Module #4b:
Graphical Excellence

Graphical Excellence

Principles

1. Graphical excellence is the well-designed presentation of interesting data---a matter of substance, of statistics, and of design.
2. Graphical excellence consists of complex ideas communicated with clarity, precision and efficiency.

Graphical Excellence

3. Graphical excellence is that which gives to the viewer the **greatest number of ideas** in the **shortest time** with the **least ink** in the **smallest space**

4. Graphical excellence is nearly always multivariate.

5. And graphical excellence requires telling the truth about the data.

Summary of Tufte's Principles

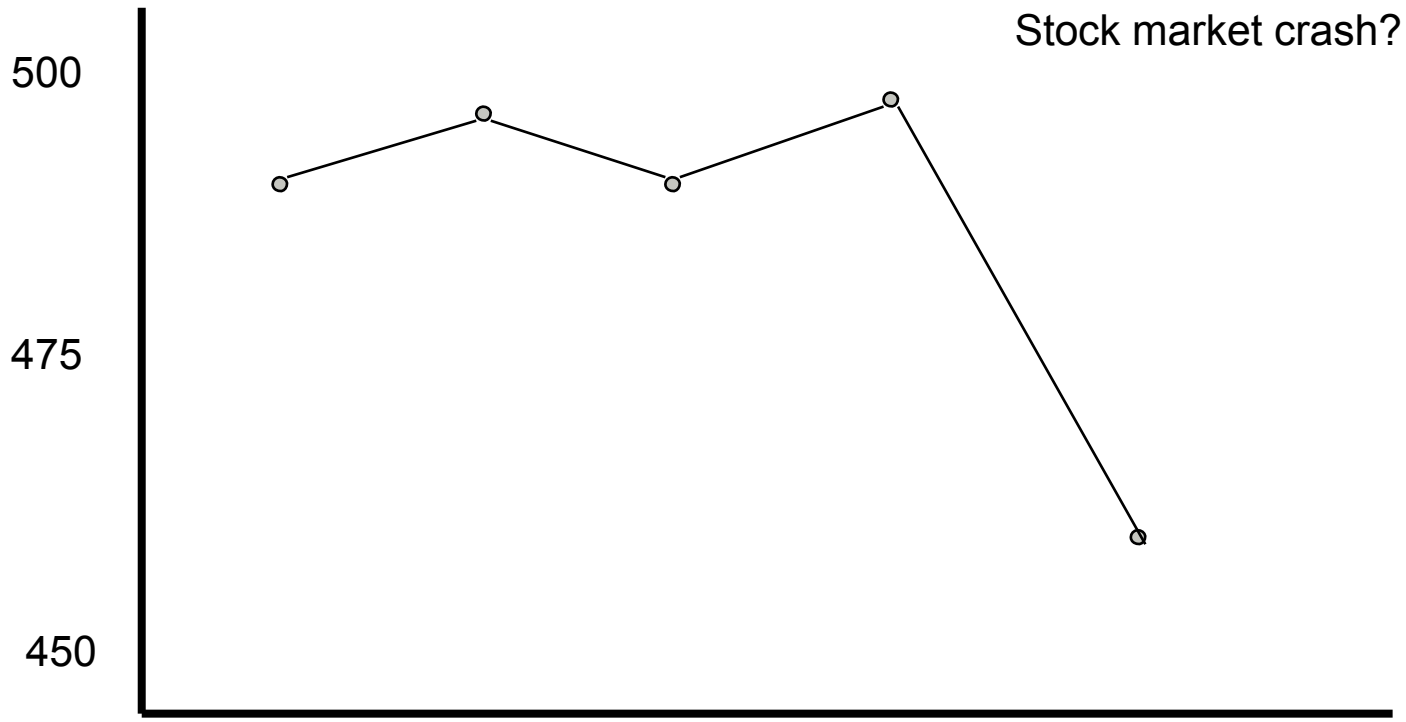
1. Tell the truth

   Graphical integrity

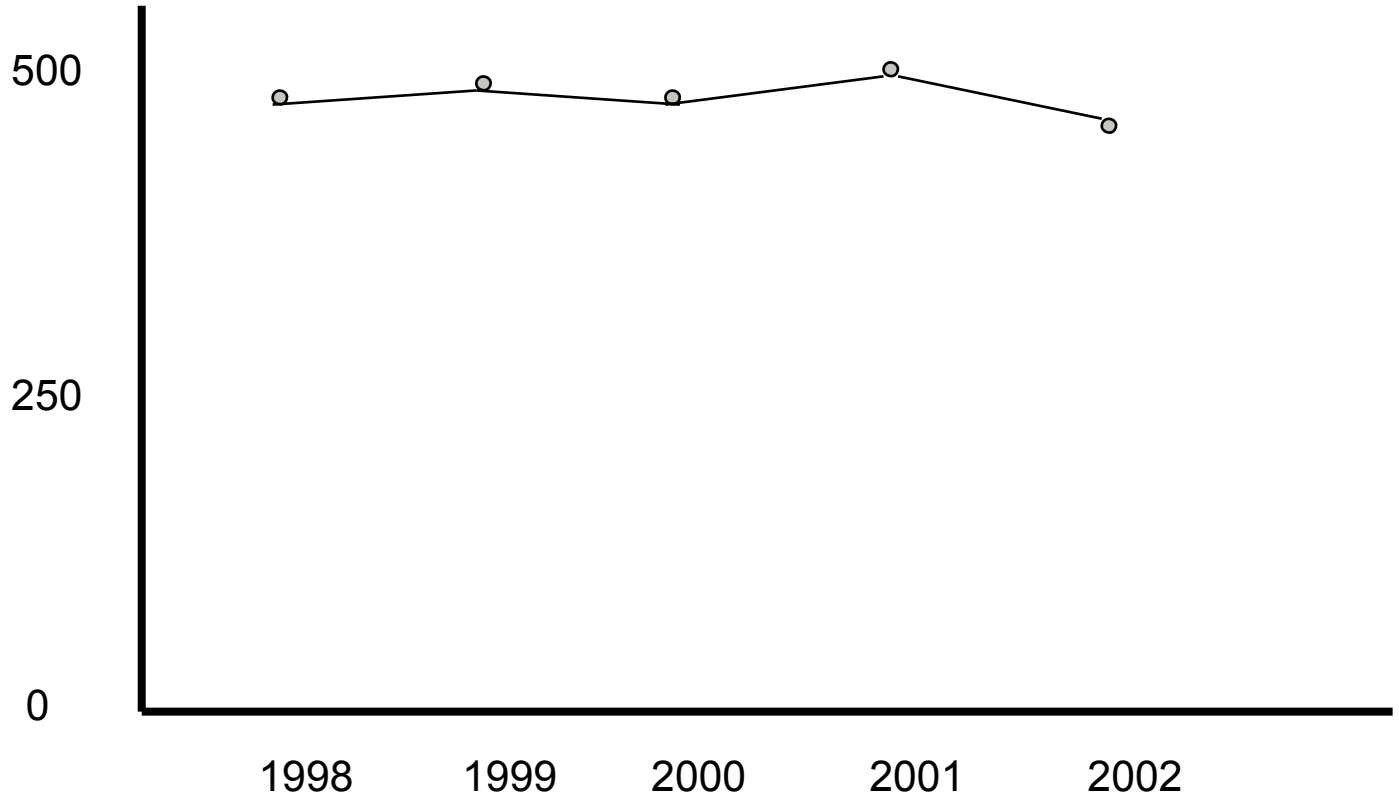
2. Do it effectively with clarity, precision…

