6 : Visual Communication

EN3106– Communication Skills II

Level II - Semester 3

Overview

This is the sixth topic of the course module, Communication Skills (EN3106). This section will introduce you to visual communications.

The section will provide an overview of the graphical elements used in technical writing. This section will also elaborate on choosing effective visuals and how to present clean graphs and figures.

Intended Learning Outcomes

• At the end of this lesson, you will be able to;

➢ identify different graphical elements that can be used in technical writing.

➢ use appropriate visuals to represents text and data.

➢ draw and visualize data by selecting the most suitable graphs.

➢ interpret different graphs.
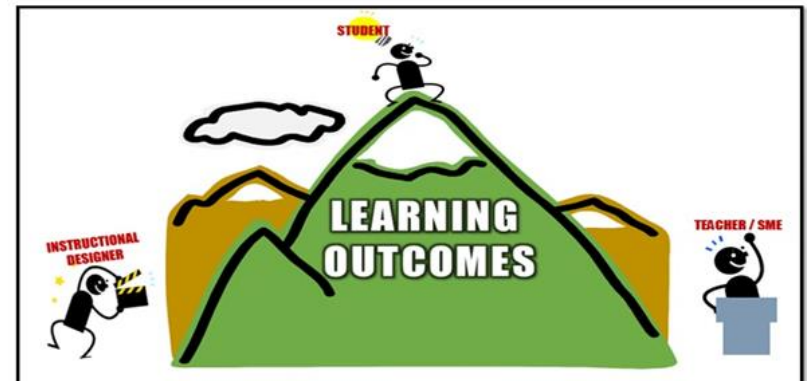
Intended Learning Outcomes

- At the end of this lesson, you will be able to;

  ➤ identify the situations where the certain graphs should not be used.

  ➤ generate clean graphs.

  ➤ arrange figures appropriately in technical writing.
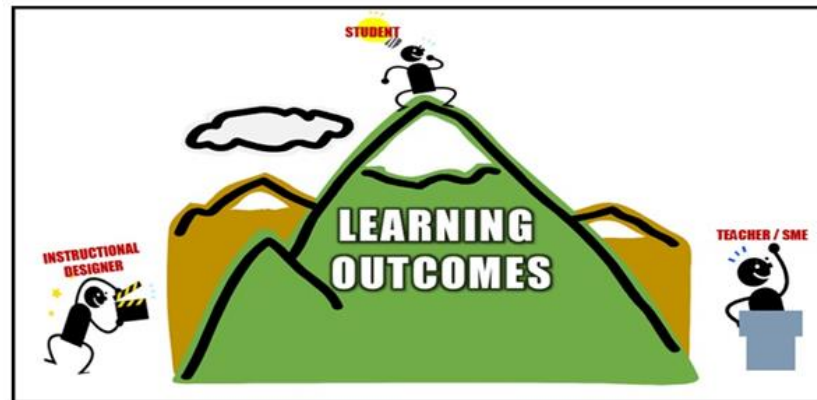
List of Sub-Topics

6.1 Using Graphical Elements in Technical Writing **[Ref 1: Pg. (163 - 172)]**

6.2 Choosing Effective Visuals

    6.2.1 Simple Text **[Ref 2: Pg. (38 - 40)]**

    6.2.2 Tables **[Ref 2: Pg. (40 - 43)] [Ref 1: Pg. (175-177)]**

    6.2.3 Graphs **[Ref 2: Pg. (43 - 69)]**

        6.2.3.1 Points

        6.2.3.2 Lines

        6.2.3.3 Bars

        6.2.3.4 Area

        6.2.3.5 Graphs to be Avoided

    6.2.4 Presenting Clean Graphs – Decluttering **[Ref 2: Pg. (90-98)]**

6.3 Figures **[Ref 1: Pg. (172 - 175)]**

References

[REF1] Laplante, P. A., (2018) Technical Writing: A Practical Guide for Engineers, Scientists, and Nontechnical Professionals -Routledge; 2nd edition.

[REF2] Knaflic, C.N., (2015) Storytelling with data: a data visualization guide for business professionals-Wiley; 1st edition.

6.1 Using Graphical Elements in Technical Writing

- Graphical elements will break up the monotony in technical writing.

- The readers attention can be captured more effectively by using graphical elements in an appropriate manner.

- Dull writing can diminish the interest and comprehension of a reader.

6.1 Using Graphical Elements in Technical Writing

- The Graphical Elements include

  ➤ figures,

  ➤ equations,

  ➤ photographs,

  ➤ tables etc.

- Graphical elements can enliven the presentation, enrich ideas, and alleviate the boredom of a dry, text-only exposition.

  ➤ Using a bullet list can alter the monolithic writing.

6.1 Using Graphical Elements in Technical Writing

- Modeling Ideas with Graphics

  ➢Words, tables, figures, equations, etc. can be used to model an idea.

  ➢It can often be harder to construct good charts and write equations.

  ➢Too many graphical elements in a piece of writing

  ❏the reader becomes distracted as the flow of the narrative is lost.

6.1 Using Graphical Elements in Technical Writing

- Too few graphical elements in a piece of writing

  ➢ the reader's attention can be lost in overly long textual passages.

- The challenge is to find the right techniques for the ideas that you want to explain.

How do you get the correct blend of content and non text elements in specialized composing?

6.1 Using Graphical Elements in Technical Writing

- A picture is worth a thousand words

  - A group of analysts attempted to degree the affect of graphical components in scholarly research

  - Using a customized version of the page ranking algorithm that used Google, researchers observed that with every diagram provided, papers attracted nearly 2 additional citations.
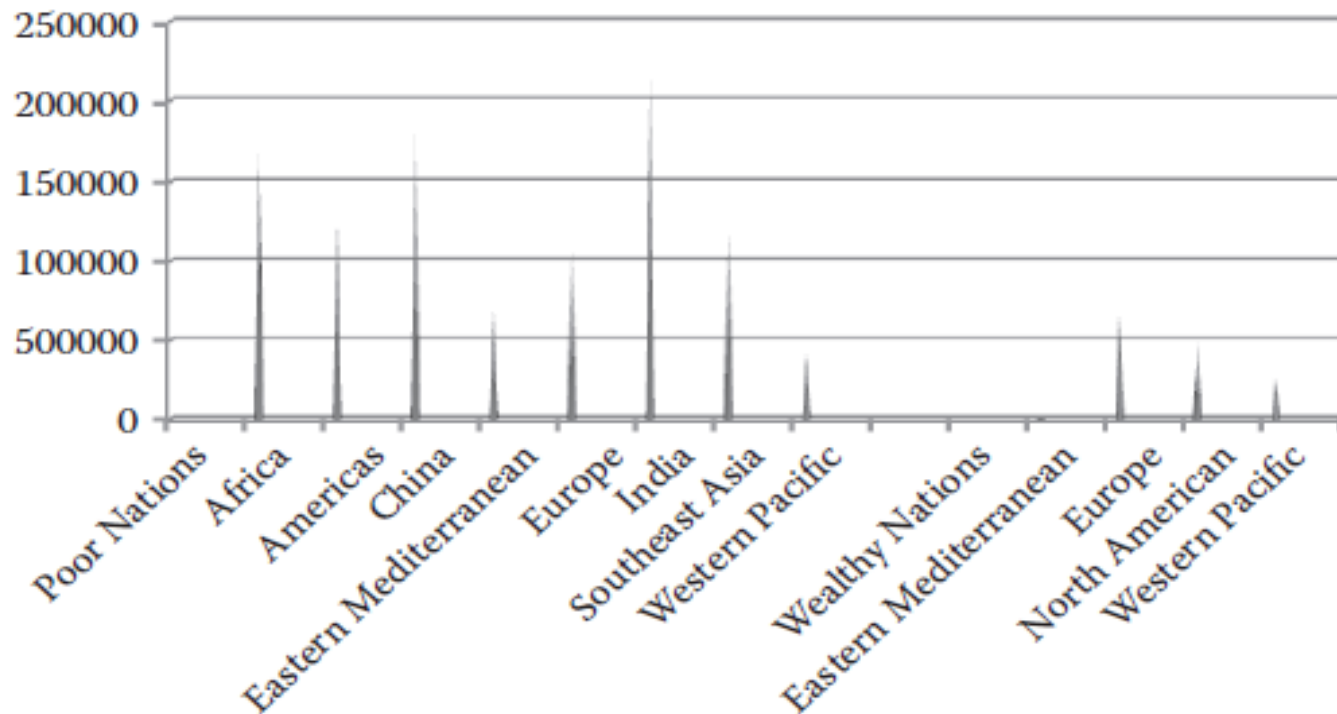
6.1 Using Graphical Elements in Technical Writing

<u>Example:</u> Consider the following narrative on traffic deaths in various countries:

There were over 1,170,000 recorded traffic deaths globally in 1998. In developing countries, the number of traffic deaths was 8.7 percent higher than in rich nations. With more than 178,000 and 170,000 deaths, respectively, China and Africa had the misfortune of leading the way. Of the wealthy countries, with just 923 deaths, those in Eastern Europe did the poorest.

6.1 Using Graphical Elements in Technical Writing

- Now consider the following figure depicting the Narrative.

FIGURE: Worldwide Road Traffic Fatalities — 1998 [Ref2]

6.1 Using Graphical Elements in Technical Writing

Narrative vs. Figure

- The figure conveys more detail, and easier to understand than the narrative.

- In the figure the number of the fatalities per region, depicted by the boxes, grabs the attention and makes comparisons very easy.

6.1 Using Graphical Elements in Technical Writing

Narrative vs. Figure

- However, be careful when using graphical representations as, it could be a weapon to shock the reader or misrepresent information to advance a hidden agenda.

  ➢ In the figure the whole story is not obvious because the chart gives only gross fatalities, not fatalities as a percentage of population.

- Though words are better than pictures, usually when both used together it makes a most powerful exposition.

6.2 Choosing Effective Visuals

- Choosing the wrong chart type of data visualization could confuse users or lead to data misinterpretation.

- The same data set can be represented in many ways.

- A set of statistical information can be demonstrated by most of the elaborated types of visuals.

- It is important to choose the most appropriate visual for the given context.

Choose the right chart
I would like to **see**

Relationship

Snapshot (Static)
- Scatter chart
- Bubble chart
- Network Diagram

Comparison

Snapshot (Static)
- Column chart
- Bar chart
- Circular area chart

Over time
- Line chart
- Column chart
- Column overlap chart

Composition

Snapshot (Static)
- Pie/Donut chart
- Tree map
- Heat map
- Sunburst chart

Over time
- Stacked column chart
- Stacked area chart
- Waterfall chart

Distribution

Snapshot (Static)
- Scatter chart
- Histogram chart
- Bell curve
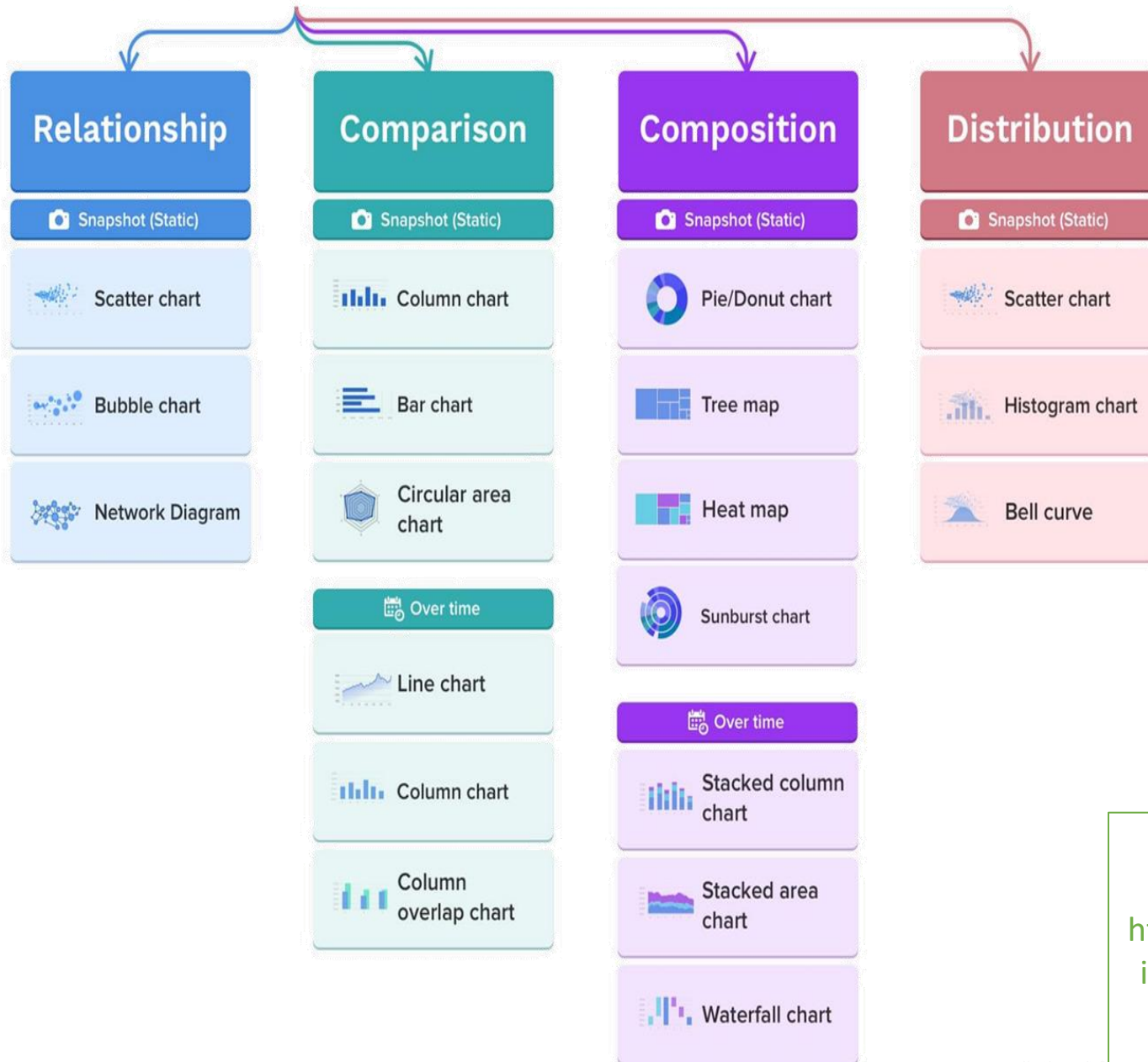
Source of Reference: Figure is taken from https://uxdesign.cc/20-ideas-for-better-data-visualization-73f7e3c2782d

© e-Learning Centre, UCSC

by Taras Bakusevych

17

6.2.1 Simple Text

- Simple text can be a great way to communicate when you have only a number or two to share.

