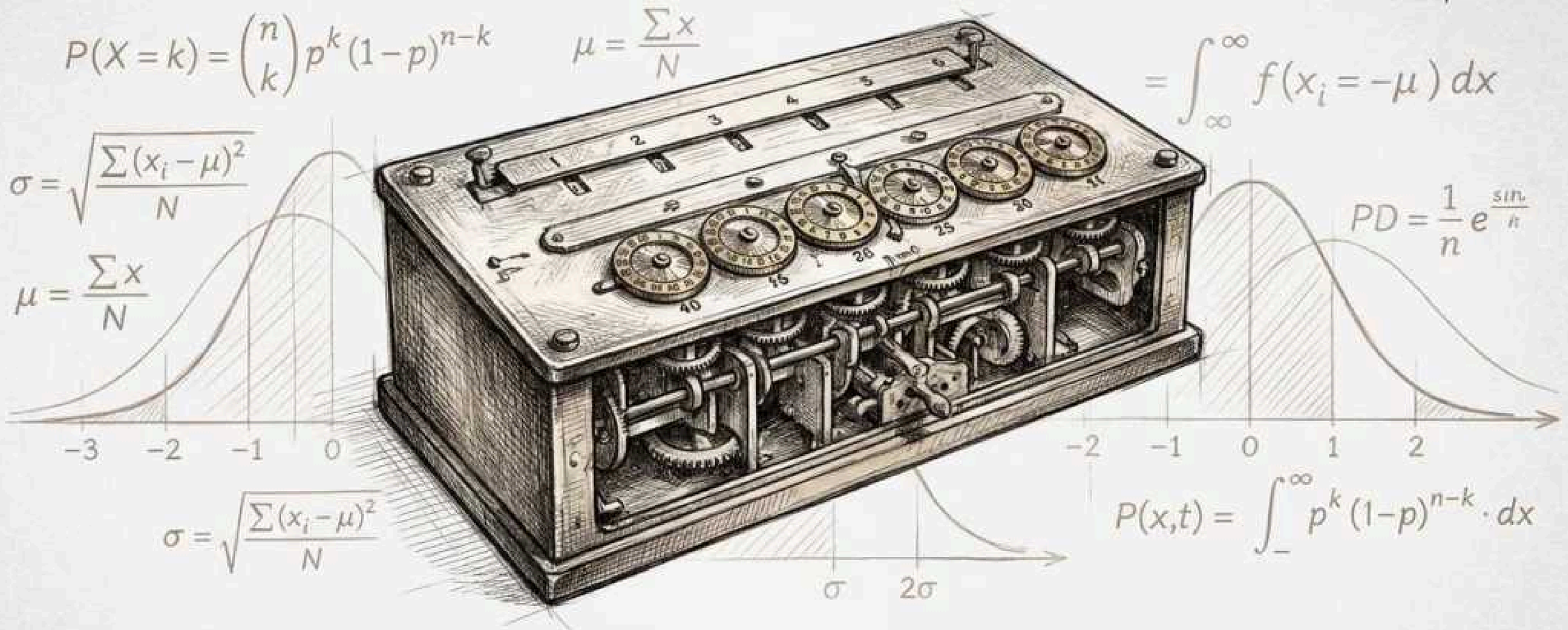
¶ 5.1



Numbers, Chance, and Statistics

PHIL 110 B – Lecture 5

¶ 5.2

We are poor at thinking about chance.

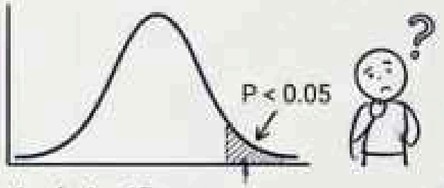
Cognitive pitfalls in probabilistic reasoning.

Base Rates



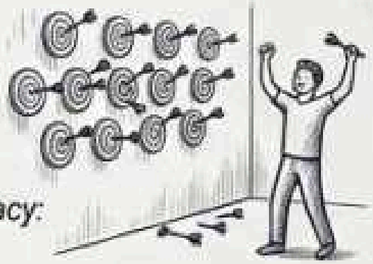
Ignoring the general population frequency.

P-Values



Misinterpreting statistical significance as practical importance.

Multiple Comparisons



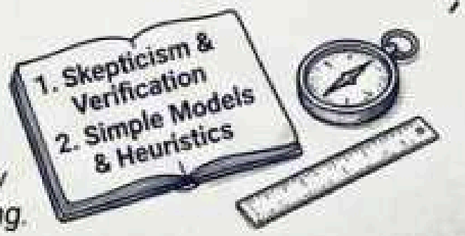
The "Texas Sharpshooter" fallacy: finding patterns by chance.

Data Biases



Selection bias, survivorship bias, and confirmation bias.

