Introduction into Biostatistics

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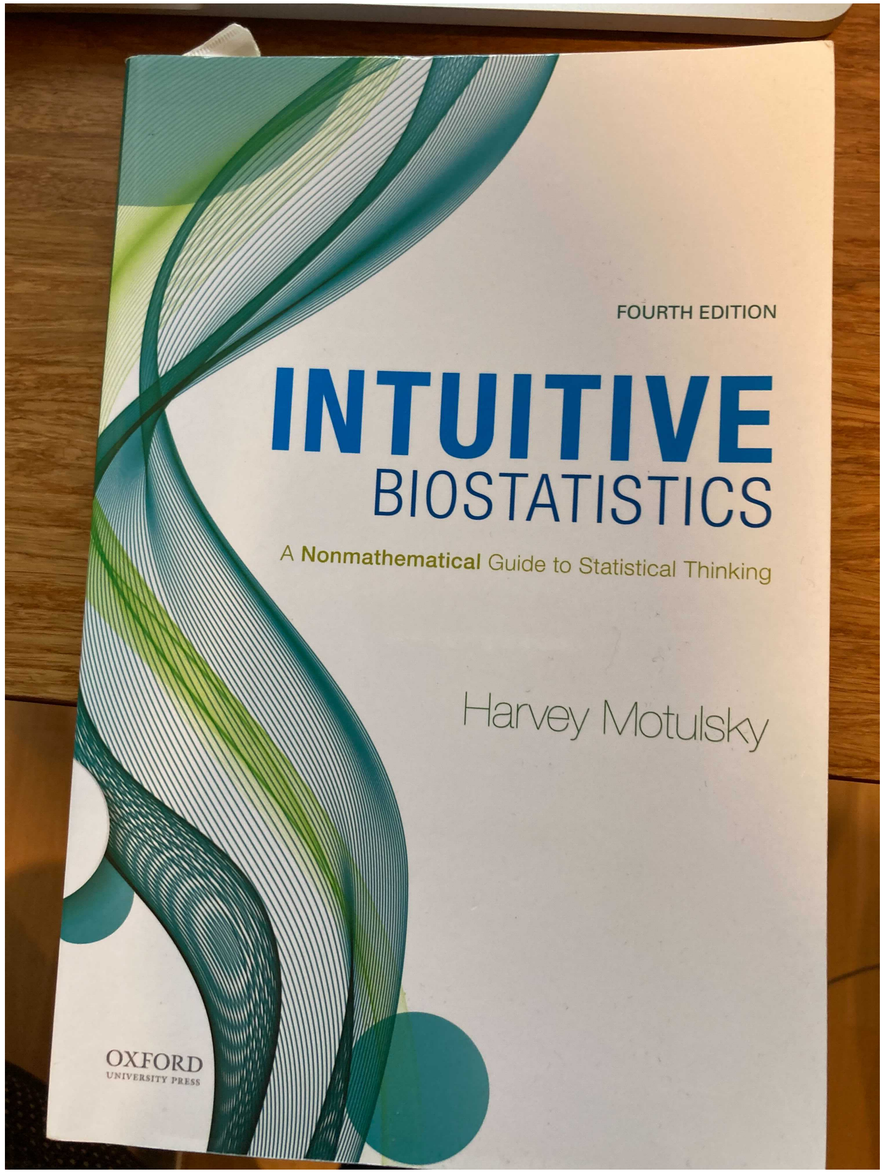
Organisation

- **9.5. Introduction to biostatistics**
- **16.5. Descriptive statistics**
- **23.5. Hypothesis testing**
- 6.6. Introduction machine learning (Robert)
- 13.6. Unsupervised Machine learning (Melissa)
- 20.6. Supervised machine learning/ deep learning (Melissa)
- 21.6. Introduction into genomics data
- 4.7. Multimodal machine learning
- 11.7. Summary (all)

Sources



& “the internet”