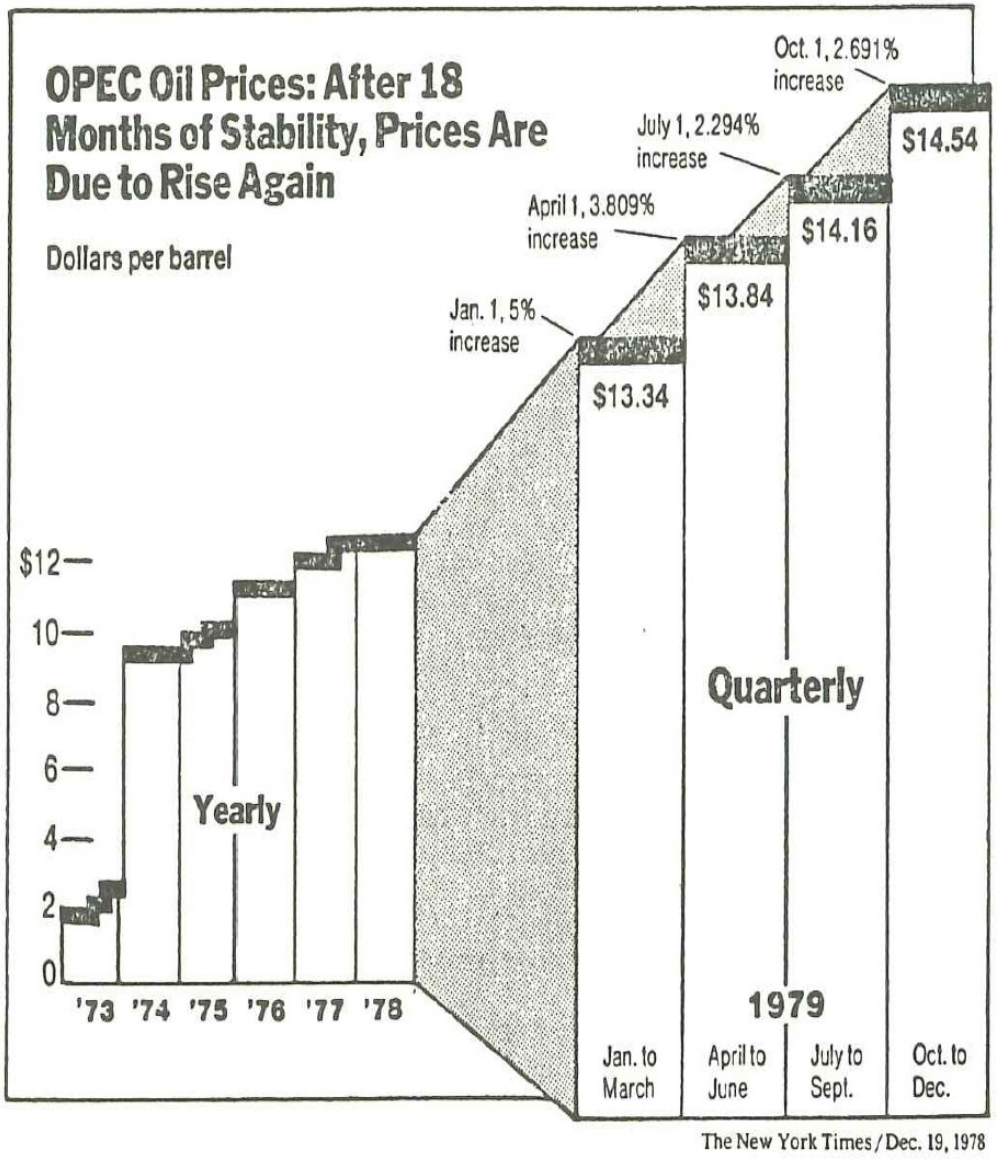
   Design aesthetics

Graphical Integrity



Graphical Integrity: Show Entire Scale



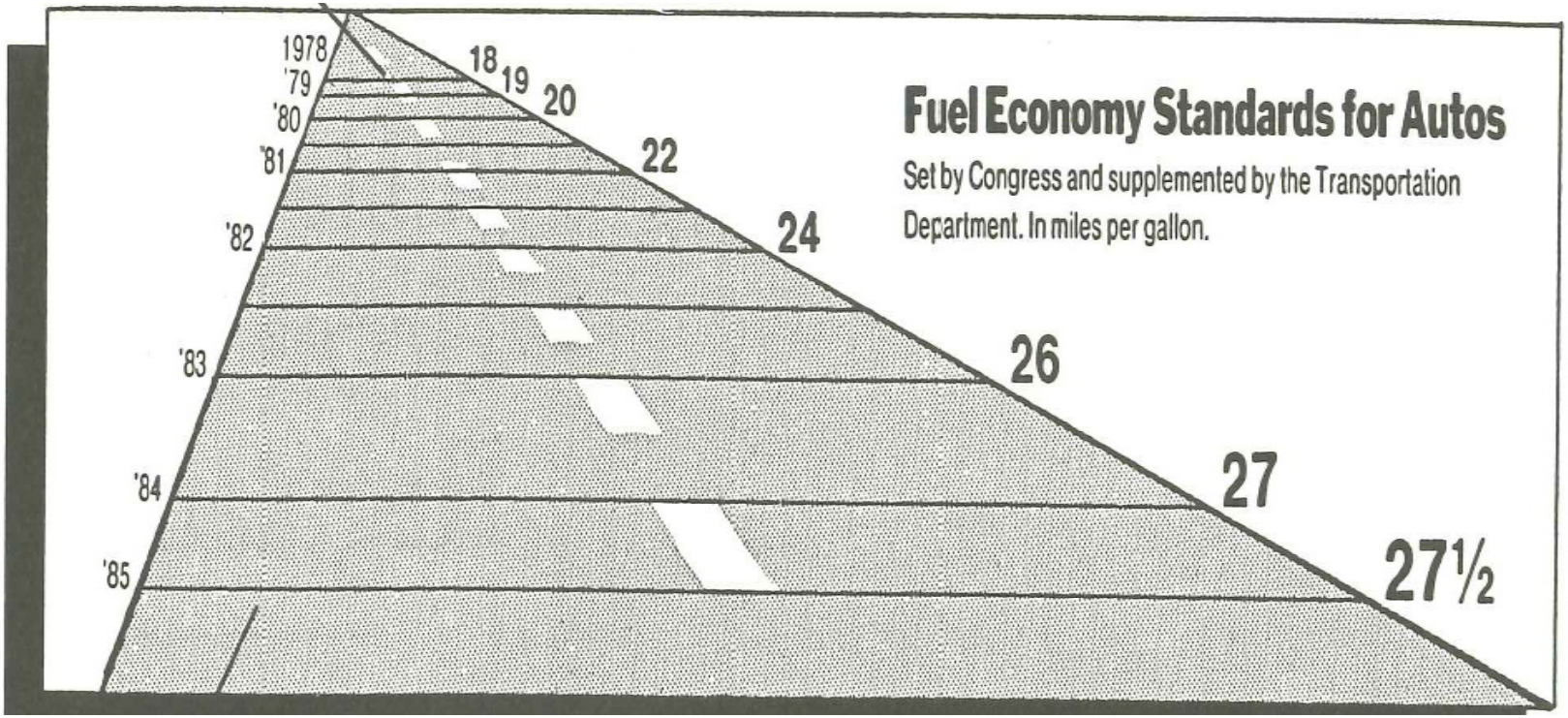


- 5 different vertical scales to show price
- 2 different horizontal scales to show time

(based on comparison of image space units to value changes)