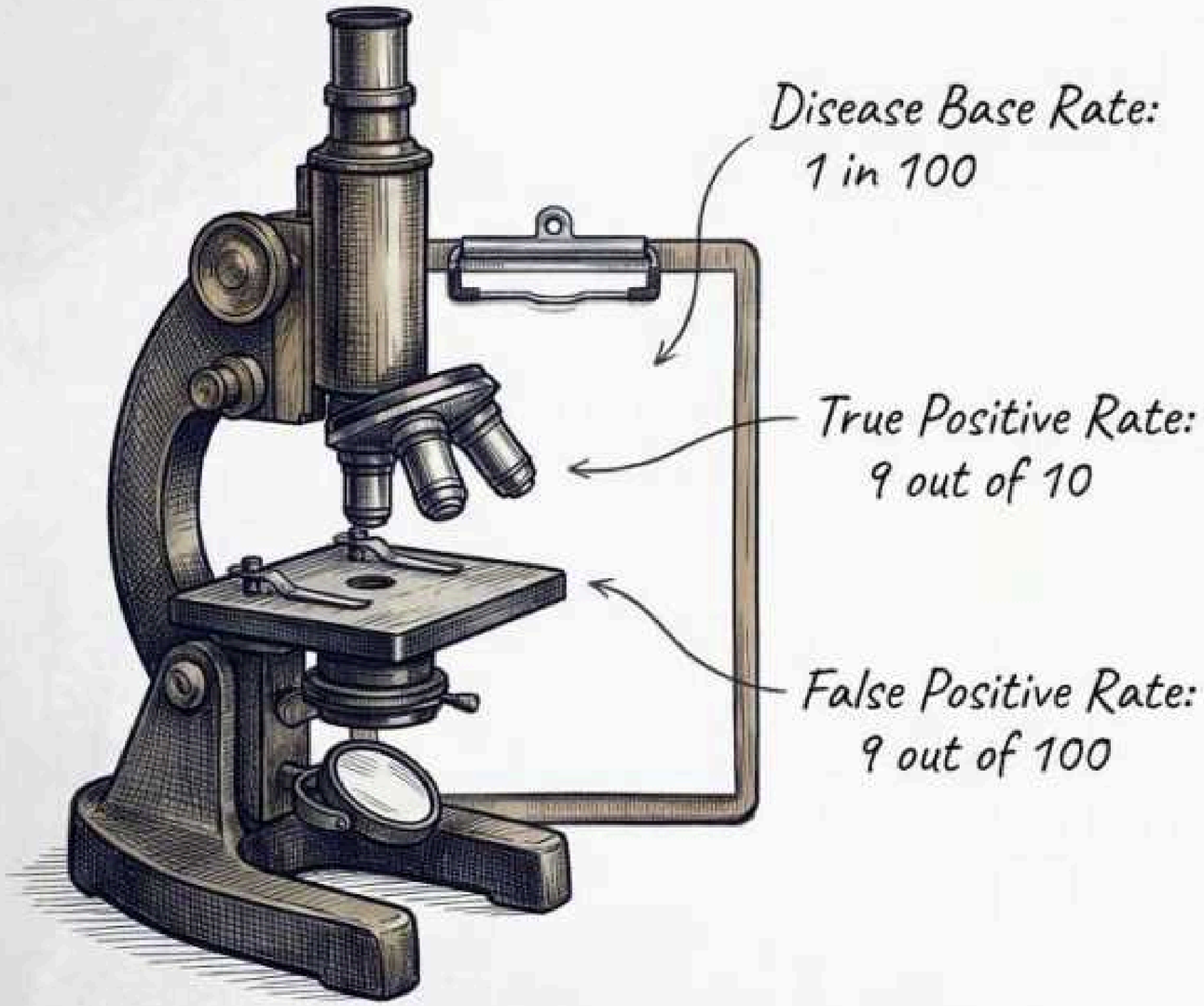
Practical Rules



Navigating uncertainty with structured thinking.

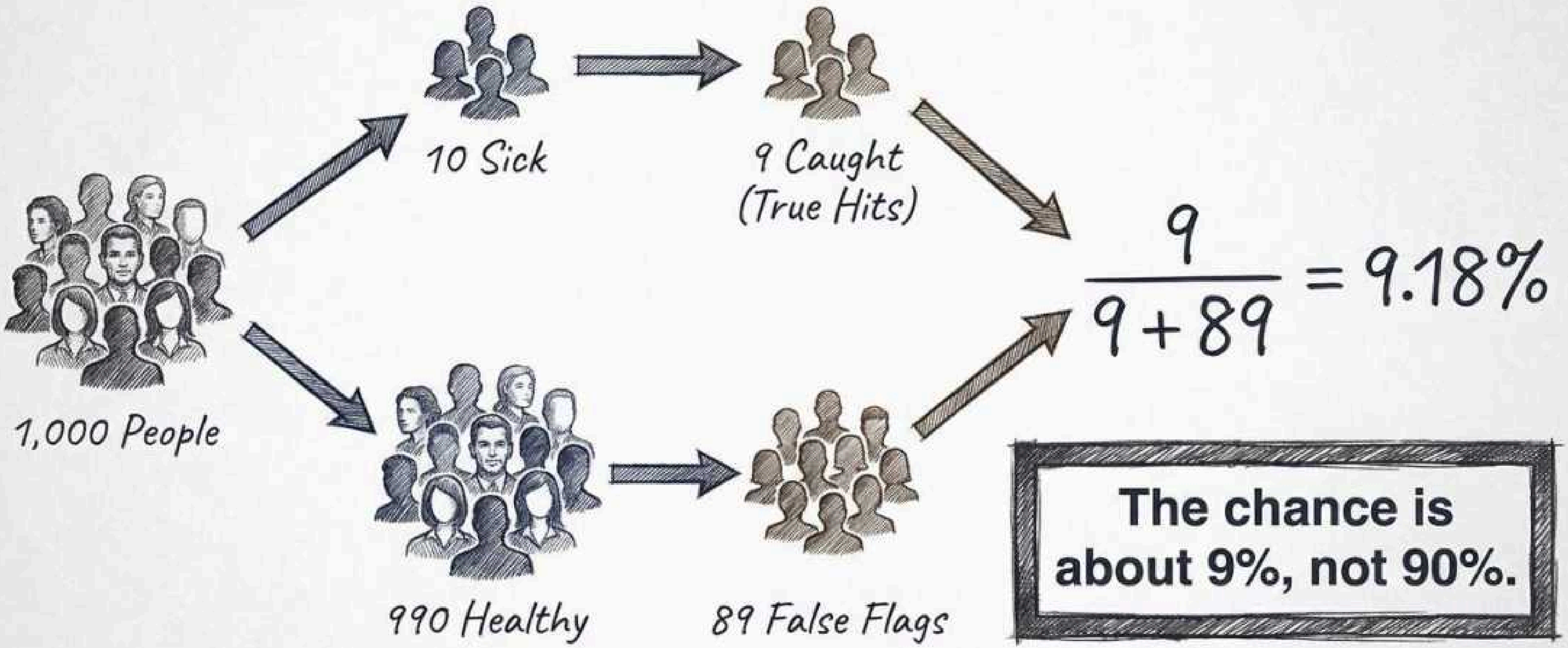
The Medical Test Dilemma

¶ 5.3



You test positive. What is the chance you are actually sick?

Intuition says 90%...


10 Sick
9 Caught
(True Hits)
1,000 People
990 Healthy
89 False Flags
$\frac{9}{9+89} = 9.18\%$
The chance is
about 9%, not 90%.

