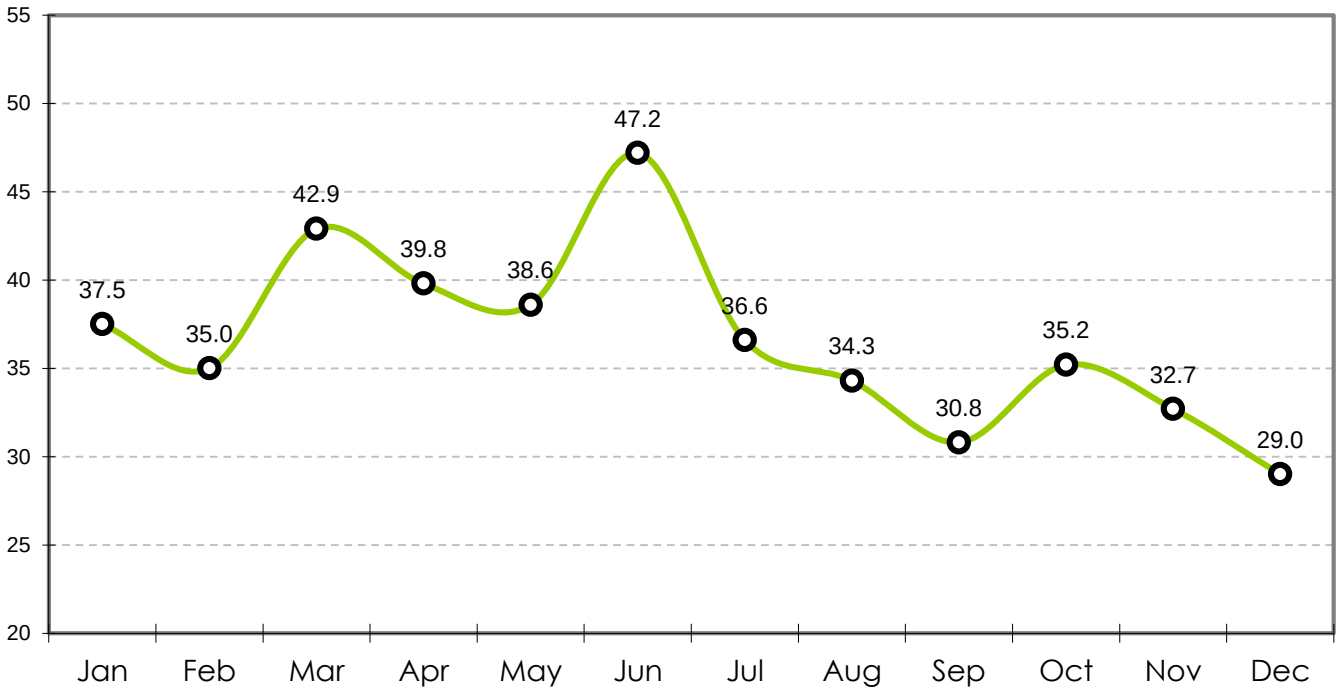
Time Series Plots:

- **Time Series Analysis** is the analysis of the plotted data in order to get meaningful information.
- Different behaviors of the data can be observed such as:
  - Upward and downward trends.
  - Shifts in the mean.
  - Changes in the amount of variation.
  - Patterns and cycles
  - Anything not random.
- **Time Series Forecasting** is the use of a model to predict future values based on observed values.



- Graphical Analysis

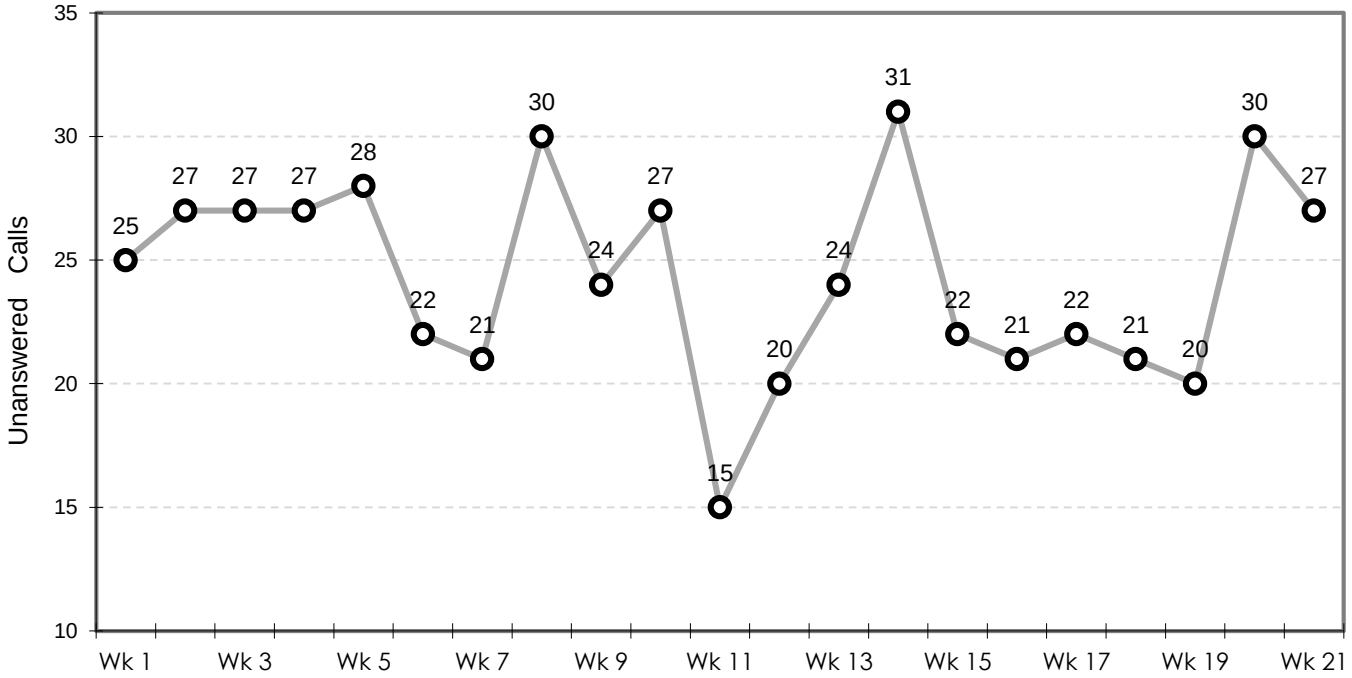
Example – The average time it needed to change a label:



