# BAYESIAN STATISTICS AND MONTE CARLO SIMULATION

Thank you to Cam Kirk

# BAYES' THEOREM

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Prior

p(A) = *probability of A*

Prior - Our hypothesis w/o evidence

# BAYES' THEOREM

p(A|B) = *probability of A given B*

Posterior

Posterior - Our hypothesis *given* some evidence B

# BAYES' THEOREM

Likelihood

p(B|A) = *probability of B given A*

Likelihood - Probability of results *given* our hypothesis

# BAYES' THEOREM

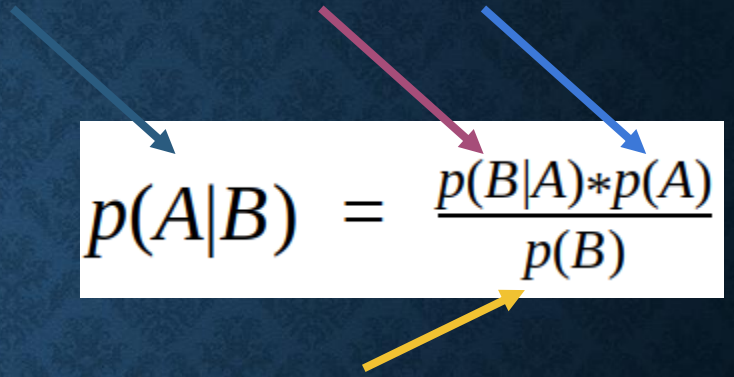
Total Equation

$$p(A|B) = \frac{p(B|A)*p(A)}{p(B)}$$

The posterior is proportional to the product of the likelihood and the prior, normalized

# BAYES' THEOREM

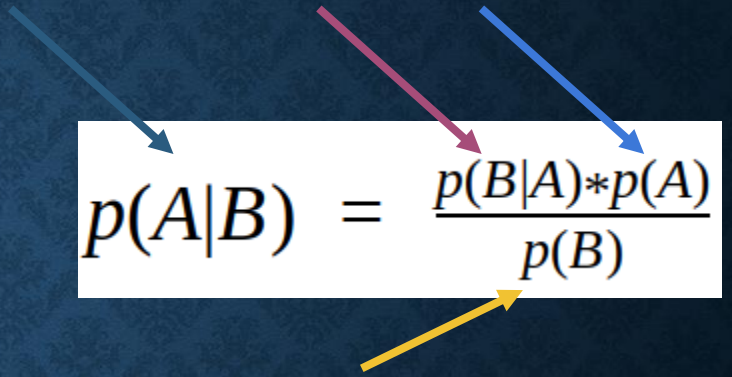
Total Equation




The posterior is proportional to the product of the likelihood and the prior, normalized

# WHAT?

This isn't even English.

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# MONTY HALL PROBLEM

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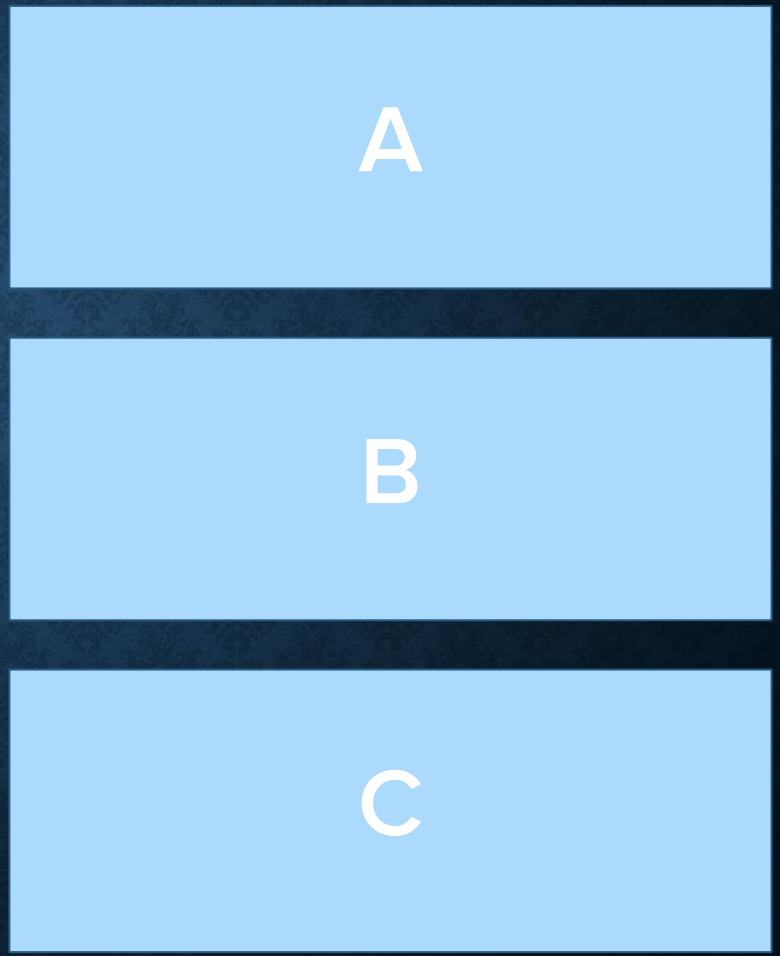

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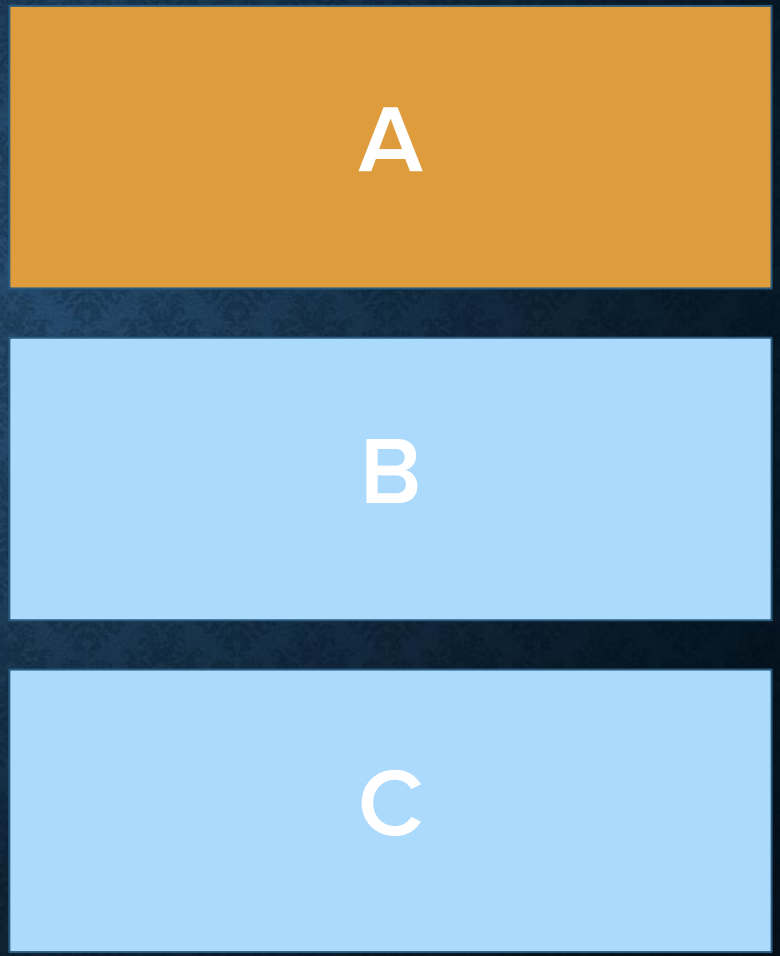

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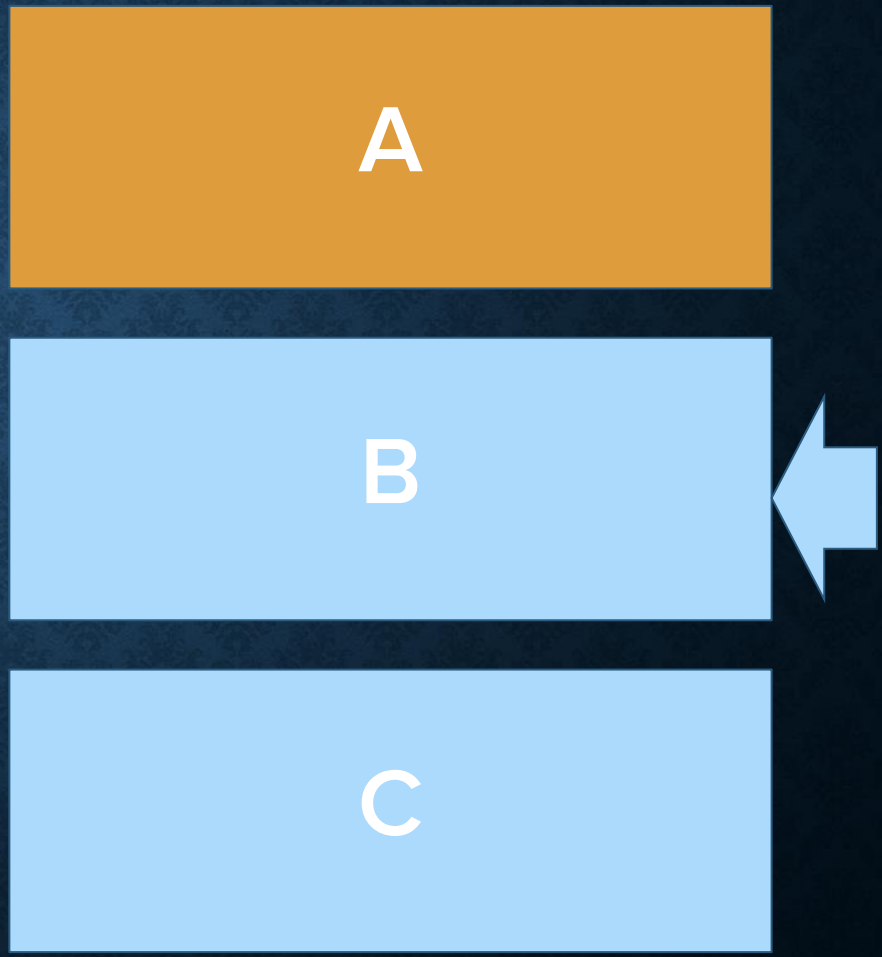

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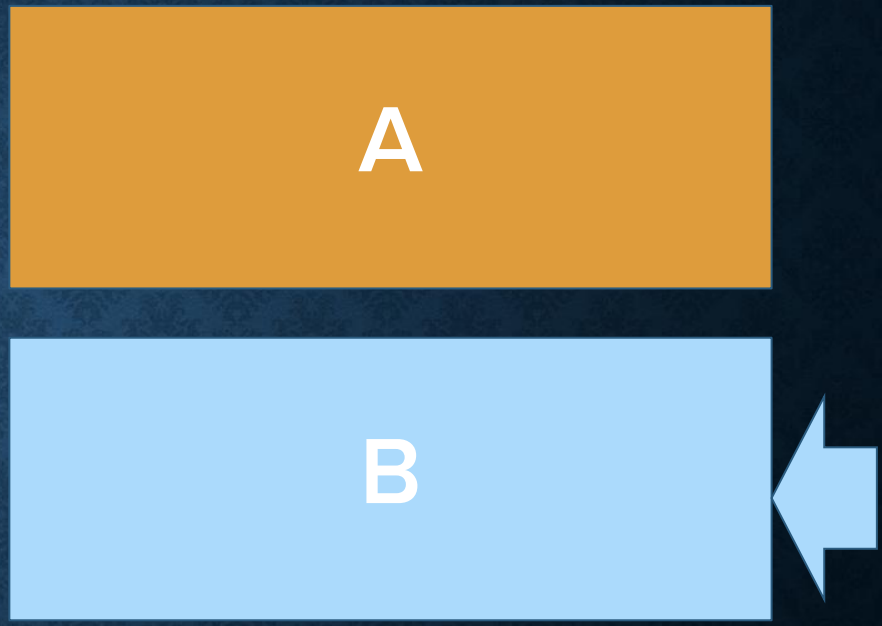

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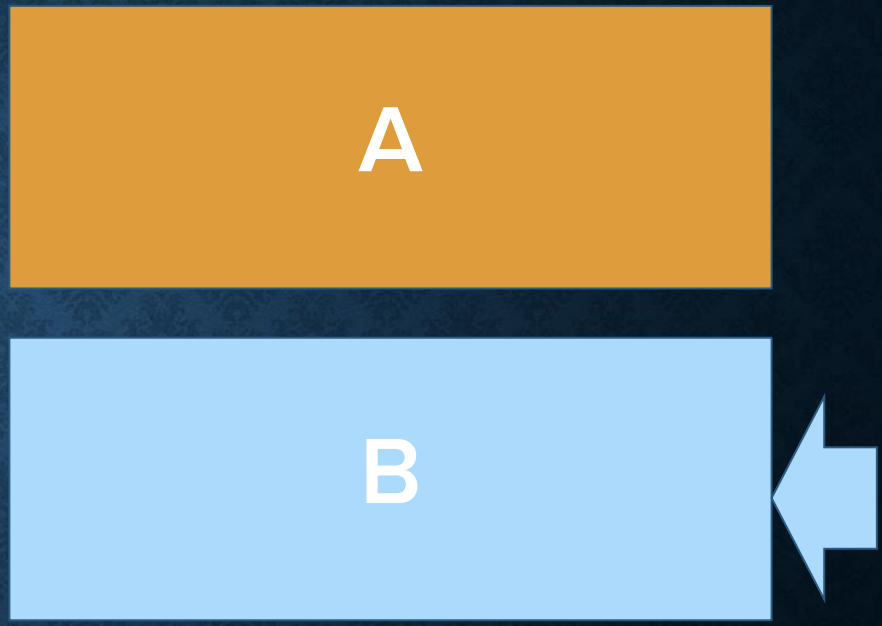
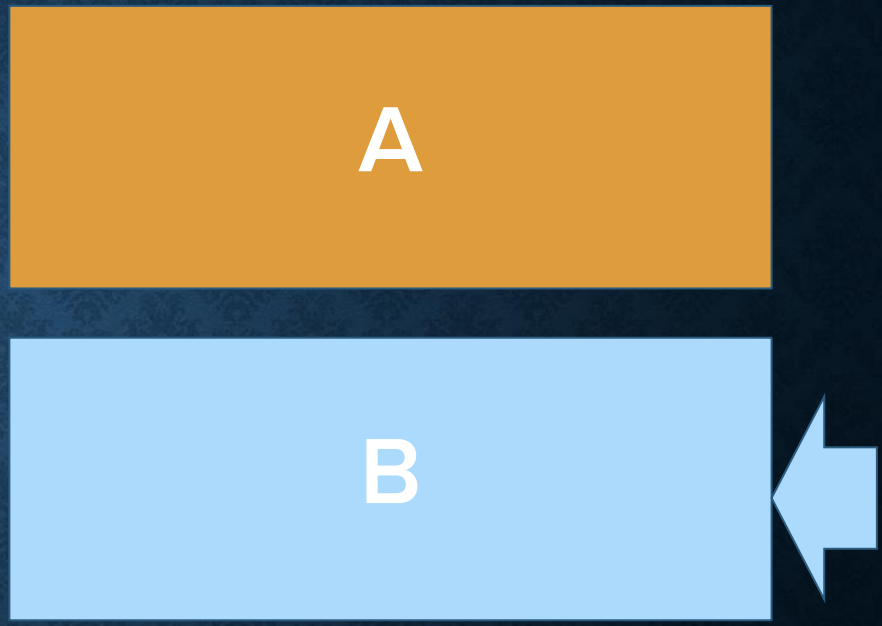



Should you switch?

# MONTY HALL PROBLEM




What is your win rate?

# TABULAR METHOD

| | Prior | Likelihood | Product | Posterior |
|---|---|---|---|---|
| | p(A) | p(B\|A) | p(A)p(B\|A) | p(A\|B) |
| A | | | | |
| B | | | | |
| C | | | | |

Contestant Vision

1/3

A

1/3

B

1/3

C

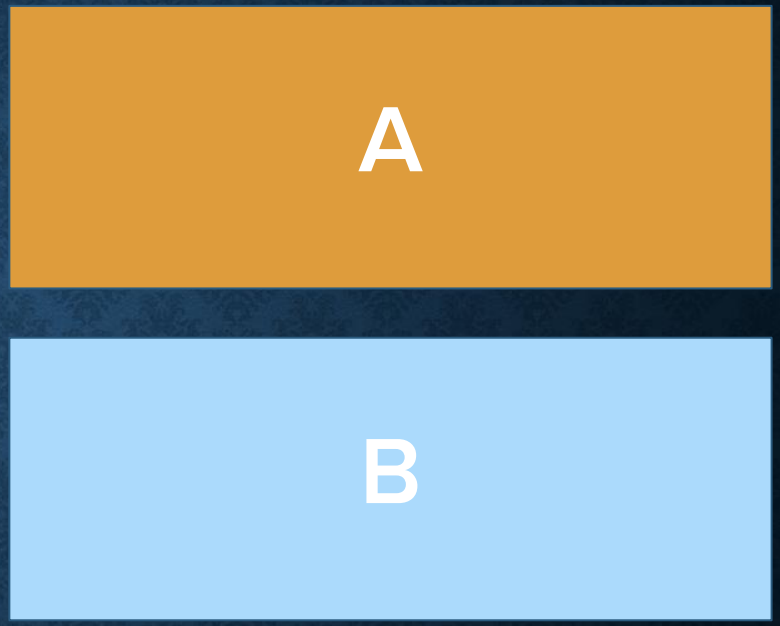
| | Prior | Likelihood | Product | Posterior |
|---|---|---|---|---|
| | p(A) | p(B\|A) | p(A)p(B\|A) | p(A\|B) |
| A | 1/3 | | | |
| B | 1/3 | | | |
| C | 1/3 | | | |

Contestant Vision

½

1

0



| | Prior | Likelihood | Product | Posterior |
|---|---|---|---|---|
| | p(A) | p(B\|A) | p(A)p(B\|A) | p(A\|B) |
| A | 1/3 | 1/2 | | |
| B | 1/3 | 1 | | |
| C | 1/3 | 0 | | |

| | Prior | Likelihood | Product | Posterior |
|---|---|---|---|---|
| | p(A) | p(B\|A) | p(A)p(B\|A) | p(A\|B) |
| A | 1/3 | 1/2 | 1/6 | |
| B | 1/3 | 1 | 1/3 | |
| C | 1/3 | 0 | 0 | |

| | Prior | Likelihood | Product | Posterior |
|---|---|---|---|---|
| | p(A) | p(B\|A) | p(A)p(B\|A) | p(A\|B) |
| A | 1/3 | 1/2 | 1/6 | 1/3 |
| B | 1/3 | 1 | 1/3 | 2/3 |
| C | 1/3 | 0 | 0 | 0 |

Sum of column 3 is ½. Divide by ½ to scale to 1.

p(B)

SURE…
PABLO…!! I
DON’T BELIEVE
YOUR MATHY
LIES….

# EXPERIMENTAL METHOD

# MONTE CARLO SIMULATION

Short Definition:

Throw random ~~$#!%~~ numbers at a system until it converges on useful information

# LET’S CODE!