Naive Bayes

By: Ernesto Lee

Conditional Probability

What are the chances of being part of the 1%?

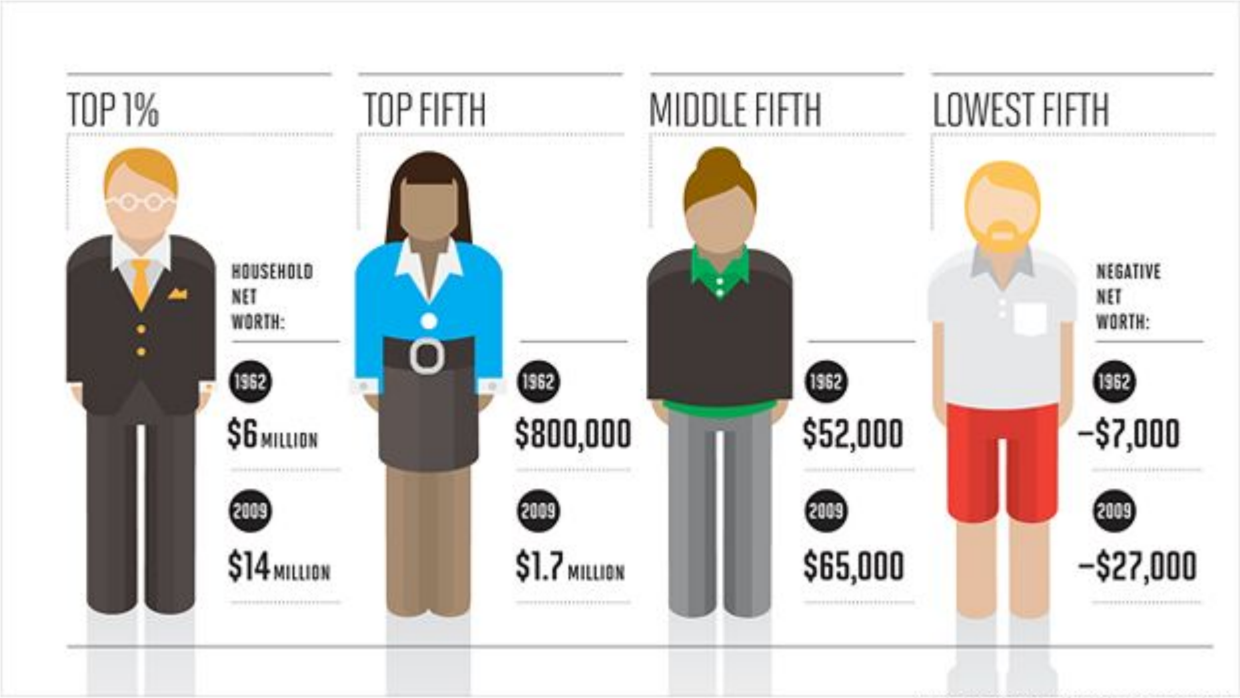

ILLUSTRATION: THOMAS POROSTOCKY

Research

- ***<u>Research has shown that ¼ of the 1% is female</u>***
- Math Alert:

¼ of 1% is female

or

$.25 * .01 = .0025$ is female

What are the chances of being FEMALE **<u>if</u>** you are 1%?

CHANCES OF BEING FEMALE AND IN THE 1% = CHANCES OF BEING FEMALE IF YOU ARE IN THE 1% × CHANCES OF BEING IN THE 1%

What are the chances of being 1% <u>**if**</u> you are FEMALE?

CHANCES OF BEING FEMALE AND IN THE 1% = CHANCES OF BEING IN THE 1% IF YOU ARE FEMALE X CHANCES OF BEING FEMALE

What are the chances of being 1% **if** you are FEMALE?

$$\boxed{\text{CHANCES OF BEING FEMALE AND IN THE 1\%}} = \boxed{\text{CHANCES OF BEING IN THE 1\% IF YOU ARE FEMALE}} \times \boxed{\text{CHANCES OF BEING FEMALE}}$$

$$\boxed{\text{CHANCES OF BEING IN THE 1\% IF YOU ARE FEMALE}} = \frac{\boxed{\text{CHANCES OF BEING FEMALE AND IN THE 1\%}}}{\boxed{\text{CHANCES OF BEING FEMALE}}}$$

$$\boxed{\text{CHANCES OF BEING FEMALE AND IN THE 1\%}} = \boxed{\text{CHANCES OF BEING IN THE 1\% IF YOU ARE FEMALE}} \times \boxed{\text{CHANCES OF BEING FEMALE}}$$

$$\boxed{\text{CHANCES OF BEING IN THE 1\% IF YOU ARE FEMALE}} = \frac{\boxed{\text{CHANCES OF BEING FEMALE AND IN THE 1\%}}}{\boxed{\text{CHANCES OF BEING FEMALE}}}$$

x * 0.5= .0025

x = .0025 / 0.5

x = .005

“Bayes Rule” is just a formalization of the logic I just explained.

$$\boxed{\text{CHANCES OF BEING IN THE 1\% IF YOU ARE FEMALE}} = \frac{\boxed{\text{CHANCES OF BEING FEMALE AND IN THE 1\%}}}{\boxed{\text{CHANCES OF BEING FEMALE}}}$$

$$= \quad x = .0025 / 0.5$$

$$= \quad x = \frac{(.25 * .01)}{0.5}$$

$$\boxed{\text{CHANCES OF BEING IN 1\% IF YOU ARE FEMALE}} = \frac{\boxed{\text{CHANCES THAT YOU ARE FEMALE IF YOU'RE IN THE 1\%}} \times \boxed{\text{CHANCES OF BEING IN THE 1\%}}}{\boxed{\text{CHANCES OF BEING FEMALE}}}$$

$$\boxed{\text{CHANCES A, GIVEN B}} = \frac{\boxed{\text{CHANCES OF B, GIVEN A}} \times \boxed{\text{TOTAL CHANCES OF A}}}{\boxed{\text{CHANCES OF B}}}$$

Bayes Theorem

Likelihood

How probable is the evidence given that our hypothesis is true?

Prior

How probable was our hypothesis before observing the evidence?

$$P(H \mid e) = \frac{P(e \mid H)\, P(H)}{P(e)}$$

Posterior

How probable is our hypothesis given the observed evidence? (Not directly computable)

Marginal

How probable is the new evidence under all possible hypotheses?

$P(e) = \sum P(e \mid H_i)\, P(H_i)$

Use Bayes to discover the chances that you are in the 1% IF you are male

Probability of B occurring given evidence A has already occurred

Probability of A occurring

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

Probability of A occurring given evidence B has already occurred

Probability of B occurring

$$p(A|B) = \frac{(0.75)\times(.01)}{0.5}$$

Bayes' Theorem

Bayes' Theorem is a rule (and formula) in probability theory that can help you assess the probability of an event happening given prior knowledge about conditions related to that event.

Mathematically, it looks like this:

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

Note: $P(B)$ must not be zero

"P" means probability.

$P(A)$ means the probability of <u>event A</u> happening independently → whether or not <u>event B</u> happens.

$P(B)$ means the same for <u>event B</u>

$P(A|B)$ means the probability of <u>event A</u> happening, given that <u>event B</u> <u>does</u> happen

$P(B|A)$ is the inverse; it's the probability of <u>event B</u> happening given that <u>event A</u> happens.

By taking the probability of <u>event B</u> into consideration, you can come to a more accurate conclusion about the probability of <u>event A</u> happening