A time series plot for evaluating **continuous data**

- Graphical Analysis

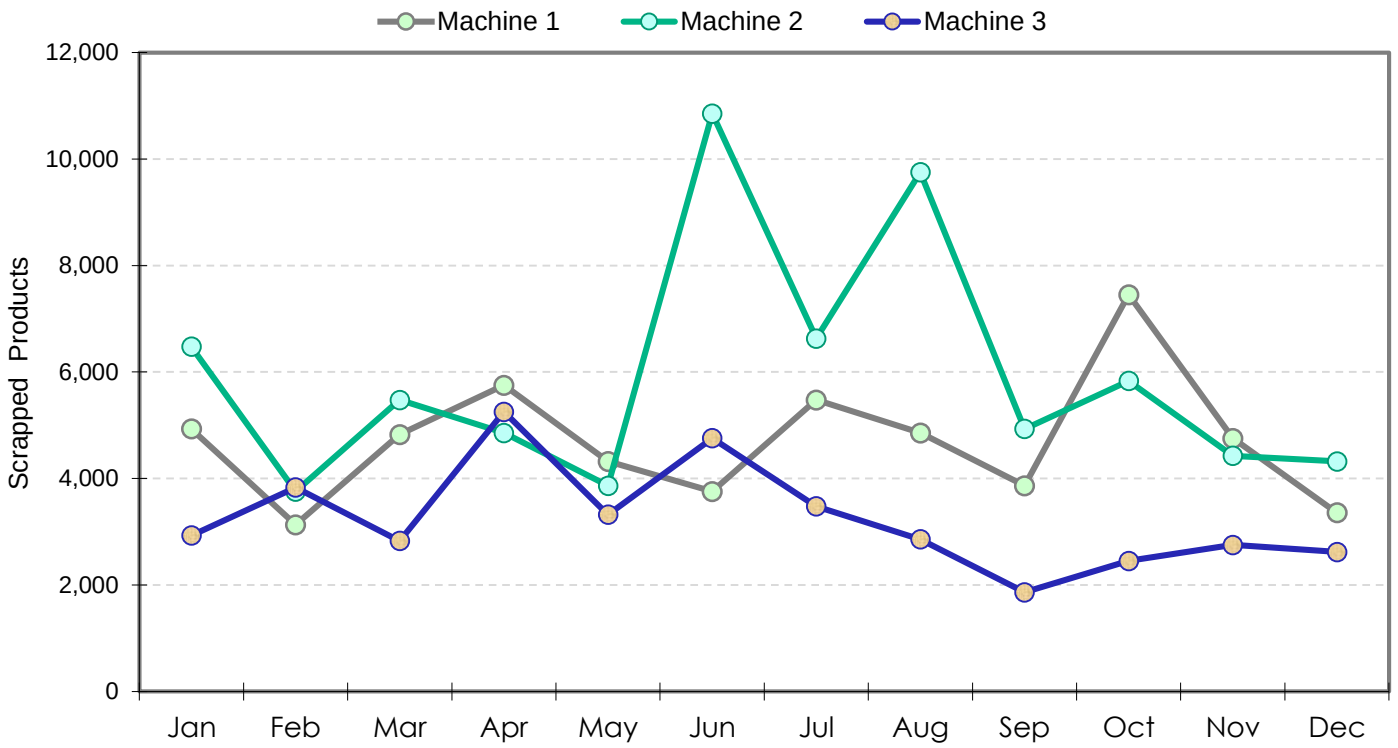
Example – The number of unanswered calls in a call center:



A time series plot for evaluating **count data**

- Graphical Analysis

Example – The number of scrapped products generated from three machines:



- Graphical Analysis

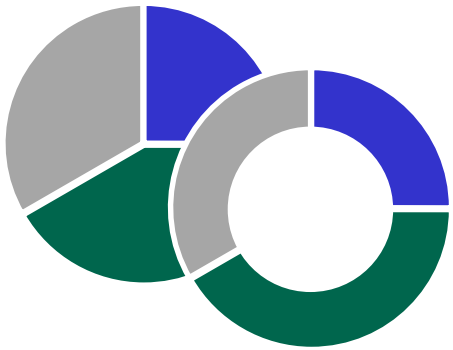
Pie Charts:

- Circular charts that make it easy to compare proportions.
- Widely used in the business and media worlds for their simplicity and ease of interpretation.
- They represent each category as a slice of the pie.
- They display the proportion of each category relative to the whole data set.

- Graphical Analysis

Pie Charts:

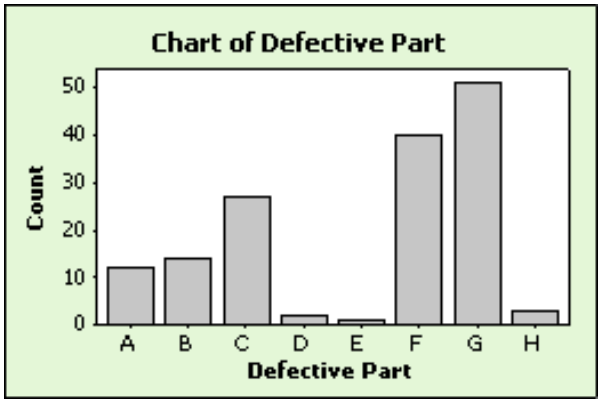
- A **Doughnut Chart** is a variation of the pie chart with a blank center.
- It allows for additional information to be included about the data.
- Pie and doughnut charts work well with few categories.
- They are suitable for presenting data for around seven groups or fewer.

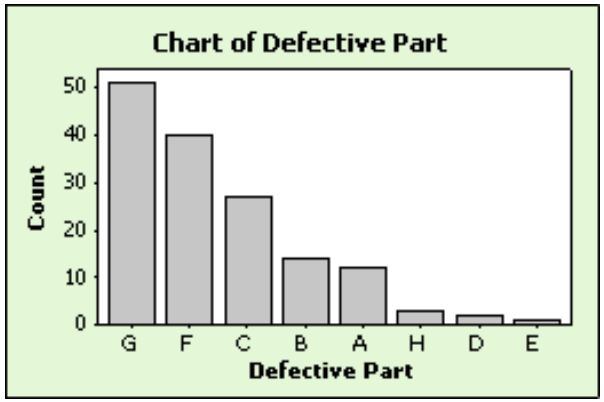


- Graphical Analysis

Bar Charts:

- Used to display frequencies of attribute data.
- They focus on the absolute value of the data.
- The bars on the chart are presented horizontally or vertically.
- When a bar chart presents the categories in descending order of frequency, this is called a **Pareto Chart**.

