Data Visualization: Design Principles and Processes

SMM635 - Week 1

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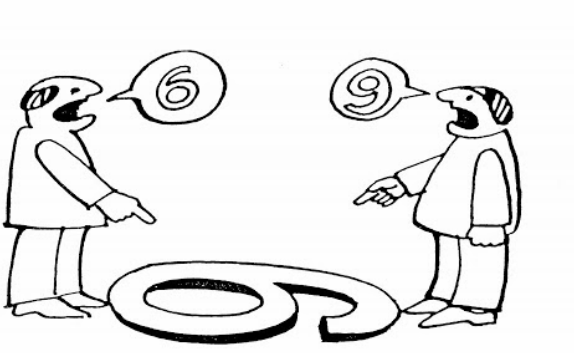
Bayes Business School

What is Good Data Visualization?

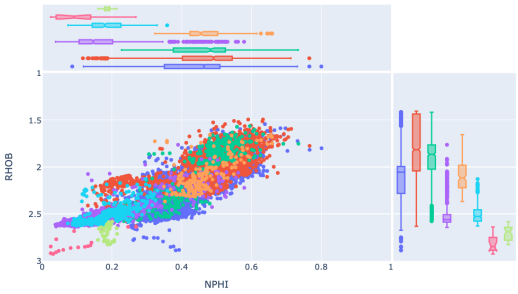
The fundamental question every data analyst must ask



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

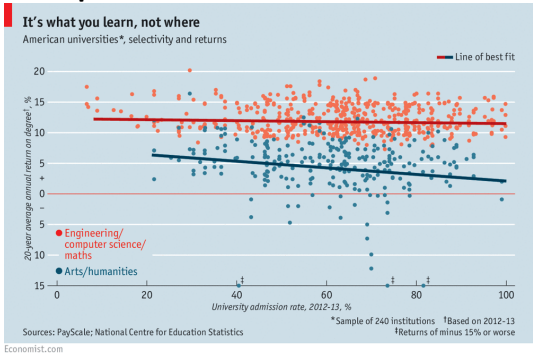
Tale of Two Visualizations

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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- **Show the data** clearly and accurately

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

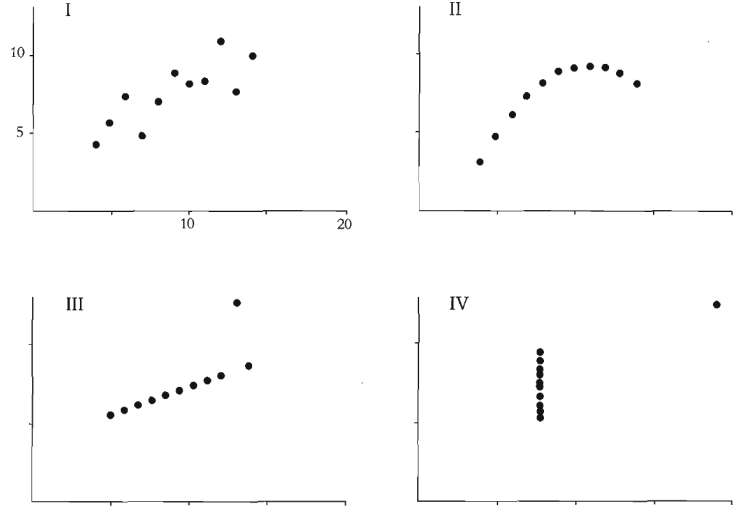
I		II		III		IV	
X	Y	X	Y	X	Y	X	Y
10.0	8.04	10.0	9.14	10.0	7.46	8.0	6.58
8.0	6.95	8.0	8.14	8.0	6.77	8.0	5.76
13.0	7.58	13.0	8.74	13.0	12.74	8.0	7.71
9.0	8.81	9.0	8.77	9.0	7.11	8.0	8.84
11.0	8.33	11.0	9.26	11.0	7.81	8.0	8.47
14.0	9.96	14.0	8.10	14.0	8.84	8.0	7.04
6.0	7.24	6.0	6.13	6.0	6.08	8.0	5.25
4.0	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 $X - \overline{X} = 110.0$
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