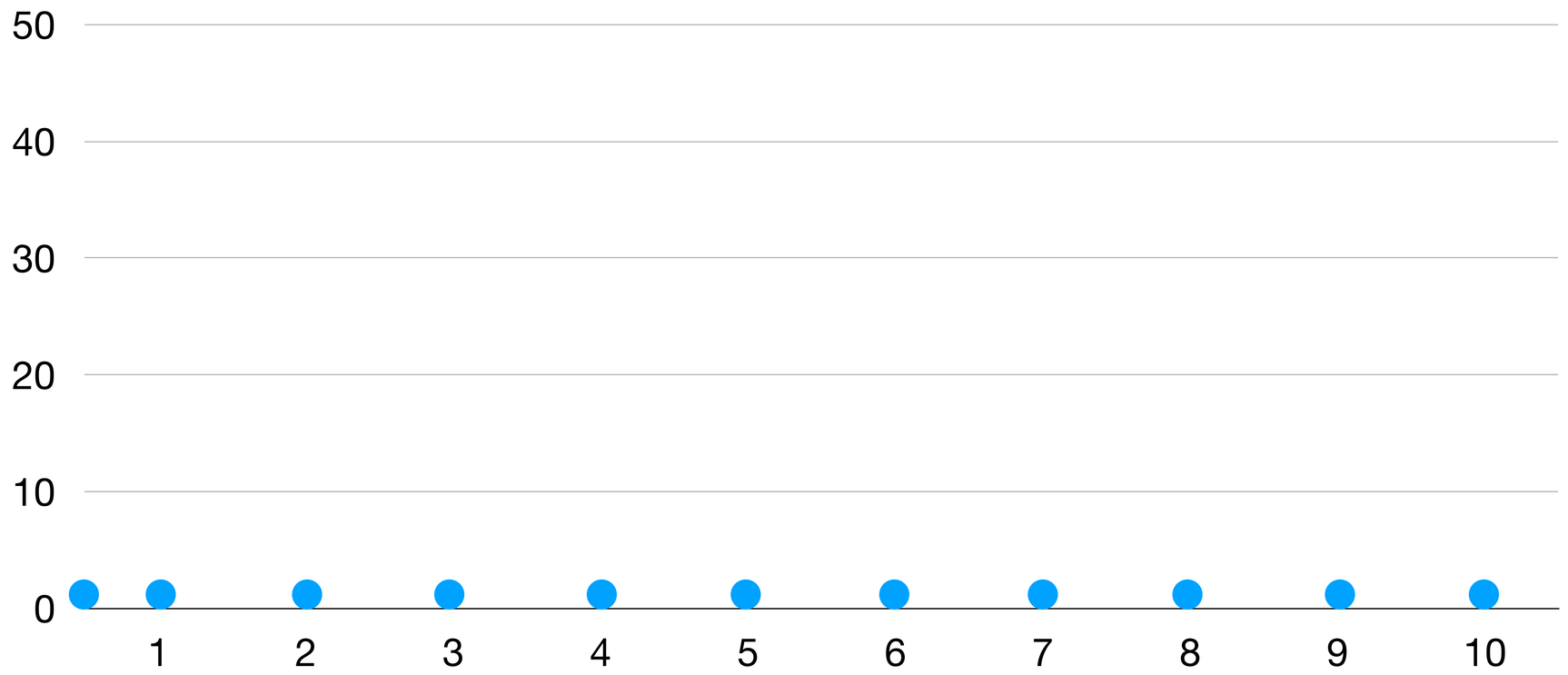
Introduction

- Intuition and bias
- Accuracy and precision
- Probability
- Confidence

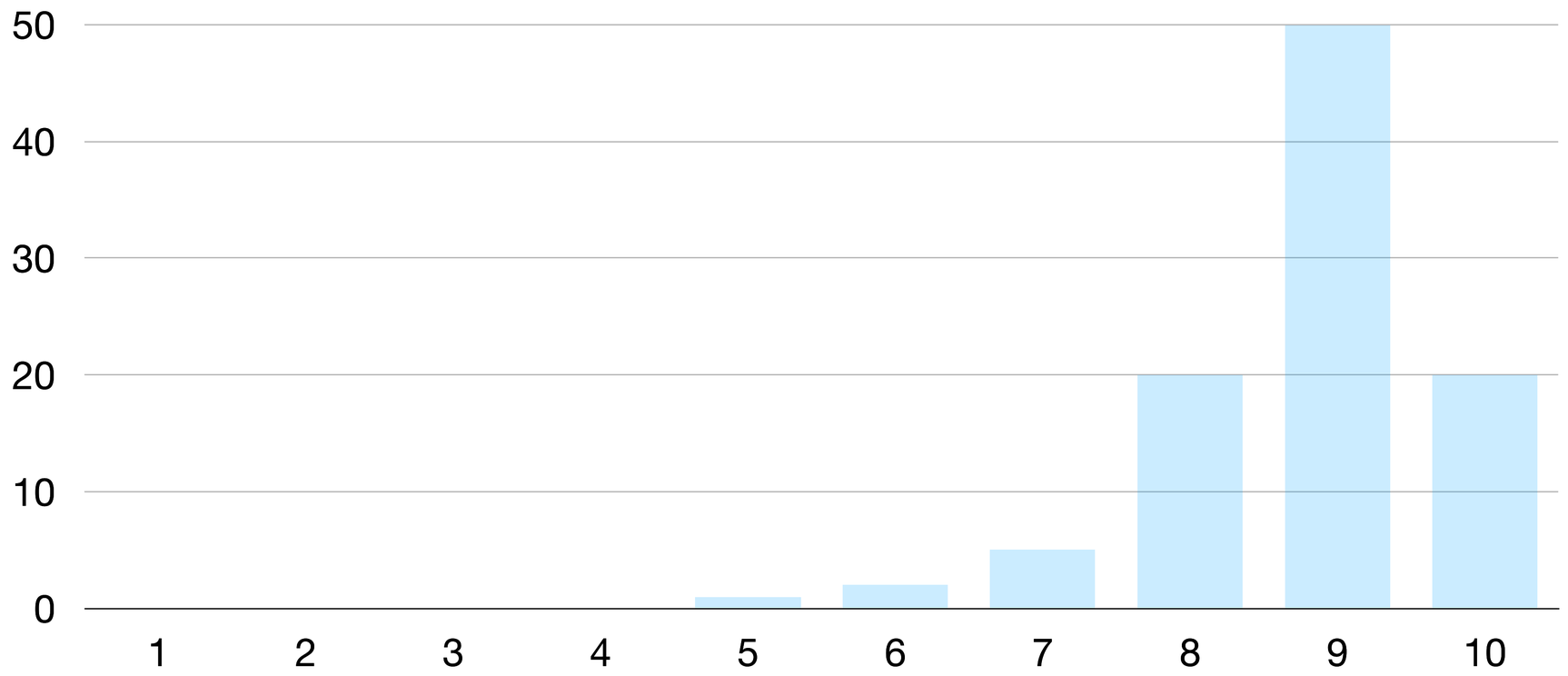
Quiz

Quiz

Stats