The Base Rate Fallacy

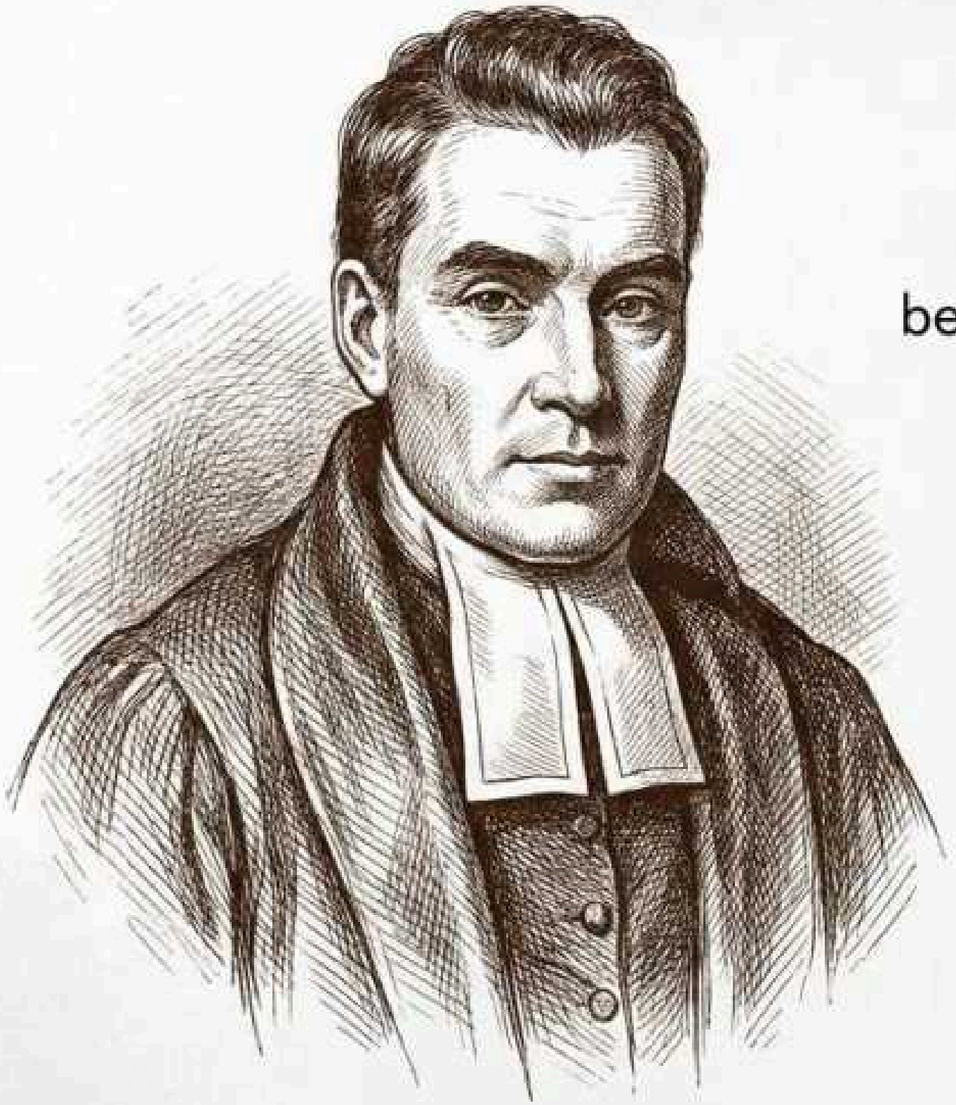
¶ 5.5



The starting frequency of a condition is its base rate. ↖ architectural handwiting

When a condition is rare, false alarms from the majority easily swamp the true hits from the minority.

