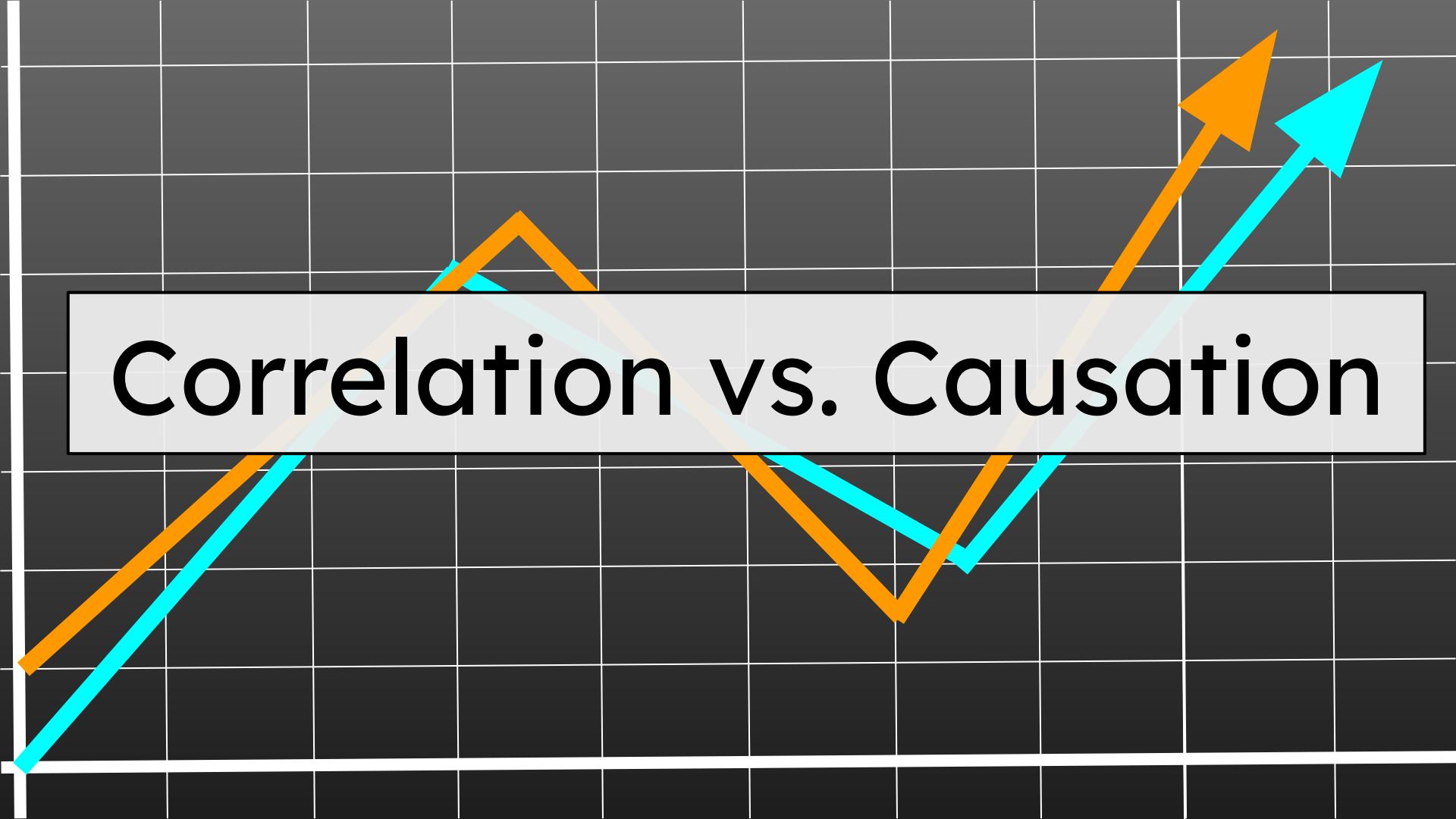


Correlation vs. Causation

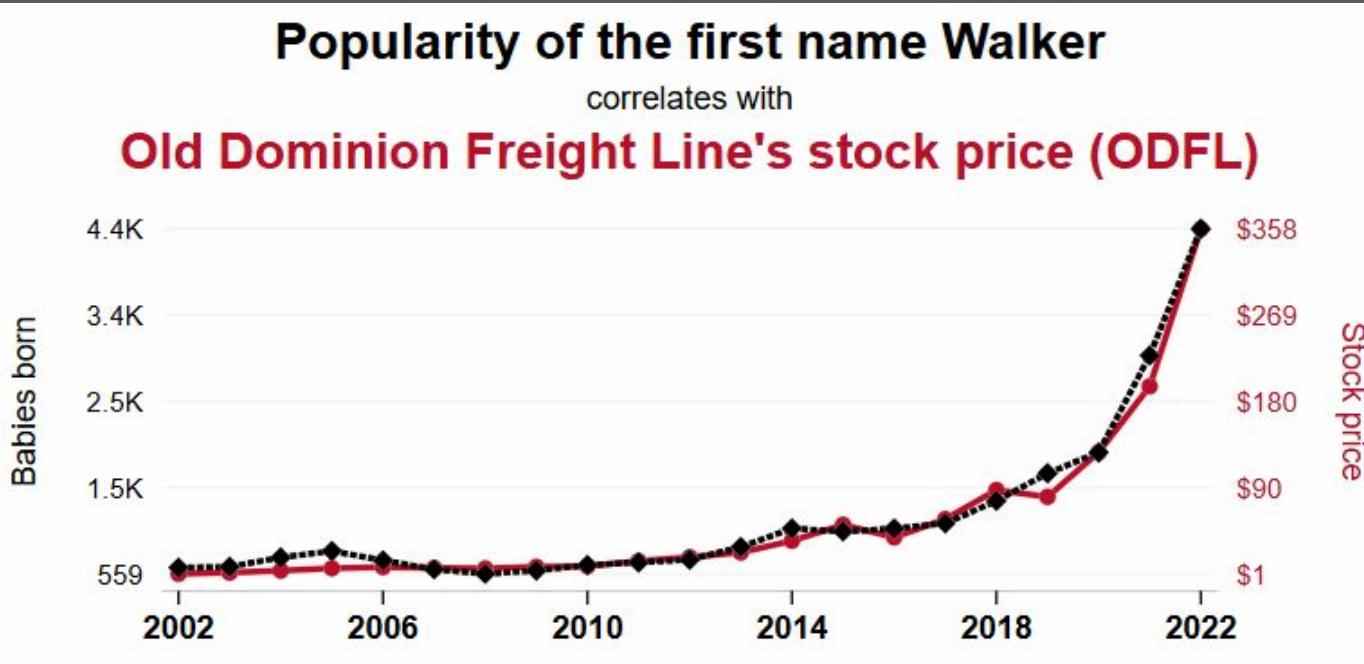


Meeting Name: ‘CvC’



Today can be summed
up in 5 words:
**Correlation does NOT
imply causation!!!**

How Correlation and causation are Different:



◆--- Babies of all sexes born in the US named Walker · Source: US Social Security Administration

●— Opening price of Old Dominion Freight Line (ODFL) on the first trading day of the year · Source: LSEG Analytics (Refinitiv)

2002-2022, $r=0.992$, $r^2=0.985$, $p<0.01$ · tylervigen.com/spurious/correlation/2159