Expected Stats



We tend to fool ourselves!

- We tend to be overconfident

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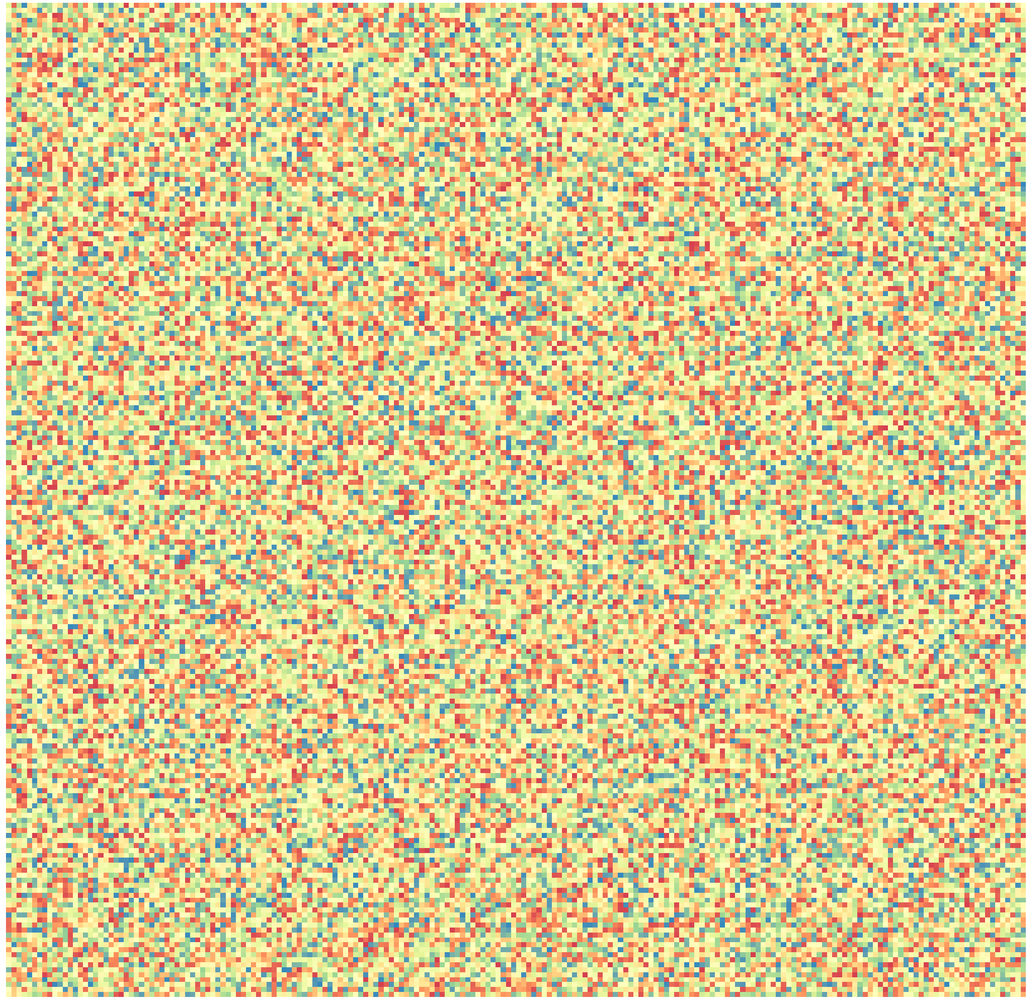
- We see patterns in random data