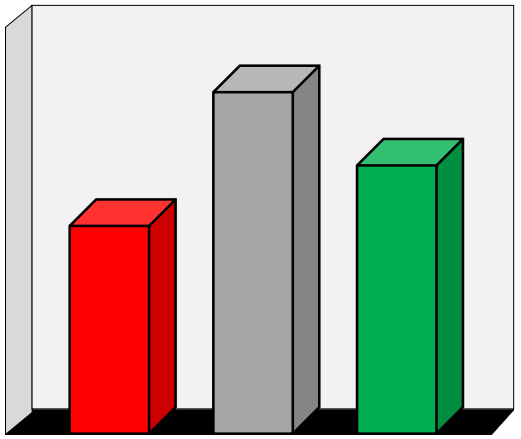




- Graphical Analysis

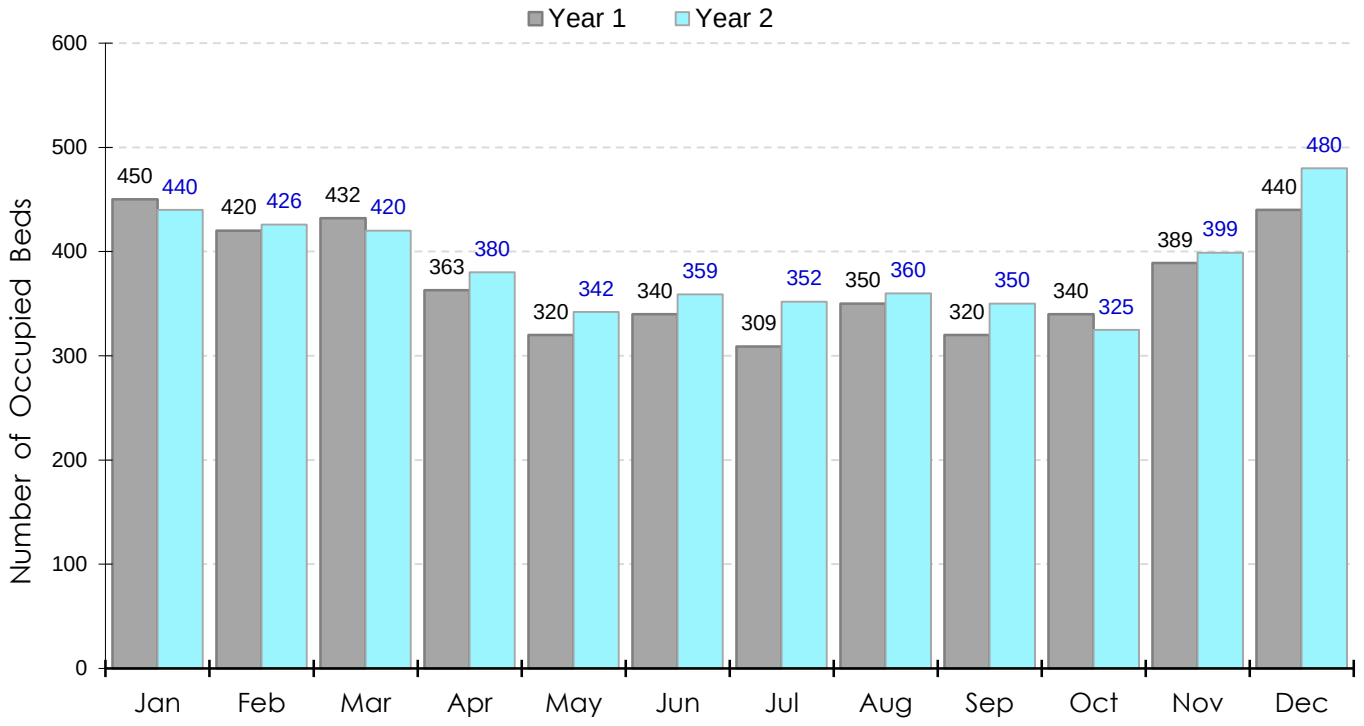
Bar Charts:

- **Grouped Bar Charts** display bars clustered in groups.
- **Staked Bar Charts** stack bars of each group on top of each other to show the cumulative effect.
- A **100% Staked Bar Chart** is used for demonstrating the difference in proportion between categories.