¶ 5.6



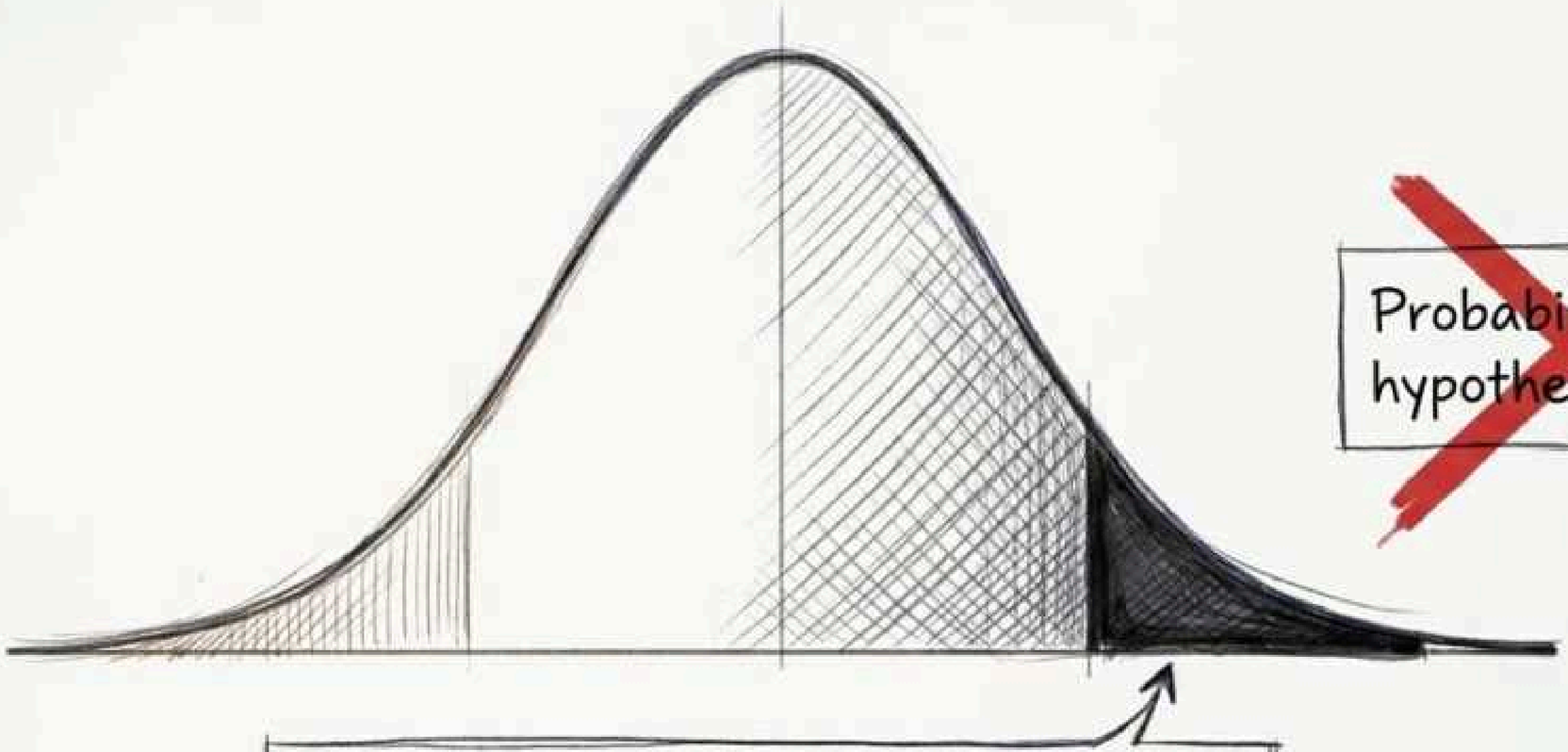


$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

A strong test cannot rescue a very unlikely conclusion on its own.

The Meaning of Statistical Significance

¶ 5.7

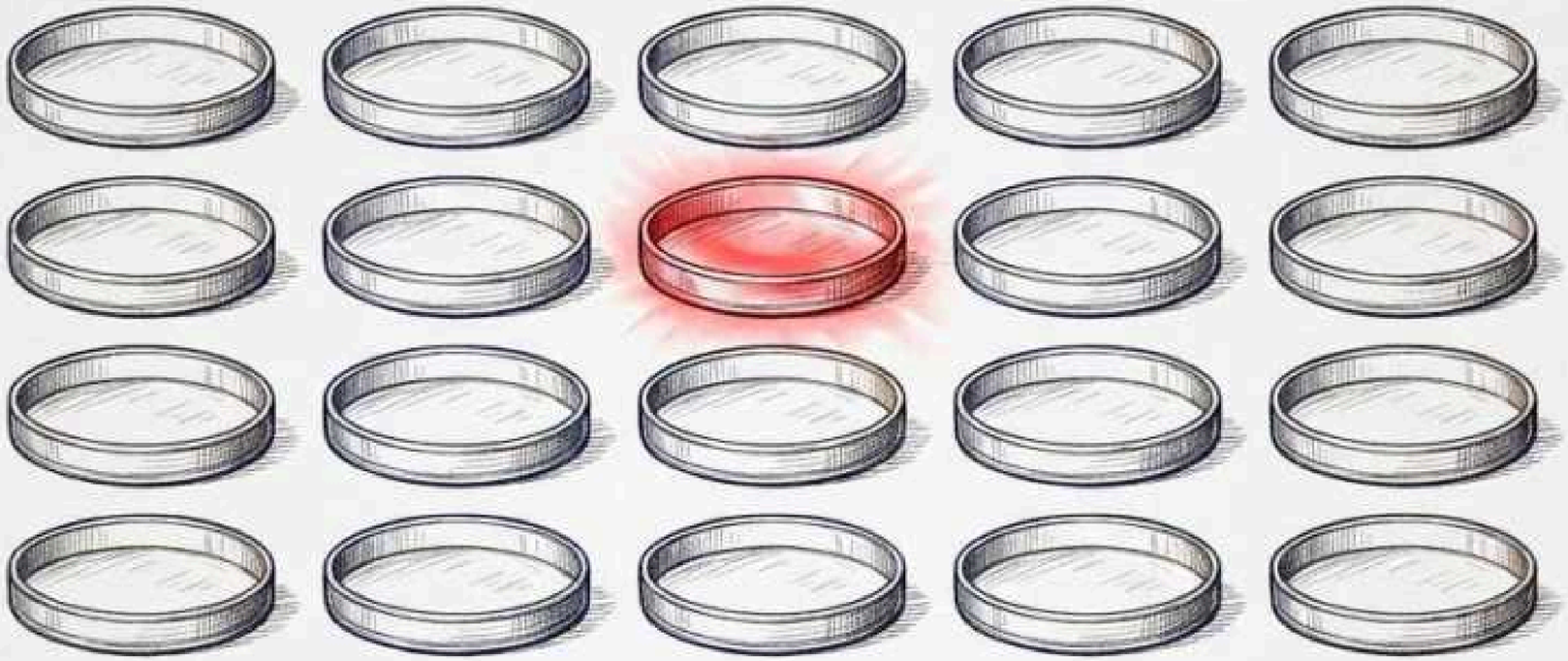


~~Probability the hypothesis is true.~~

If nothing were really going on, how often would we see results at least this extreme by chance? (< 5%)