- We tend to be overconfident
- We tend to jump to conclusions
- We see patterns in random data
- We don’t realise that coincidences are common

Enzo Ferrari

Died in 1988

Mesut Özil

Born in 1988

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Small countries and COVID19 incidence

Tanzania	8.52
Micronesia (country)	8.69
Vanuatu	13.02
Samoa	15.12
Kiribati	16.74
Solomon Islands	29.12

Cumulative incidence/ 1M inhabitants
https://ourworldindata.org; 31.05.2021

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Andorra	177,221.25
Montenegro	158,591.03
Czechia	155,118.29
San Marino	149,949.91
Bahrain	139,961.44
Slovenia	122,000.62

The extremes are likely linked to small sample sizes!

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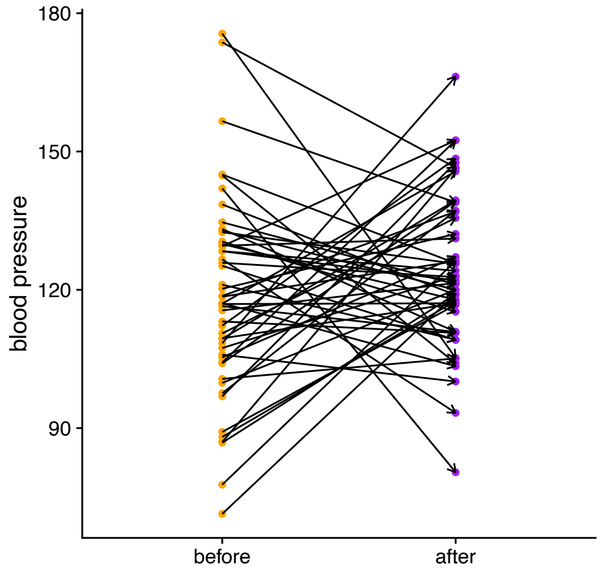
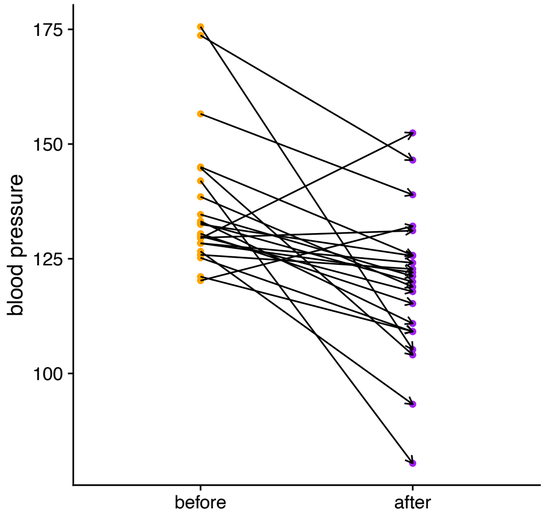
- We intuitively follow logic that is in fact dictated by regression to the mean