Avoid Distortion

18mpg in 1978, 0.6 inch line

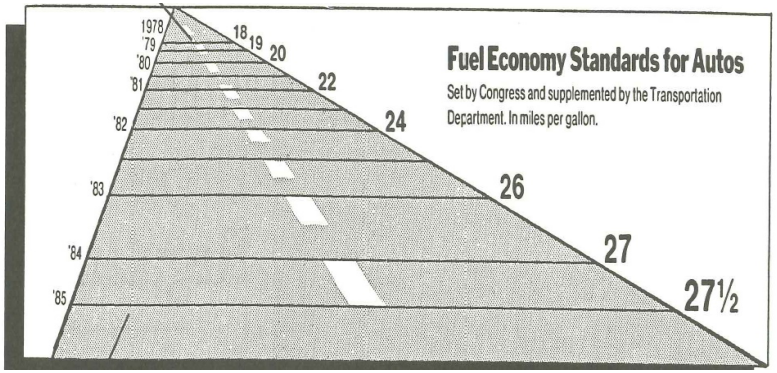


27.5 mpg in 1985, 5.3 inch line

Measuring Misrepresention

Visual attribute value should be directly proportonal to data attribute value

$$\textbf{Lie factor} = \frac{\text{Size of effect shown in graphic}}{\text{Size of effect in data}}$$

