

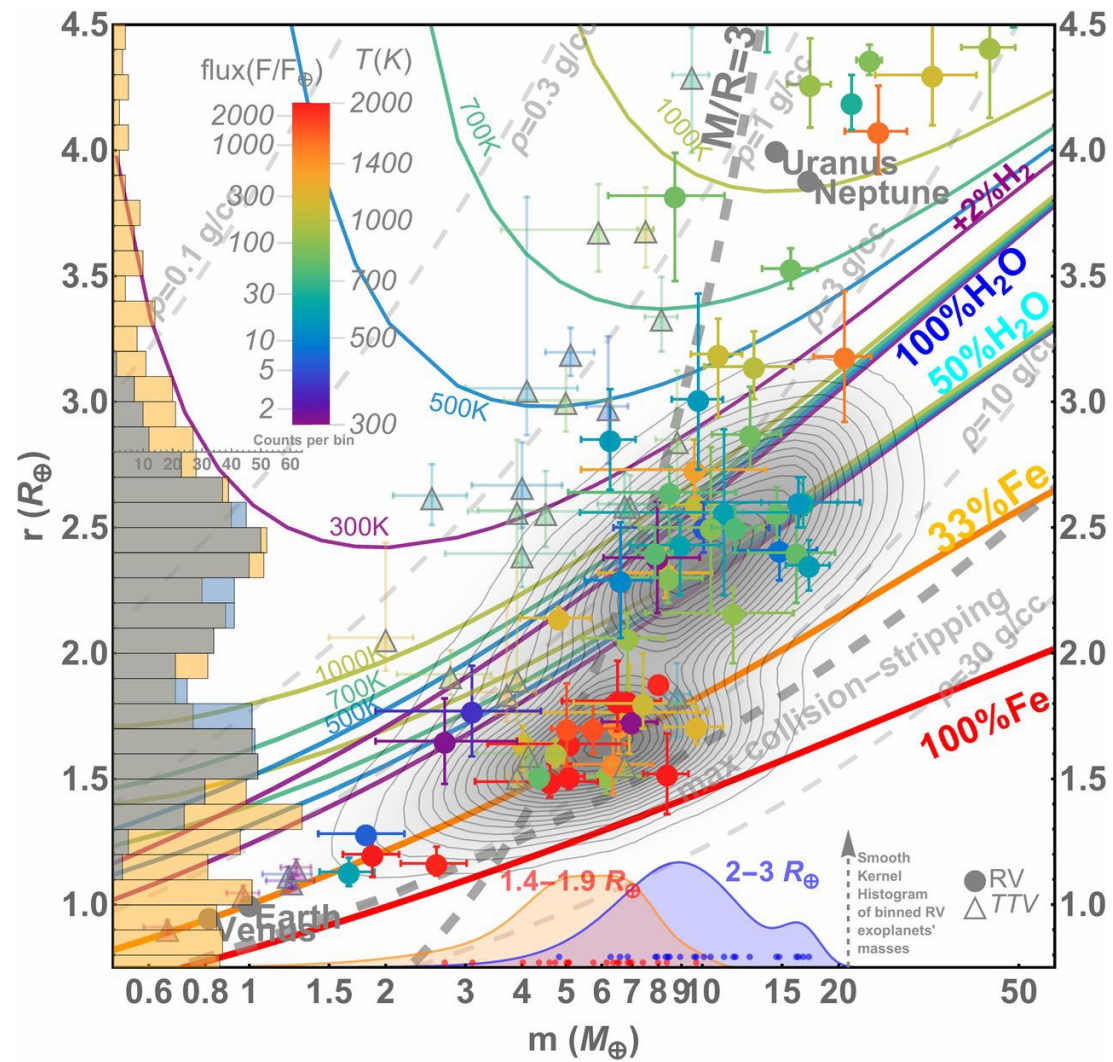


# Data Visualization

Jonathan Kho

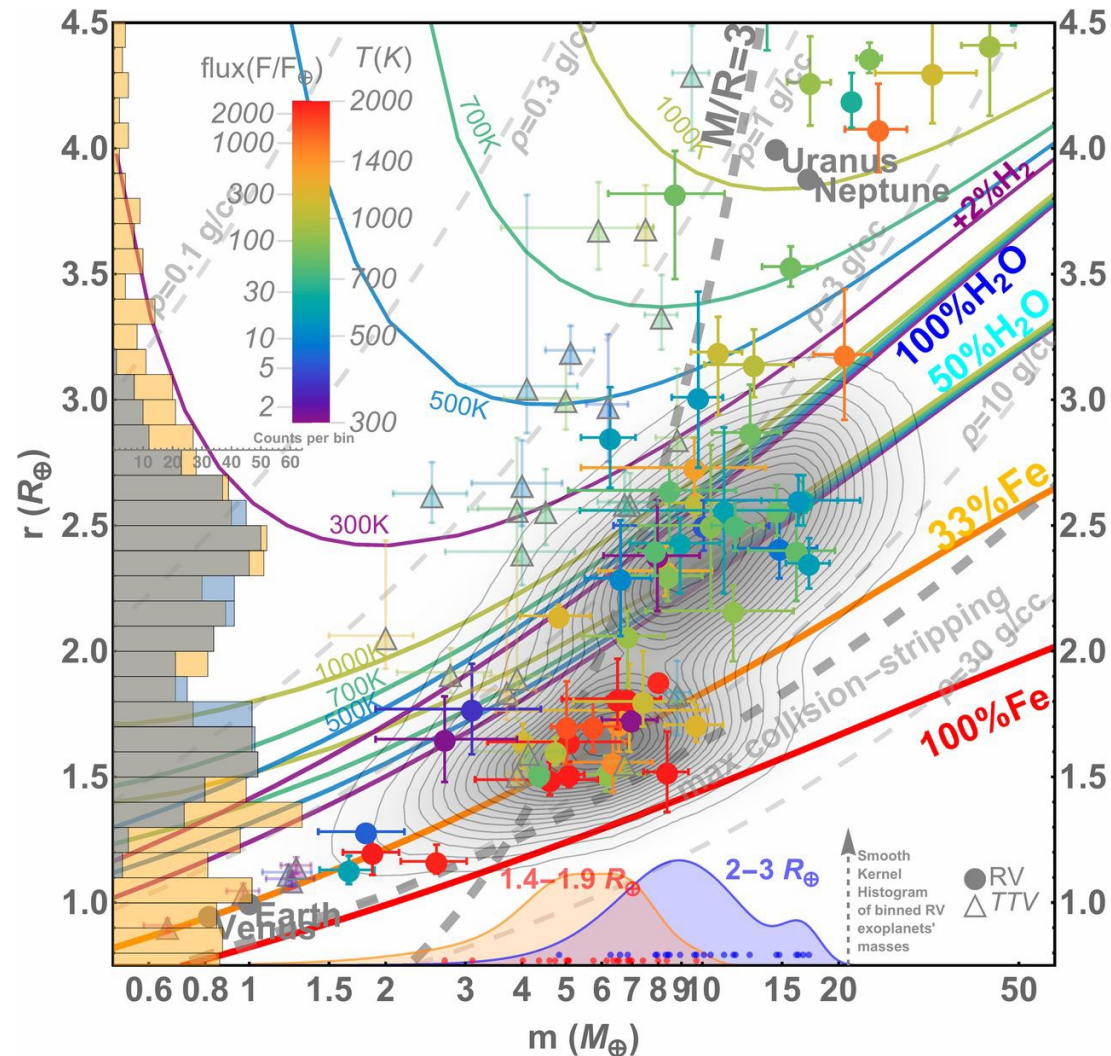
How do we  
feel about this  
plot?

Fig credit: Fig. 2 of Zeng et al. (2019)



# Some things you may have noticed:

- Figure is too crowded!  
Impossible to read and understand
  - Overlapping error bars, contour plot, labels, and lines
- Poor use of colors: meaning becomes confusing
  - Temperature/flux color bar is a rainbow
  - If someone who is colorblind looked at this plot, how much information would they lose?