Regression to the mean

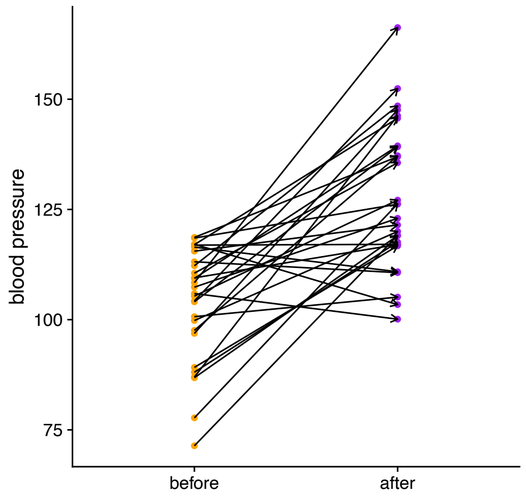


Using a drug to
lower blood pressure

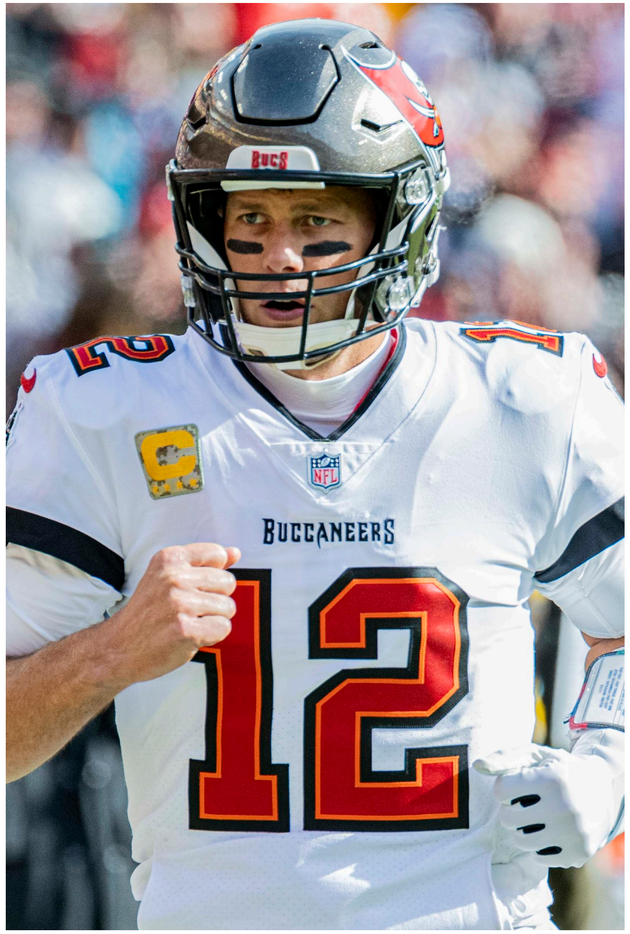
Patient selection for
high blood pressure



The rest



Regression to the mean or:
The curse of being on the cover



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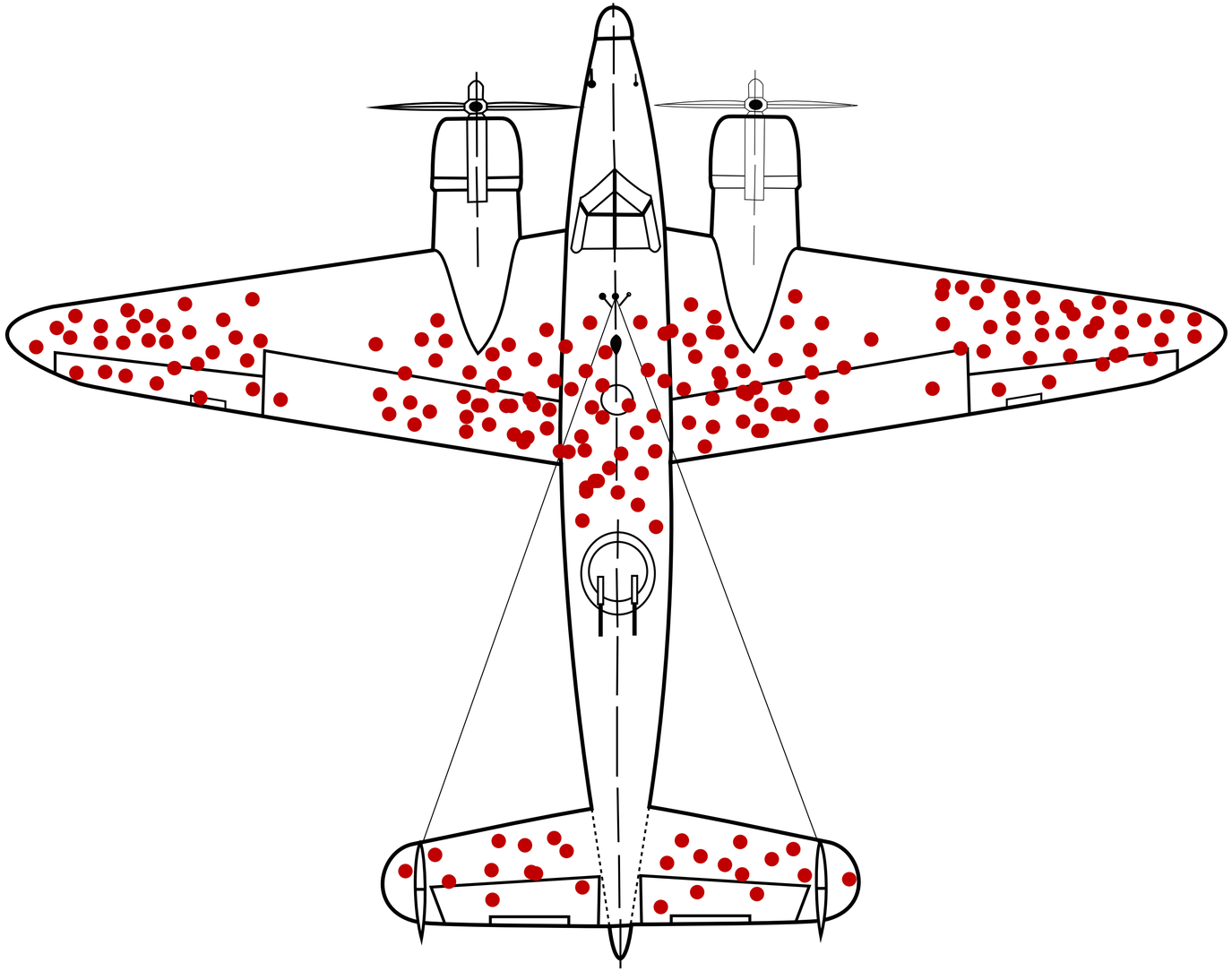
- We are biased