➤ Example: Consider the following
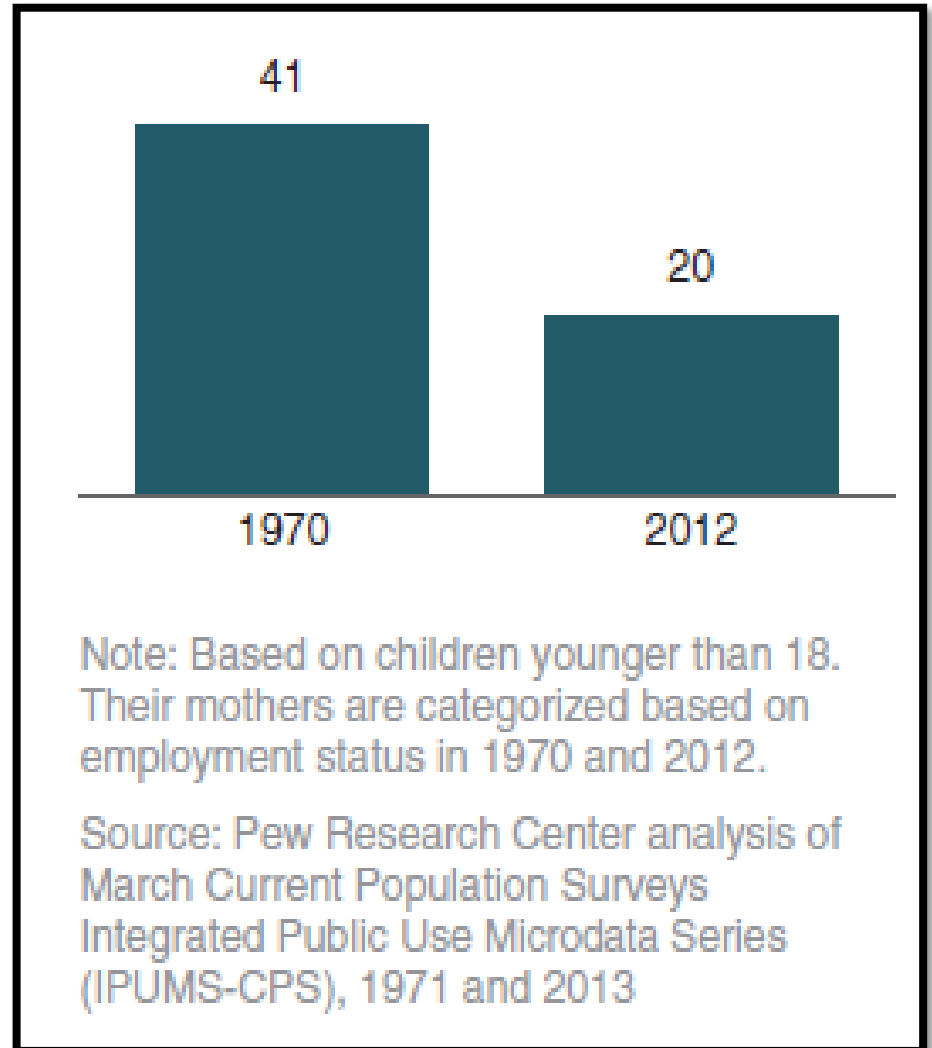
Figure: Stay-at-home moms' original graph [Ref2]

6.2.1 Simple Text

- Having some numbers does not imply that a graph is required to represent the facts.

- In the previous Figure,

  ➢ for a grand total of two numbers, quite a lot of text and space are used.

  ➢ the graph does not do anything to help explain the statistics.

- In such instances, a simple sentence would be adequate

20 percent of children had In 2012, a typical stay-at-home wife, compared with 41 percent in 1970.

6.2.1 Simple Text

- Alternatively, in a presentation or report, same can be visualize as below.

20%
of children had a
traditional stay-at-home mom
in 2012, compared to 41% in 1970

Figure [Ref 2]

- Use the numbers directly when there is just a number or two to communicate.

- When there are more data to display one can use a table or graph.

6.2.2 Tables

- Tables are an effective way for displaying complex information and textual information.

- Tables interact with the verbal system (we are reading across rows, down columns and compare values).

- To communicate multiple different units of measure, it is easier to use a table than a graph.

6.2.2 Tables

Tables in live presentations

Using a table in a live presentation is rarely a good idea. As your audience reads it, you lose their ears and attention to make your point verbally. When you find yourself using a table in a presentation or report, ask yourself: what is the point you are trying to make? Odds are that there will be a better way to pull out and visualize the piece or pieces of interest. In the event that you feel you're losing too much by doing this, consider whether including the full table in the appendix and a link or reference to it will meet your audience's needs.

6.2.2 Tables

Table Design Consideration TIPS

- Fade the background, to let the data take center stage.

- Don't use strong borders or shading to struggle for emphasis.

- Use light borders or simply white space to set apart elements of the table.

- Examine the following tables and identify how the data stands out more than the structural components of the table in the second and third iterations (light borders, minimal borders).

6.2.2 Tables

Heavy borders

Group	Metric A	Metric B	Metric C
Group 1	$X.X	Y%	Z,ZZZ
Group 2	$X.X	Y%	Z,ZZZ
Group 3	$X.X	Y%	Z,ZZZ
Group 4	$X.X	Y%	Z,ZZZ
Group 5	$X.X	Y%	Z,ZZZ

Light borders

Group	Metric A	Metric B	Metric C
Group 1	$X.X	Y%	Z,ZZZ
Group 2	$X.X	Y%	Z,ZZZ
Group 3	$X.X	Y%	Z,ZZZ
Group 4	$X.X	Y%	Z,ZZZ
Group 5	$X.X	Y%	Z,ZZZ

Minimal borders

Group	Metric A	Metric B	Metric C
Group 1	$X.X	Y%	Z,ZZZ
Group 2	$X.X	Y%	Z,ZZZ
Group 3	$X.X	Y%	Z,ZZZ
Group 4	$X.X	Y%	Z,ZZZ
Group 5	$X.X	Y%	Z,ZZZ

Figure: Different types of table boarder types [REF2]

6.2.2 Tables

- A heatmap can be used to mix the detail in a table while making use of visual cues.

- A heatmap is a way to visualize data in tabular format, where in place of the numbers, you leverage colored cells that convey the relative magnitude of the numbers.

- It uses color saturation to provide visual cues.

6.2.2 Tables

Table

	A	B	C
Category 1	15%	22%	42%
Category 2	40%	36%	20%
Category 3	35%	17%	34%
Category 4	30%	29%	26%
Category 5	55%	30%	58%
Category 6	11%	25%	49%

Heatmap

LOW-**HIGH**

	A	B	C
Category 1	15%	22%	42%
Category 2	40%	36%	20%
Category 3	35%	17%	34%
Category 4	30%	29%	26%
Category 5	55%	30%	58%
Category 6	11%	25%	49%
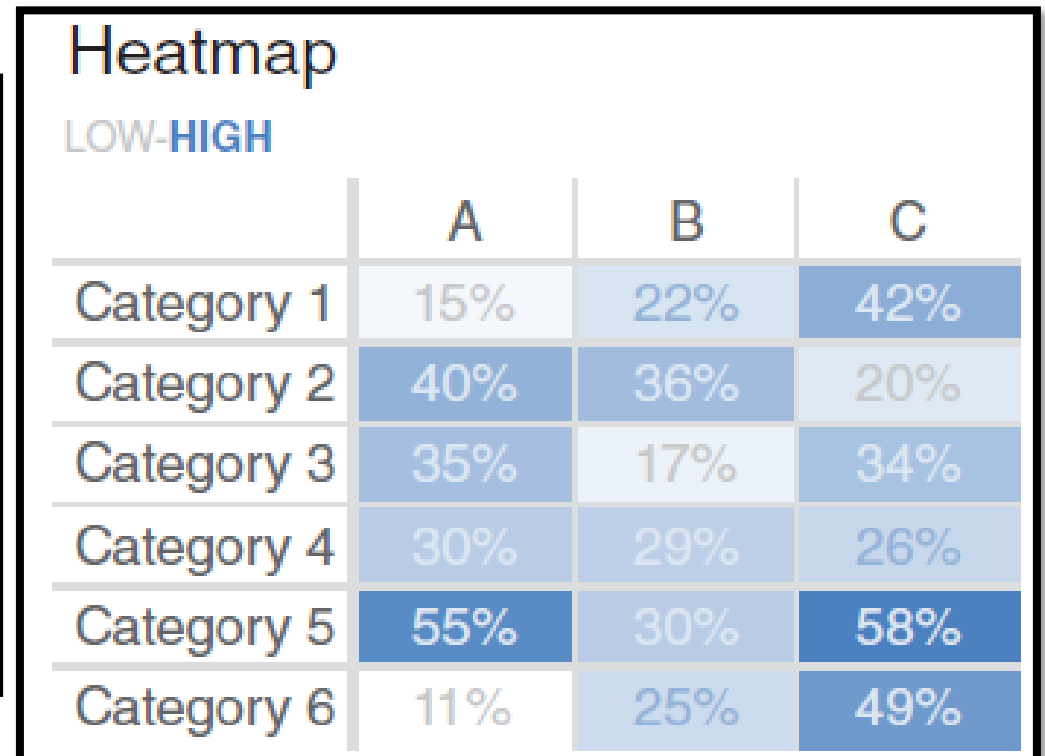
Figure: Standard Table vs Heatmap [REF2]

6.2.3 Graphs

- Tables interact with our verbal system, while graphs interact with our visual system and communicates information faster.

- There are several types of graphs.

  ➢Points, lines, bars, area etc.
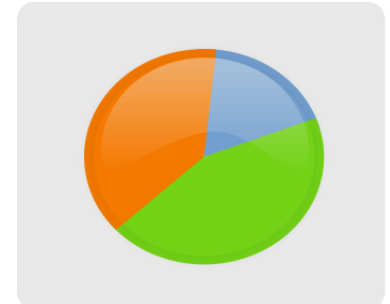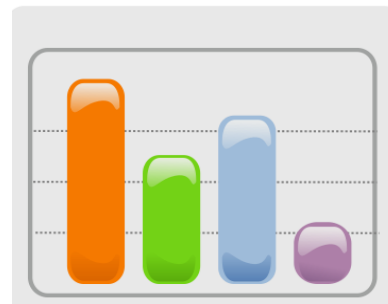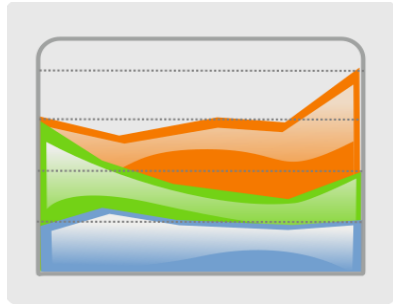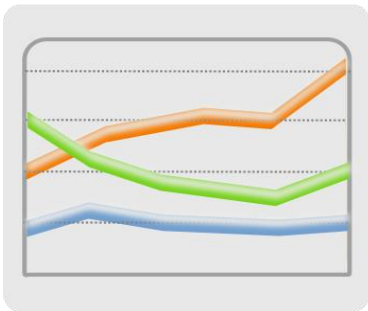
6.2.3.1 Points

Scatterplot:

- Shows the connection between two entities.

- Allows to encode data on the horizontal x-axis and vertical y-axis simultaneously to see whether and what relationship exists.

- More often used in scientific disciplines and in business context.

