

# **Data Visualization**

## **A Practical Introduction**

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Future Forum

2021 YRP Seminar, May 18, 2021

# Goal of Today's Seminar

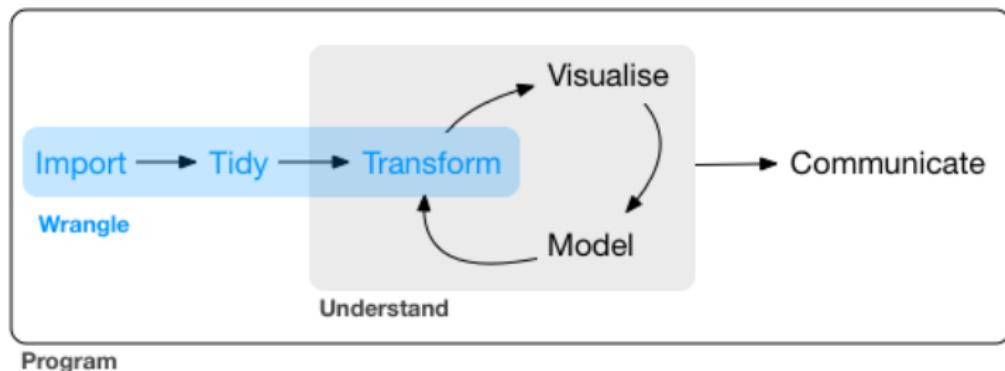
- ▶ Know the types of graphs we should avoid
- ▶ Learn about RStudio IDE (integrated development environment)
- ▶ Data visualization in R
- ▶ Data import and transformation
- ▶ Data export
- ▶ Discussion about your questions or any concerns about R or datasets

**Remember:** It will not work in a flow and structure, because we practice in the real example as a researcher have a dataset and applied it for a specific research study.

# Seminar Materials

- ▶ You can code, data and slide from my repository at GitHub:  
<https://github.com/nithkosal/DataVisualization>
- ▶ Intermediate level: R for Data Science by Hadley Wickham and Garrett Grolemund. Available online:  
<https://r4ds.had.co.nz/>
- ▶ Advanced R by Hadley Wickham. Also available here:  
<https://adv-r.hadley.nz/>
- ▶ R Blog: <https://www.r-bloggers.com/>
- ▶ Ask questions or share your knowledge about programming:  
<https://stackoverflow.com/questions/tagged/r>

# The Thing to know when you work with data



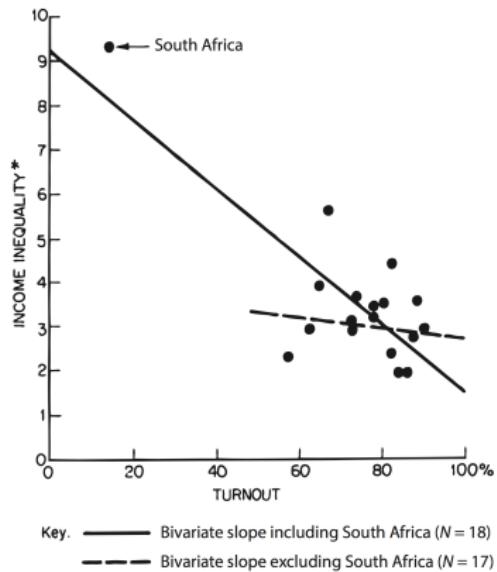
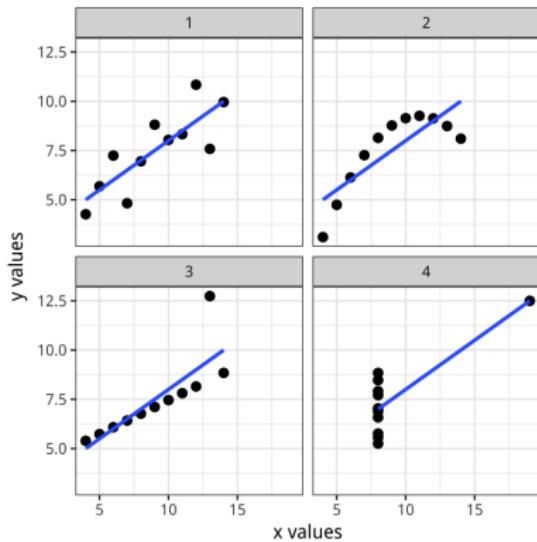
Source: Grolemund and Wickham (2016)

