

Data Visualization: Design Principles and Processes

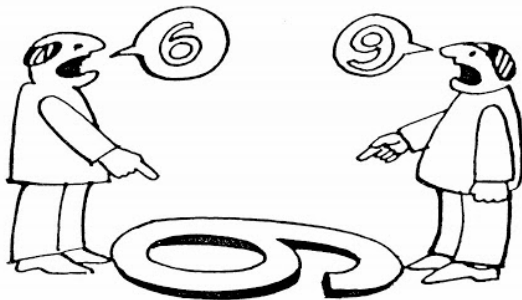
SMM635 - Week 1

Prof. Simone Santoni

Bayes Business School

What is Good Data Visualization?

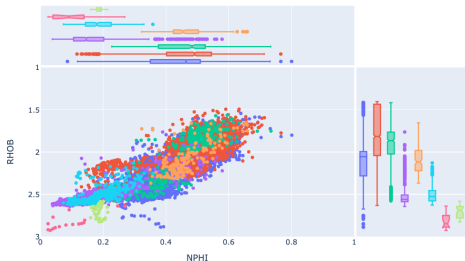
The fundamental question every data analyst must ask



“Excellence in statistical graphs consists of complex ideas communicated with clarity, precision, and efficiency.” - Edward Tufte

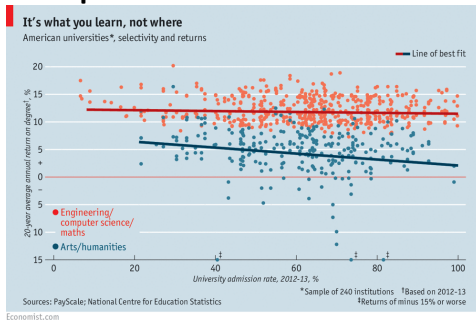
Tale of Two Visualizations

Example A: Technical Plot



Shows data relationships
Cluttered interface
Distracting elements

Example B: The Economist



Clean, focused design
Clear narrative
Professional aesthetics

Tufte's Principles of Graphical Excellence

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Figure 1: Edward Tufte

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- ▶ **Integrate** with statistical and verbal descriptions



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The Power of “Show the Data” - Anscombe's Quartet

Four datasets with identical summary statistics

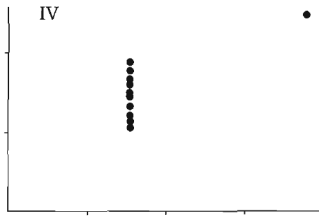
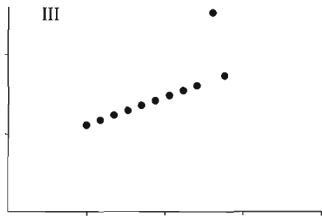
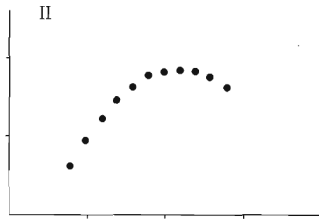
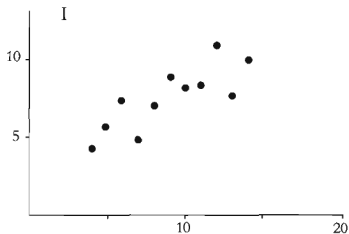
I		II		III		IV	
X	Y	X	Y	X	Y	X	Y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	4.26	4.0	3.10	4.0	5.39	19.0	12.50
12.0	10.84	12.0	9.13	12.0	8.15	8.0	5.56
7.0	4.82	7.0	7.26	7.0	6.42	8.0	7.91
5.0	5.68	5.0	4.74	5.0	5.73	8.0	6.89

$N = 11$
mean of X's = 9.0
mean of Y's = 7.5
equation of regression line: $Y = 3 + 0.5X$
standard error of estimate of slope = 0.118
 $t = 4.24$
sum of squares $X - \bar{X} = 110.0$
regression sum of squares = 27.50
residual sum of squares of Y = 13.75
correlation coefficient = .82
 $r^2 = .67$

Same means, same correlations, same regression lines...

Anscombe's Quartet Revealed

...but completely different data patterns!



The Design Process Framework

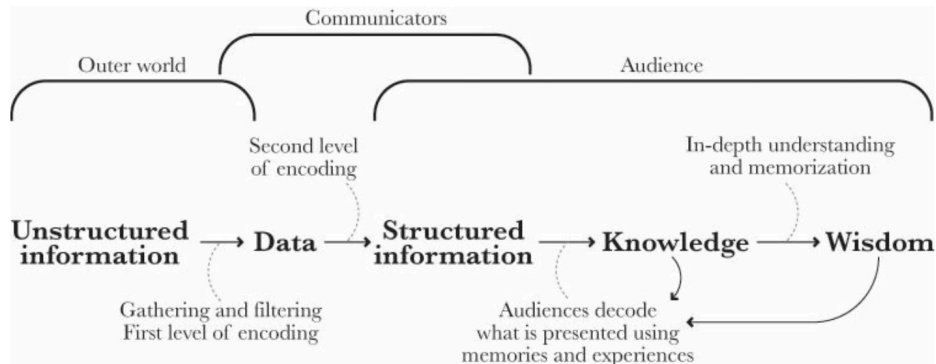
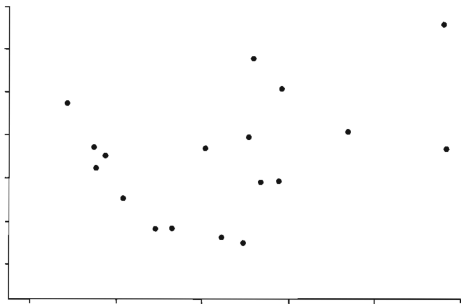


Figure 1.8. From reality to people's brains.

Source: Cairo, A. (2012). *The Functional Art*

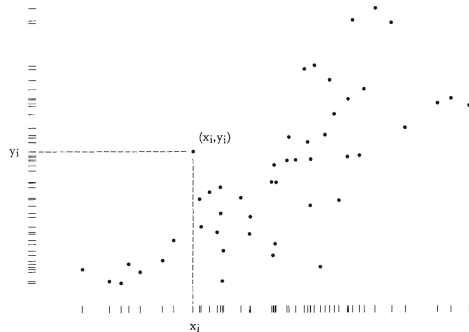
Design Principles in Action

Traditional Approach



Heavy gridlines, excessive decoration

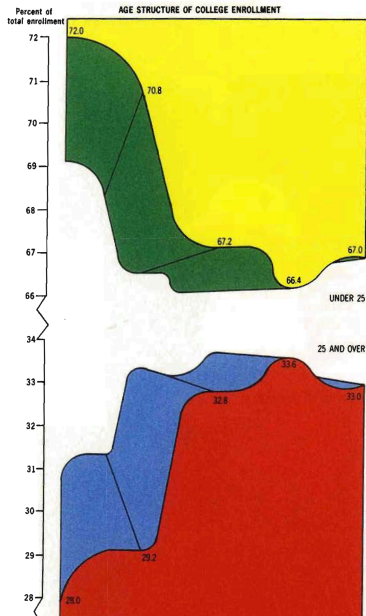
Tufte's Approach



Minimalist, data-focused design

Principle: Maximize the **data-ink ratio** - every mark should represent data

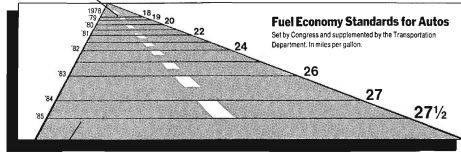
Chart Junk - What Not to Do



Before and After - Redesign Example

Before: Cluttered Design

This line, representing 18 miles per gallon in 1978, is 0.6 inches long.

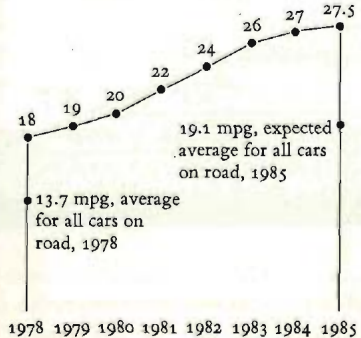


This line, representing 27.5 miles per gallon in 1985, is 5.3 inches long.

Issues: 3D effects, poor labeling, distracting elements

After: Clean Redesign

REQUIRED FUEL ECONOMY STANDARDS: NEW CARS BUILT FROM 1978 TO 1985



Solutions: Clear hierarchy, direct labeling.

Key Takeaways for Week 1

Your visualization design checklist

Purpose: Does your chart serve a clear analytical goal?

Data: Does your visualization accurately represent the data?

Clarity: Can viewers understand the message quickly?

Simplicity: Have you removed unnecessary elements?

Aesthetics: Is the design professional and appropriate?

Iteration: Have you tested and refined your design?

***Remember:** Good visualization design is both art and science - it requires understanding your data, your audience, and your design principles.*

Next Steps

For next week: Read Tufte Chapter 1 and Cairo Introduction and Chapter 1

Practice: Complete the Data visualization and communication exercise

Resources

- ▶ Course GitHub: github.com/simoneSantoni/data-viz-smm635
- ▶ Design principles checklist in Moodle
- ▶ Office hours: Wednesdays 15:00-17:00