6.2.3.1 Points

Example:

Examine the connection between miles driven and expense per mile for a bus fleet.

Figure: Scatter Plot [REF2]
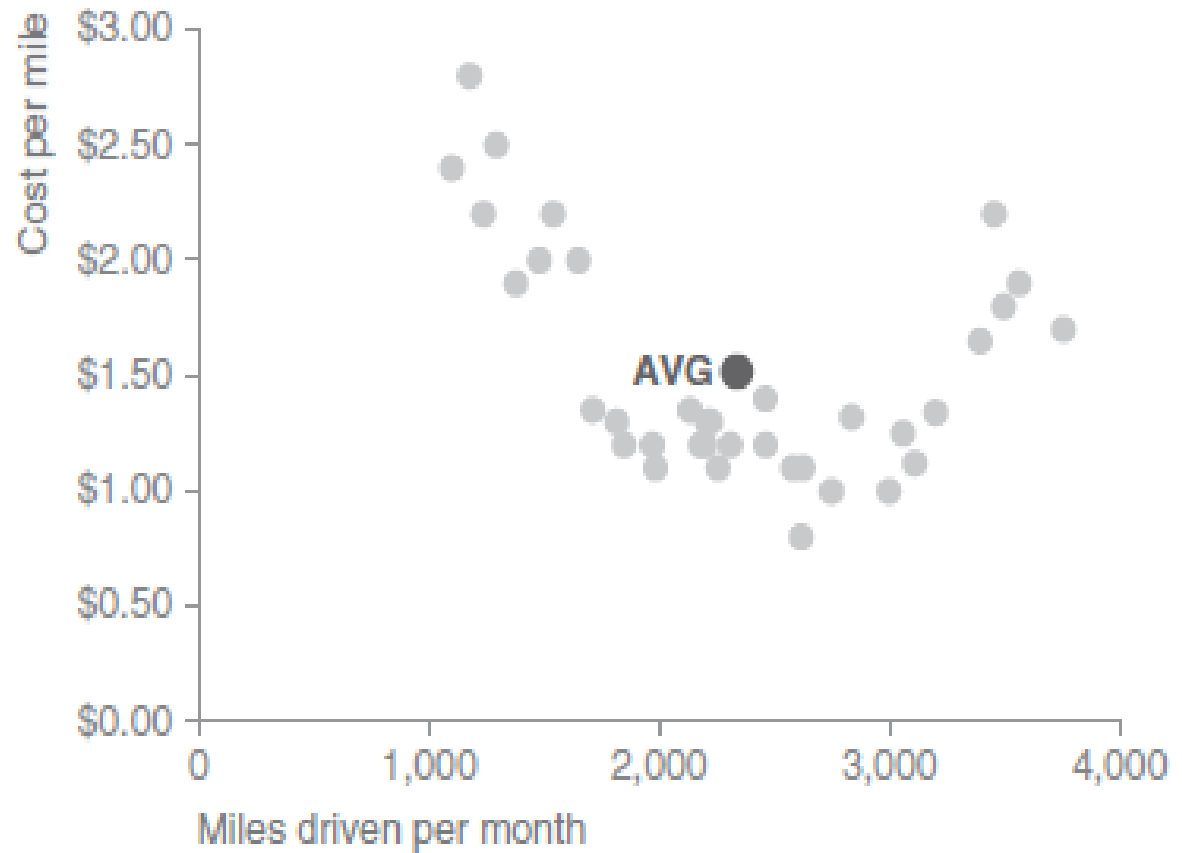
6.2.3.1 Points

- The scatterplot can be further modified if we want to concentrate mainly on the cases where the cost per mile is above average

Figure: Modified scatterplot [REF2]
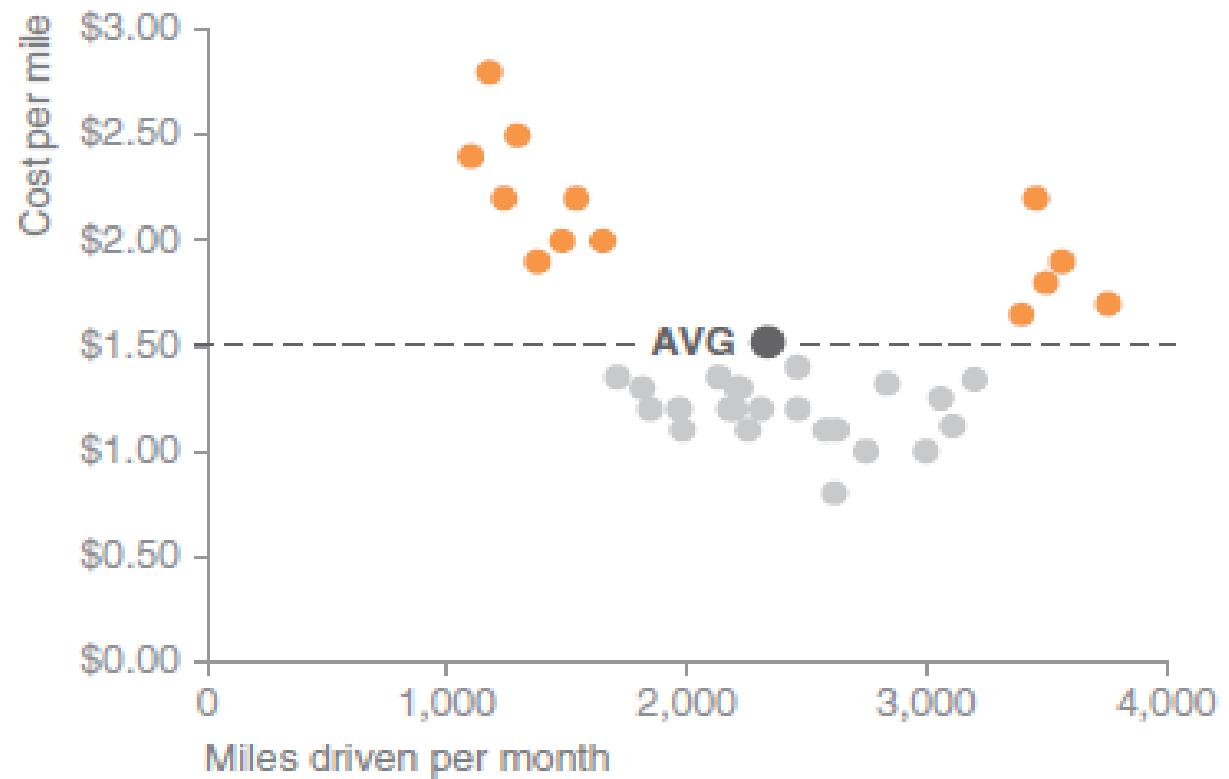
6.2.3.2 Lines

- A line graph represents the trend.

  ➢It is important to adapt the scale based on the data set for a given period and keep the line occupying two-thirds of the y-axis range.

- Line graphs are widely used to plot continuous data.

6.2.3.2 Lines

- The points are linked physically through the line.

  ➢It implies a connection between the points that may not make sense for categorical data.

- There are basically 2 types of line graphs.

  ➢Standard line graph

  ➢Slope graph.

6.2.3.2 Lines

A Standard Line Graph

- The line graph can show a single series of data, two series of data, or multiple series.
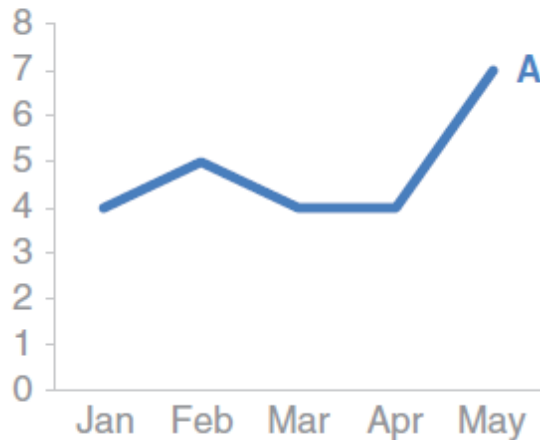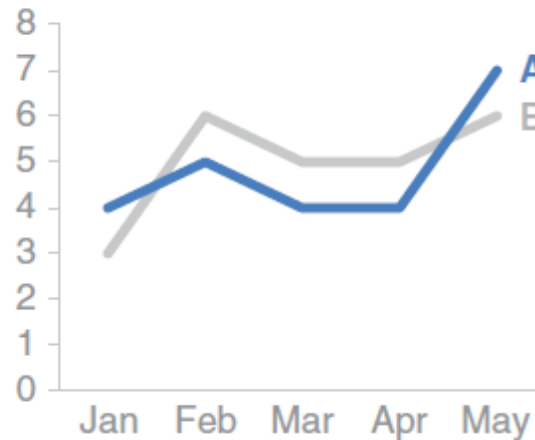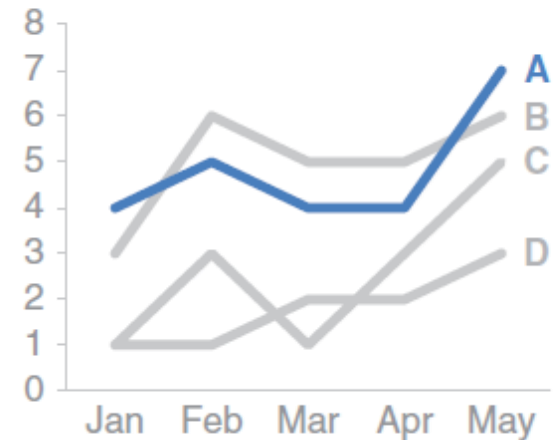
Figure: Different types of line graphs [REF2]

6.2.3.2 Lines

- The data plotted must be at regular intervals when graphing the time on the horizontal x-axis of a line graph.

- The line in a line graph may, represent a summary statistic, such as the average, or the point estimate of a forecast.

6.2.3.2 Lines

Example:

The line graph shows the minimum, average, and maximum wait times at passport control for an airport over a 13-month period.
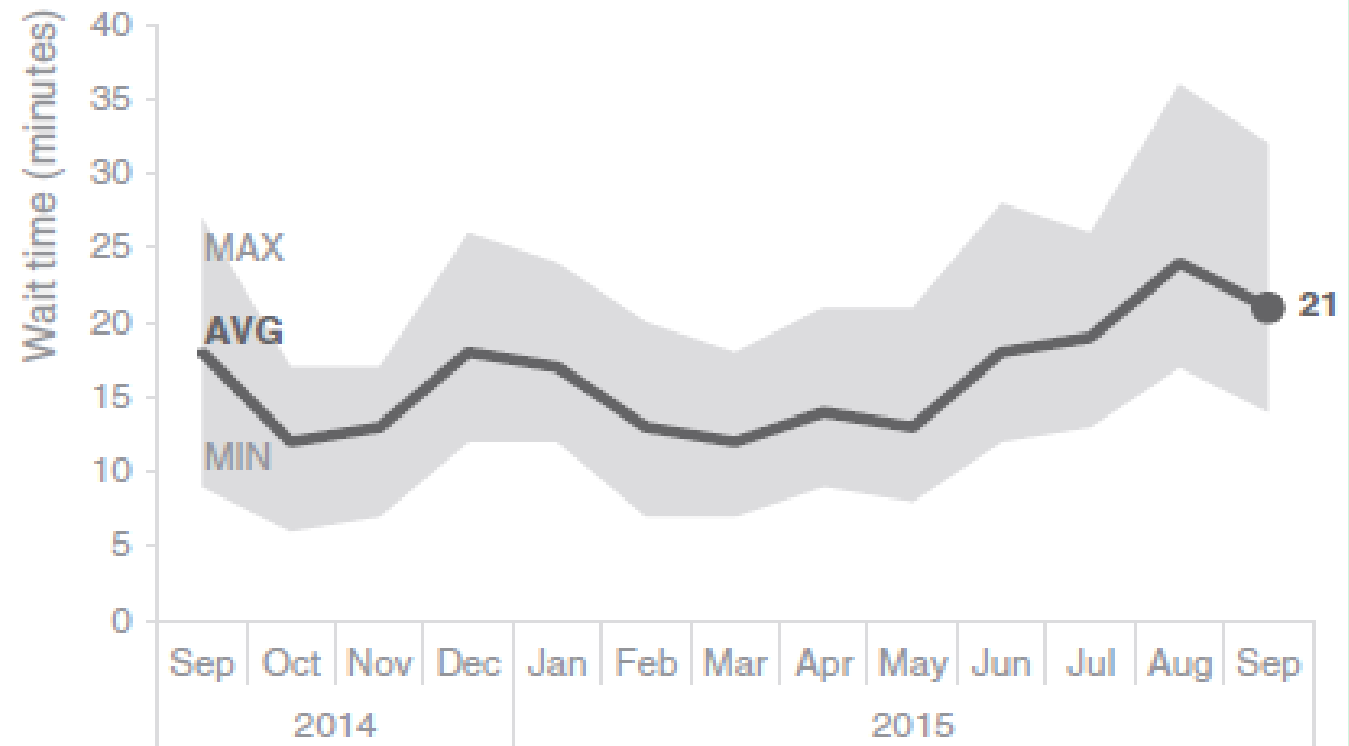
Figure: Line graph representing summary statistics [REF2]

6.2.3.2 Lines

Slope graphs,

- useful when there are two time periods or points of comparison.