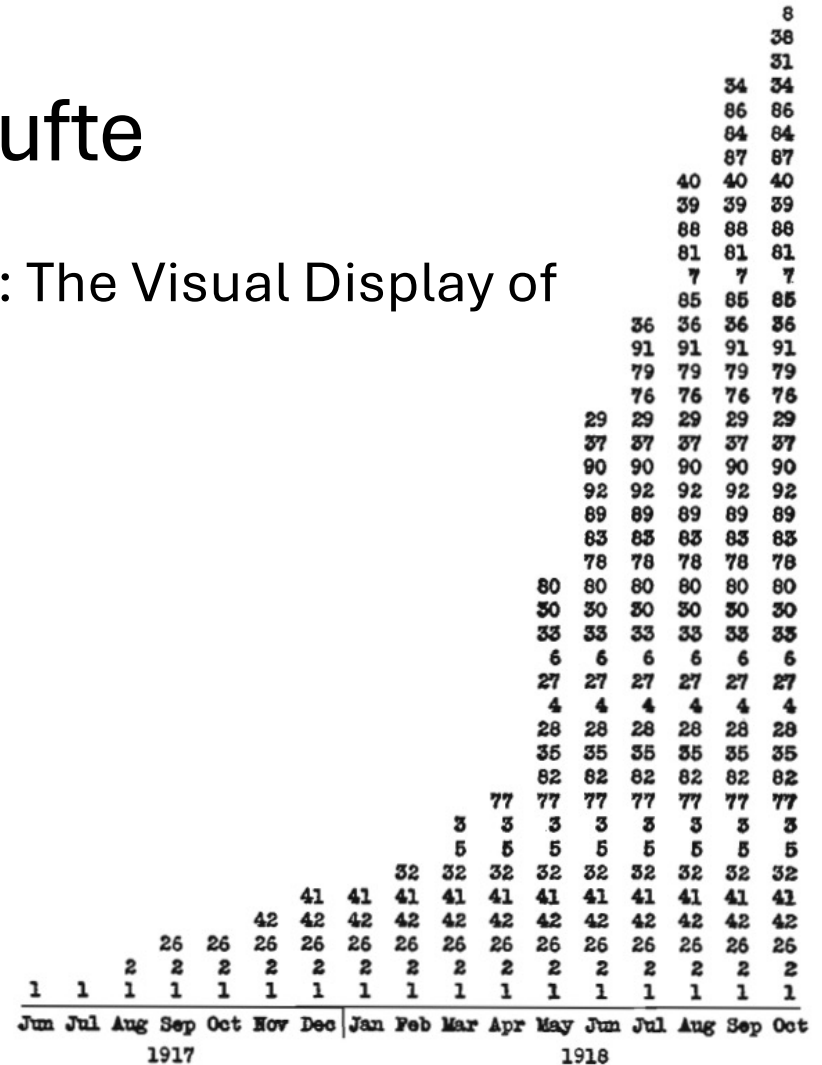
# Case Studies with Edward Tufte

For those interested in additional reading: *The Visual Display of Quantitative Information*

Main topics to discuss:

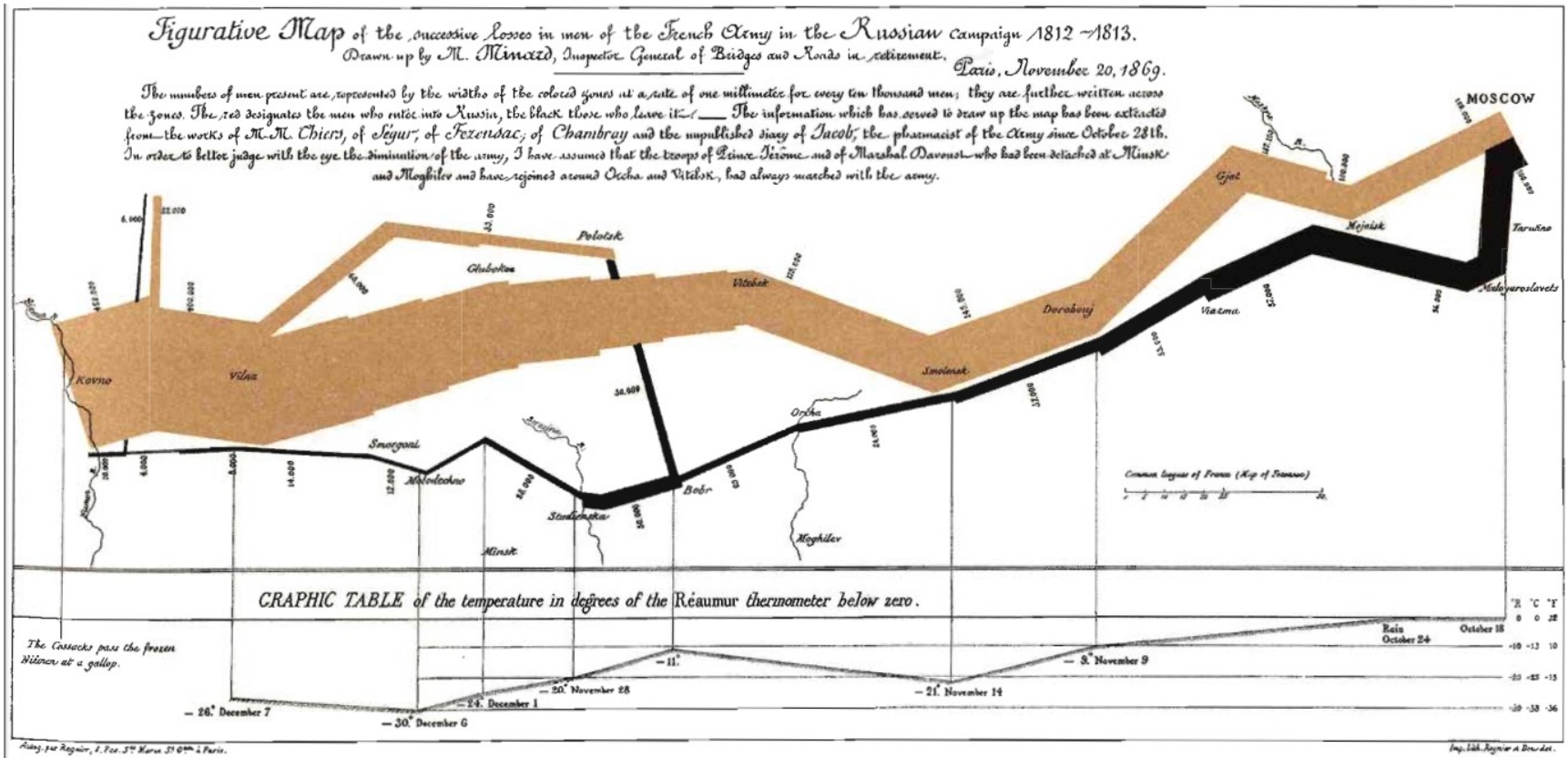
- Tell a story
- Colors
- Pitfalls to avoid

Fig Credit: Leonard P. Ayres, *The War with Germany* (Washington, D.C., 1919), p. 102.



# Telling a story

Fig. credit: Charles Joseph Minard, Tableaux Graphiques et Cartes Figuratives de M. Minard, 1845-1869, Bibliothèque de l'École Nationale des Ponts et Chaussées, Paris, item 28 (62 by 25 cm, or 25 by 10 in). English translation by Dawn Finley and redrawing by Elaine Morse, completed August 2002.



# Using colors well

<https://adniconseils.ca/en/the-iridis-color-palette-a-good-choice-in-data-visualization/>

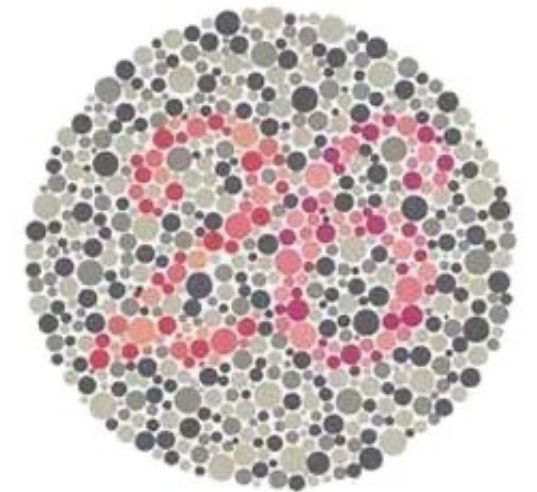
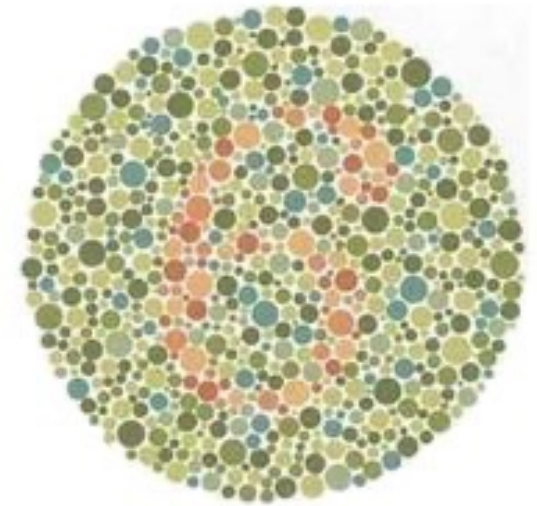
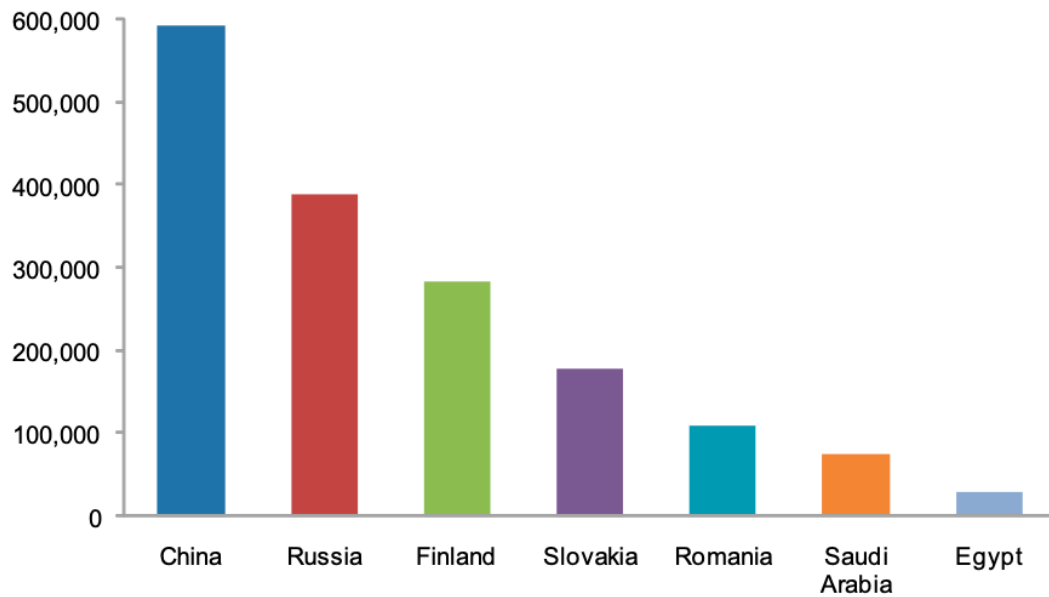
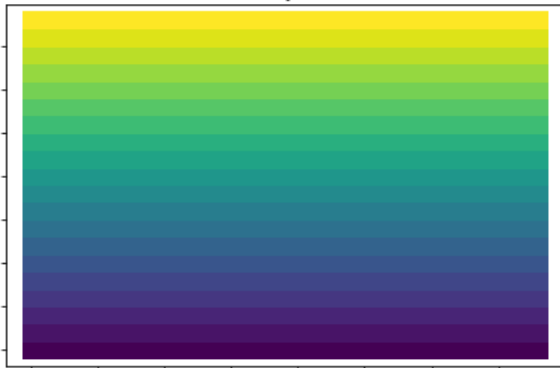


Fig. Credit: Stephen Few, Practical Rules for Using Color in Charts, 2008

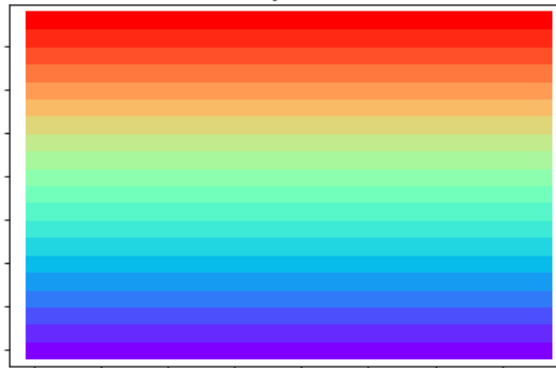
# Using colors well: matplotlib

<https://matplotlib.org/stable/users/explain/colors/colormaps.html>

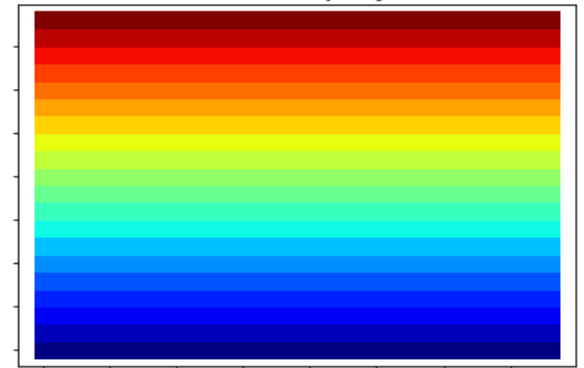
Color map: viridis



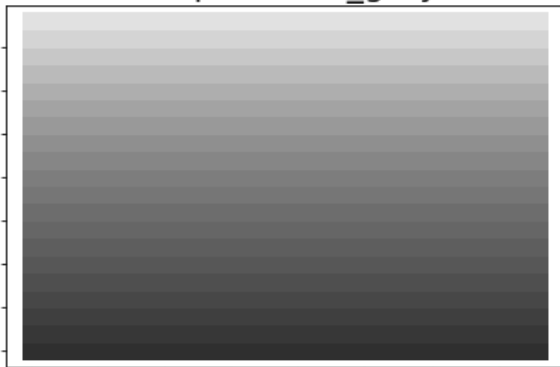
Color map: rainbow



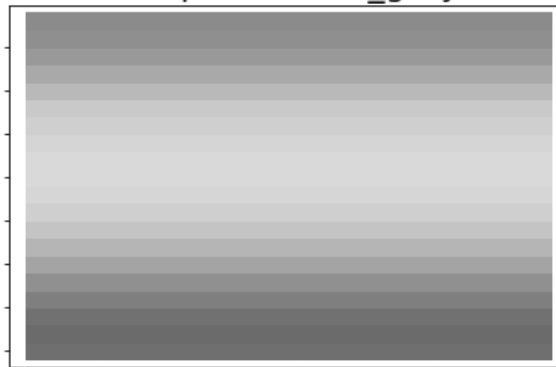
Color map: jet



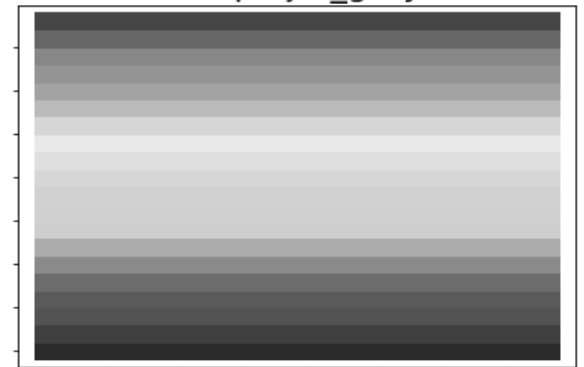
Color map: viridis\_grayscale



Color map: rainbow\_grayscale

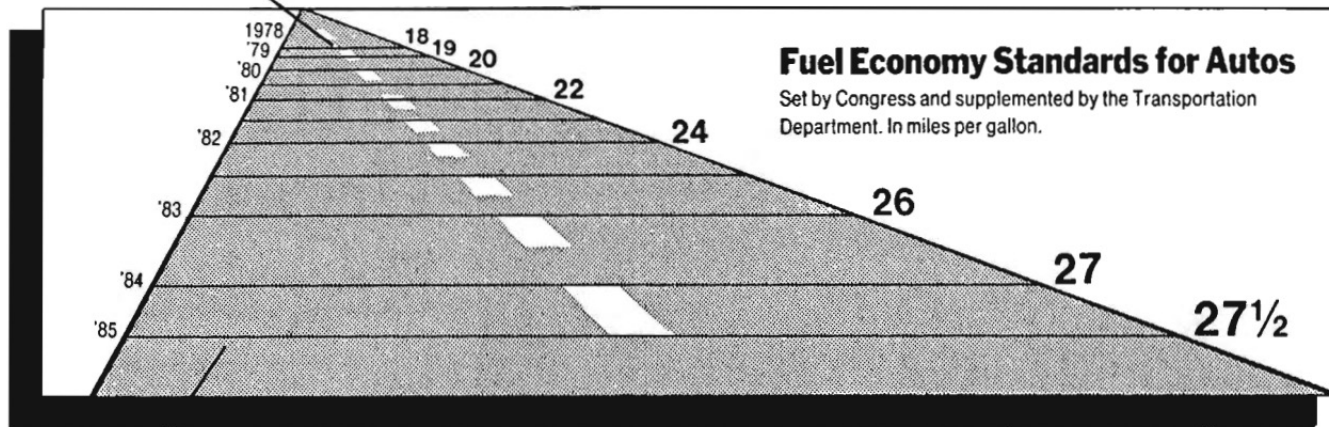


Color map: jet\_grayscale



# Pitfalls to avoid

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

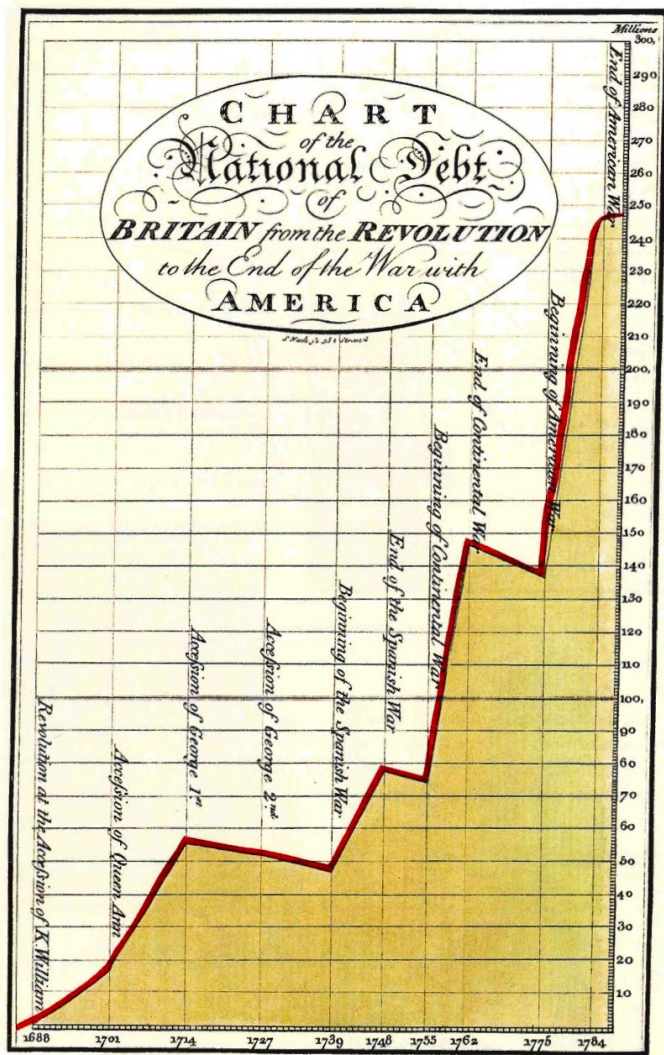


This line, representing 27.5 miles per gallon in 1985, is 5.3 inches long.

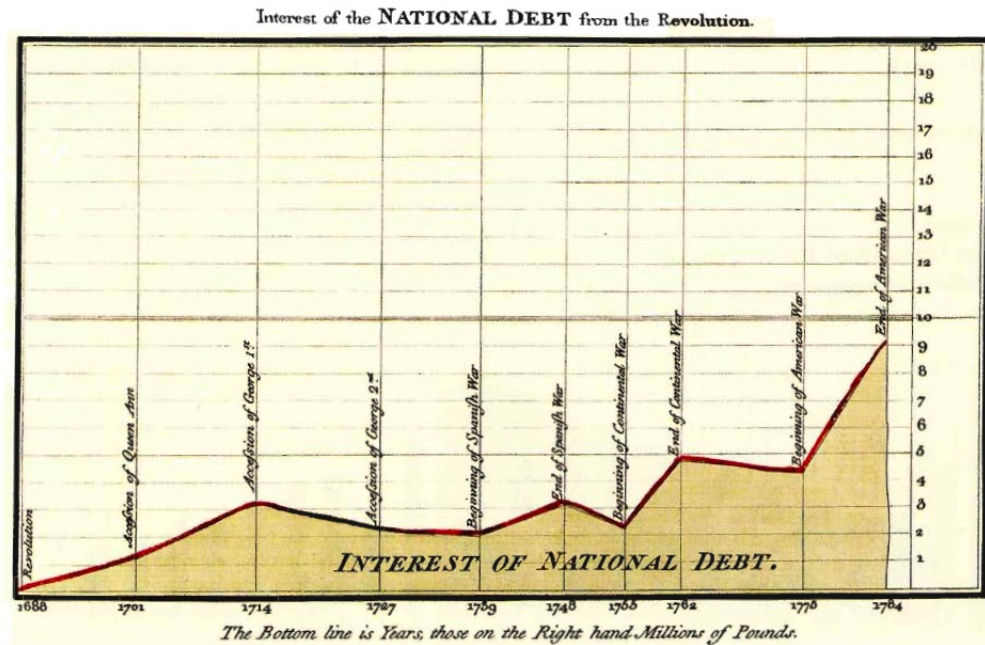
Fig Credit: New York Times, August 9, 1978, p. D-2.

# Pitfalls to avoid

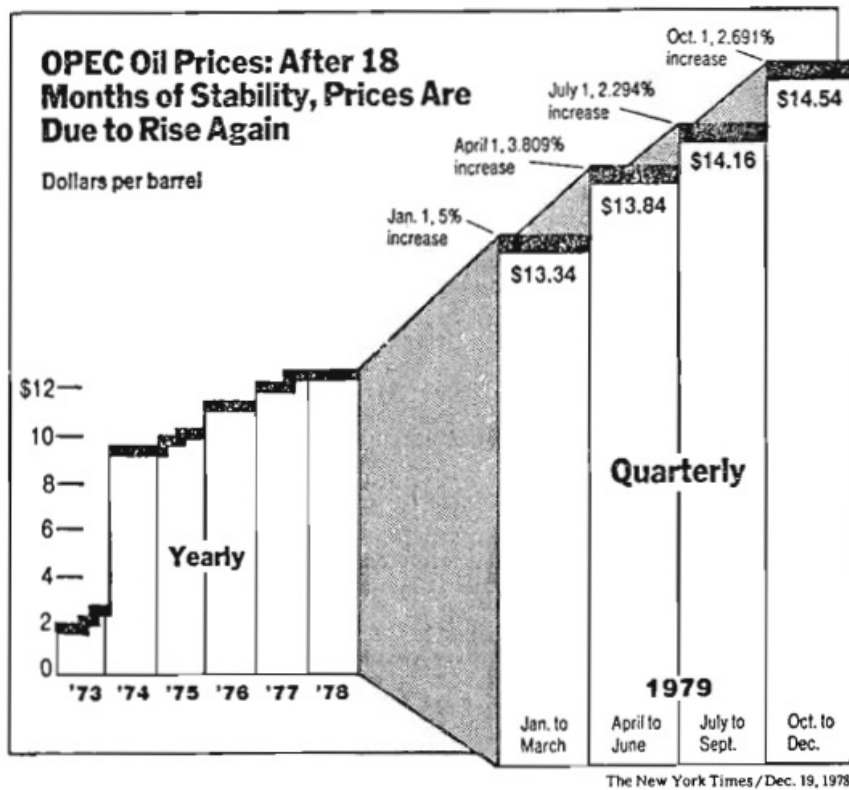
Fig. Credit: Playfair, The Commercial and Political Atlas, 1786



The Divisions at the Bottom are Years, & those on the Right hand Money.



# Pitfalls to avoid



Five different vertical scales show the price:

During this time	one vertical inch equals
1973-1978	\$8.00
January-March 1979	\$4.73
April-June 1979	\$4.37
July-September 1979	\$4.16
October-December 1979	\$3.92

And two different horizontal scales show the passage of time:

During this time	one horizontal inch equals
1973-1978	3.8 years
1979	0.57 years

Fig. Credit: New York Times, December 19, 1978, p. D-7.

# Pitfalls to avoid

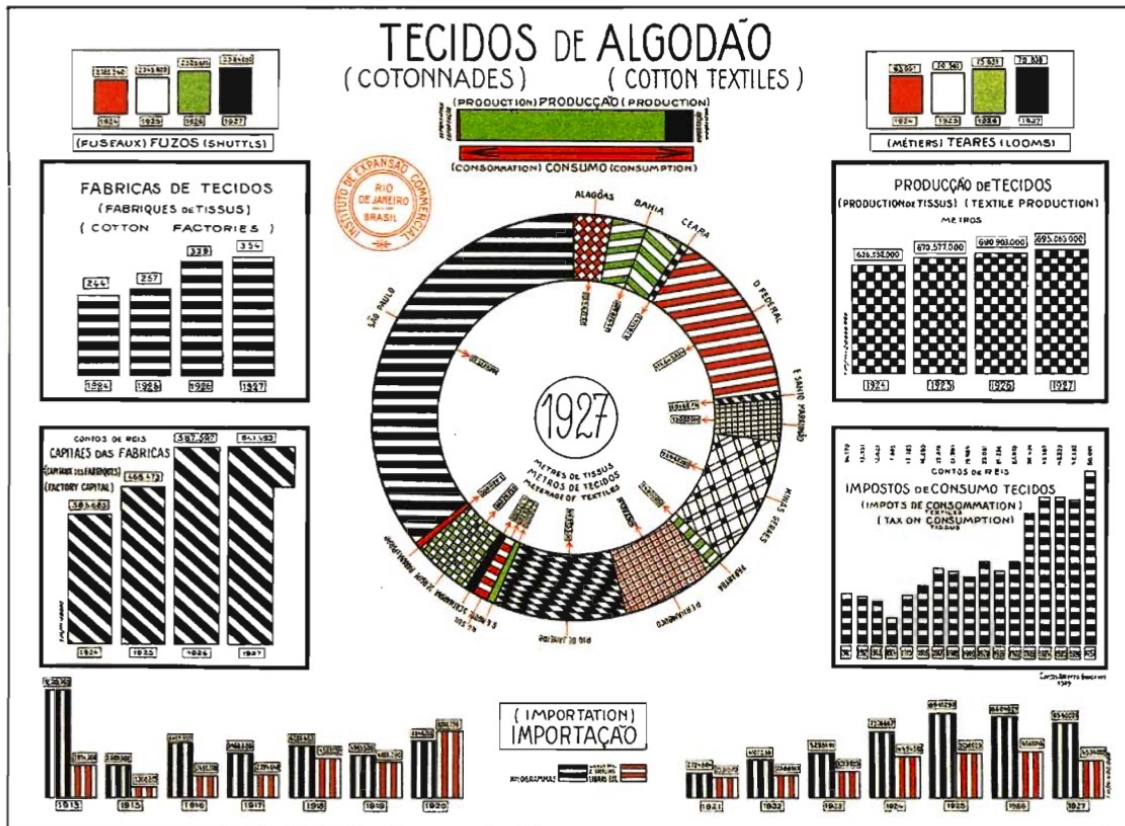


Fig Credit: Instituto de Expansão Comercial, Brasil: Graphics Economicos-Estatisticas (Rio de Janeiro, 1929), P. 15.

# Main takeaways

- Ensure that every figure used has a clear purpose/story
- Use color and pattern thoughtfully
- The representation of numbers, as physically measured on the surface of the graphic itself, should be directly proportional to the numerical quantities represented.
- The number of information-carrying (variable) dimensions depicted should not exceed the number of dimensions in the data.
- Show data variation, not design variation

Takeaways quoted or paraphrased from Tufte's [The Visual Display of Quantitative Information](#)

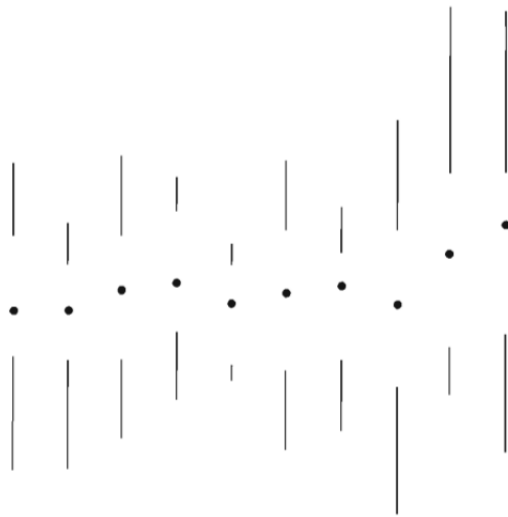
Now let's critique some of Bob's plots!

Just kidding!

Questions?

# Bonus: Tufte's unusual perspective

The "superior" boxplot:



The "superior" scatter plot:

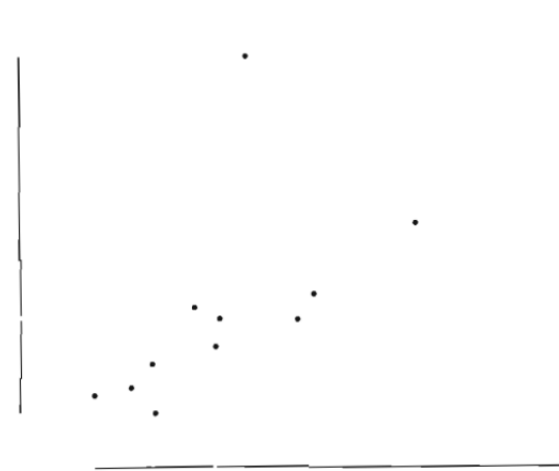


Fig. Credit: The Visual Display of Quantitative Information, Edward Tufte

# Bibliography

- Ayres, Leonard P. *The War with Germany*. Washington, D.C., 1919.
- Few, Stephen. *Practical Rules for Using Color in Charts*. 2008.
- Instituto de Expansão Commercial. *Graphicos Economicos-Estatisticas*. Rio de Janeiro, 1929.
- Minard, Charles Joseph. *Tableaux Graphiques et Cartes Figuratives de M. Minard, 1845–1869*. Bibliothèque de l'École Nationale des Ponts et Chaussées, Paris. English translation by Dawn Finley and redrawing by Elaine Morse, completed August 2002.
- *New York Times*. August 9, 1978, p. D-2.
- *New York Times*. December 19, 1978, p. D-7.
- Playfair, William. *The Commercial and Political Atlas*. 1786.
- Tufte, Edward R. *The Visual Display of Quantitative Information*. Graphics Press, 2022.
- Zeng, Li, et al. “Growth Model Interpretation of Planet Size Distribution.” *Proceedings of the National Academy of Sciences* 116, no. 20 (April 29, 2019): 9723–9728.  
<https://doi.org/10.1073/pnas.1812905116>