The Trap of Multiple Comparisons

¶ 5.8

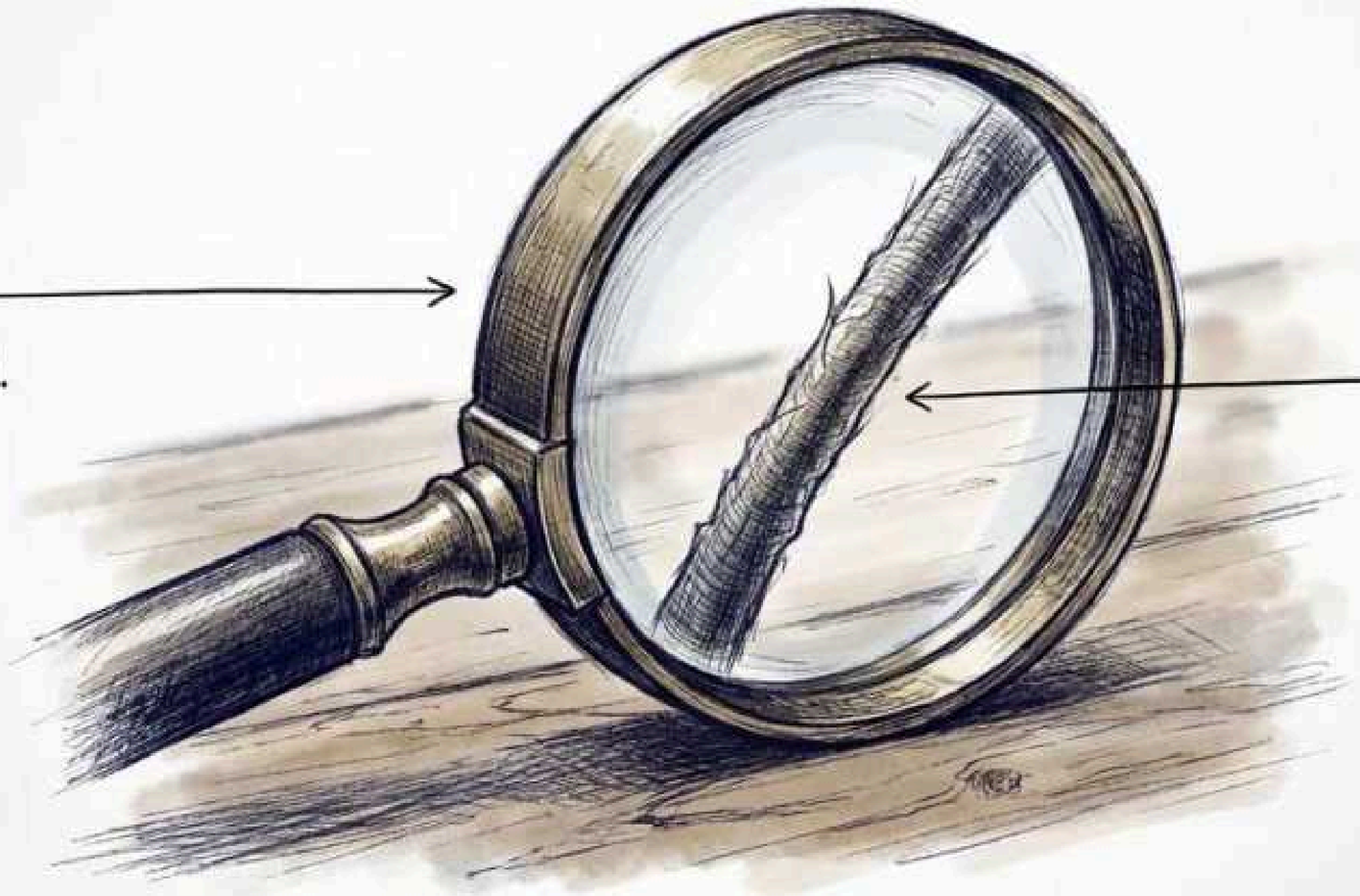


Test 20 unrelated things at the 5% level.

$$1 - (0.95)^{20} \approx 64\%$$

Even if nothing is happening, there is a 64% chance at least one result looks significant. Test enough ideas, and something will always seem to work.

Significance:
Statistically Solid.
The lens works.

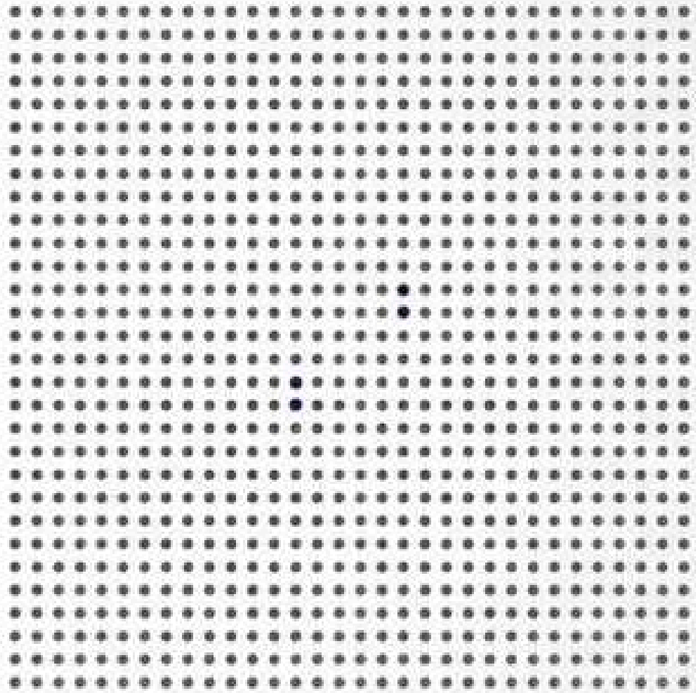


Importance:
Useless in Practice.
The effect is microscopic.

Always ask how big the effect is, not just just whether it is real. (Effect Size)