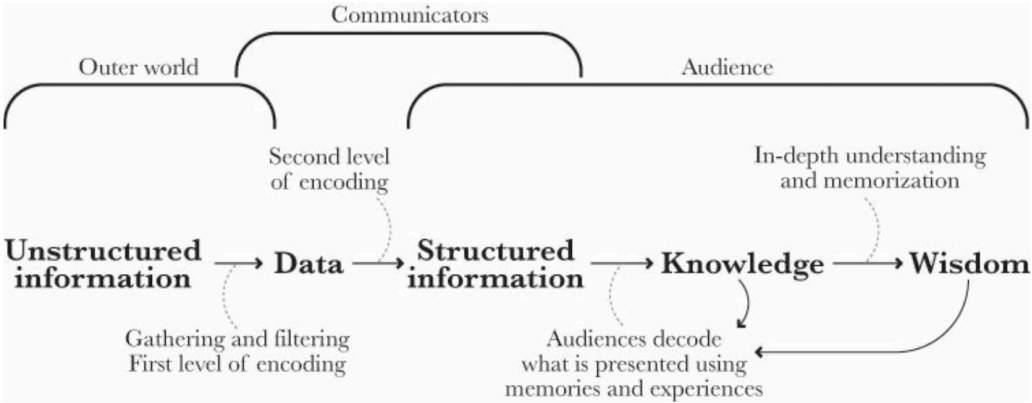
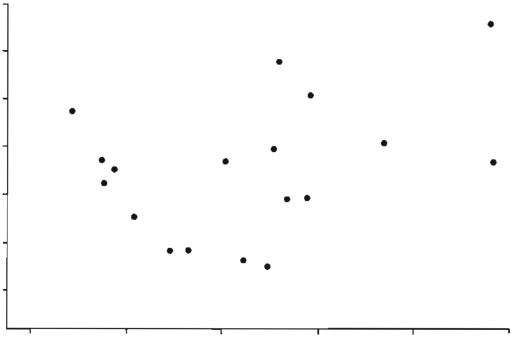


Figure 1.8. From reality to people's brains.

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

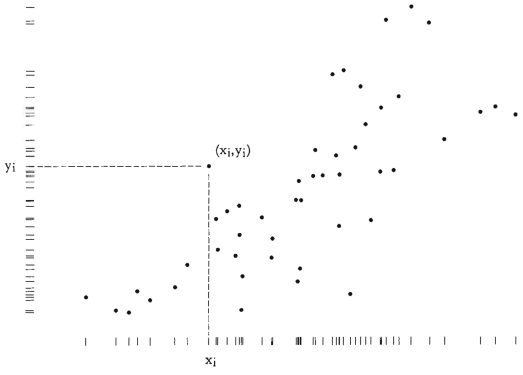
Design Principles in Action

Traditional Approach



Heavy gridlines, excessive decoration

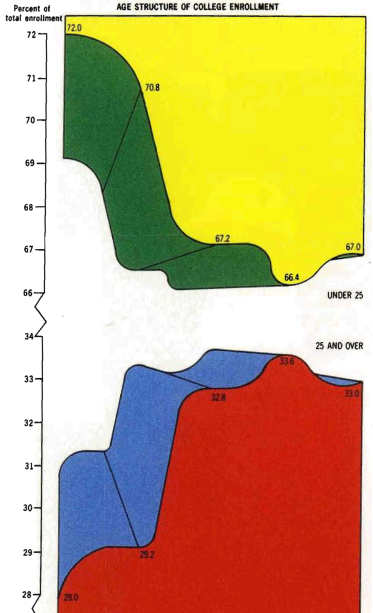
Tufte's Approach



Minimalist, data-focused design

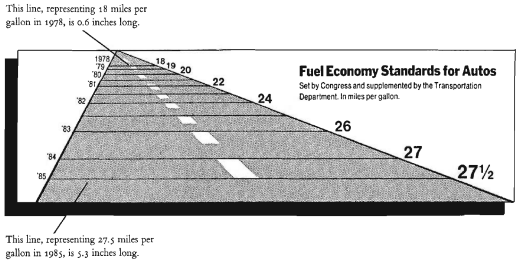
Principle: Maximize the **data-ink ratio** - every mark should represent data

Chart Junk - What Not to Do



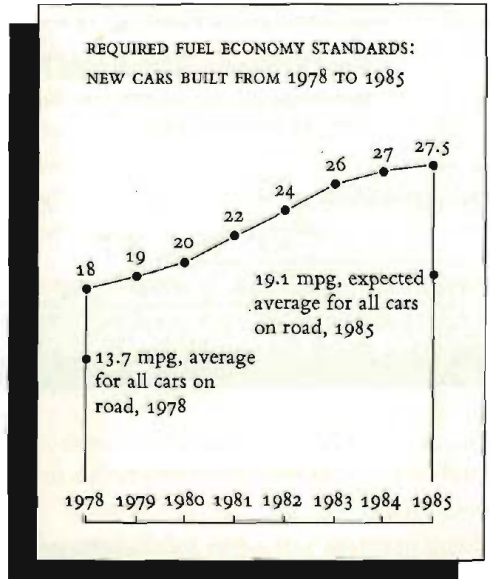
Before and After - Redesign Example

Before: Cluttered Design



Issues: 3D effects, poor labeling, distracting elements

After: Clean Redesign



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 excercise

Resources

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