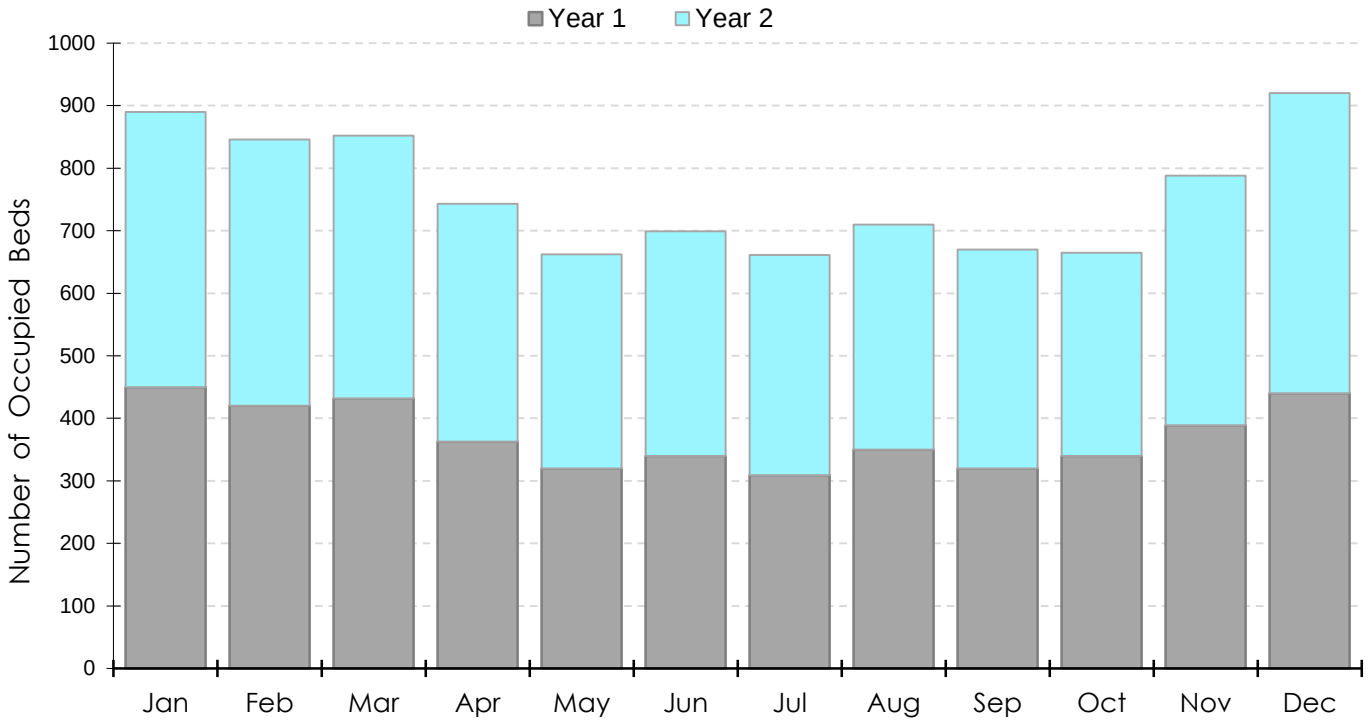
- Graphical Analysis

Example – A grouped bar chart displaying the number of occupied beds in a hospital in two consecutive years.



- Graphical Analysis

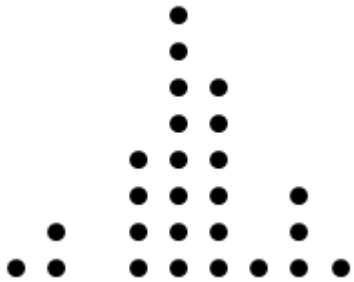
Example – A stacked bar chart displaying the number of occupied beds in a hospital in two consecutive years.



- Graphical Analysis

Dotplots:

- A Dotplot is a graphical representation of data using dots plotted on a simple scale.
- A form of frequency distribution.
- It is suitable for displaying small to moderate data sets.

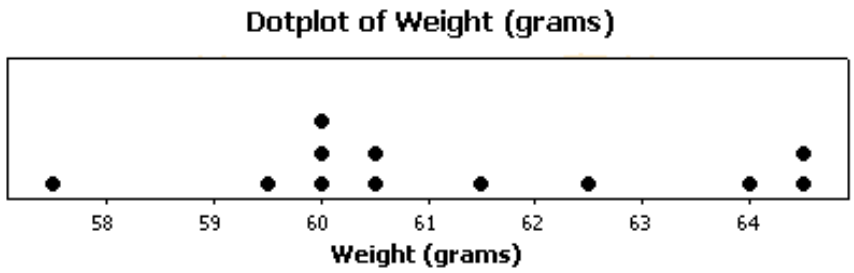


- The X-axis is divided into many small intervals called bins.
- The data values falling within each bin are represented by dots (one or more dots per data point).
- The end result is a set of vertical lines of dots.

- Graphical Analysis

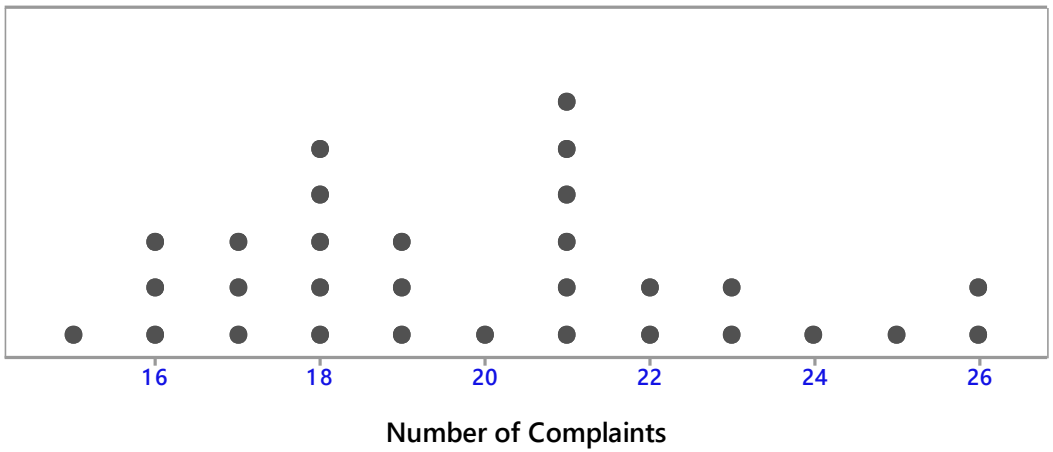
Dotplots:

- It is generally used when the data is discrete.
- It can also be used to present continuous data.
- It shows where the data are clustered, where the gaps are located and can help identify outliers.
- Dotplots are also useful for comparing distributions in terms of their shape, location and spread.



- Graphical Analysis

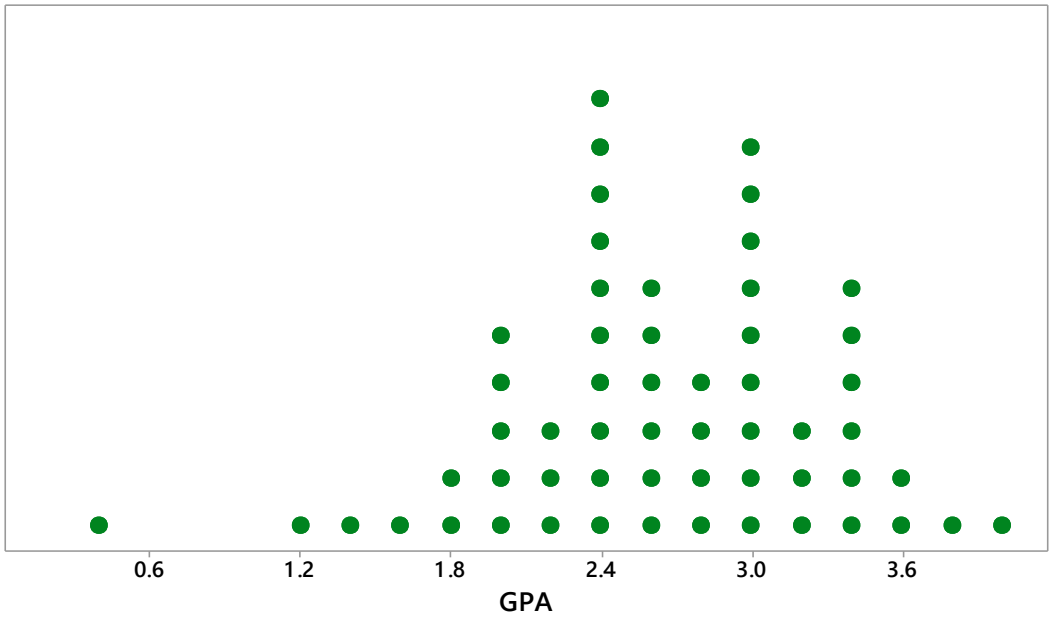
Example – A dotplot that displays the number of complaints made by customers in a given period of time.