- show relative increases and decreases or differences across various categories between the two data points.

- pack in a lot of information.

- the lines that connect the absolute values (the points), give you the visual increase or decrease in rate of change (via the slope or direction).

6.2.3.2 Lines

Figure: Slope graph [REF2]

6.2.3.2 Lines

- A slope graph will work in the specific situation depending on the data

- A slope graph may not work, if many of the lines are overlapping,

- However, in some cases this can emphasize a single series at a time with success.

6.2.3.2 Lines
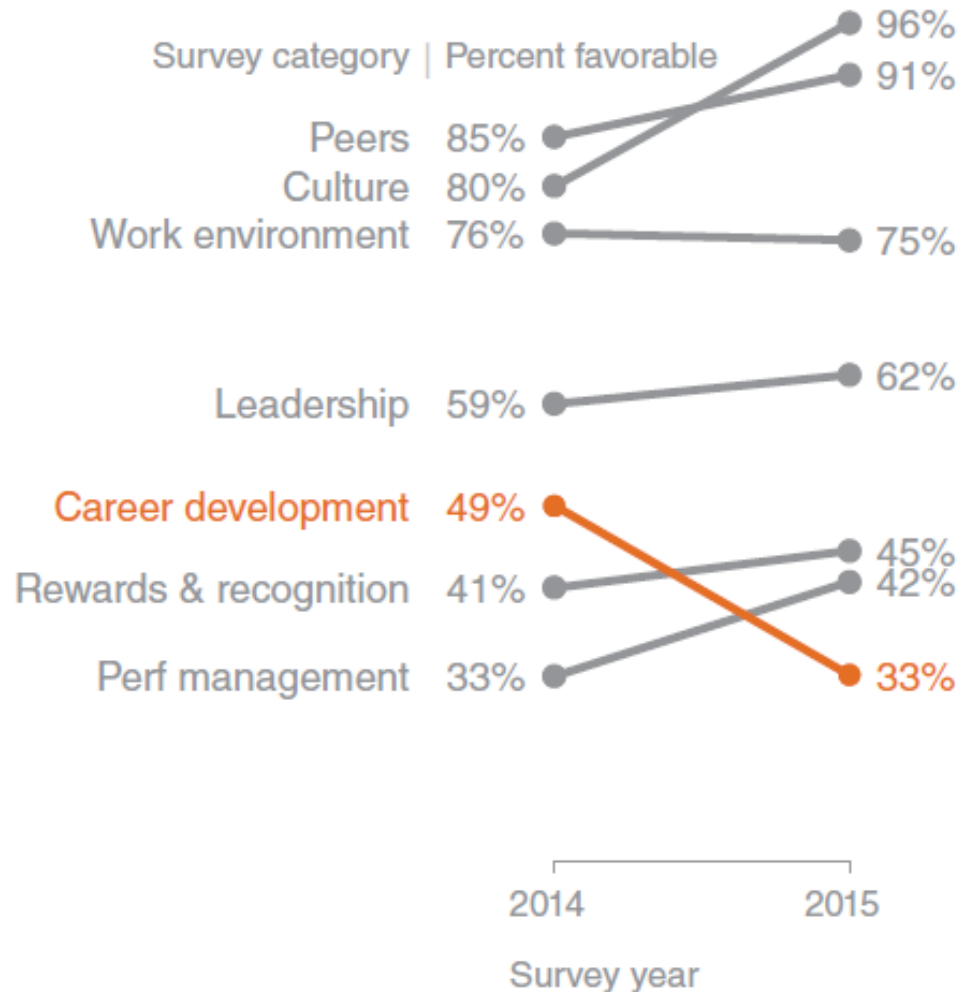
Example: Attention is drawn immediately to the decrease in "Career development,"

Figure: Modified Slope graph [REF2]

6.2.3.3 Bars
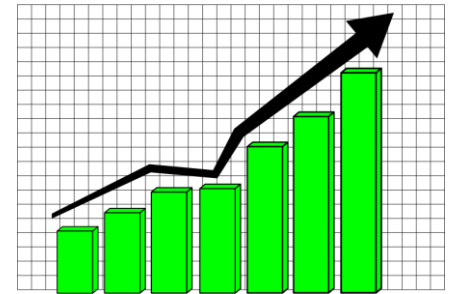
- Bar charts are easy to read.

- Illustrates easily which category is the highest, and which is the smallest.

- Shows the incremental variance between categories.

- Bar charts always must have a zero baseline (where the x-axis crosses the y-axis at zero)

- However, this does not apply to line graphs (nonzero baseline)

  ➢ In line graphs, the focus is on the relative position in space (rather than the length from the baseline or axis)

6.2.3.3 Bars

- Example:

Non-zero baseline: as originally graphed

IF BUSH TAX CUTS EXPIRE
TOP TAX RATE
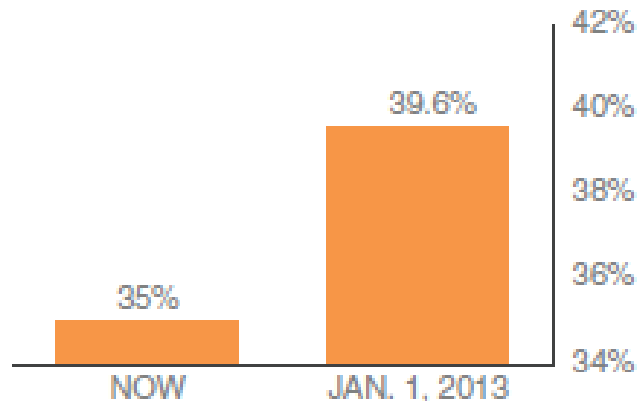
Zero baseline: as it should be graphed

IF BUSH TAX CUTS EXPIRE
TOP TAX RATE
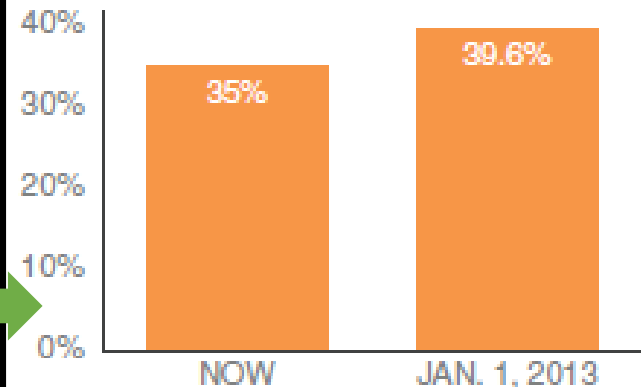
Figure: None Zero vs Zero baseline Bar graph [REF2]

A huge increase on the left graph is reduced considerably when plotted appropriately.

Hence, perhaps the tax increase isn't so worrisome, or at least not as severe as originally depicted.

6.2.3.3 Bars

Graph axis vs Data labels

- If the focus is on big-picture trends, preserve the axis but deemphasizing it by making it grey.

- If the specific numerical values are important, better to label the data points directly and omit the axis to avoid the inclusion of redundant information.

- Always consider how you want your audience to use the visual and construct it accordingly.

- Inaccurately visualizing data by changing the scale on a bar chart or manipulating the data to better reinforces the points to mislead the audience is a BAD Practice.

6.2.3.3 Bars

The width of bars

- In general, the bars should be wider than the white space between the bars.

Example:
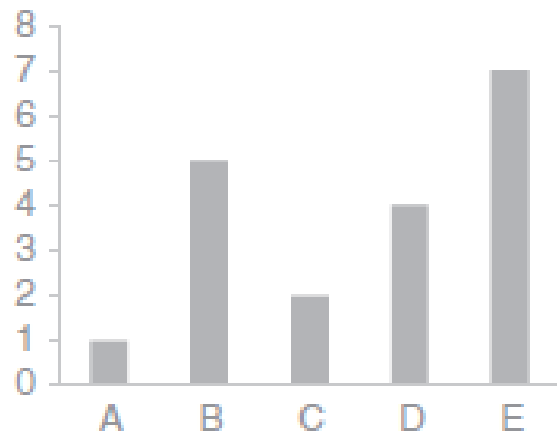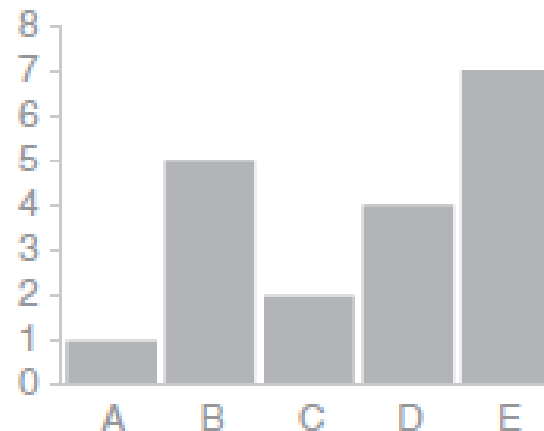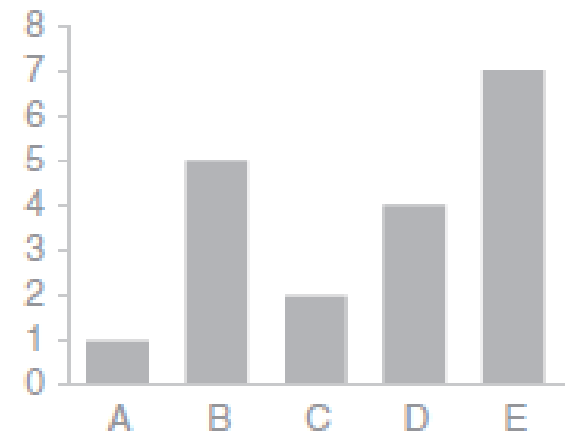
Figure: Bar graphs with different bar widths [REF2]

6.2.3.3 Bars

- There are several types of bar charts.

  ➢Vertical bar chart

  ➢Stacked vertical bar chart

  ➢Waterfall chart

  ➢Horizontal bar chart

  ➢Stacked horizontal bar chart

6.2.3.3 Bars

Vertical bar chart:

- Also known as a column chart

- Vertical bar charts can be single series, two series, or multiple series.

- It becomes more difficult to focus on when there are multiple series bar charts.

- Visual groups happens as a result of the spacing in bar charts having more than one data series.

6.2.3.3 Bars

Figure: Different types of vertical bar charts [REF2]

6.2.3.3 Bars

Stacked Vertical bar chart:

- Compare totals across categories and within a given category to see the subcomponent elements.

- Hard to compare the subcomponents across the various categories beyond the bottom series.

- Better to include the absolute numbers for each category total to aid in the interpretation of the data.

  - Either in an unobtrusive way in the graph directly, or possibly in a footnote

6.2.3.3 Bars
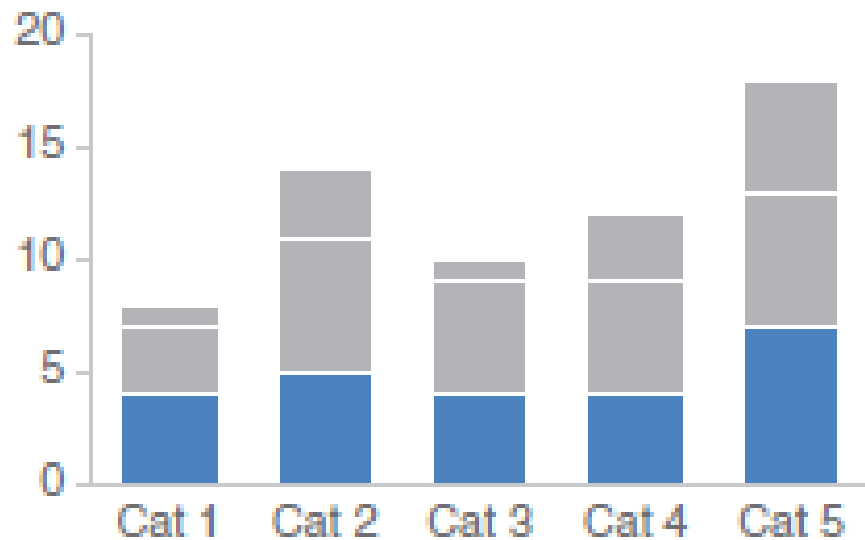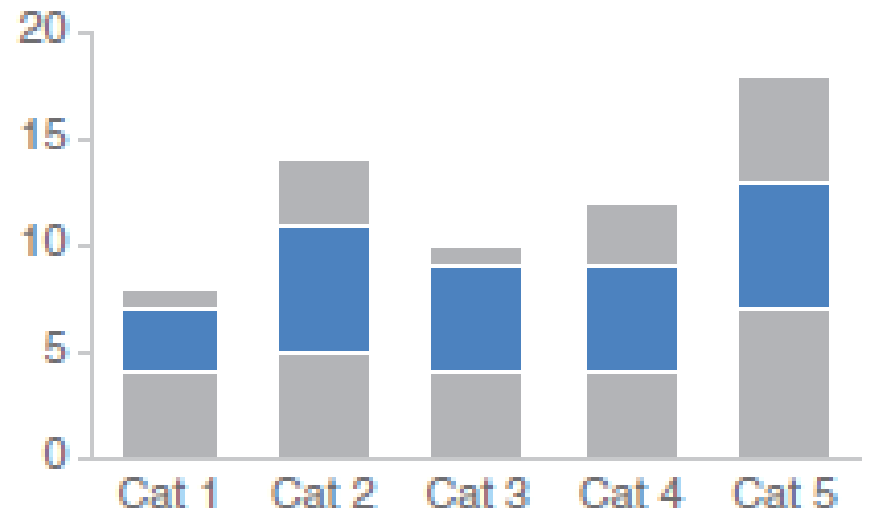
Figure: Stacked vertical bar charts [REF2]

6.2.3.3 Bars

Waterfall chart:

- Used to pull apart the pieces of a stacked bar chart to focus on one at a time

- Shows a starting point, increases and decreases, and the resulting ending point.