Representation bias

Survivorship bias



By Martin Grandjean (vector), McGeddon (picture), Cameron Moll (concept) - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=102017718

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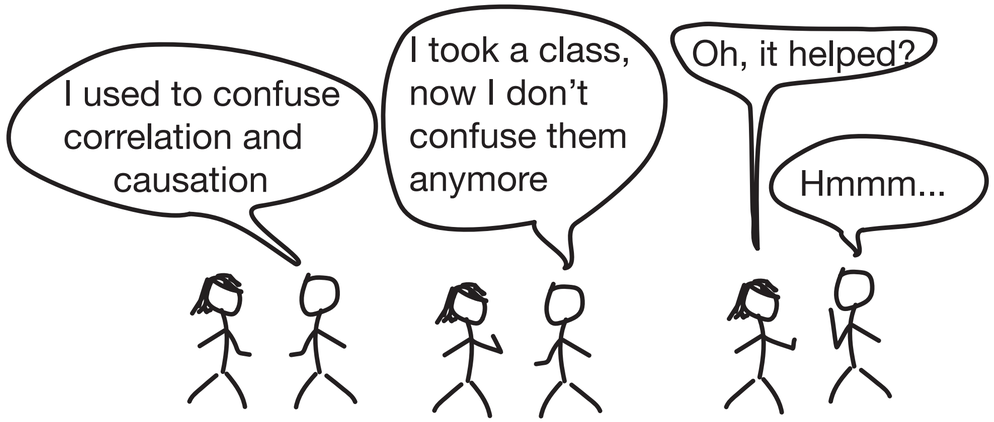
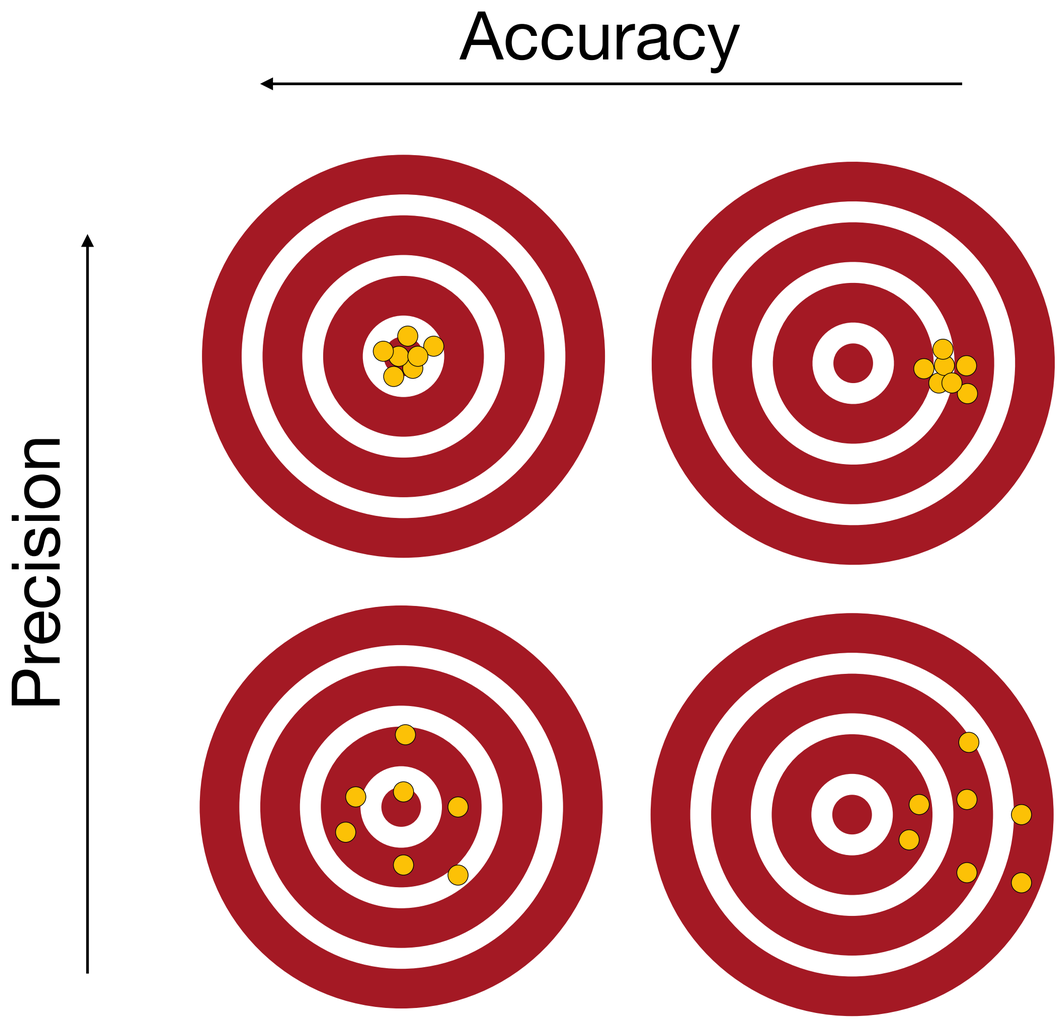
- We confuse correlation with causation