A dotplot for evaluating **count data**

- Graphical Analysis

Example – A dotplot showing the GPA scores of all students in a business college.

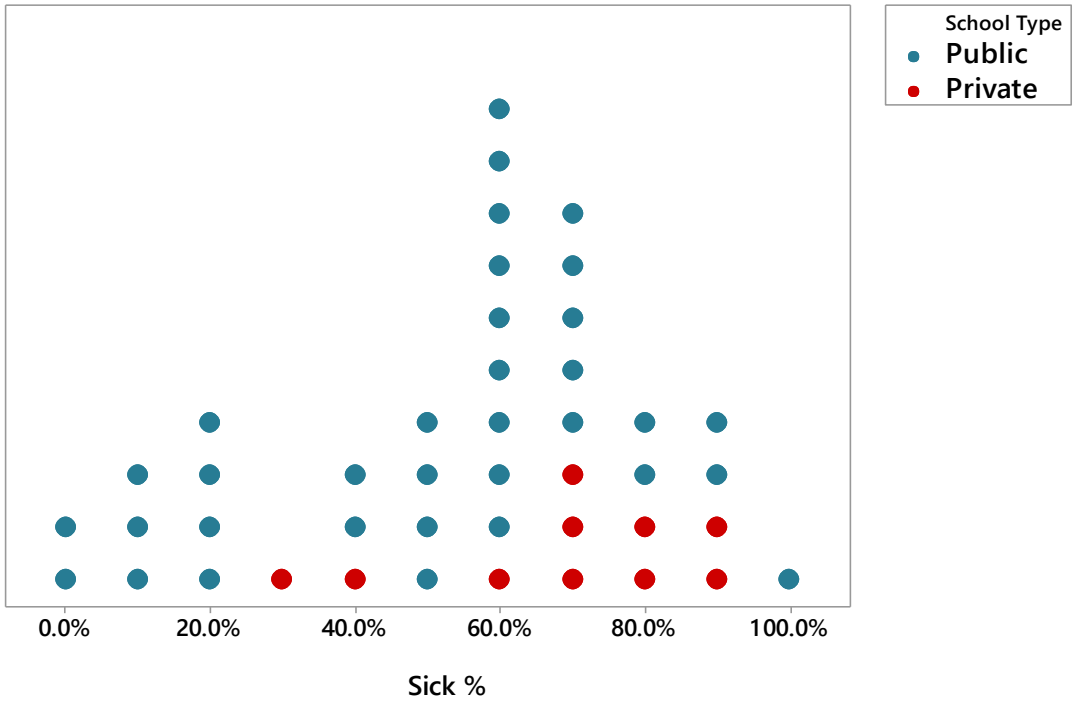


Each symbol represents up to 4 observations.

A dotplot for evaluating **continuous data**

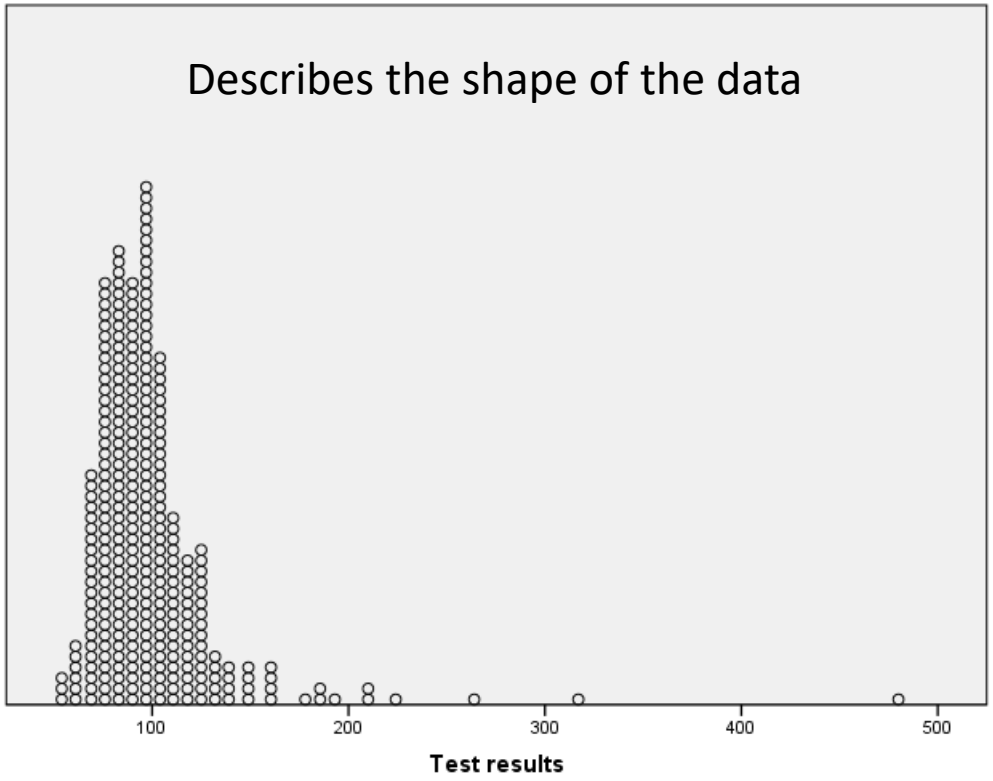
- Graphical Analysis

Example – A dotplot is created to compare the teachers who had been on sick leave between two types of schools.