- ▶ Tidying your data means storing it in a consistent form that matches the semantics of the dataset with the way it is stored.
- ▶ Together, tidying and transforming, we called *wrangling*

# What does data visualization mean?

- ▶ A reporting tool: the representation of information in the form of a chart, diagram, picture, etc.
- ▶ It is a part of *hypothesis generation or data exploration*.
  - A precise mathematical model to generate falsifiable predictions.
  - Only use an observation once to confirm a hypothesis.
- ▶ Modelling is an important part of the exploratory process.

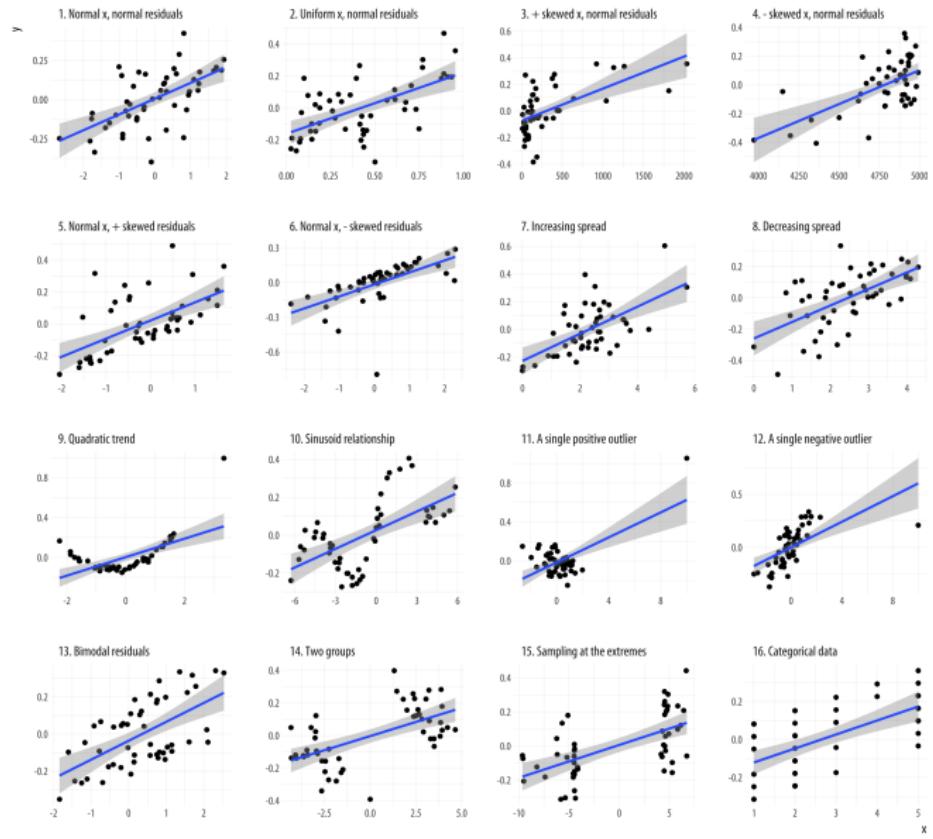
# Now, We Look at Some Data Visualizations



Source: Chatterjee and Firat (2007), Jackman (1980)

- ▶ Scatterplots are the workhorse of data visualization in social science.
- ▶ A scatterplot shows the relationship between two quantities, such as height and weight, age and income, or time and unemployment.

Within each panel, the correlation between the x and y variables is set to be 0.6, a pretty good degree of association. But the actual distribution of points is created by a different process in each case.

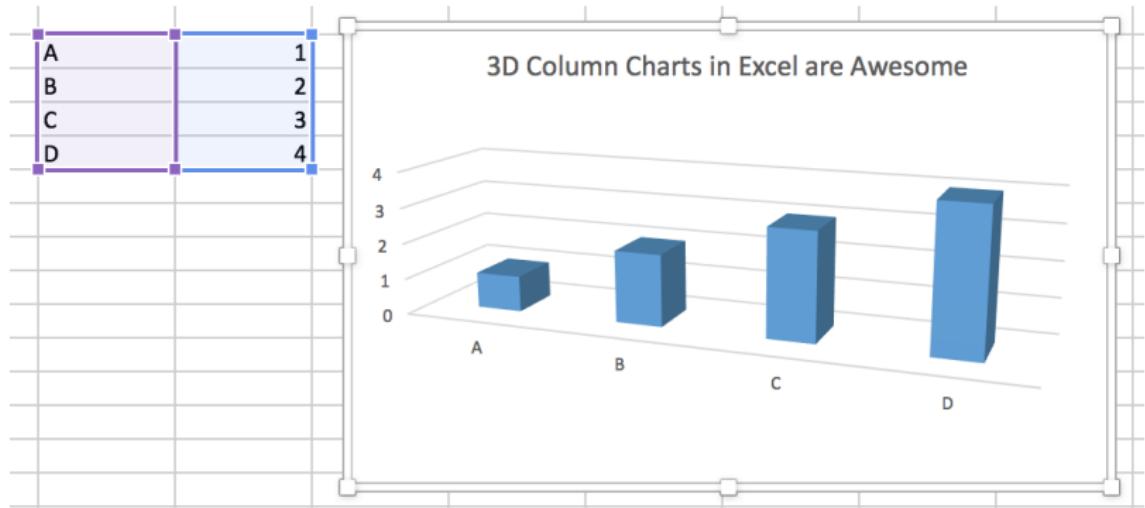


Source: Jan Vanhove (2016)



Source: Kieran Healy (2018)

The bars are hard to read and compare.



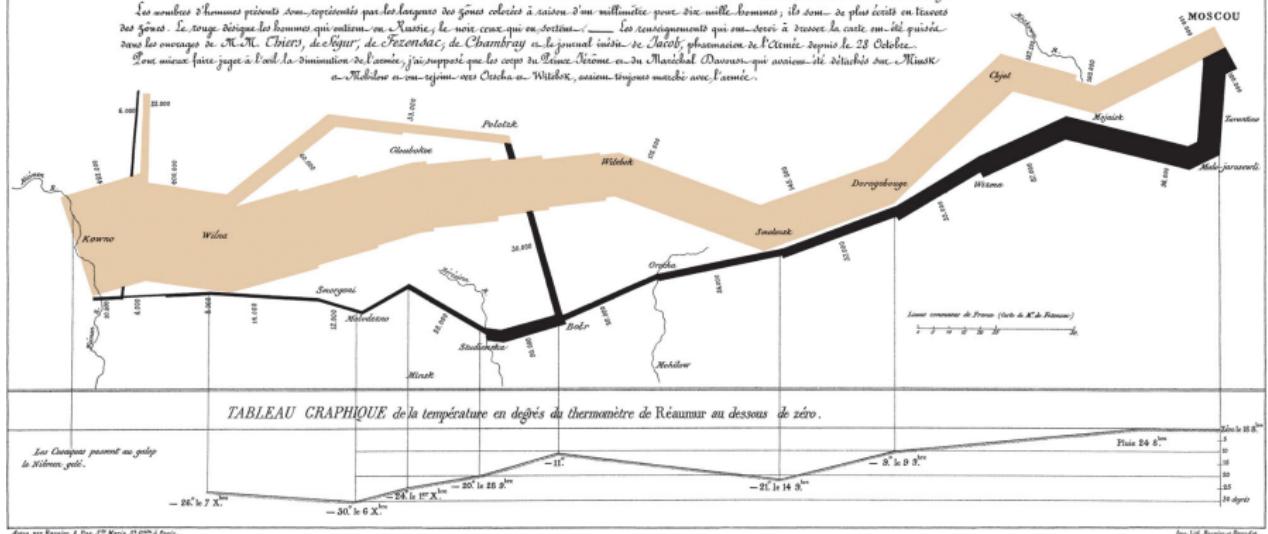
- ▶ Charts like this are common in business presentations and popular journalism, and are also seen in academic journal articles. Here we seek to avoid too much junk by using Excel's default settings.

*Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.*

*Élevée par M. Minard, Ingénieur Général des Ponts et Châteaux et établie à Paris, le 20 Novembre 1869.*

Les nombres d'hommes perdus sont représentés par les longues des gènes colorés à saison d'un millier pour dix mille hommes; ils sont de plus courts en hiver dans les gènes. Le rouge désigne les hommes qui entrent en Russie, le noir ceux qui sortent... Les renseignements qui me servent à dresser la carte mi-juillet quittant dans les envirages de M. Chiat, de Chiat, de Chambry et de Satory, phénomène de l'Armée depuis le 28 Octobre.

Long mètre faire juge à l'est, la diminution de l'armée j'ai rapporté que les corps au Peine, Neman et du Mecklembourg-Danube, qui avaient été détruits sur le Niémen et le Niémen et qui se sont vers Ostroga et Wilek, assister toujours marche avec l'armée.



*Avec ses Repères, à Paris, 2<sup>e</sup> partie, 25 octobre 1869.*

*Imp. L. H. Richepin et Cie.*

Source: Charles Joseph Minard — Minard's visualization of Napoleon's retreat from Moscow.

Edward Tufte's comment: “Graphical excellence is the well-designed presentation of interesting data—a matter of substance, of statistics, and of design, it consists of complex ideas communicated with clarity, precision, and efficiency.”

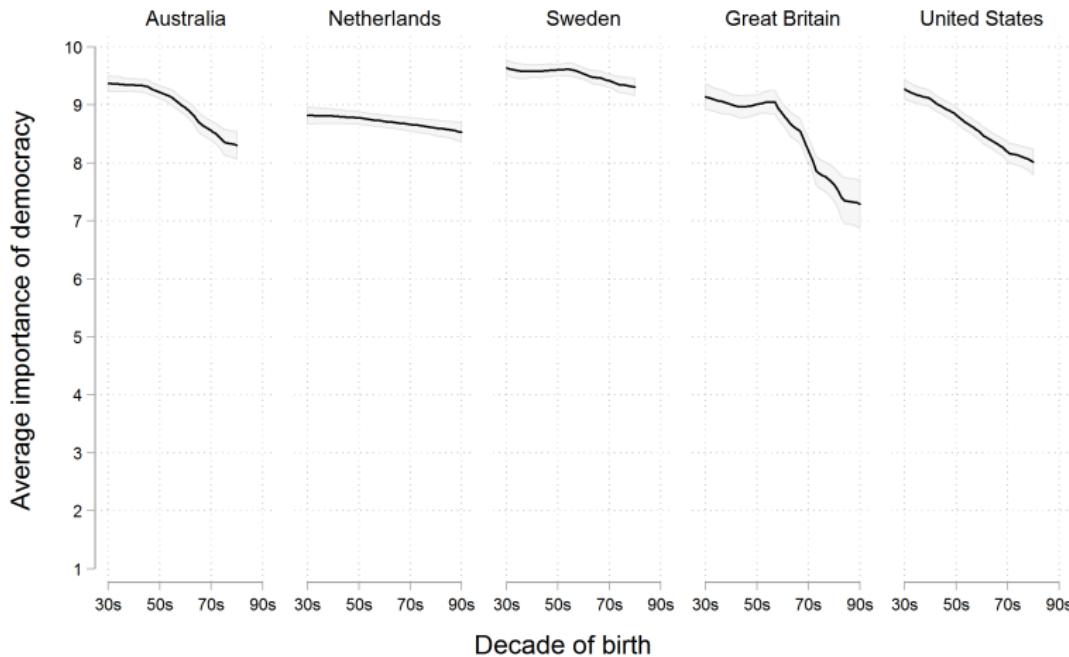
## MONSTROUS COSTS

Total House and Senate campaign expenditures,  
in millions



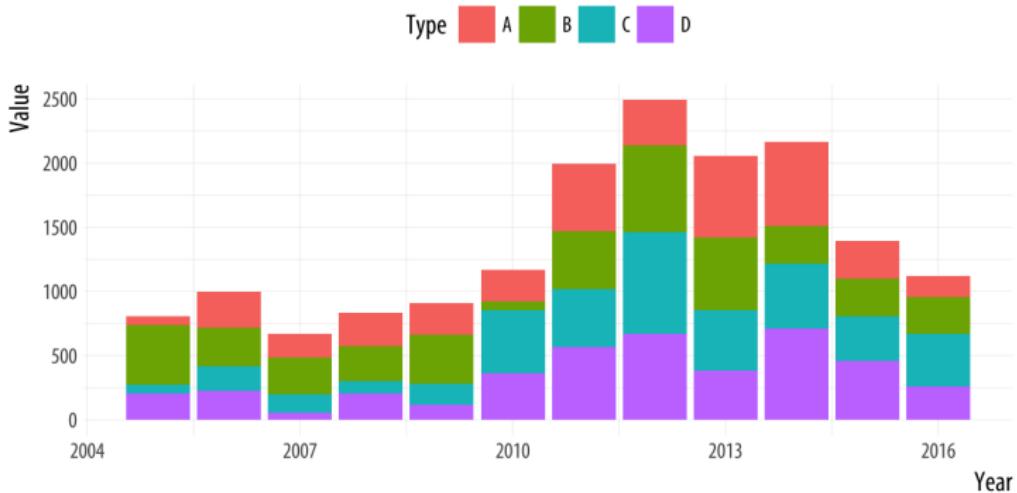
Source: 'Monstrous Costs' by Nigel Holmes

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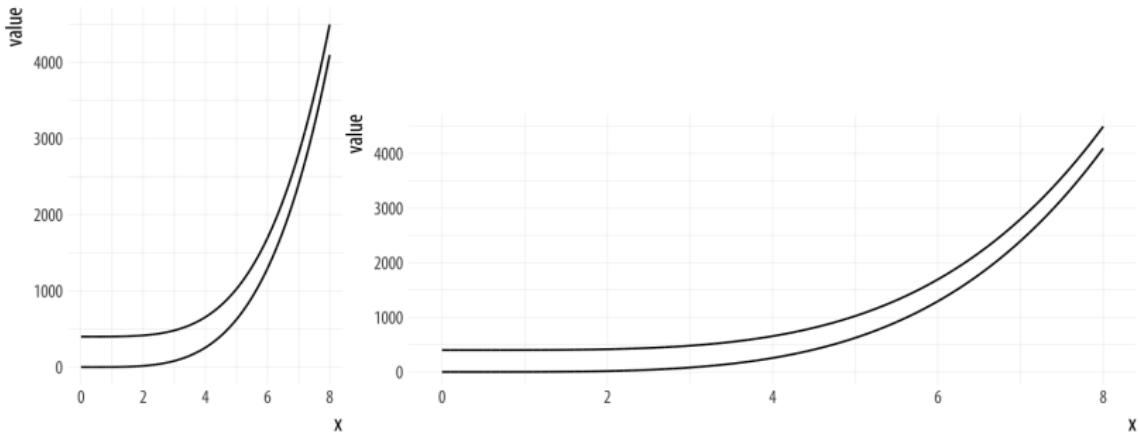
Graph by Erik Voeten, based on WVS 5

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A junk-free plot that remains hard to interpret

- ▶ The bars show the total value, with subdivisions by the relative contribution of different categories to each year's observation.
- ▶ Charts like this are common when showing the absolute contribution of various products to total sales over time, or the number of different groups of people in a changing population.



Source: An example by William S. Cleveland

- ▶ In the left-side panel, the lines appear at first glance to be converging as the value of  $x$  increases.
- ▶ The data plotted in each panel are the same, however. The apparent convergence in the left panel is just a result of the aspect ratio of the figure.

## In Short

These problems are not easily solved by the application of good taste, or by following a general rule to maximize the data-to-ink ratio, even though that is a good rule to follow. Instead, we need to know a little more about the role of perception in the interpretation of graphs.

# Variable Types in the Statistical Software

- ① int stands for integers
- ② dbl stands for doubles, or we call real numbers
- ③ chr stands for character vectors, and strings
- ④ dttm stands for date-times (a date + a time)

At the same time, there are three other common types of variables

- ① lgl stands for logical, vectors that contain only TRUE or FALSE
- ② fctr stands for factors, which R uses to represent categorical variables with fixed possible values.
- ③ date stands for dates.

# Let us go practice!