

*Do I know
enough to call
it now?*

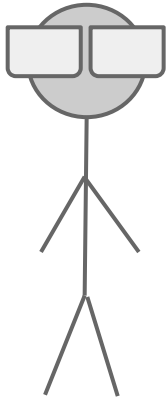
*Did this happen
because of X?*

Bayesian Thinking

Gursimran Singh (@gnarmis)

eSparkLearning.com

You're walking down the street...



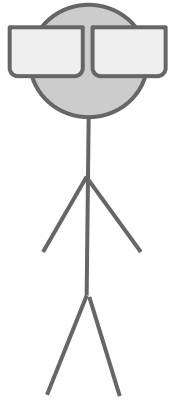
Question:

Barista or Consultant?



plaid shirt, skinny
jeans, looks cool &
young

You're walking down the street...



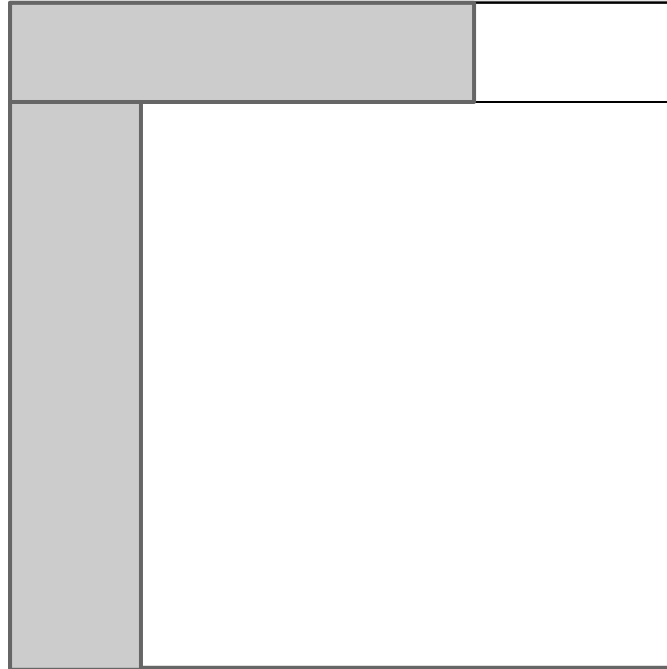
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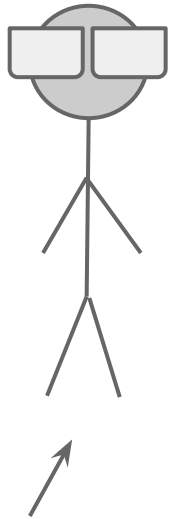
Consultants



Baristas



You're walking down the street...



plaid shirt, skinny
jeans, looks cool &
young

Barista : Consultant

prior odds 1 : 10

likelihood ratio 5 : 1

posterior odds 1 : 2

General Rule

$$\text{prior_odds} * \text{evidence_adjustment} = \text{posterior_odds}$$

- You can get a lot more rigorous, but working with odds is easier and hard-to-mess-up
- Convert prob. \leftrightarrow odds: $P=O/(1+O)$; $O=P/(1-P)$

Real Problem

- 1% of the population has cancer
- 9.6% of healthy people test positive, 80% of people with cancer do
- If Sally tests positive for cancer, what's the probability she actually has it?

Real Problem

- usually, only around 15% of doctors get it right!

Real Problem

- Cancer:Healthy ratio is **1:99**
- Evidence adjustment: $80/100 : 9.6/100 = \mathbf{80:9.6}$
- **$1:99 * 80:9.6 = 80:950.4$**
 - (roughly 1:12 odds of cancer, $(1/12)/(1+1/12) \Rightarrow \sim 7.7\%$ chance)

Practical Ways to Use Bayes Rule?

- It's okay to use numbers to represent your uncertainty
- A few notes about how it can be used as a practical tool...