Accuracy and precision



“Accuracy” is the ability to hit a target, “Precision” is the ability to achieve the same results over and over.

You can be accurate without being precise and precise without being accurate.

We crave easy explanations,

follow intuitions,

and aim for certainty.

Statistics offers probabilities!

Probability

Probabilities range from 0 to 1

They are displayed as proportions or in %

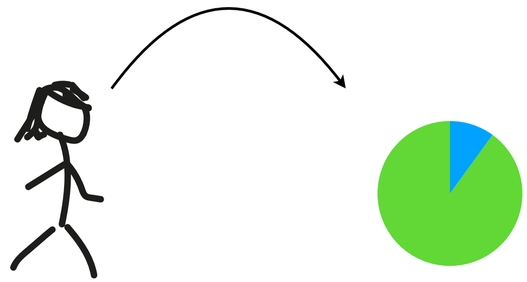
“Used to quantify a prediction on future events,

describe past events,

or the certainty of a belief. “

Views on probability

A model



Views on probability

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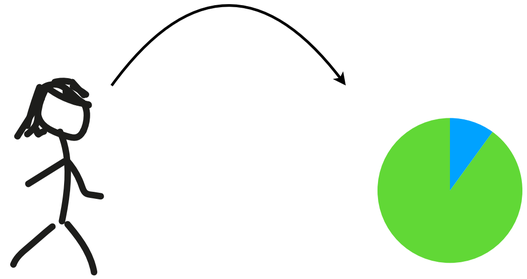
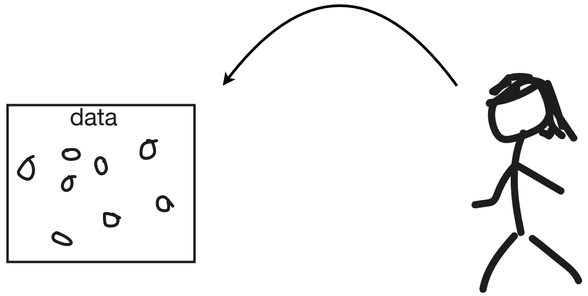


Data



Views on probability

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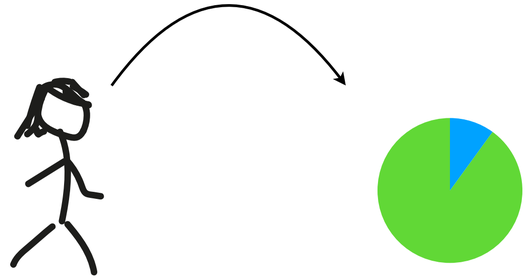
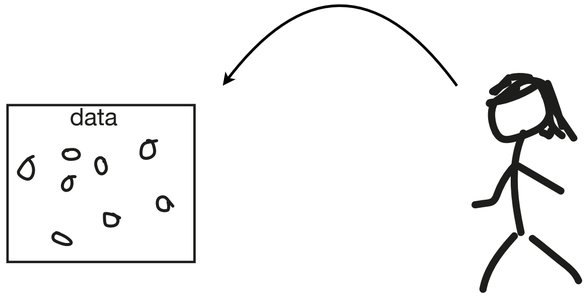
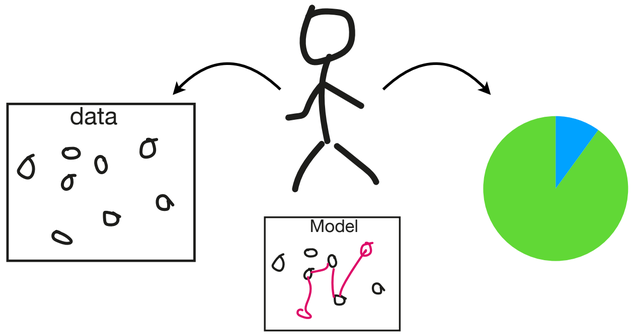
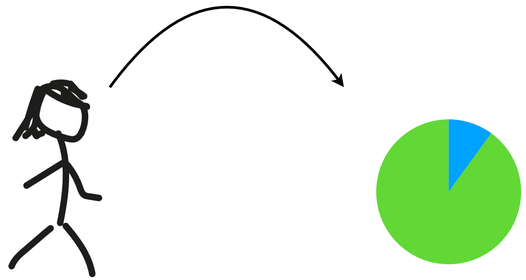


