

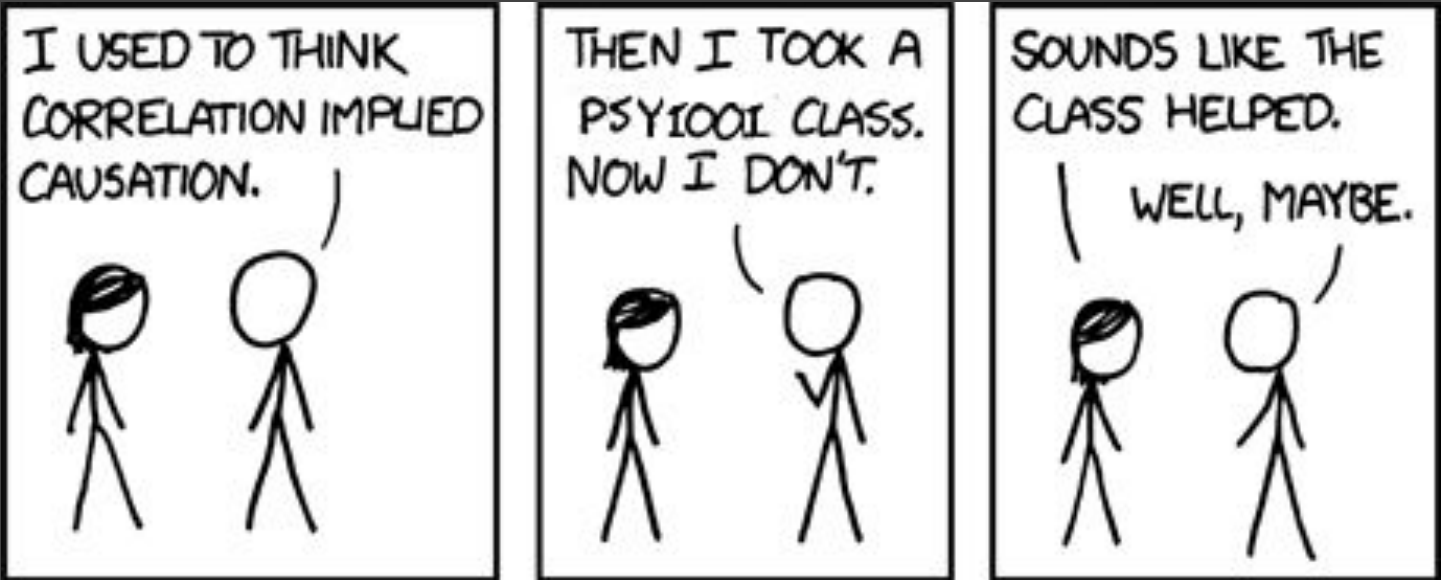
Causality

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then what is causation? (XKCD/552)



How do we define causality?

“We may define a cause to be an object followed by another, and where all the objects, similar to the first, are followed by objects similar to the second. Or, in other words, where, if the first object had not been, the second never had existed.”

For further discussion and references on the history of causality
<http://plato.stanford.edu/entries/causation-counterfactual/>



http://en.wikipedia.org/wiki/David_Hume

The causal effect of a treatment on a subject is the change in the outcome:

from the treatment the subject actually received and

what would of occurred had she or he received the other treatment

Twist 'N Tone

The exerciser that's fun, is easy and works. Helps you keep fit and helps take off inches. Burn up calories while you shape up waist, hips and legs. Provides same stimulating exercise as expensive equipment used in health clubs. Can be used by men and women.

1164-006-7A396—Wt. 3 lbs. \$5.95

392

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The advertisement features a man in a dark suit and a woman in a green dress standing on either side of a red circular exerciser. The exerciser is shown in a close-up inset at the bottom center. The background is white with a red horizontal line. The text is in a bold, sans-serif font.

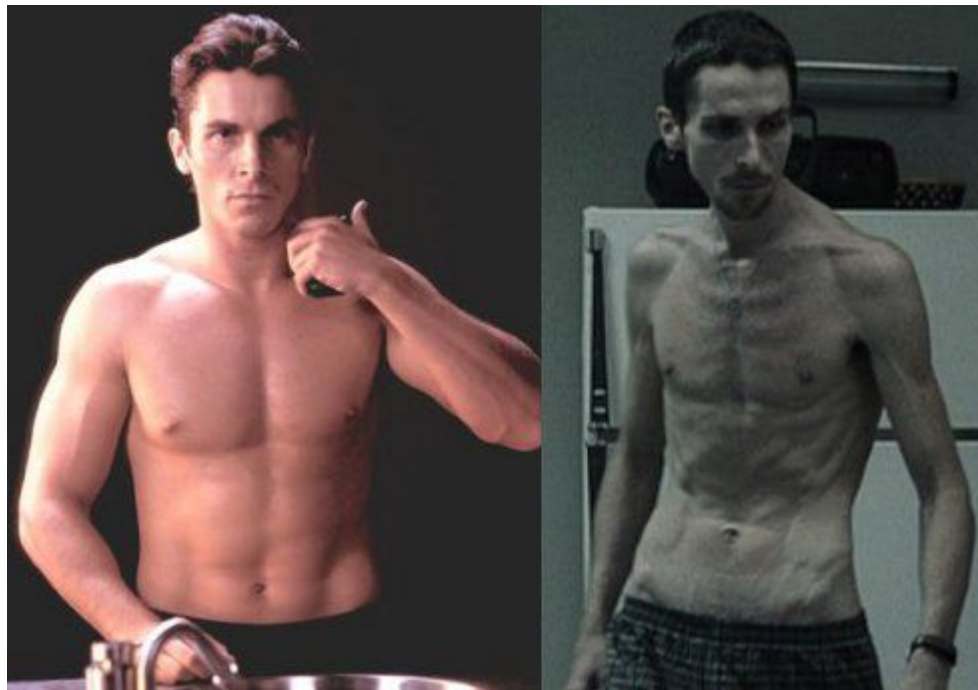
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An advertisement for a product called "Twist 'N Tone". It features a man in a suit on the left and a woman in a green dress on the right, both standing next to a red, circular, spiral-shaped exerciser. The text describes the product as a fun and easy way to stay fit, claiming to burn calories and shape the waist, hips, and legs. It also mentions that it provides the same stimulating exercise as expensive health club equipment and can be used by both men and women. The product is identified by the number 1164-006-7A396 and weighs 3 lbs. The price is listed as \$5.95. The number 392 is printed below the man, and the copyright notice "© London Media" is at the bottom left.

The average causal effect is the average of the subject-specific causal effects

This way of thinking about causal inference requires an assignable treatment or intervention

We can't observe counterfactuals; we only get to observe one state of nature

We can, with assumptions and careful study design, make inferences about average causal effects

Causal thinking is essential for understanding the causal implications associated assumptions in our data analysis

Think about these study designs in
the light of counterfactuals

Crossover trials: Give a subject a treatment, then after a suitable washout period, give the other

Consider a study of chronic migraines; give subjects one relief medication, washout period, then another

Why would this not work for an ad campaign, or a weight loss study?

How does it actualize counterfactual thinking?





<http://bit.ly/1cDE08b>



<http://bit.ly/1AUj1t9>



<http://bit.ly/1ARH7Fh>

Randomization is our most effective tool for estimating average causal effects

(we have an entire lecture on randomization)

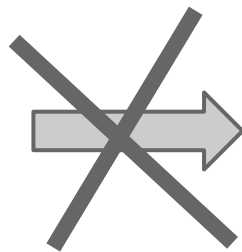
Randomization, with high probability, makes the treated and untreated groups directly comparable

This can be shown to lead to causal inferences

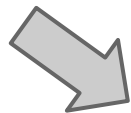


What else can we do?
Some examples

Reimbursement
rates



ovarian cancer



oral
contraceptives







Modeling comes with a lot of assumptions

Most well known modeling technique in causal inferences use propensity scores