



# Scientific Reasoning

Philosophy 206

Wofford College

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# Two Types of Reasoning

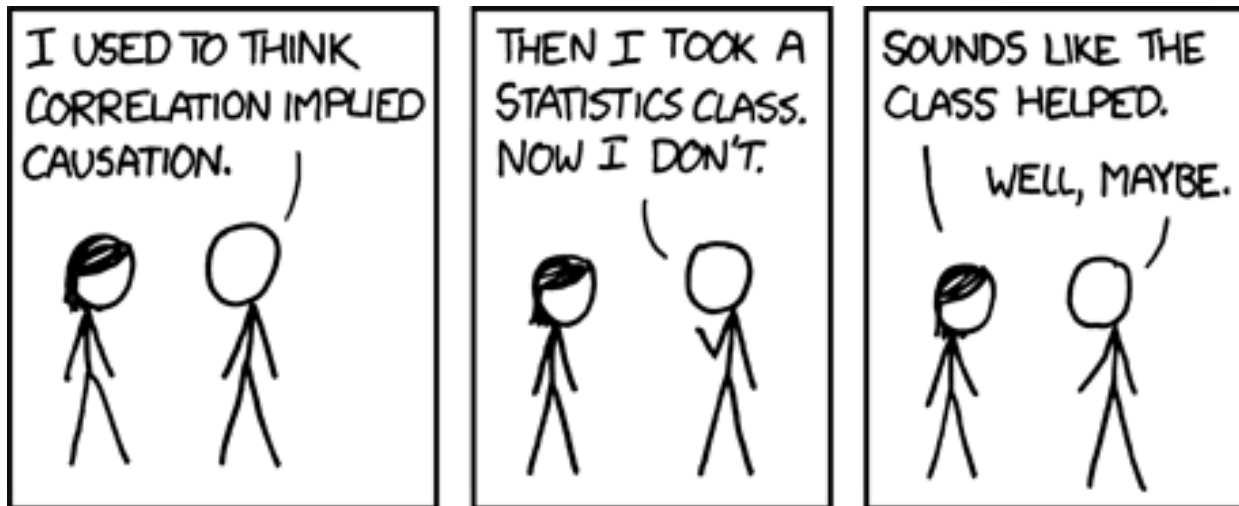
- Deductive
  - Certainty
  - Truth of premises guarantees truth of conclusion
- Inductive
  - Confidence
  - Truth of premises supports, but doesn't guarantee, truth of conclusion

# Scientific Reasoning

- Scientific reasoning is a search for causal explanations: how and why do things happen?
- Causal claims involve (unprovable) implicit counterfactual statements
  - Thus, inductive reasoning is more relevant

# The Problem of Causality

- Causality cannot be observed, only inferred
- What can be observed?
  - Correlation and temporal sequencing