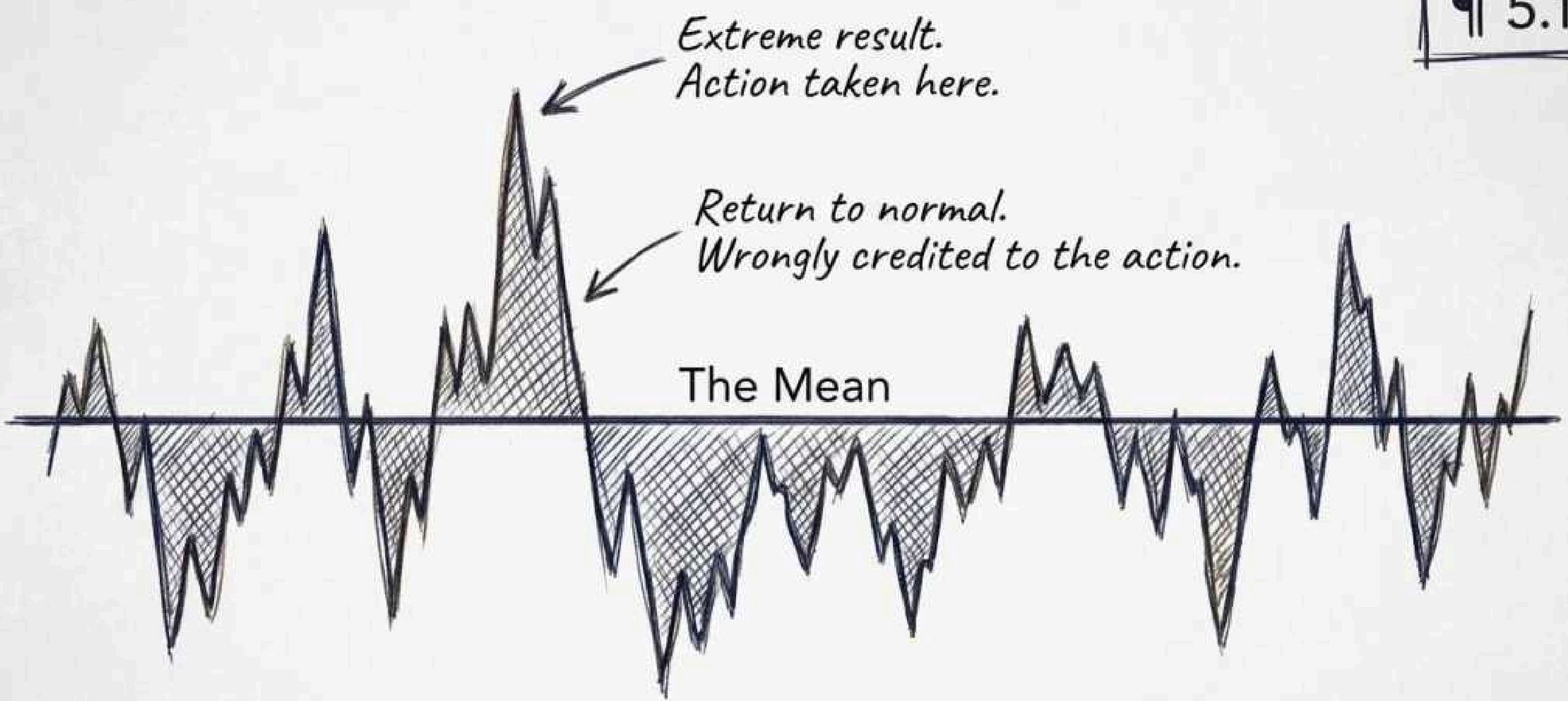
Double the risk of a
1 in 10,000 illness...



...is just one extra case
in ten thousand people.

Always ask for the absolute numbers.

¶ 5.11

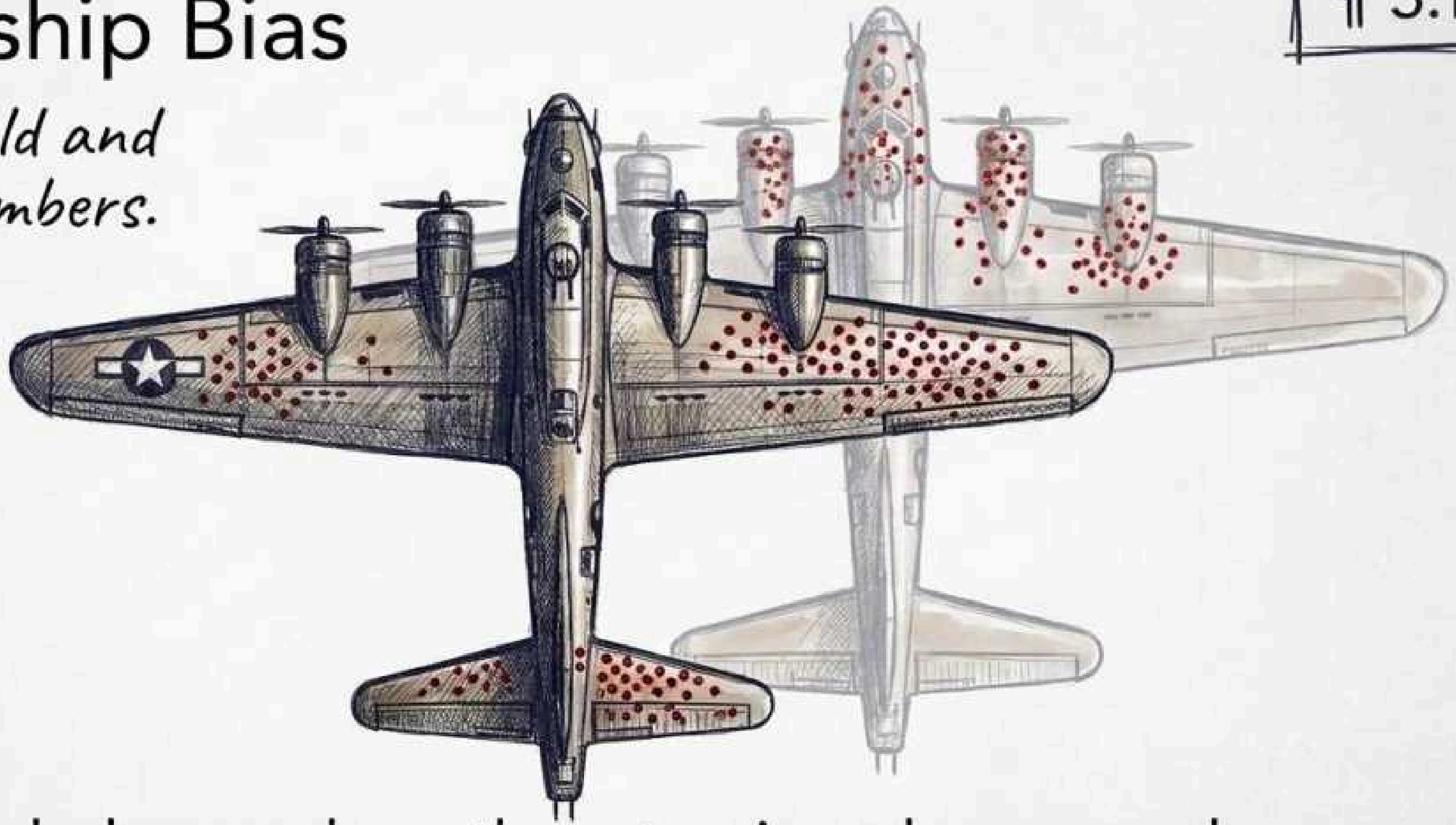


Extreme results are partly luck, and tend to be followed by more ordinary ones.