Remembering Base Rate

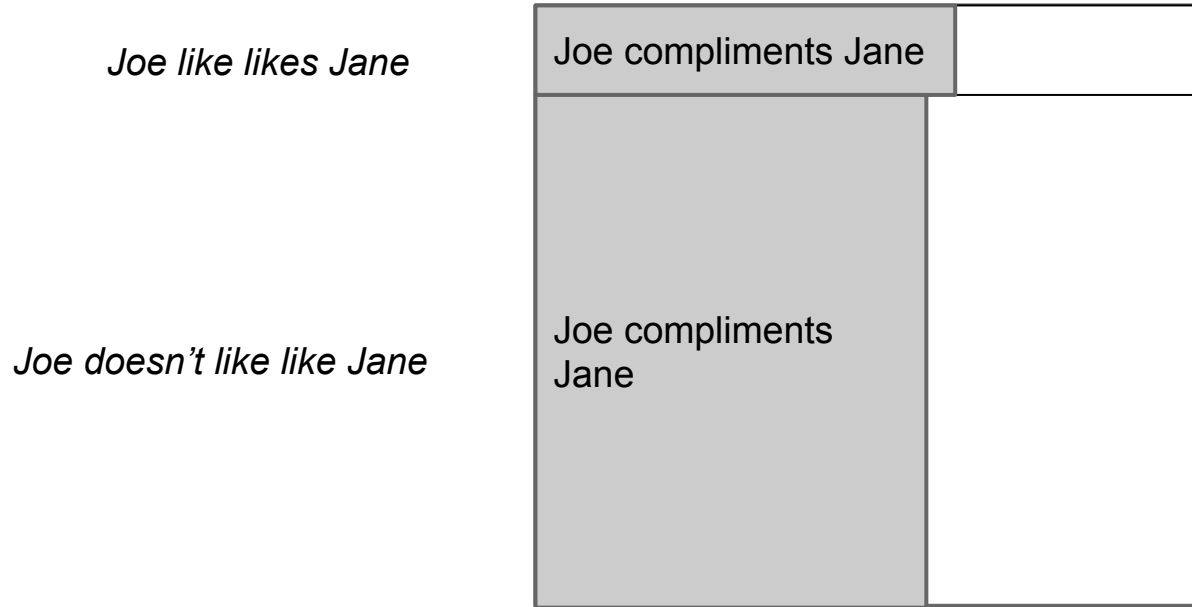
- If you just saw \$event and are trying to decide whether it's because \$a or \$b...

-> think about how likely \$event is in case of \$a or \$b

-> but also, think about the **base rate**, how likely are \$a and \$b by themselves

Weighing Evidence

- Imagine your guess/theory is false; would the world look different?



... so “Joe complimenting Jane” is very lightweight evidence for/against “Joe like likes Jane”

Geeky diversion!

Instead of multiplying ratios, can we
add/subtract evidence?

Log Odds! Thanks to E.T. Jaynes

- priors of 1:10 in favor of Consultants
 - $\Rightarrow 10 \cdot \log(1:10) \Rightarrow -10$ dB
- evidence adjustment: 5:1 in favor of Baristas
 - $\Rightarrow 10 \cdot \log(5:1) \Rightarrow \sim 7$ dB
- adjusted odds: $-10 + 7 \Rightarrow 3$ dB

- and back to odds $\Rightarrow 1/10^{(3/10)} \sim 0.5 \Rightarrow 1:2$

Why Log Odds?

- Probability of 100% or 0% is not reachable, log odds make that obvious
 - $10 \cdot \log(10000000000000000)$ only 130 dB, and so on
 - $10 \cdot \log(1/10000000000000000)$ only -130 dB, and so on
- Add/subtract to update based on evidence

Resources (so many!!!)

- [Better Explained article](#)
- E.T. Jaynes's Probability Theory: The Logic of Science

Appendices

You're walking down the street...



what:

Consultant

job title, keywords or company

where:

city, state, or zip

Find Jobs

Consultant jobs

Sort by: **relevance** - [date](#)

Salary Estimate



[Upload your resume](#) - Let employers find you

Tip: Enter your zip code in the "where" box to show results in your area.

Jobs 1 to 10 of 223,933

You're walking down the street...



what:

job title, keywords or company

where:

city, state, or zip

Find Jobs

Barista jobs

Tip: Enter your zip code in the "where" box to show results in your area.

My recent searches

Consultant



Upload your resume - Let employers find you

Jobs 1 to 10 of 19,889