Source: <http://xkcd.com/552/>

# The Problem of Causality

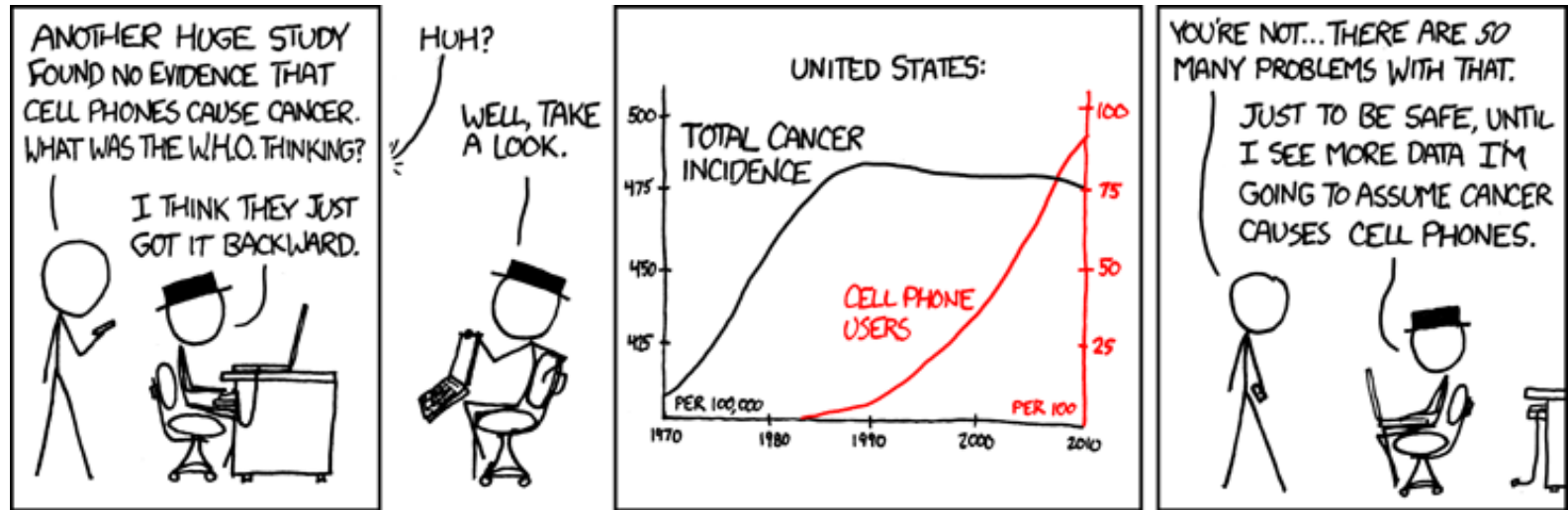
Premise: X and Y

Conclusion: X caused Y

Three alternatives

- Y caused X
- Z caused X and Y
- Coincidence

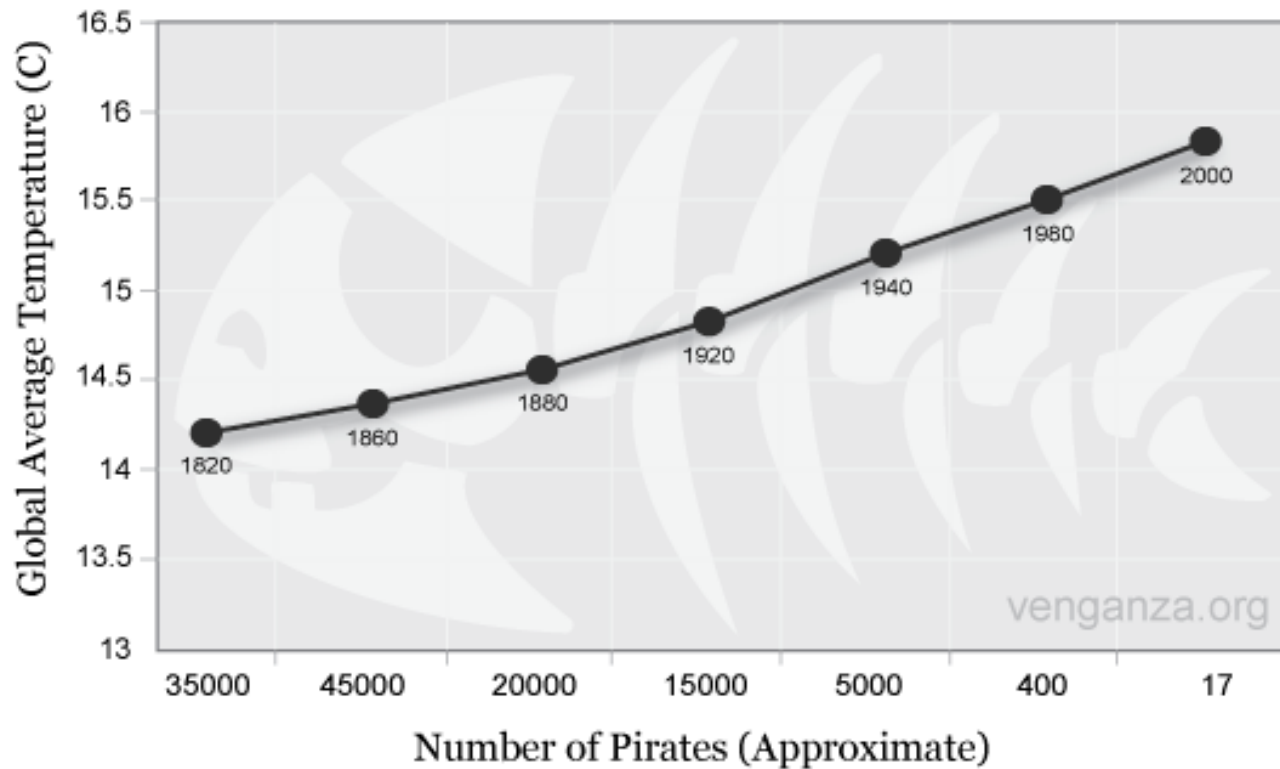
# The Problem of Causality



Source: <http://xkcd.com/925/>

# The Problem of Causality

Global Average Temperature Vs. Number of Pirates



Source: [www.venganza.org/about/open-letter](http://www.venganza.org/about/open-letter)

# Causal Explanations

- As soon as telephones were installed in that neighborhood, the crime rate doubled.
- Public schools in the wealthiest neighborhoods win state team championships more than twice as often as poorer schools.
- In the 18<sup>th</sup> Century, church towers were struck by lightning more often than gambling houses that stood next to them.



# Resolving the Impasse

- Devise experiments to distinguish causation from mere correlation
  - Test the implicit counterfactual claims

# Mill's Methods

- Agreement
- Difference
- Agreement & Difference
- Concomitant Variation
- Residue

# Agreement

Epidemiologists traced SARS to a professor from China who was staying at the Metropole Hotel in Hong Kong. Five of the earliest cases of SARS involved people who stayed at the same hotel, with some of them staying on the same floor as the professor.

# Difference

The general mortality rate of SARS is 10-15%. However, the mortality rate is not the same for all groups. For those who are otherwise healthy and under 25, it is slightly less than 1%. But for the elderly and those who are already suffering from respiratory conditions, the rate rises to almost 50%. So it is probable that SARS is much more difficult to treat successfully when the patient is elderly or suffering from a prior respiratory condition.

# Agreement & Difference

All domesticated dog breeds become quite adept at responding to human gestures such as pointing. By contrast, neither their genetically close relatives, wolves, nor intellectually superior primates, such as chimpanzees, respond as well as dogs to the same cues. Therefore, it is likely that something happened in the evolutionary heritage of dogs since they split off from wolves and that factor is responsible for this ability.

# Concomitant Variation

The unemployment rate in the United States dropped from 6.6% in 1961 to 3.4% in 1969. During the same time period, the crime rate nearly doubled, from 1.9 to 3.7 per 1,000. Robberies nearly tripled. The recession from 1980 to 1982 was accompanied by a clearly discernible drop in crime, and as the economy revived so did the crime rate. Thus, those who argue that crime is caused by joblessness are mistaken.

# Residue

The man probably fell asleep at the wheel before his fatal car crash last month. The police report confirmed that he wasn't drinking, speeding, talking on his cell phone, or having a health problem before the crash. Police ruled out weather and road conditions as the cause.

# Applying Mill's Methods

- You think that your grades might be higher if you spent more time studying.
- You want to figure out why your child has started fussing at bedtime and not sleeping through the night.
- “My grandma recovered from her illness because her church prayed for her.”



# Applying Mill's Methods

In a study commissioned by HP, researchers found that extensive use of email or text messaging can temporarily reduce IQ-test performance by as much as ten points—more of a dip than occurs after losing a night's sleep or smoking pot. It's linked to a condition dubbed 'infomania', wherein people become addicted to email, instant messaging, and text messages.

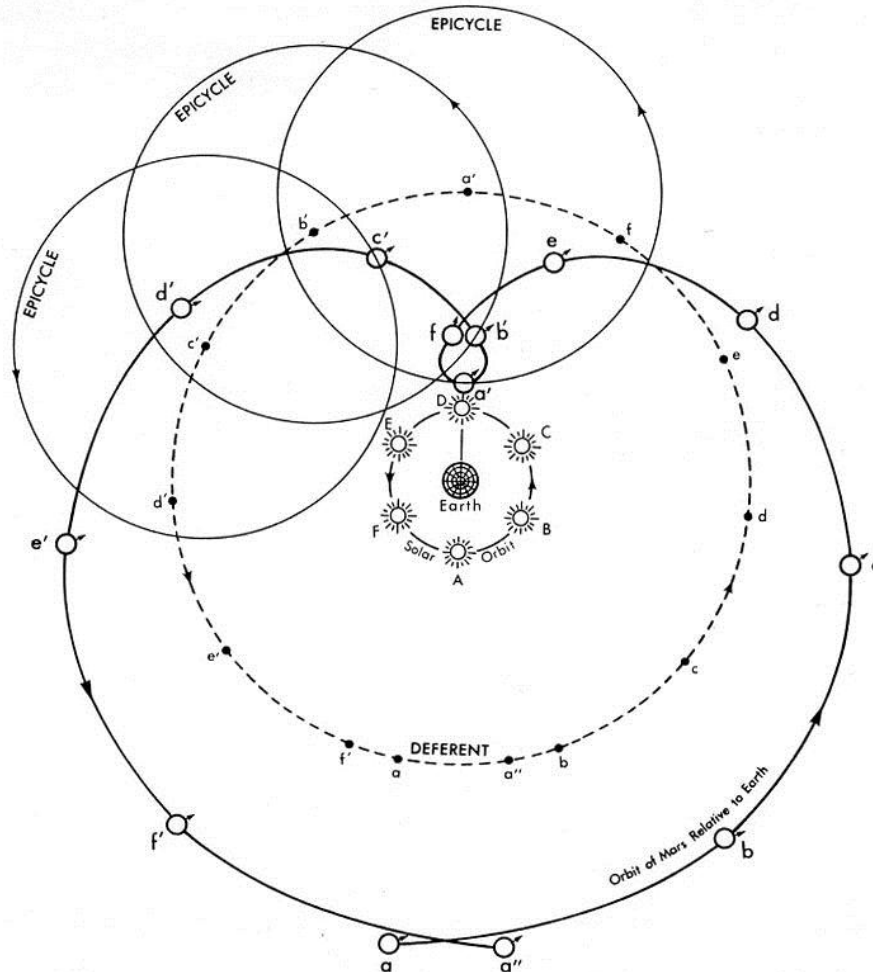
Source: *Reader's Digest*, November 2005

# Argument from Best Explanation

- The “best explanation” is one that
  - Accounts for all of the relevant facts
  - Doesn’t create more puzzles than it solves
    - Occam’s Razor
  - Is testable, enabling you to make predictions
  - Doesn’t contradict established knowledge
  - Is not *ad hoc*

# Argument from Best Explanation

Ptolemy's Geocentric model of the solar system



Source: <http://web.njit.edu/~gary/202/assets/epicycle1.jpg>

# Identifying Best Explanations

- Adverse reactions to vaccinations have risen in the last two decades
  - a) Vaccinations have become stronger
  - b) Vaccinations have become more contaminated
  - c) Children are less resilient than before
  - d) A law was passed 18 years ago requiring doctors to report all adverse reactions, no matter how minor

# Identifying Best Explanations

- Men commit far more crimes than women do
  - a) Crime is related to testosterone
  - b) Crime is related to the Y chromosome
  - c) Women are better people than men are
  - d) Women are more risk-averse than men
  - e) Men have more opportunities to commit crime than women do