6.2.3.3 Bars

Illustrates how employee headcount has changed over the past year for the client group

2014 Headcount math

Though more employees transferred out of the team than transferred in, aggressive hiring means overall headcount (HC) increased 16% over the course of the year.
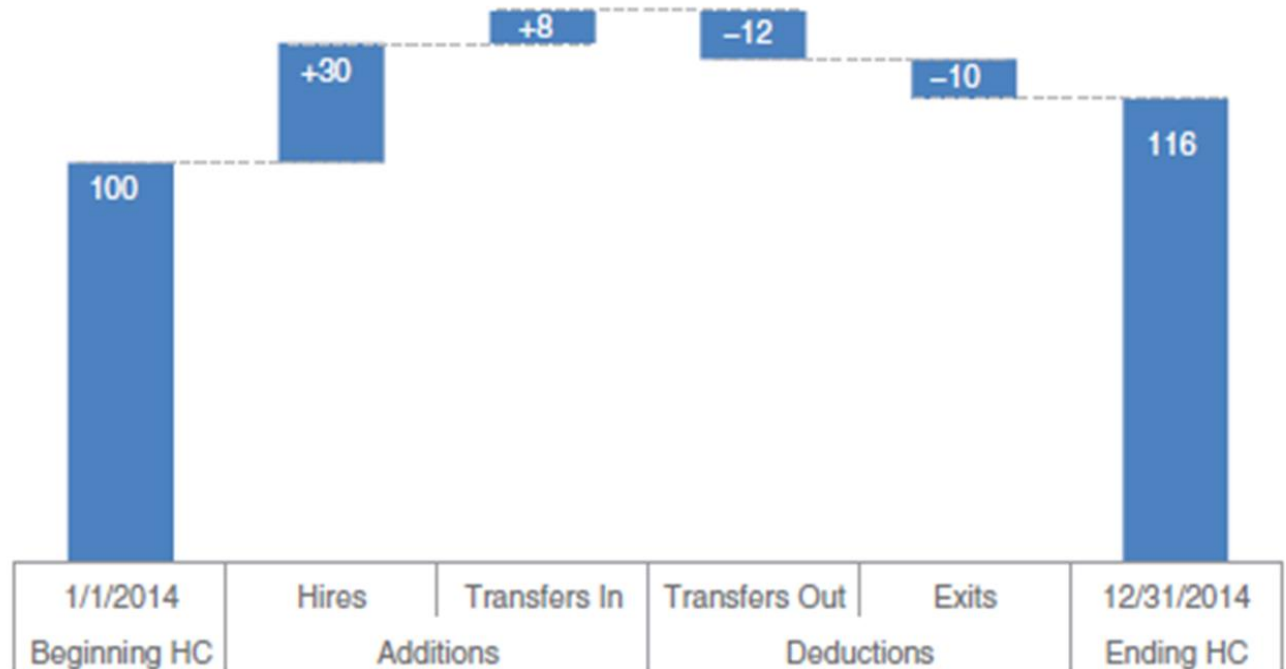
- The first column reflects The staff headcount for the given team at the beginning of the year.
- Shifting to the right, the columns reflects the gradual additions.
- At the end of the year, the final column reflects employee headcount.

Figure: Waterfall Chart [REF2]

6.2.3.3 Bars

Horizontal Bar chart:

- If the category names are long, the horizontal bar chart is particularly useful.

- The text is written from left to right.

- The horizontal bar chart can be single series, two series, or multiple series

6.2.3.3 Bars

Single series
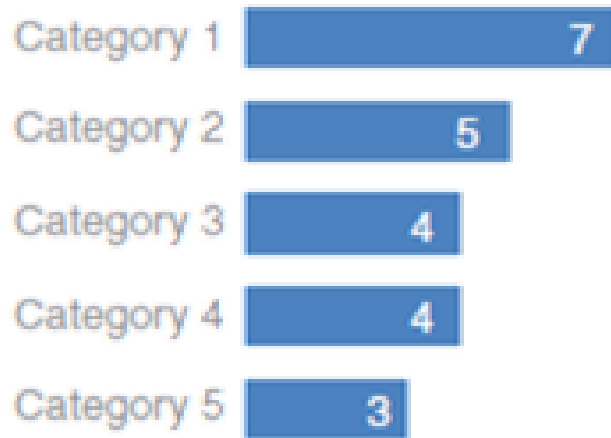
Two series
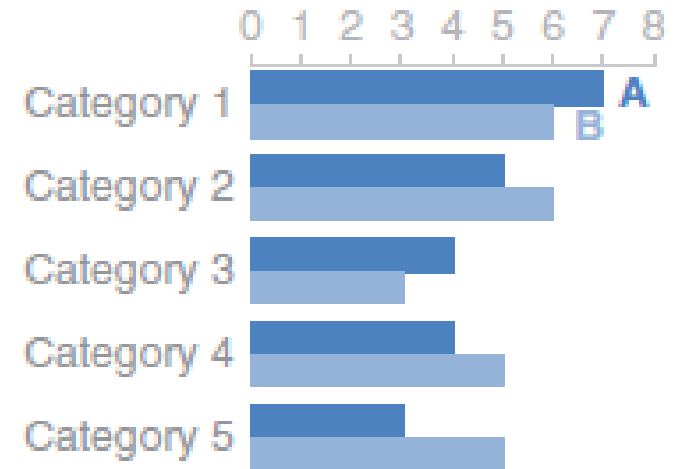
Multiple series
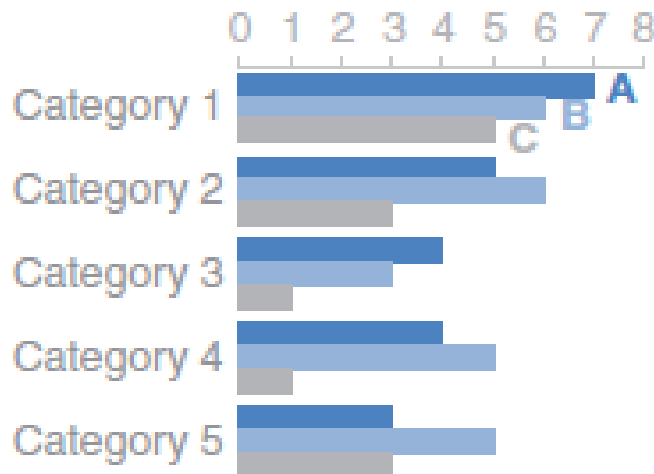
Figure: Different types of Horizontal bar charts [REF2]

6.2.3.3 Bars

Stacked Horizontal Bar chart:

- Display the totals across various categories, but also to provide a sense of the sub-component components.

- Display either absolute values or a 100% sum.

6.2.3.3 Bars

Work well for visualizing survey data collected along a Likert scale (typically ranges from Strongly Disagree to Strongly Agree)
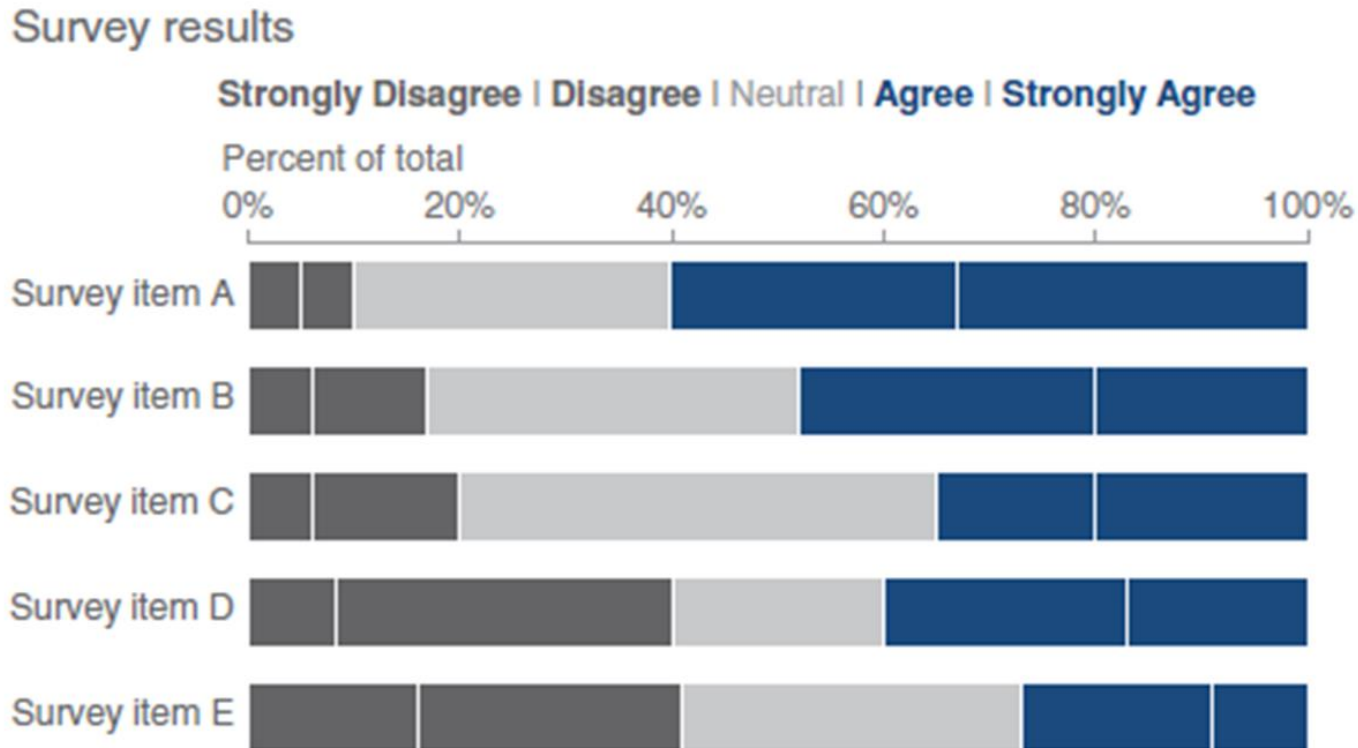
Figure: Stacked horizontal bar chart [REF2]

6.2.3.4 Area

- Area graphs are more difficult to read.

    - The eyes of humans do not do a good job of assigning quantitative value to two-dimensional space

- Can be used to visualize numbers of vastly different magnitudes.

Example:

Figure: Square area graph [REF2]
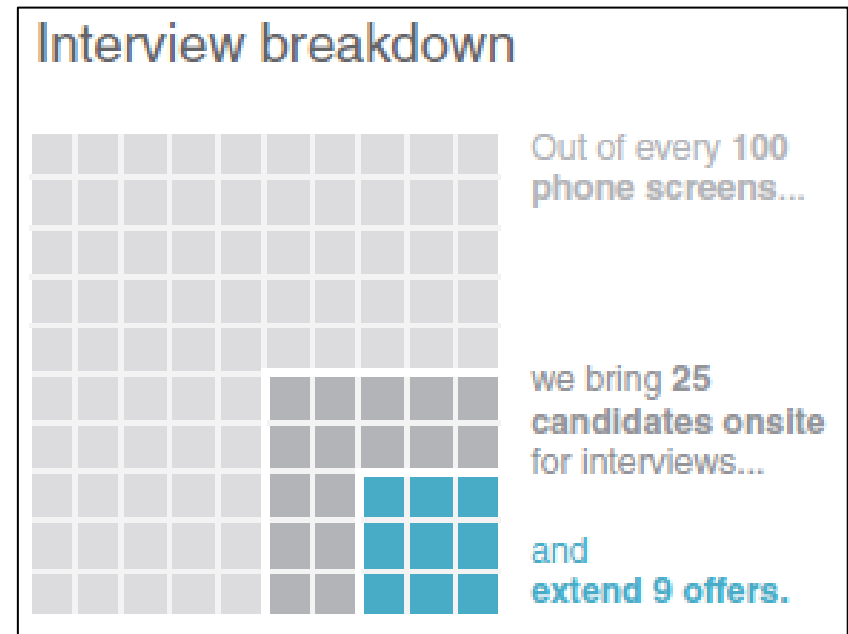
6.2.3.5 Graphs to be avoided

- There are also several specific graph types and elements that should be avoided.

- Examples

  ➢Pie charts,

  ➢Donut charts,

  ➢3D, and

  ➢Secondary y-axes.
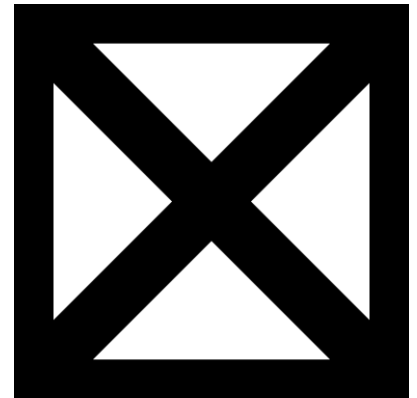
6.2.3.5 Graphs to be avoided

Pie Charts:

• First let's look at an example.

Examine the following pie chart that shows market share across four suppliers: A, B, C, and D. which supplier is the largest based on this visual?

Supplier Market Share

- Supplier A
- Supplier B
- Supplier C
- Supplier D

Supplier B

Figure: Pie Chart [REF2]

6.2.3.5 Graphs to be avoided

- Most people will agree that "Supplier B," rendered in medium blue at the bottom right, appears to be the largest.

- If you had to estimate what proportion supplier B makes up of the overall market, what percent might you estimate?

  - 35%?

  - 40%?

Supplier Market Share

- Supplier A
- Supplier B
- Supplier C
- Supplier D

Figure: Pie Chart [REF2]
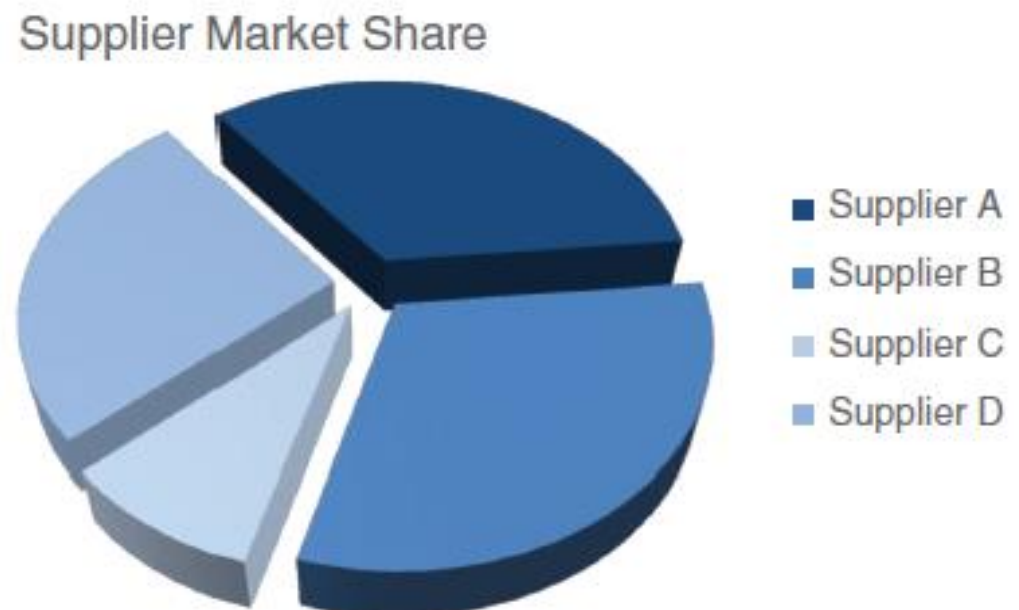
6.2.3.5 Graphs to be avoided

- In reality....

Supplier Market Share

34%

26%

9%

31%

- Supplier A
- Supplier B
- Supplier C
- Supplier D
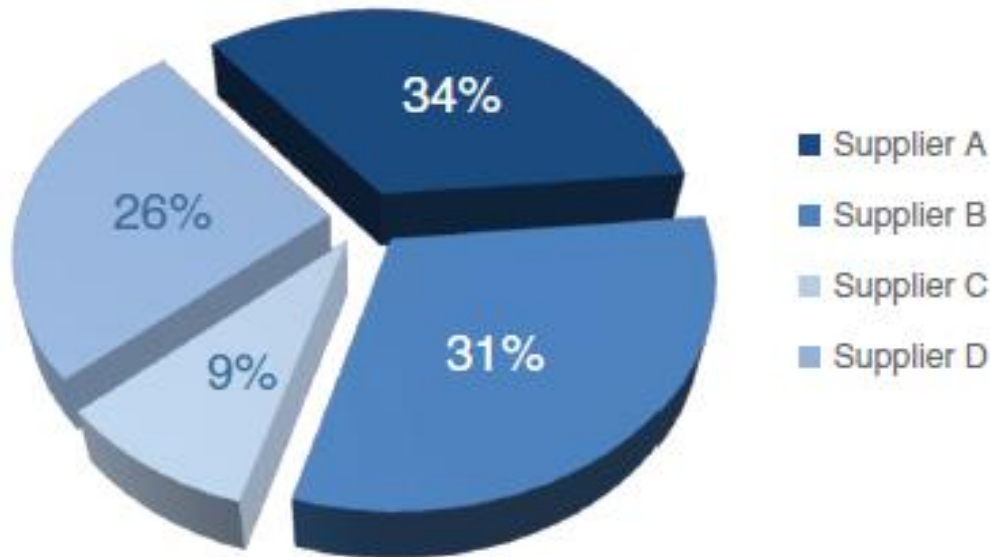
Figure: Pie Chart [REF2]

"Supplier B" which looks largest, at 31%—is actually smaller than "Supplier A" above it, which looks smaller.

The 3D and strange perspective that is been applied to the graph, tilting the pie and making the pieces at the top appear farther away and thus smaller than they actually are, while the pieces at the bottom appear closer and thus bigger.

6.2.3.5 Graphs to be avoided

- An alternative to the pie chart …

Which one is better?

Figure: Pie Chart [REF2]

Figure: Relevant bar Chart [REF2]

6.2.3.5 Graphs to be avoided

The Donut Chart:

- Expect the audience to compare one arc length to another arc length / to contrast angles and areas

- Is it comfortable to relate quantitative meaning to the length of an arc?

Figure: Donut Chart [REF2]

6.2.3.5 Graphs to be avoided

3D Graphs:

• Never use 3D to plot a single dimension.

• 3D skews the numbers, making them difficult or impossible to interpret or compare.

• Introduces unnecessary chart elements like side and floor panels.

• Graphing applications behave strange when it comes to plotting values in 3D.

6.2.3.5 Graphs to be avoided

How many issues were there in January and February?

Number of issues
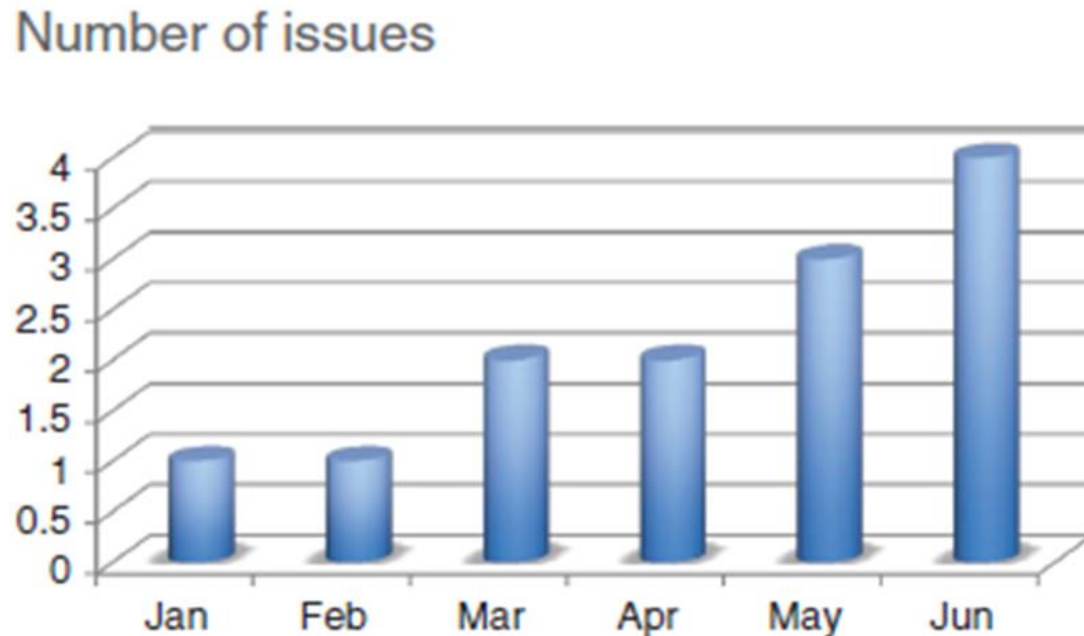
Figure: A 3D Graph[REF2]

To compare the bar height to the gridlines and follow it leftward to the y-axis is NOT Easy. **Hence this is a BAD data visualization.**

6.2.3.5 Graphs to be avoided

Secondary y-axis:

- The secondary y-axis is another vertical axis on the right-hand side of the graph.

- Plot data that is in entirely different units against the same x-axis.

Example:
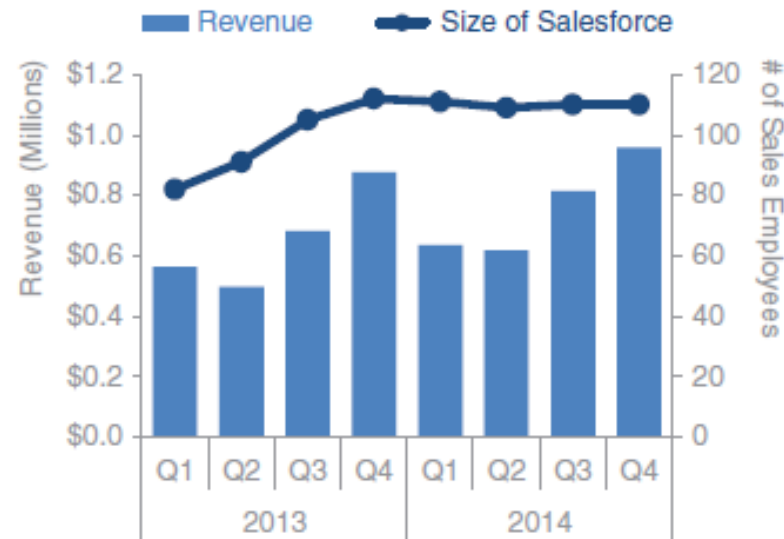
Figure: Bar Chart showing the secondary y-axis [REF2]

6.2.3.5 Graphs to be avoided

Secondary y-axis:

• Takes some time and reading to understand which data should be read against which axis.

• Avoid the use of a secondary or right-hand y-axis. Instead,

> ➢ label the data points that belong on this axis directly.

> ➢ pull the graphs apart vertically and have a separate y-axis for each (both along the left) but leverage the same x-axis across both.

6.2.3.5 Graphs to be avoided
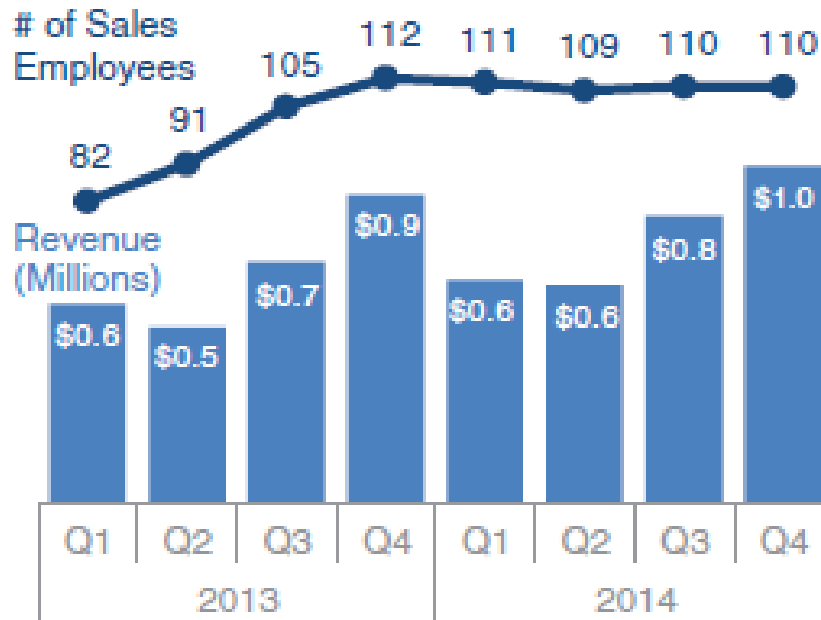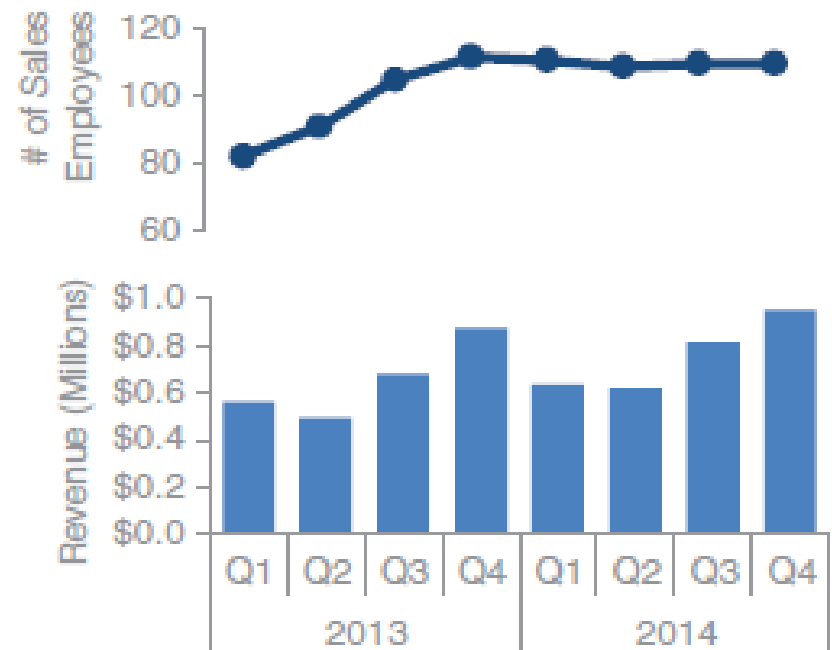
Figure: Strategies to avoid the secondary y-axis [REF2]

Activity

Refer to 20 ideas for better data visualization:

https://uxdesign.cc/20-ideas-for-better-data-visualization-73f7e3c2782d

6.2.4 Presenting Clean Graphs - Decluttering

Clutter:

- These are visual components that take up space but do not increase understanding or enhance comprehension.

- Makes our visuals appear more complicated than necessary.

- It is important to eliminate clutter from our visual communications.

Example: How to remove the Clutter? Consider the figure below.

6.2.4 Presenting Clean Graphs - Decluttering
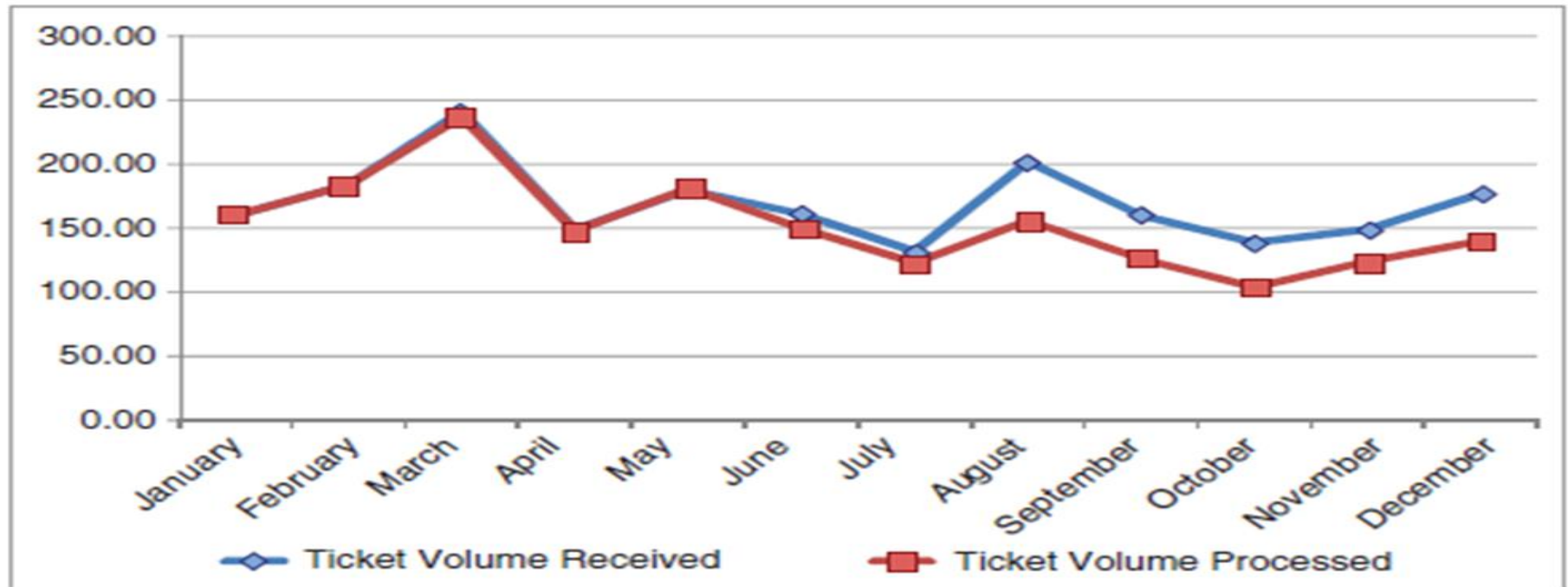
Figure: A line chart including clutter [REF2]

6.2.4 Presenting Clean Graphs - Decluttering

How to remove the Clutter?

1. Remove chart border
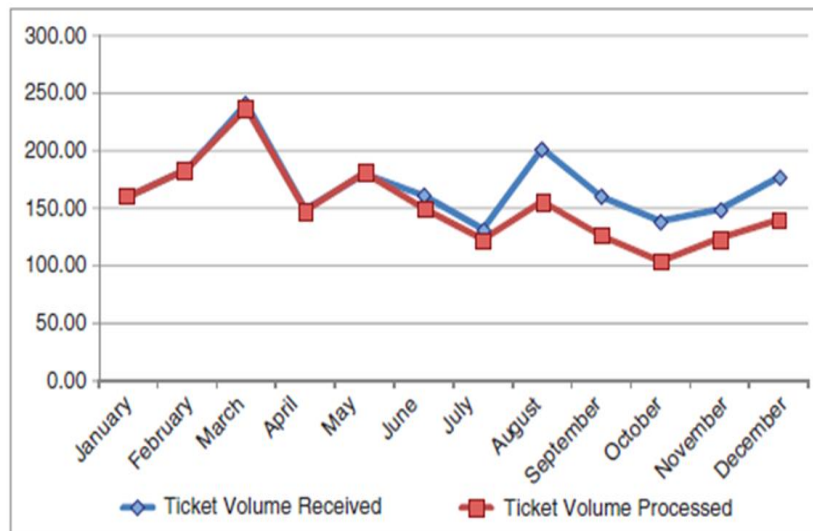
Figure: Line chart including clutter [REF2]
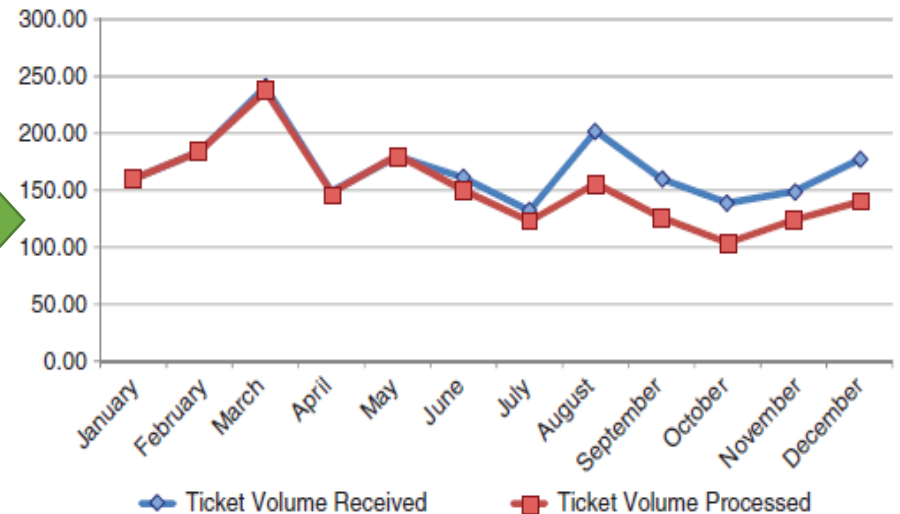
Figure: Line chart after removing the chart border [REF2]

6.2.4 Presenting Clean Graphs - Decluttering

How to remove the Clutter?

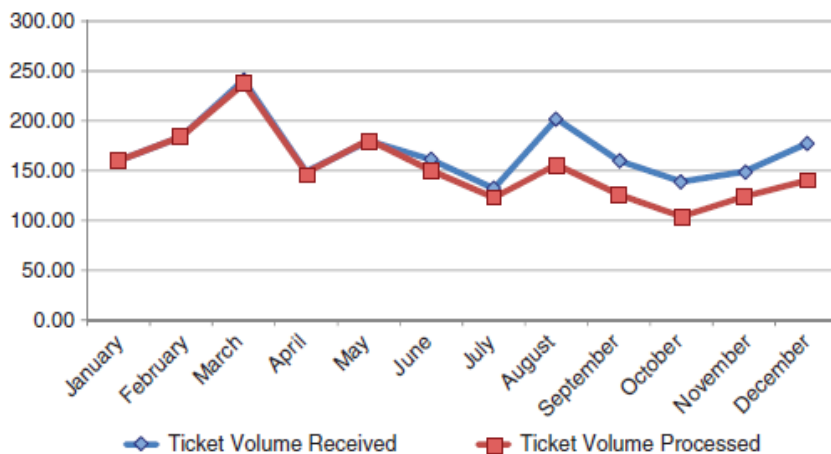2. Remove Gridlines: If required keep the grid lines and make sure they are lighter color like grey

Figure: Line chart after removing the chart border [REF2]
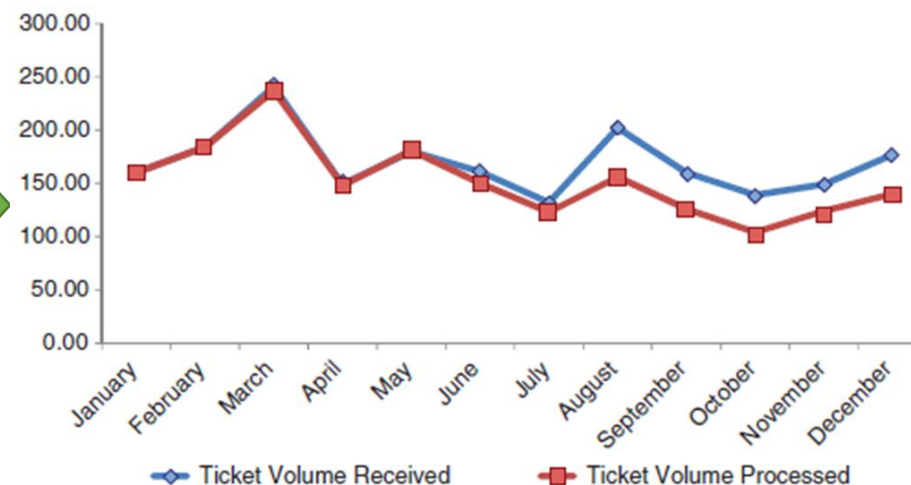
Figure: Line chart after removing the gridlines [REF2]

Greater contrast, and the data will stand out more

6.2.4 Presenting Clean Graphs - Decluttering

How to remove the Clutter?

3. Remove data markers: Use them if required on purpose and with a purpose

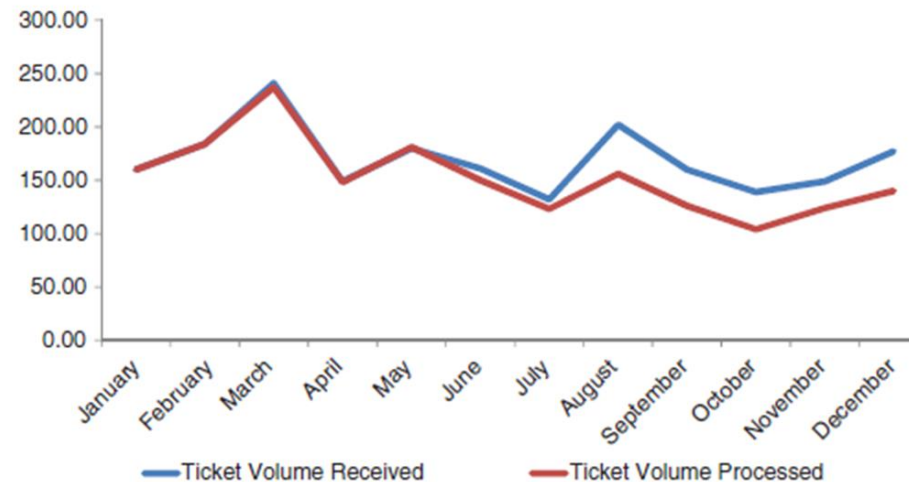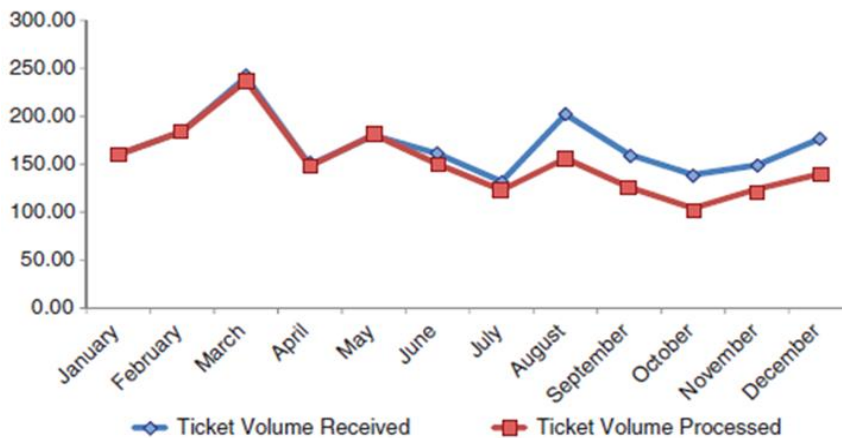Figure: Line chart after removing the gridlines [REF2]

Figure: Line chart after removing the data markers [REF2]

6.2.4 Presenting Clean Graphs - Decluttering

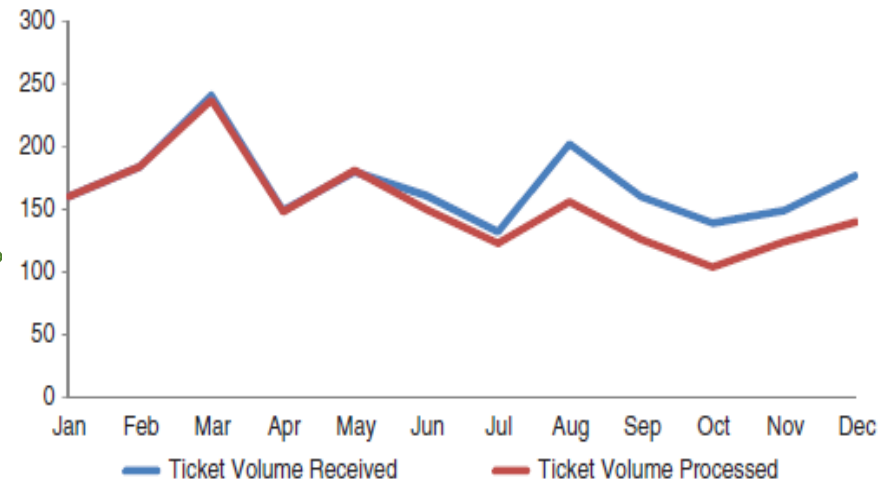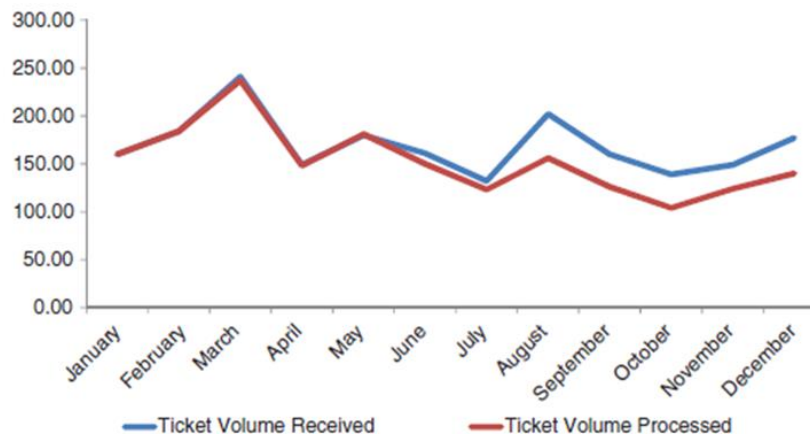How to remove the Clutter?

4. Clean up axis labels

Figure: Line chart after removing the data markers [REF2]

Figure: Line chart after cleaning the axis label [REF2]

Trailing zeros on y-axis labels do not carry any informative value, and yet make the numbers look more complicated.

Abbreviate the months of the year to fit horizontally on the x-axis, eliminating the diagonal text.

6.2.4 Presenting Clean Graphs - Decluttering

How to remove the Clutter?
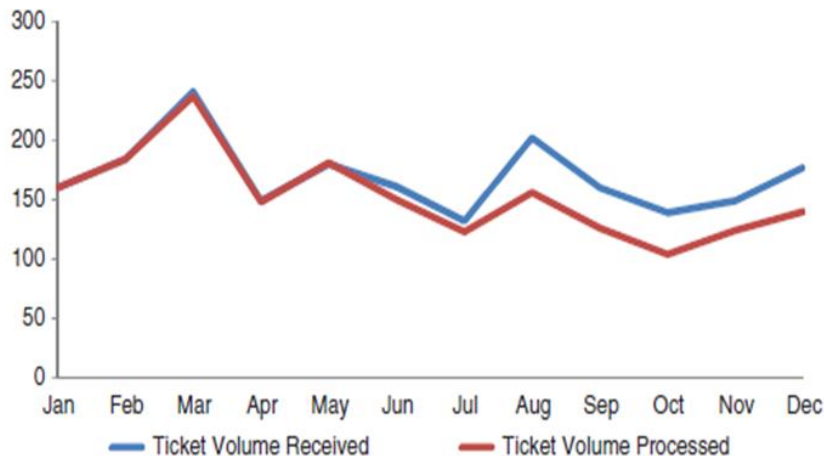
5. Label data directly

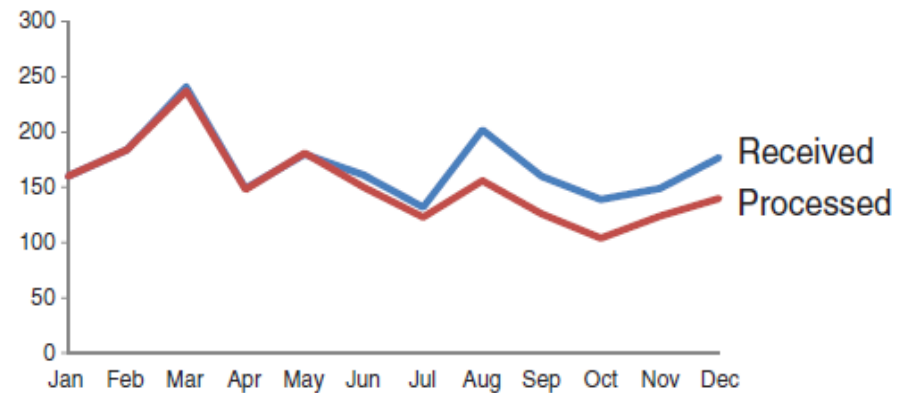Figure: Line chart after cleaning the axis label [REF2]   Figure: Line chart after using label data [REF2]

Include the data labels right next to the data to describe

6.2.4 Presenting Clean Graphs - Decluttering

How to remove the Clutter?

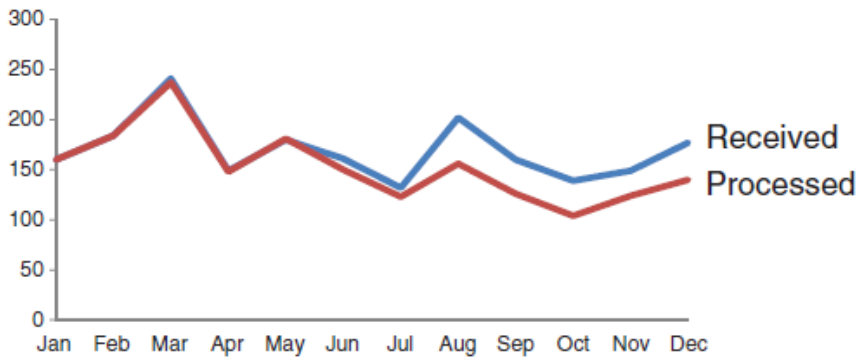### 6. Leverage consistent color
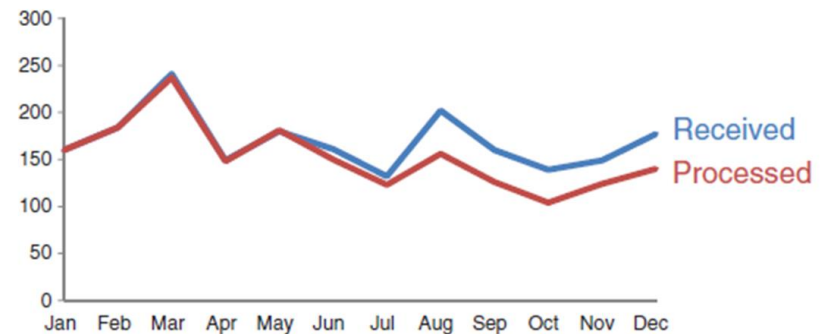

Figure: Line chart after using label data [REF2]

Figure: Line chart after leveraging consistent color [REF2]

Make the labels of data the same color as the details they describe. Visual hint: "these two pieces of data are related."

6.2.4 Presenting Clean Graphs - Decluttering
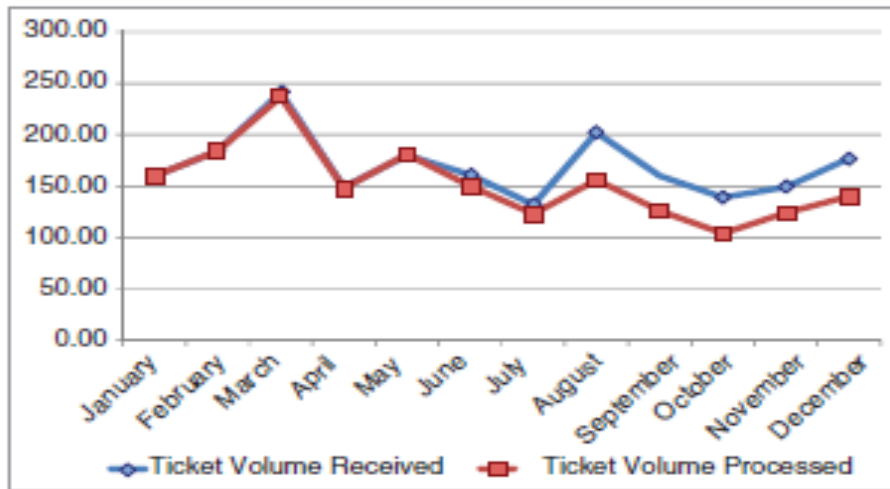
How to remove the Clutter?

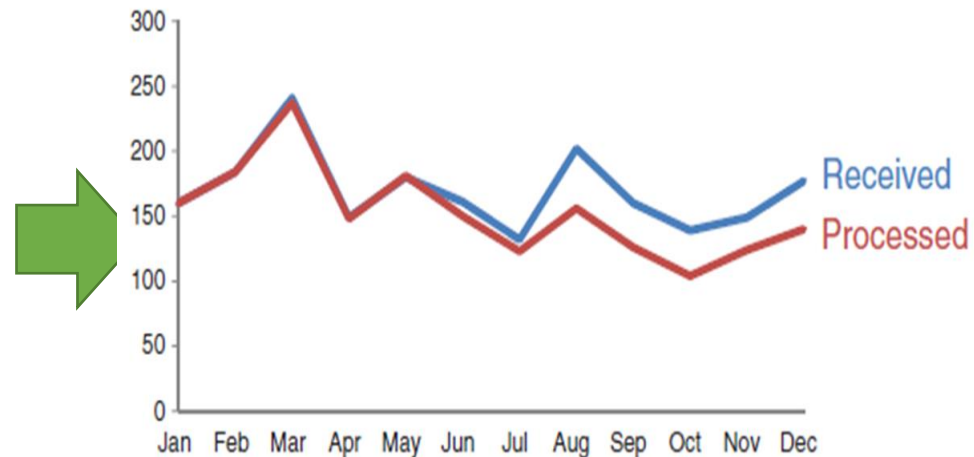**Before**

After

Figure: Original Line chart [REF2]

Figure: Line chart after removing clutter [REF2]

6.3 Figures

There are certain simple conventions that must be followed when using figures in technical writing.

- Every figure must have a caption, and the caption must have a number.

- The caption and number help in referencing the figure.

- Any reference in the text to the figure is called a "callout." Make sure to callout every figure.

6.3 Figures

- Make sure that, the figure appears after its first callout, and not before.

- Do not end a section or chapter with a figure caption. Finish the chapter or section with a discussion pertaining to the figure after the figure caption.

- Keep the figure caption as simple as possible.

6.3 Figures

Permissions for Figures

- If the figure is originally designed by you, then you own the intellectual property rights (copyright)

  ➢ can use that figure as you like in your work.

- If you are reusing a figure from another source, you must either cite the source and/or obtain proper permissions.

6.3 Figures

Permissions for Figures

- Figure permission rules

  ➢Prior using a copyrighted figure, you must obtain the permission to use the figure.

  ➢No need to obtain prior permission if you are to redraw the figure that is substantially different from the original. However, the original should be properly cited.

Summary

Now you should be able to

identify different graphical elements that can be used in technical writing.

use appropriate visuals to represents text and data.

visualize data by selecting the most suitable graphs and interpret different graphs.

identify the situations where the certain graphs should not be used.

Generate clean graphs.

arrange figures appropriately in technical writing