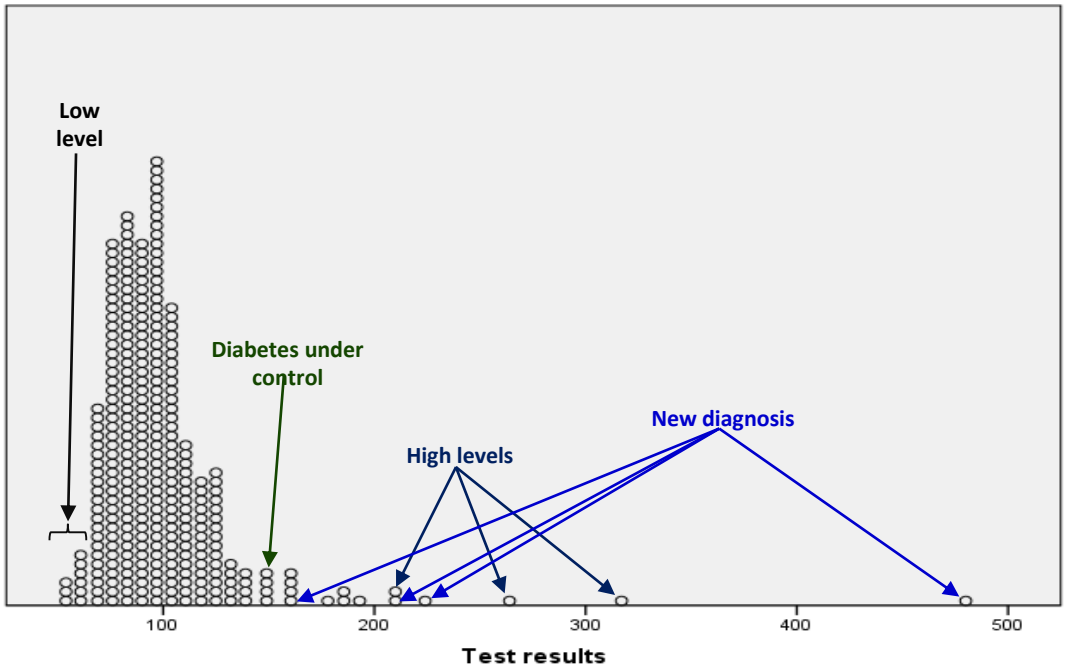
- Graphical Analysis

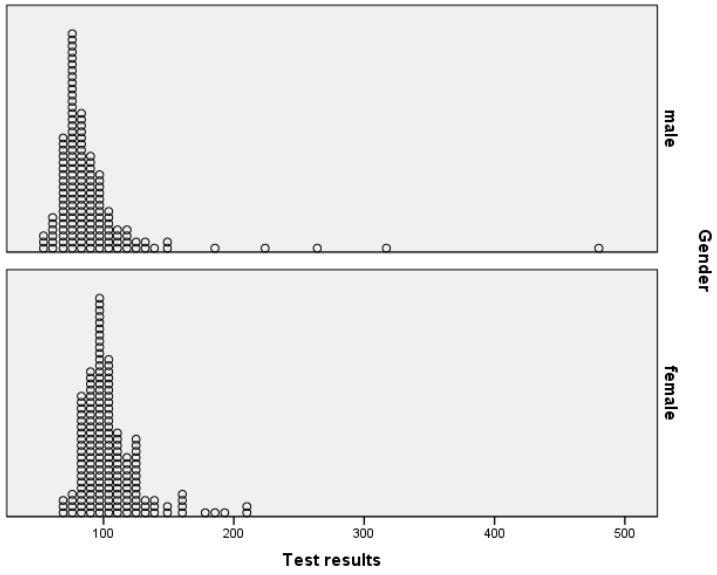
Example – An analysis that was conducted for diagnosing the presence of diabetes at a workplace.



- Graphical Analysis

Example – An analysis that was conducted for diagnosing the presence of diabetes at a workplace.

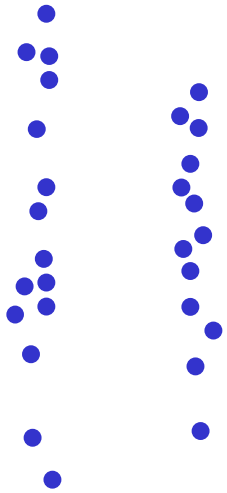




- Graphical Analysis

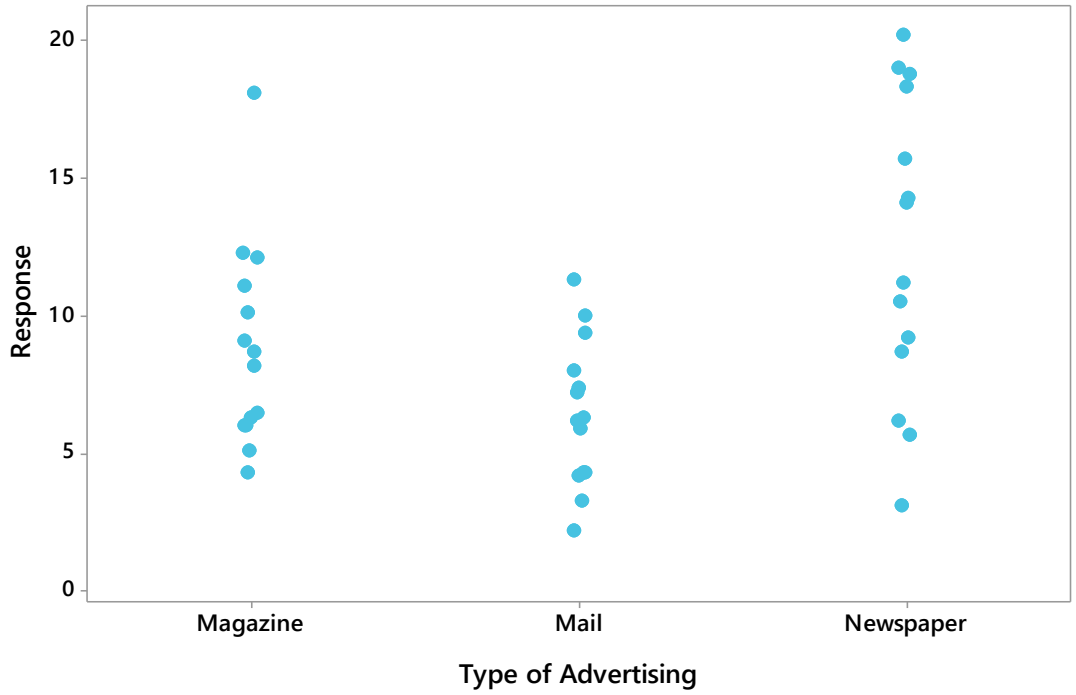
Individual Value Plots:

- Graphs that are useful to give an overall picture of the individual values that make up a data set.
- Often used for comparing distributions that have small number of data.
- They enable to see all the values of a data set even if there are similar data points.
- They give an idea of the distribution shapes and whether outliers are present.