Data

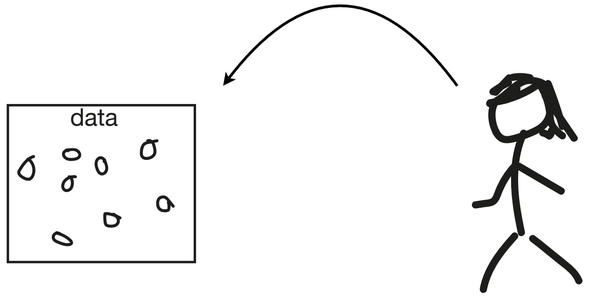


A model based on data

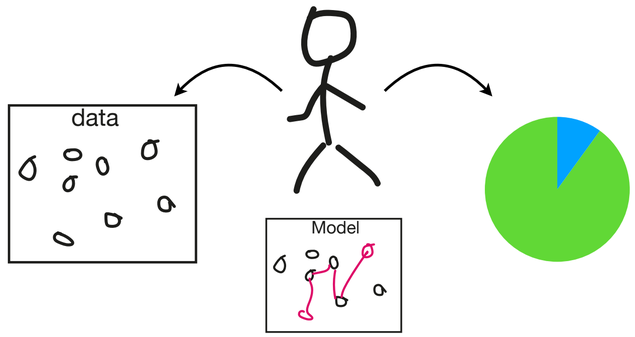




probability of male baby = 50%



probability of male baby (in 2011) = 51.7%



probability of male baby = it depends

Be aware of assumptions!

We are assuming that:

- there is only one baby
- gender is binary
- there are no differences between countries and ethnic groups
- sex ratios are equal over time and seasons
- there are no sex-selective abortions or miscarriages

Be aware of reversing probabilities!

Most COVID19 patients have a cough, it is still unlikely that someone who coughs in a tram will have COVID19

If you find that statistics books are boring, it does not mean that every boring book is about statistics

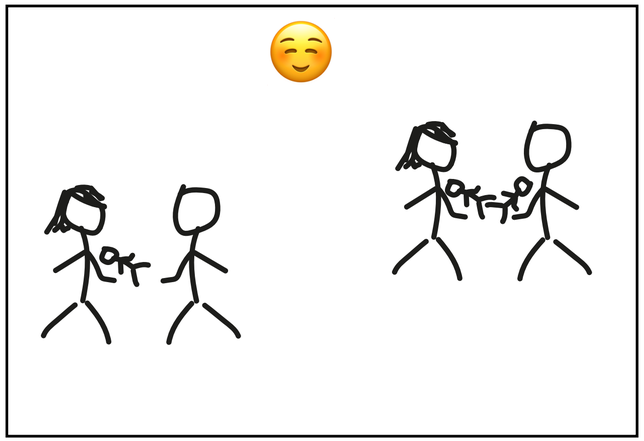
When you find a good cancer drug, you can kill your cell culture with it.
If your cells die, you might want to think for a moment before you ring Stockholm.

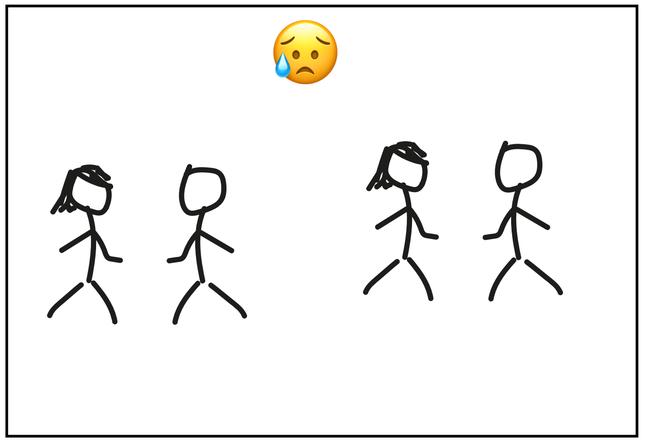
Don’t assume probability has a memory

Clearly define the numerator and denominator

Example: Success rate in in-vitro-fertilisation clinic

Do we count the babies or the mothers?





4 trials

3 babies:

2 successful attempts:

What is the success rate?

Summary

- Statistics is not always intuitive
- Multiple testing
- Regression to the mean
- Bias
- Accuracy
- Precision
- Probability
- Confidence

Confidence

-> Jupyter notebook