¶ 5.12

Survivorship Bias

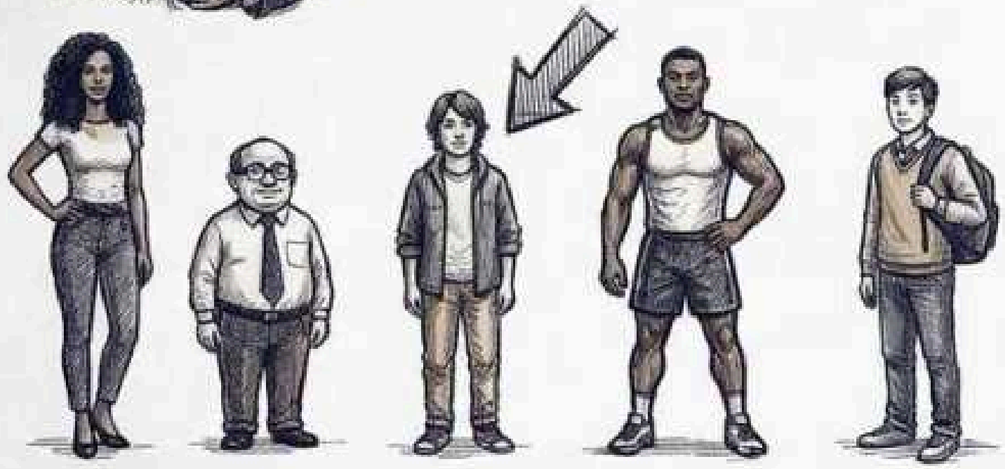
Abraham Wald and the WWII Bombers.



Armour belongs where the returning planes are clean.
We hear from the winners and forget the vanished.



Mean:
Adds everything and divides.
Extremes warp the picture.



Median: The middle value.
Resists extremes.

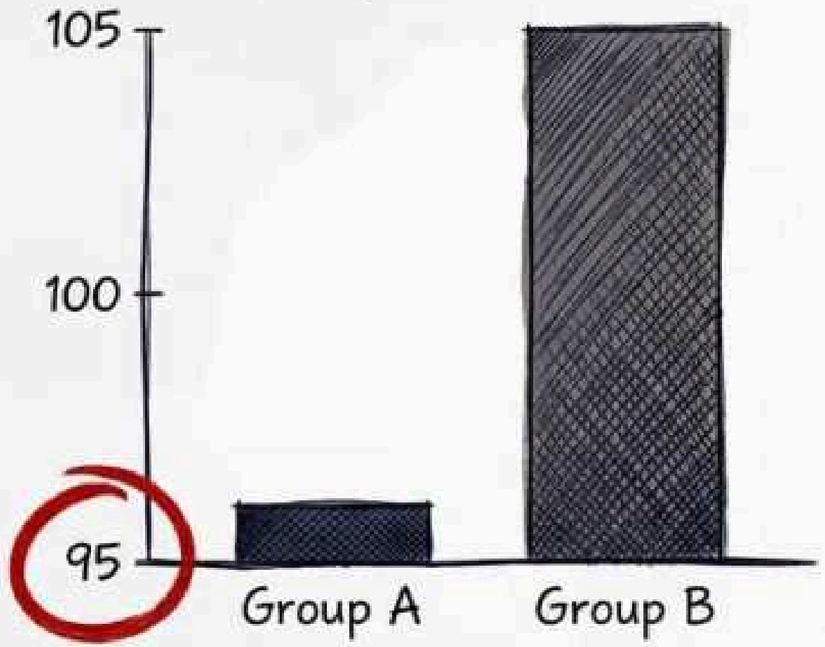


Spread: Same average,
vastly different realities.

Misleading Graphs

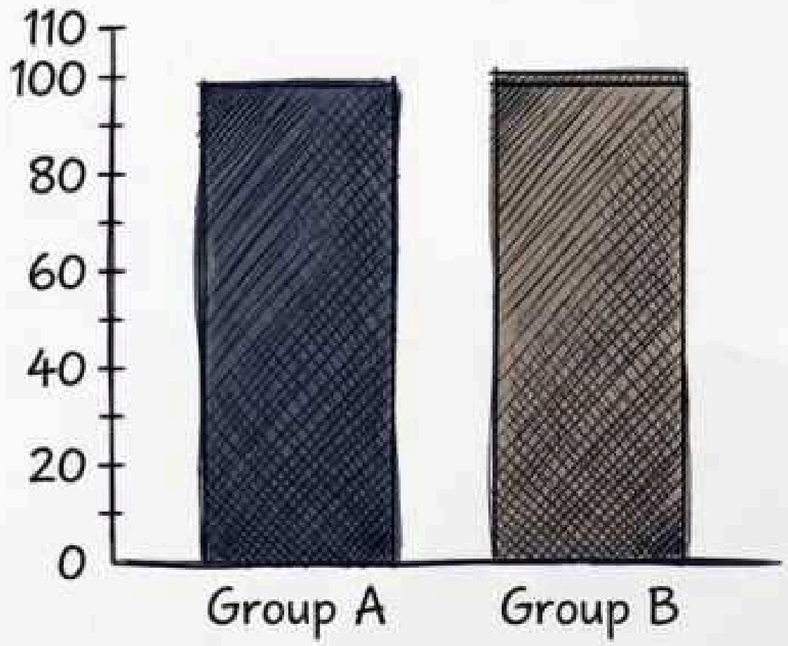
¶ 5.14

Manipulated Axis



A small gap looks huge when the axis is cut.