- Graphical Analysis

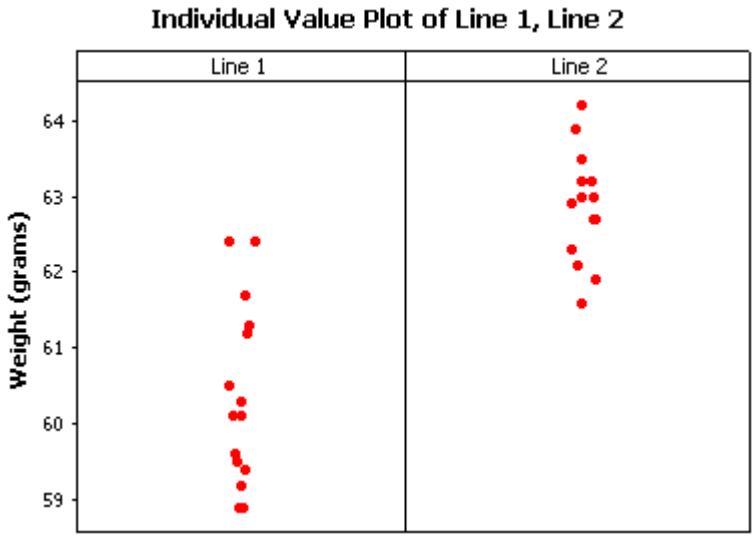
Example – An individual value plot showing the responses of a particular marketing campaign that uses multiple advertising methods.



- Graphical Analysis

Individual Value Plots:

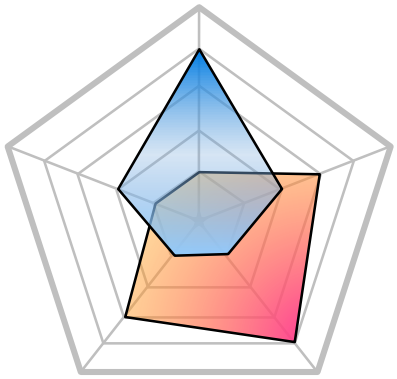
- What can you conclude from this Individual Value Plot?



- Graphical Analysis

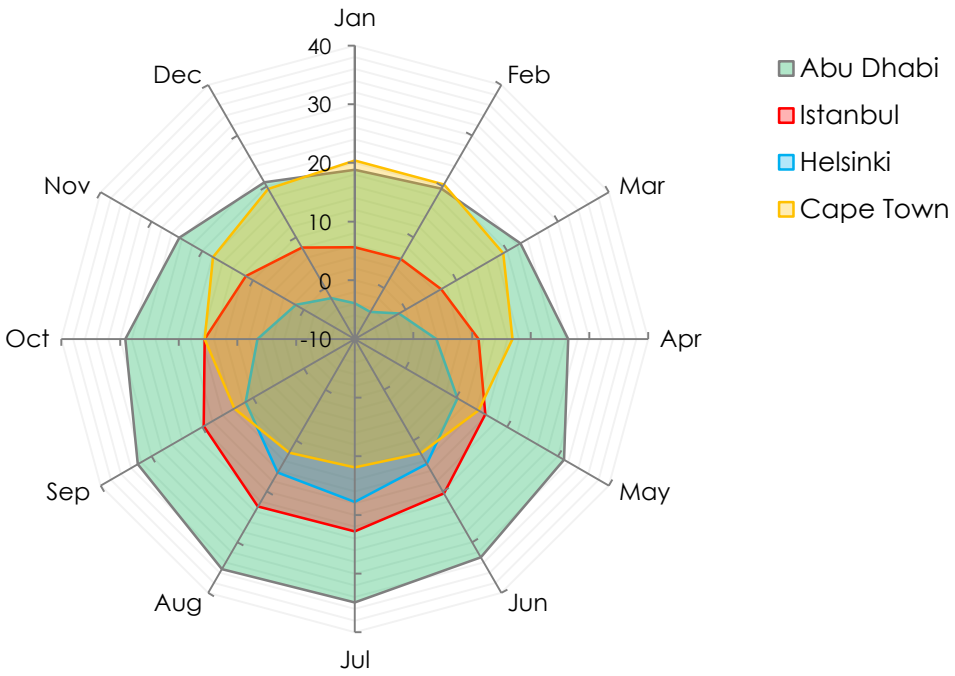
Radar Charts:

- Used to display and compare multiple data sets over a range of characteristics or over a specific period of time.
- It comes in the form of a **two-dimensional chart**.
- It has a radial axis and an angular axis.
- After plotting the data, a point close to the center indicates a low value and a point near the edge indicates a high value.
- A line is normally drawn connecting the data values for each data set.



- Graphical Analysis

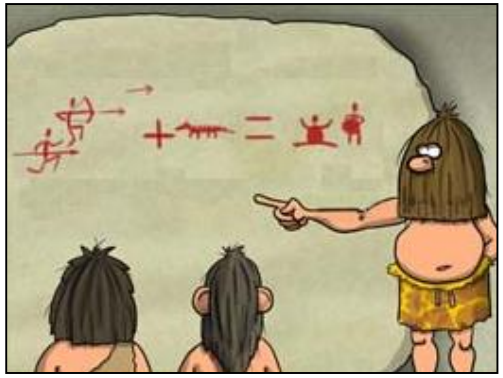
Example – A radar chart that displays the daily mean temperatures in four different cities over the year.



- Graphical Analysis

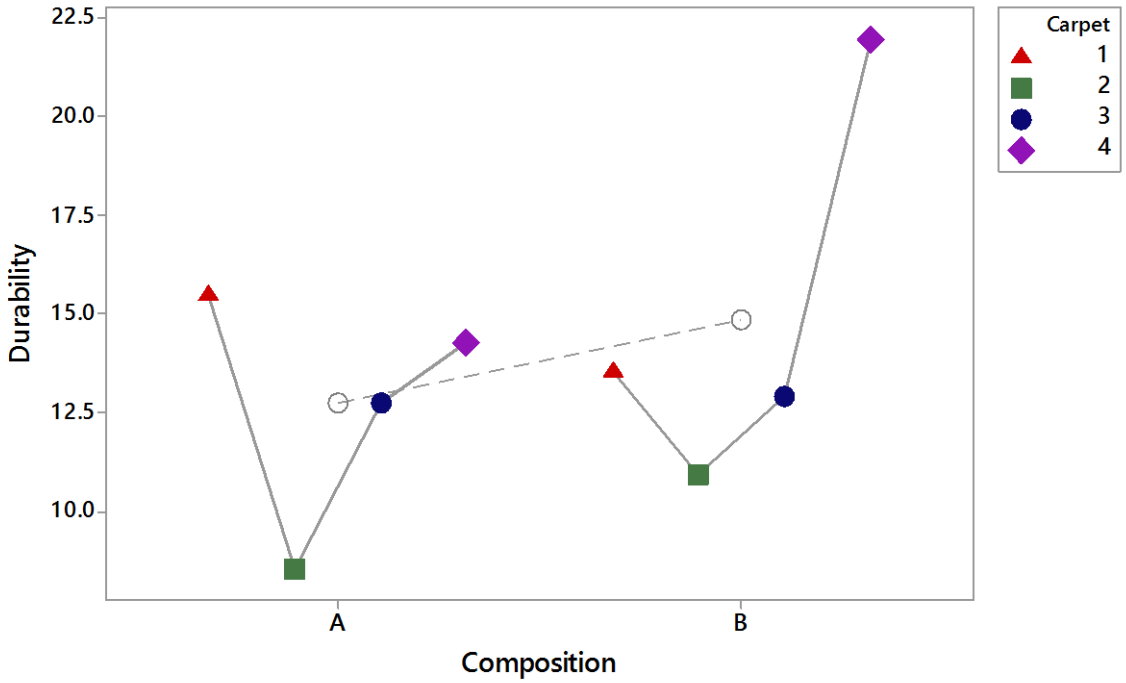
Multi-Vari Charts:

- Variation in the data may come from multiple sources.
- A **Multi-Vari Chart** is a graphical tool that allows to visually show where the major variation is coming from.
- Multiple variables are plotted together on a **single chart**.
- Often used when studying the variation within:
  - A subgroup.
  - Between subgroups.
  - Over time.



- Graphical Analysis

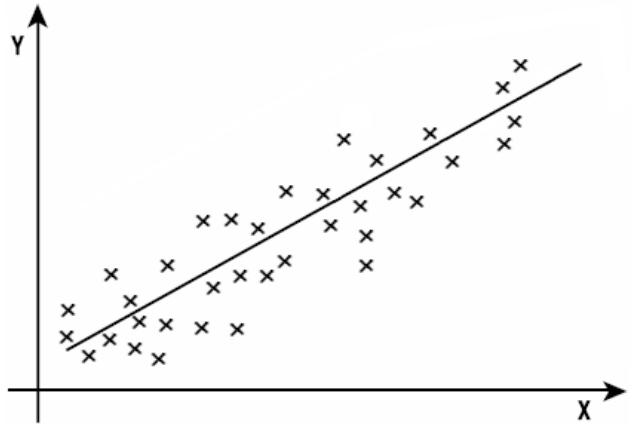
Example – A multi-vari chart showing how the type and composition affect the durability of a carpet.



- Graphical Analysis

Scatter Plots:

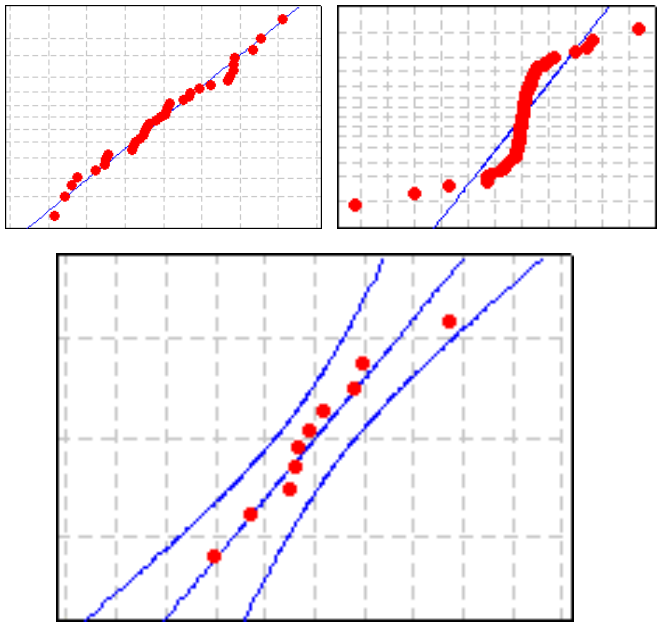
- Many problems require the estimation of the relationship between two or more variables.
- Scatter plots are used to study the relationship between two variables.
- They are used to determine what happens to one variable when another variable changes value.



- Graphical Analysis

Probability Plots:

- Graphical techniques that provide a more decisive approach for determining if your data follows a particular distribution.
- Constructed in a way that the points will fall in a straight line if they fit the distribution in question.
- They are an improvement from just assessing visually.

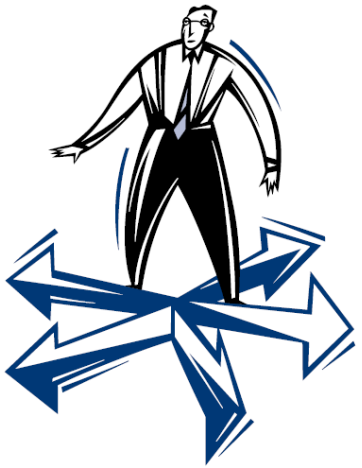


Normal Probability Plots

- Graphical Analysis

Graph Selection:

- **The graphs you choose depends on:**
  - The type of data you have.
  - The objective you are trying to achieve.
- There are graphs for continuous data and graphs for count and attribute data.
- Remember that you need to perform additional statistical analysis before drawing any conclusion.



- Graphical Analysis

Graph Selection: