VISUAL DISPLAYS OF DATA

Graphs That Tell A Story
Why is graphing important?

- Can simplify large data sets
- See patterns more easily in visual displays
- May help you to get into graduate school
  - GRE may drop geometry in favor of interpretation of tables and graphs
- We won’t get fooled again!
“Worst Graph Ever”…Why?
“Worst Graph Ever”…Why?

- Lies/Misleading
  1. Unequal Scales treated as equal (11 vs. 35 years)
  2. Incompatible Scales (interval vs. ordinal)
  3. Misleading Starting Points
  4. Reverses Meaning of Ranks
"Best Graph Ever"…Why?

Figurative Map of the successive losses in men of the French Army in the Russian campaign 1812–1813.

Drawn by M. Minard, Inspector General of Bigraphy and Maps in Retirement.

Paris, November 20, 1869.

The numbers of men present are represented by the widths of the colored zones at a rate of one millimeter for every ten thousand men. The red designates the men who entered Russia, the black those who left it. The information which has served to draw up the map has been extracted from the works of M. G. Chatelet, of Huygens, of Tassou, and of Millenary, the pharmacist of the Army since October 25th.

In order to better judge with the eye the diminution of the army, I have assumed that the troops of Russia have ceased and of Marshal Soult, who had been detached at Moscow, and those joined around Ochak and Volhok, had always marched with the army.

**GRAPHIC TABLE of the temperature in degrees of the Reissuer thermometer below zero.**

-26°, December 7
-30°, December 9
-24°, December 1
-20°, November 28
-19°, November 9

-32°, October 24
-23°, October 10
-22°, October 4
-21°, November 14
Which is better? Why?
Types of Graphs

- Scatterplot
  - A graph that depicts the relation between two interval variables
    - Linear and nonlinear relationships

![Scatterplot Example](scatterplot_image.png)
More on scatterplots...

- Linear relationships
  - The relationship between two variables is best described by a *straight* line.
More on scatterplots…

- Nonlinear relationships
  - The relationship between two variables is best described by a line that breaks or curves.
    - e.g., Yerkes-Dodson Law

![Graph showing the relationship between level of arousal and quality of performance.](image)
Types of Graphs

- **Range-Frame**
  - A scatterplot or related graph that indicates only the range of the data on each axis; the lines extend only from the minimum to the maximum scores.
Creating Scatterplots

1. Organize data by participant; each participant should have two scores, one for each variable
2. Label the x-axis with the name of the IV and its possible values
3. Label the y-axis with the name of the DV and its possible values
4. Make a mark on the graph above each participant’s score on the x-axis and next to his or her score on the y-axis
5. To convert to a range-frame, erase the axes below the minimum and above the maximum scores
Scatterplots and Outliers

![Scatterplot of Grades vs. Hours studied with an outlier](scatterplot.png)
Scatterplots and Outliers

- If you have an outlier, ask yourself these questions:
  - Did I make a typo in entering my data?
  - Does the outlier take away from a meaningful relationship?
  - How far out does an outlier have to be before I can throw it out?
  - Was there a goofball in your study?
  - Is this outlier an important clue that should not be ignored?
Types of Graphs

- **Line Graphs**
  - Used to illustrate the relation between two interval variables; sometimes the line represents the predicted y scores for each x value, and sometimes the line represents change in a variable over time.
  - Trends, Best Fit, Time Series
Types of Graphs

- **Time Plot or Time Series Plot**
  - A graph that plots an interval variable on the y-axis as it changes over an increment of time labeled on the x-axis.
Tragically Bad Graphs

History of O-Ring Damage in Field Joints

- Code:
  -  = Heating of Secondary O-Ring
  -  = Primary O-Ring Blowby
  -  = Primary O-Ring Erosion
  -  = Heating of Primary O-Ring
  -  = No Damage

- STATIC TEST MOTORS:
  - HORIZONTAL ASSEMBLY
  - SOME PUTTY REPAIRED

- No Erosion
A Better Way To Look At The Data

26°–29° range of forecasted temperatures (as of January 27, 1986) for the launch of space shuttle Challenger on January 28

O-ring damage index, each launch

Temperature °F of field joints at time of launch
Types of Graphs

- **Bar Graphs**
  - Visual depictions of data when the IV is nominal and the DV is interval. Each bar typically represents the mean value of the DV for each category.
  - *Pareto Chart*: Ordered from smallest to largest
More Bar Graphs

- Lying with Graphs or Making Relationships Clear?

Effect of Sexual Harassment Status on Female Navy Officers’ Intentions to Stay in the Navy

<table>
<thead>
<tr>
<th>Whether harassed</th>
<th>Intention score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harassed</td>
<td>4</td>
</tr>
<tr>
<td>Not harassed</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Effect of Sexual Harassment Status on Female Navy Officers’ Intentions to Stay in the Navy

<table>
<thead>
<tr>
<th>Whether harassed</th>
<th>Intention score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harassed</td>
<td>3.3</td>
</tr>
<tr>
<td>Not harassed</td>
<td>3.5</td>
</tr>
</tbody>
</table>
More on Bar Graphs

- More Than One IV

**Effect of Rank and Sexual Harassment Status on Female Navy Personnel’s Intentions to Stay in the Navy**

- Intention score
- Rank
  - Officer
  - Enlisted

- Harassment status:
  - Harassed
  - Not harassed
Types of Graphs

- Pictorial Graphs
  - Bar graphs with pictures instead of bars
Types of Graphs

- **Pie Chart**
  - A graph in the shape of a circle with a slice for every category. The size of each slice represents the proportion (or percentage) of each category.
Types of Graphs

- **Box Plot**
  - *Depict the overall distribution of a data set.*
    - The lower end of the box marks Q1
    - The upper end of the box marks Q3
  - *Whiskers are lines that indicate the minimum and maximum scores in a sample (i.e., the range)*
Box Plots

- Airport Waiting Times

![Box Plots](image-url)
Box Plots

- Outliers
APA Style

- Table
  - A presentation of data, typically quantitative, that is typed as text in rows and columns.

**Favorite Student After School Activity**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visit with Friends</td>
<td>175</td>
</tr>
<tr>
<td>Talk on Phone</td>
<td>168</td>
</tr>
<tr>
<td>Play Sports</td>
<td>120</td>
</tr>
<tr>
<td>Earn Money</td>
<td>120</td>
</tr>
<tr>
<td>Use Computers</td>
<td>65</td>
</tr>
</tbody>
</table>
APA Style

- **Figure**
  - Any visual presentation of data other than a table, such as a photograph, drawing or, most frequently, a graph.
Which Graph to Use?

- One interval variable (with frequencies): histogram or frequency polygon
- One interval IV and one interval DV: scatterplot or line graph
- One nominal IV and one interval DV: bar graph
- Two+ nominal IVs and one interval DV: bar graph