Truthful Axis



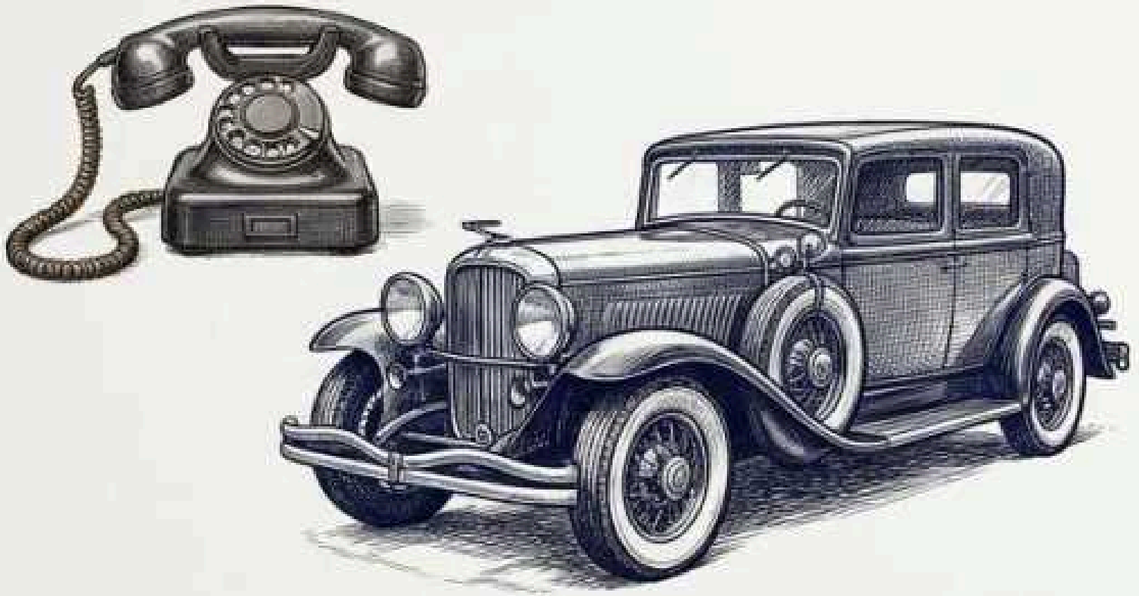
The truth when anchored to zero.

Check the axes and the time span before trusting the picture.

The Masterclass Sketchbook

¶ 5.15

1936 Literary Digest predicted Alf Landon would win by polling millions of car and phone owners.



Roosevelt won with 61%.



A big biased sample is still biased.
Who was asked matters as much as how many.

Practical Rules for Data Consumers

¶ 5.16



Rare Events and Coincidences

¶ 5.17

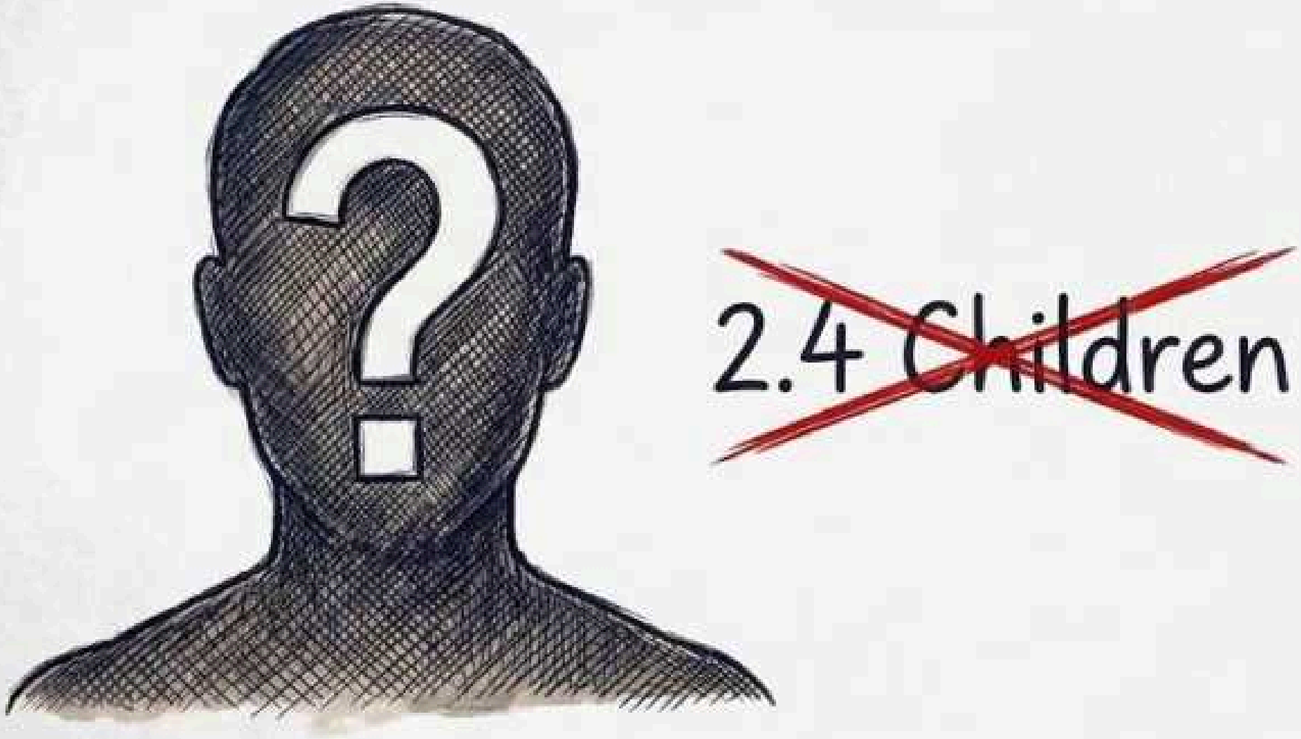


1-in-a-million chance × 1,000,000 people = Happens to someone every day.

What is rare for one person is common across a whole population.

The Fallacy of the Average Person

¶ 5.18



If the average family has 2.4 children, no family actually has 2.4 children.

An average is a summary of a group; it may describe nobody in it.

¶ 5.19

Lecture Question



Find a statistic in a recent news story. Can you tell these three things?
If not, what would you want to know before you believed it?

¶ 5.20



Next: Sources, trust, and the practice of changing your mind.