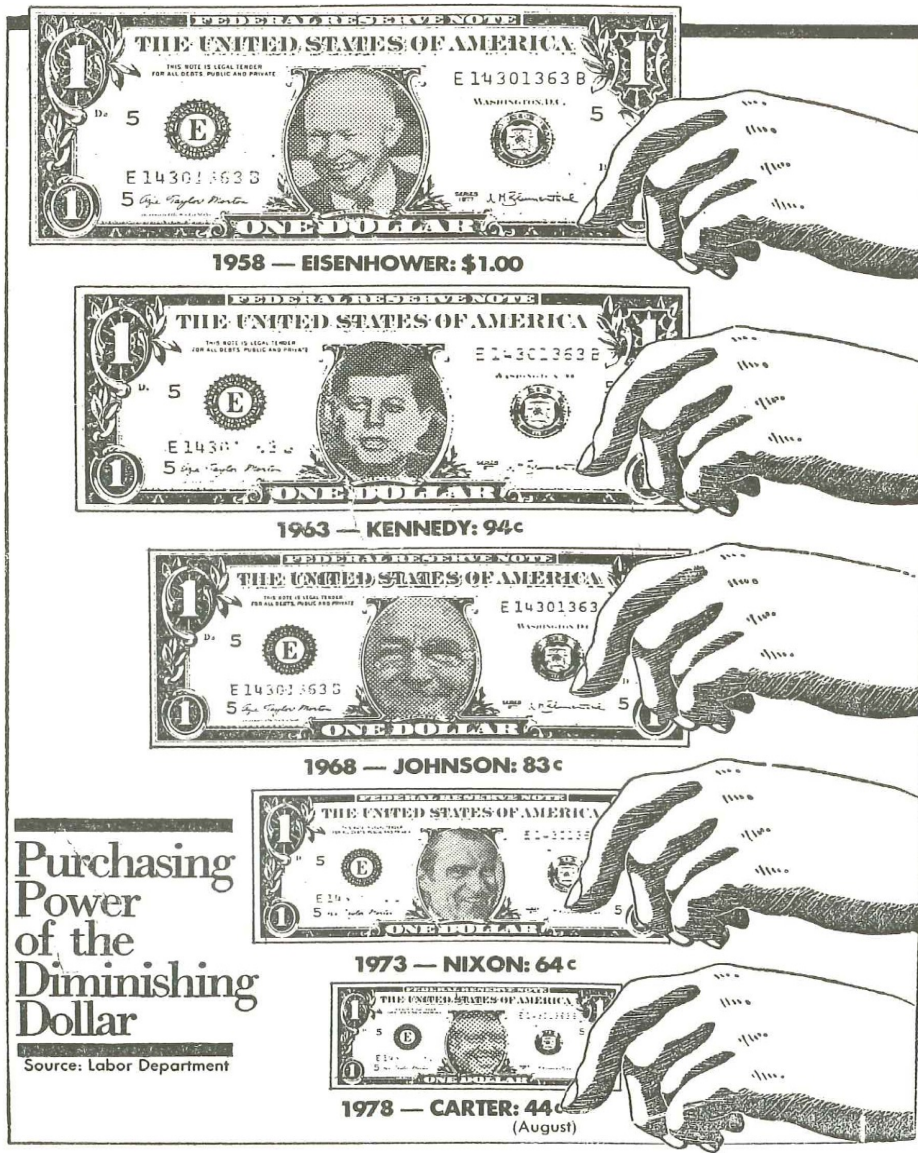


- Effect in data: 27.5 – 18.0 / 18.0 = 53% increase
- Effect in Image: 5.3 – 0.6 / 0.6 inches = 783%
- Lie = 783 / 53 = 14.8

Size Encoding

Don’t use areas (or volume) to show one dimensional data

More generally, the number of information carrying dimensions <= number of data dimensions



Summary of Tufte's Principles

1. Tell the truth

   Graphical integrity

2. Do it effectively with clarity, precision…

   Design aesthetics

2. Design Aesthetics

- Set of principles to help guide designers in arriving at a visually pleasing result that properly conveys the data

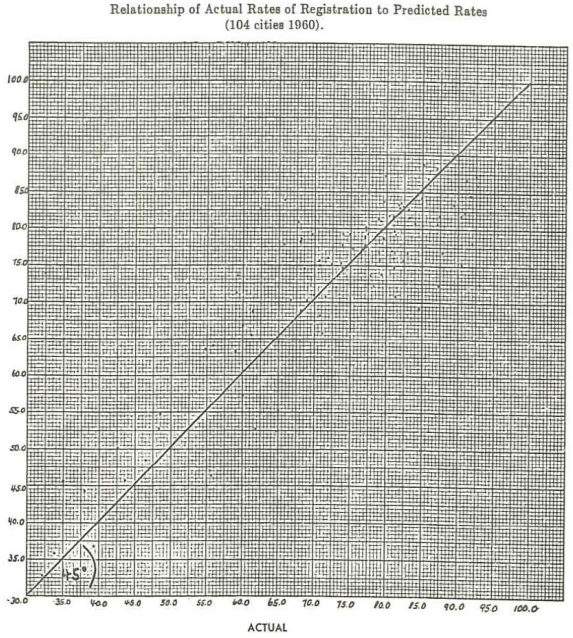
Design Principles

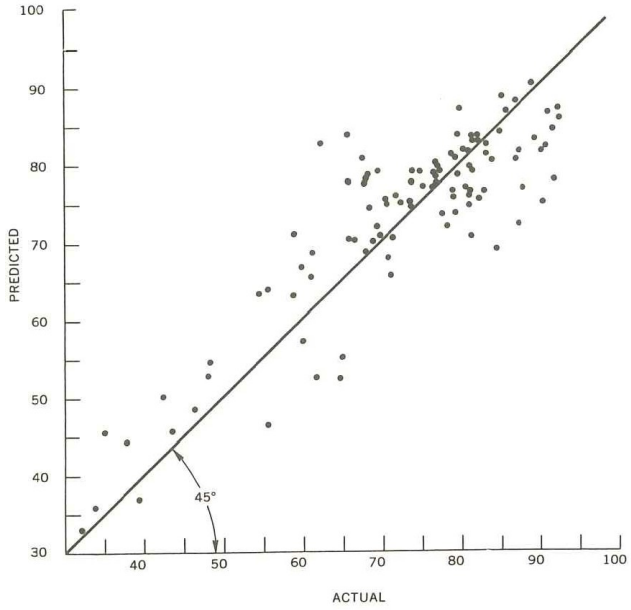
Maximize data-ink ratio

$$\text{Data ink ratio} = \frac{\text{Data ink}}{\text{Total ink used in graphic}}$$

= proportion of graphic's ink devoted to the ***non-redundant*** display of data-information

Example


Relationship of Actual Rates of Registration to Predicted Rates
(104 cities 1960).
45°
ACTUAL


100
90
80
70
60
50
40
30
PREDICTED
45°
40
50
60
70
80
90
100
ACTUAL

Maximize Data Density

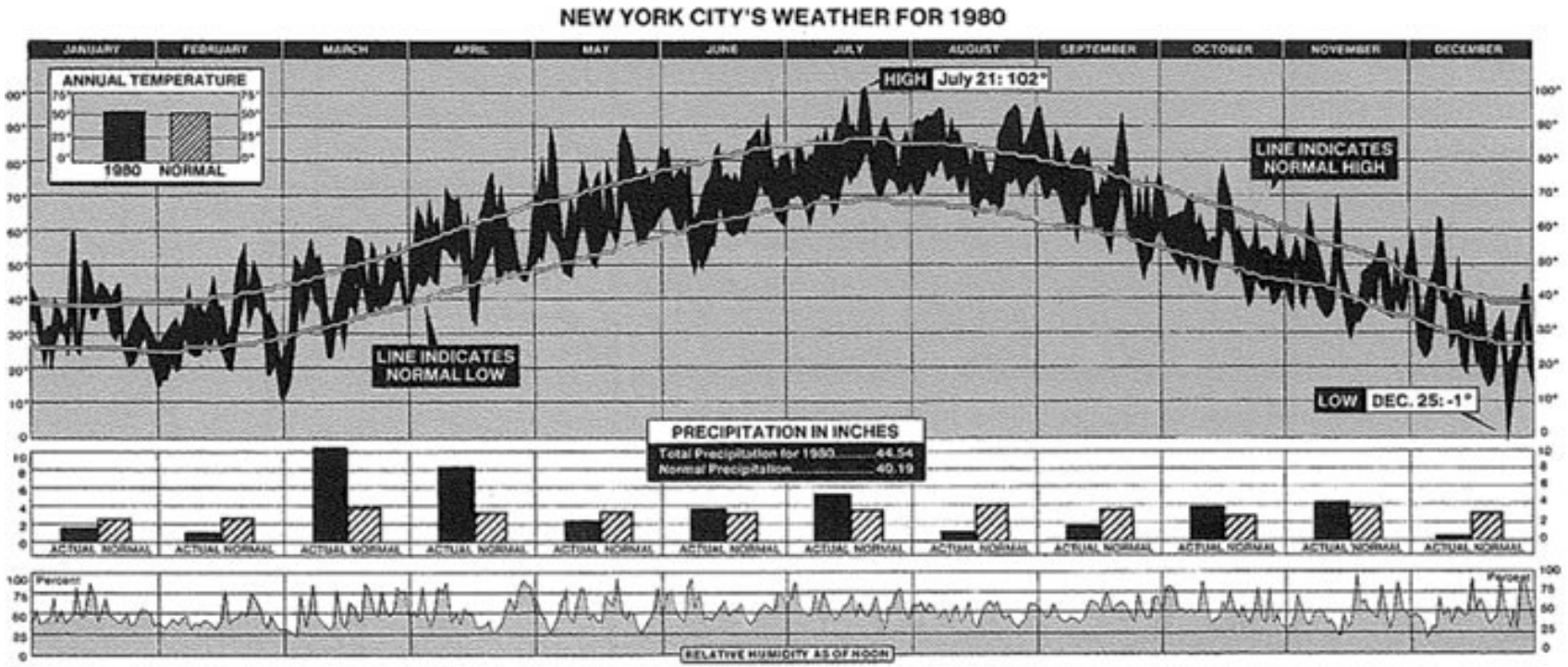
Maximize data density and the size of the data matrix within reason

$$\text{Data Density} = \frac{\text{\# entries in data matrix}}{\text{area of data graphic}}$$

Data Density Examples

Maximize data density and the size of the data matrix within reason

181 numbers / square inch

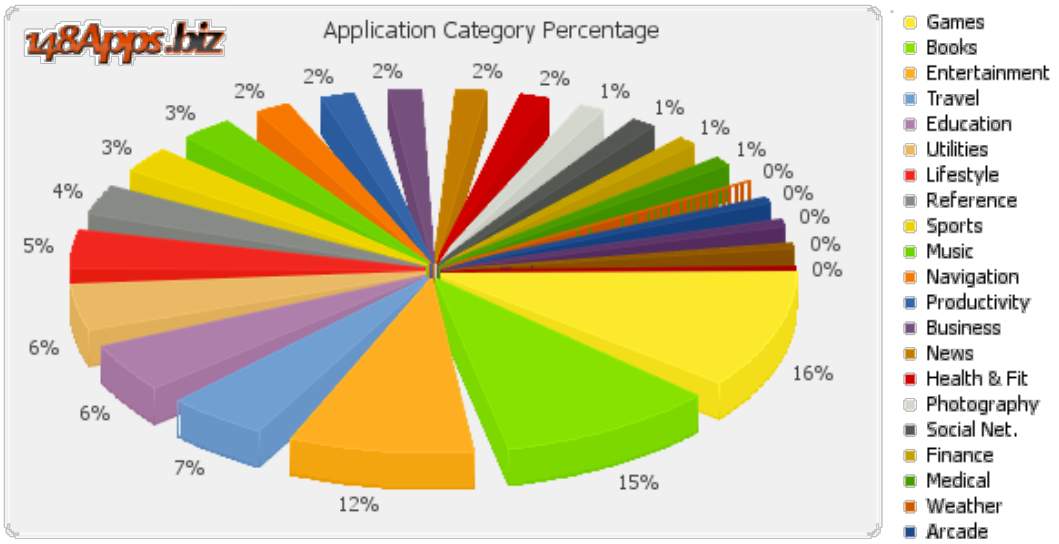


New York Times, January 11, 1981, p. 32.

Design Principles

Avoid 3D

- Data is multivariate
- Doesn't necessarily mean 3D projection
- How can we enhance mulitvariate data on inherently 2D surfaces?



Tufte's–Macro/Micro

Provide the user with both views (overview + detail)

Carefully designed view can show a macro structure (overview) as well as micro structure (detail) in one space

Conclusion

- To achieve graphical excellence we must consider integrity and design
- Design principles must be followed to create effective visualizations

JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING