Introduction to data science & artificial intelligence (INF7100)

Arthur Charpentier

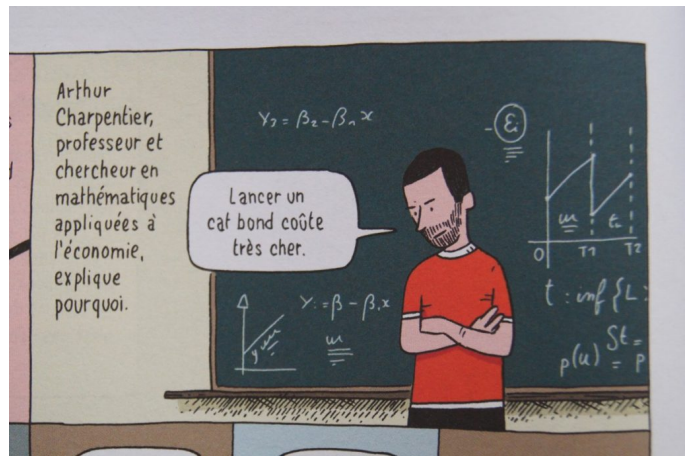
#000 Agenda

été 2020

 https://gitlab.com/inf7100

Bio

- PhD Applied Maths (KU Leuven)
- Habilitation à Diriger des Recherches
  (Université de Rennes)
- Professor (Economics Dept)
  (Université de Rennes, École Polytechnique)
- Professor (Mathematics Dept)
  (Université du Québec à Montréal)
- Director (Institute of Actuaries)
  (Data Science for Actuaries Program)
- Blog editor
  http://freakonometrics.hypotheses.org/



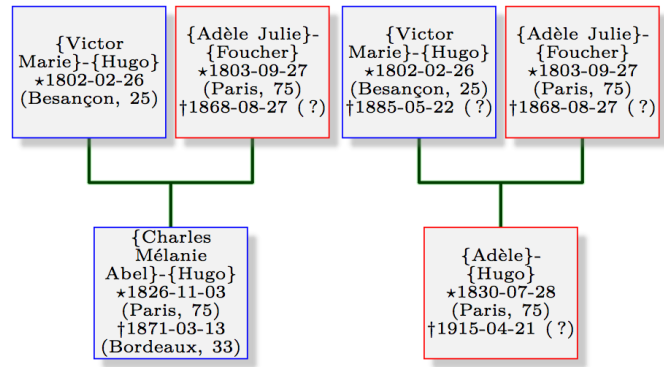
Bio

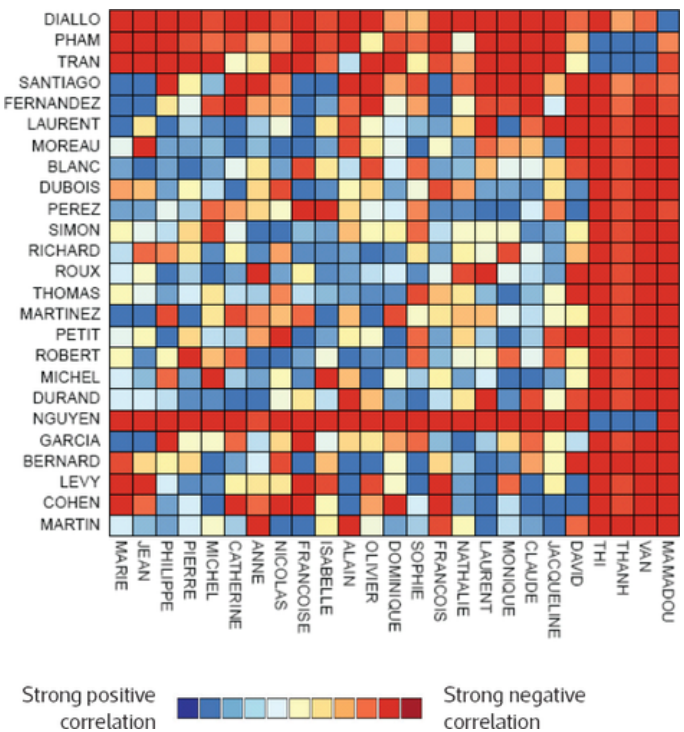
Research projects

- Machine Learning
- Reinforcement Learning
- Genealogie historique
- We are not alone!
- Tents, Tweets, and Events

Blog

- http://freakonometrics.hypotheses.org/
- Vulgarisation





Data Science

60 % des cas au Québec sont des femmes

La COVID-19 au Québec par groupes d'âge

	Cas	Morts
0-29 ans	17,9 %	0 %
30-49 ans	28 %	0,8 %
50-69 ans	24,1 %	8,3 %
70-79 ans	8,2 %	17,2 %
80-89 ans	12,7 %	40,4 %
90 ans et plus	9,1 %	33,4 %

Pour les cas confirmés et les décès dont l'âge est connu.

via 60% des cas au Québec sont des femmes , La Presse, May 2020

Garbage

Two aspects : data and model

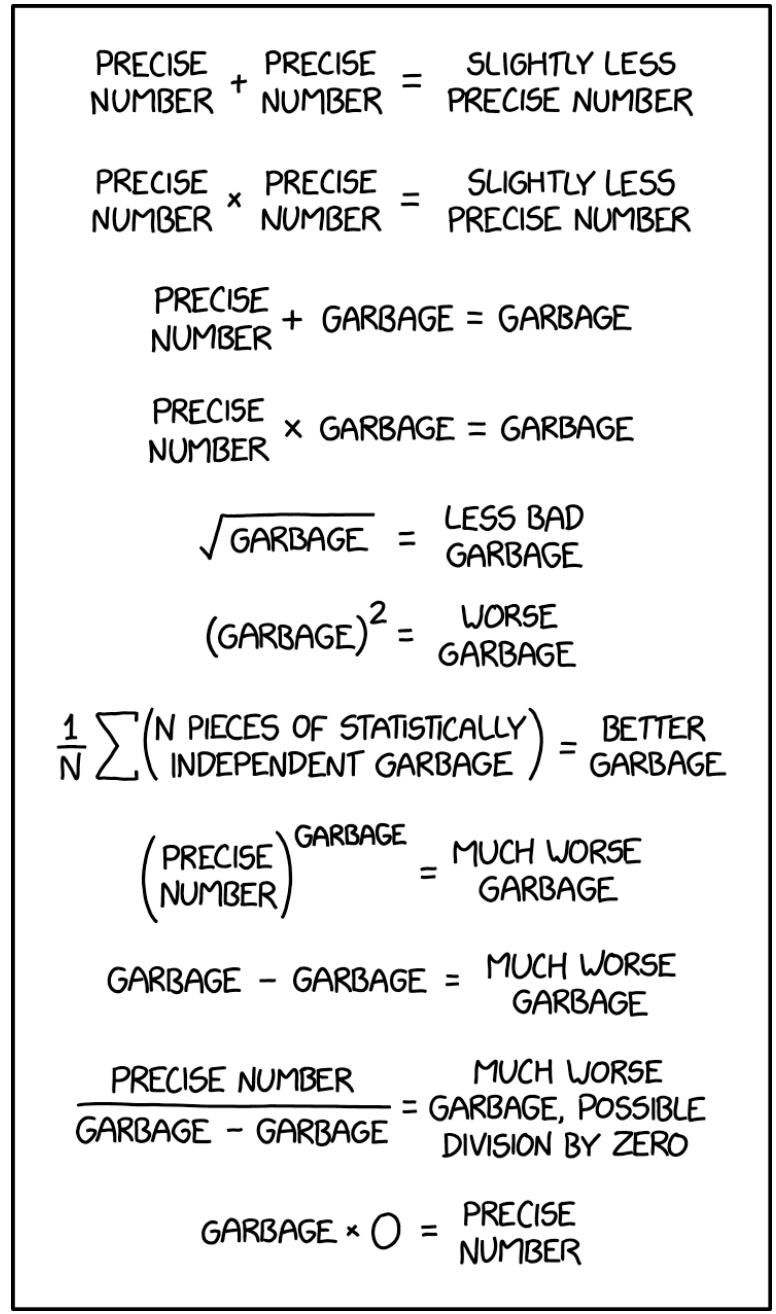
Data: "*Garbage in, garbage out*"
see Face Recognition on Flawed Data, by Clare Angelyn or xkcd

Model: machines do not understand
see Why Should I Trust You? or Recognition in Terra Incognita

(A) **Cow: 0.99**, Pasture: 0.99, Grass: 0.99, No Person: 0.98, Mammal: 0.98

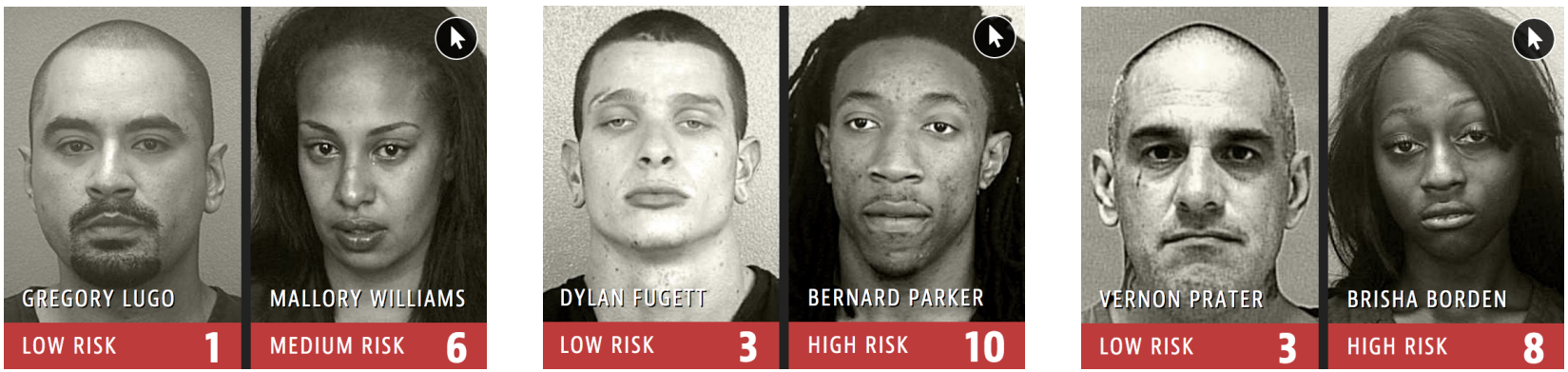
(B) No Person: 0.99, Water: 0.98, Beach: 0.97, Outdoors: 0.97, Seashore: 0.97

(C) No Person: 0.97, **Mammal: 0.96**, Water: 0.94, Beach: 0.94, Two: 0.94



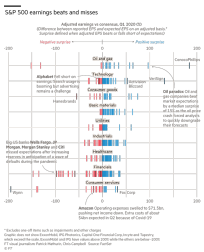
Machine Bias

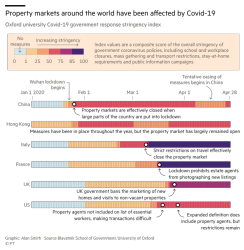
see Machine Bias (Propublica, 2016), on *Correctional Offender Management Profiling for Alternative Sanctions* (compas)

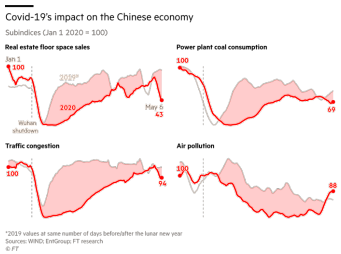


Data Science & Data Visualization

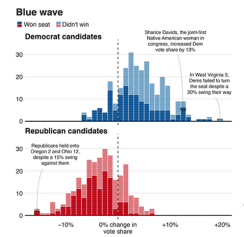
See FT.com,

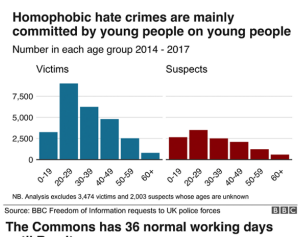


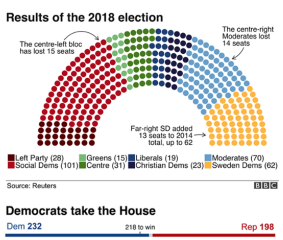


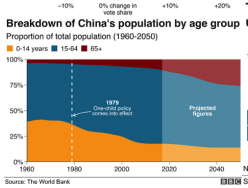


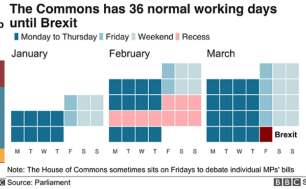
Going from raw data to some analysis, see BBC Visual

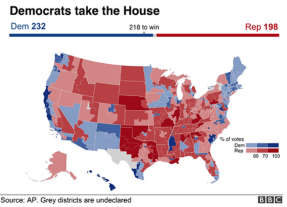


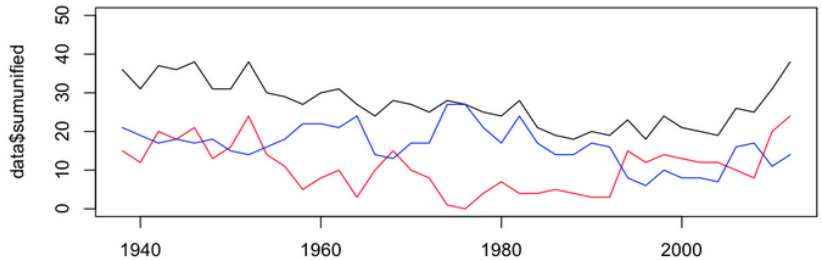


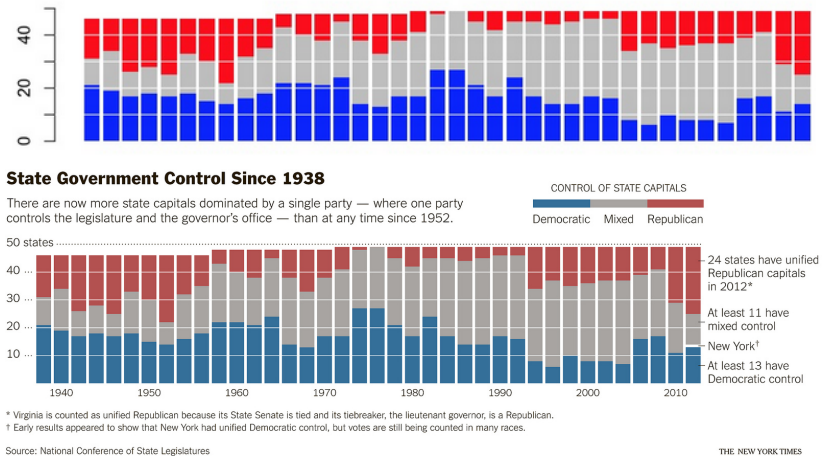








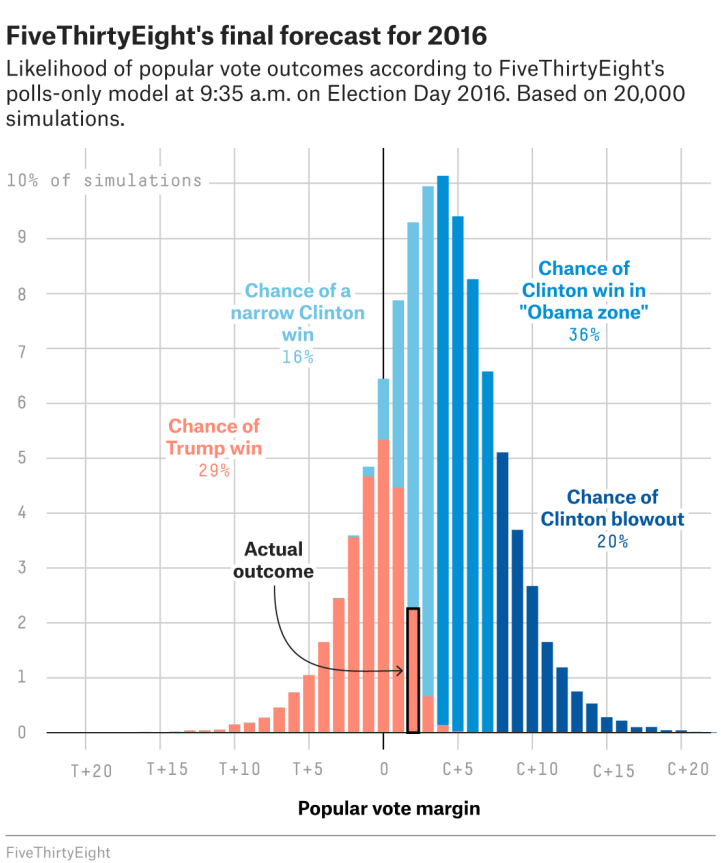


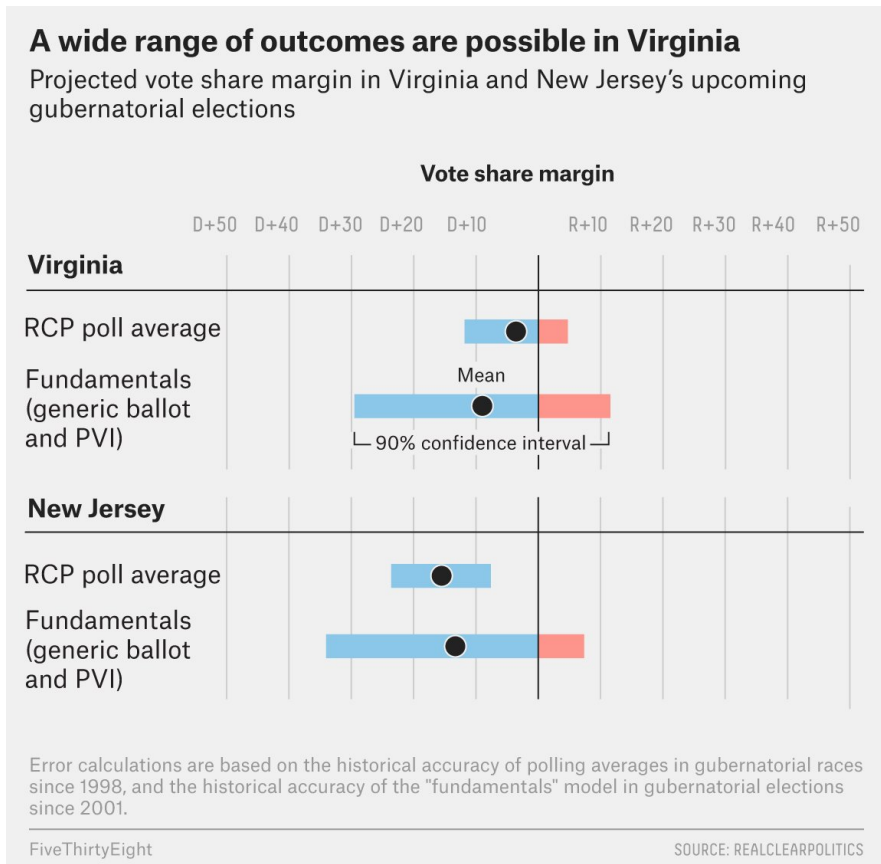


see Amanda Cox's interview, NYT Graphics Editor

Data Science

"*The media's demand for certainty – and its lack of statistical rigor – is a bad match for our complex world*" The Media Has A Probability Problem, Nate Silver (2017).





Agenda

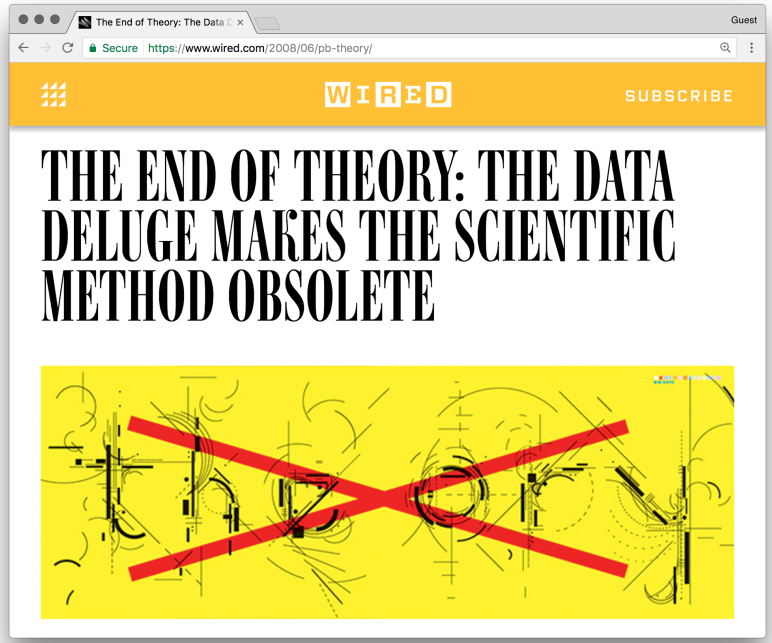
1. Observation and Experiment : on data
2. Visualization and Statistical Indicators
3. Correlation and Regression
4. Mathematics

"*'Begin at the beginning,' the King said, gravely, 'and go on until you come to an end, then stop'*" Lewis Carroll (1865, Alice's Adventures in Wonderland)

End of Theory?

Chris Anderson's The End of Theory: The Data Deluge Makes the Scientific Method Obsolete (in 2008)

(see also Fulvio Mazzocchi's few remarks on the epistemology of data-driven science)



generalization is both advantageous and disadvantageous, in that while it can make a claim less concrete and less visualizable, it can also make it more powerful and more applicable as a result
(via The Definitive Glossary of Higher Mathematical Jargon)

Mathematics? ($\neq$ calculus)

In order to better understand

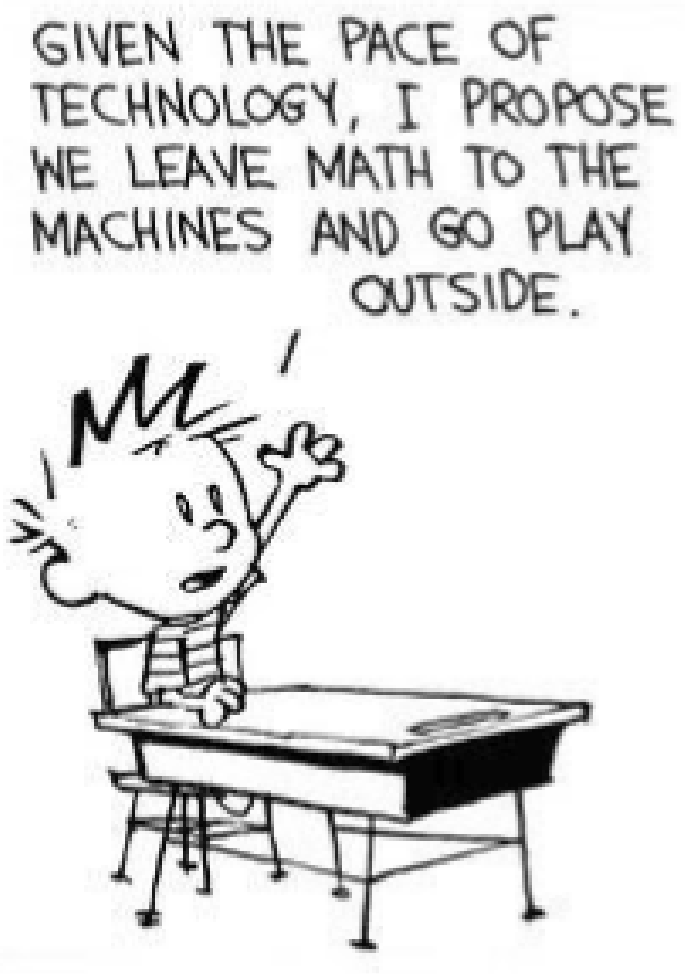
- logarithm
- derivatives, integrals
- optimisation
- vectors, matrices
- projections
- probabilities

log : multiplicative $\rightarrow$ additive

exp : additive $\rightarrow$ multiplicative

$\mathbb{E}$: average value

$\int$: sum vs. $\frac{\partial}{\partial x}$: difference



Mathematics...

There will be a few slides on mathematical aspects of data science and machine learning...

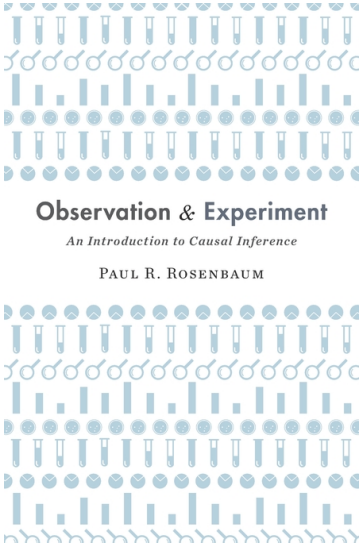
$$\text{we want } \underbrace{\text{the best model}}_{\min_{m\in\mathcal{M}}\{\text{criteria}(m)\}}, \text{ but it should } \underbrace{\text{not be too complicated}}_{\text{complexity}(m)\leq\text{bound}}$$

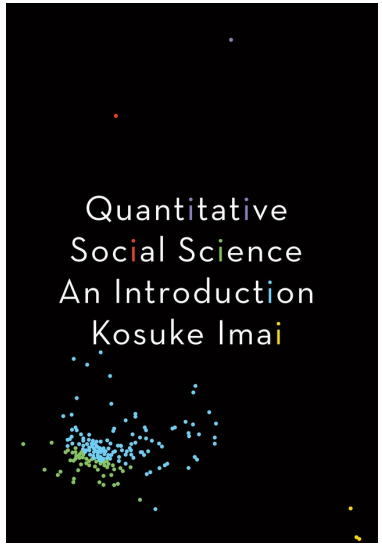
(see constrained optimization) or

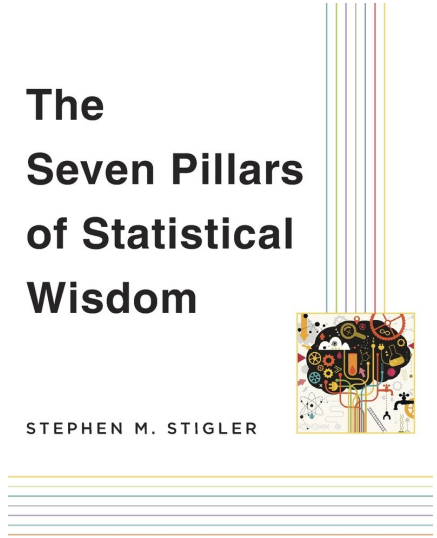
$$\text{find the best 3 clusters , } \begin{cases} \text{between each cluster, maximal heterogeneity} \\ \text{within each cluster, minimal heterogeneity} \end{cases}$$

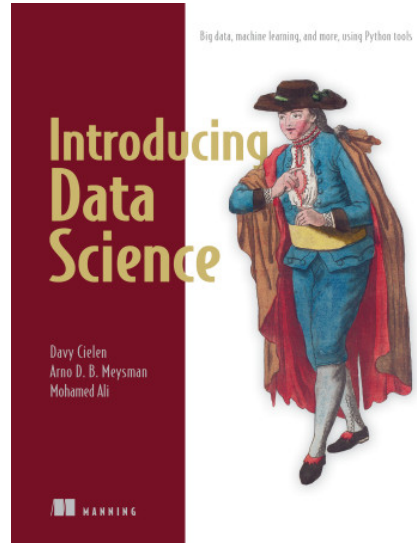
or log scales and areas in data-visualisation...
Word vectorization, datasets as matrices, pictures as tensors, etc.

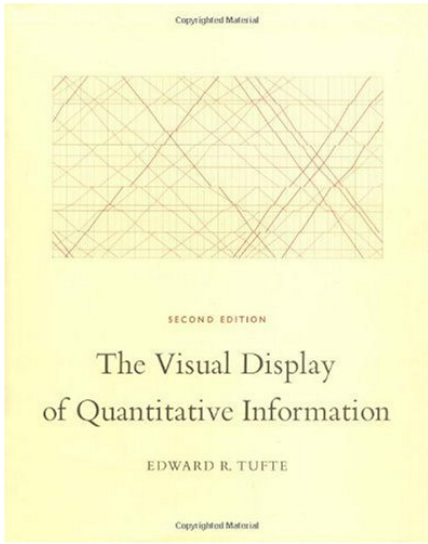
References

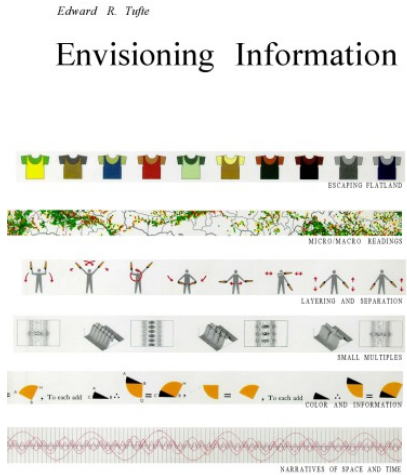


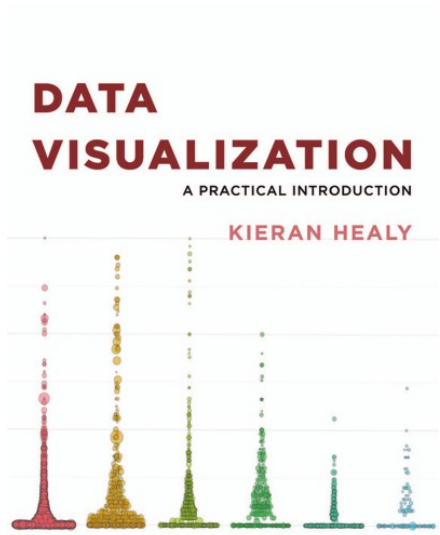


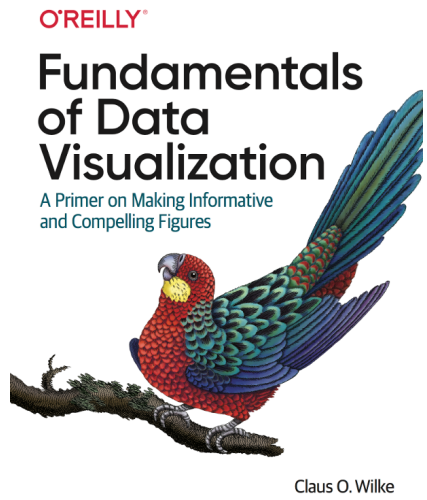












See Fundamentals of Data Visualization (on R)