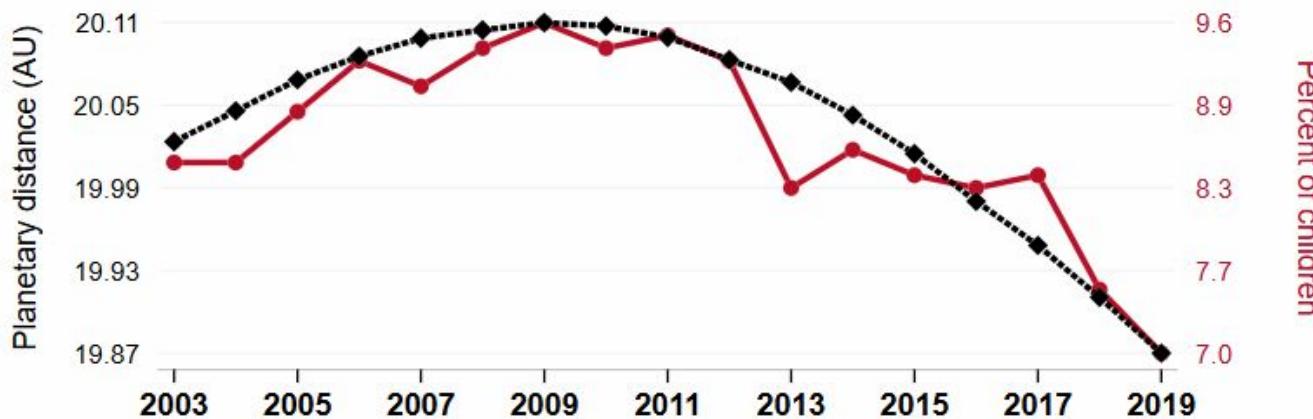
tylervigen.com/spurious-correlations

How Correlation and causation are Different:

The distance between Uranus and Earth

correlates with

Asthma prevalence in American children



◆ The average distance between Uranus and Earth as measured on the first day of each month · Source: Calculated using Astropy

● Percent of children in the US with asthma · Source: National Center for Health Statistics

2003-2019, $r=0.932$, $r^2=0.869$, $p<0.01$ · tylervigen.com/spurious/correlation/2592

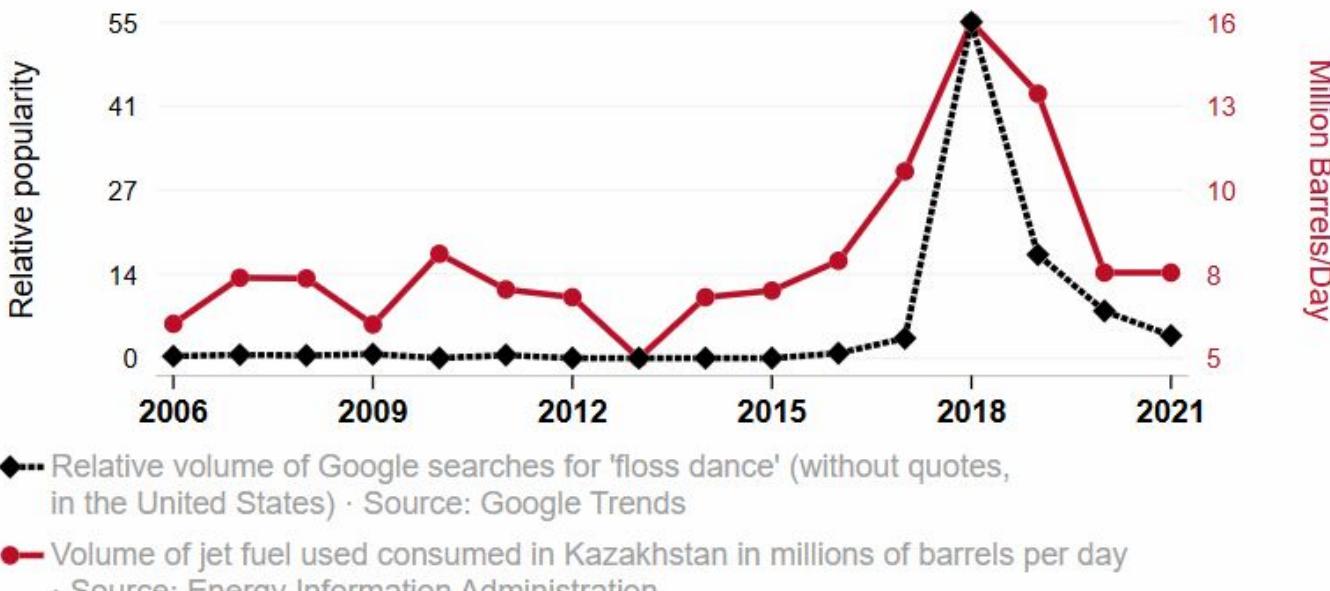
tylervigen.com/spurious-correlations

How Correlation and causation are Different:

Popularity of the 'floss dance' meme

correlates with

Jet fuel used in Kazakhstan



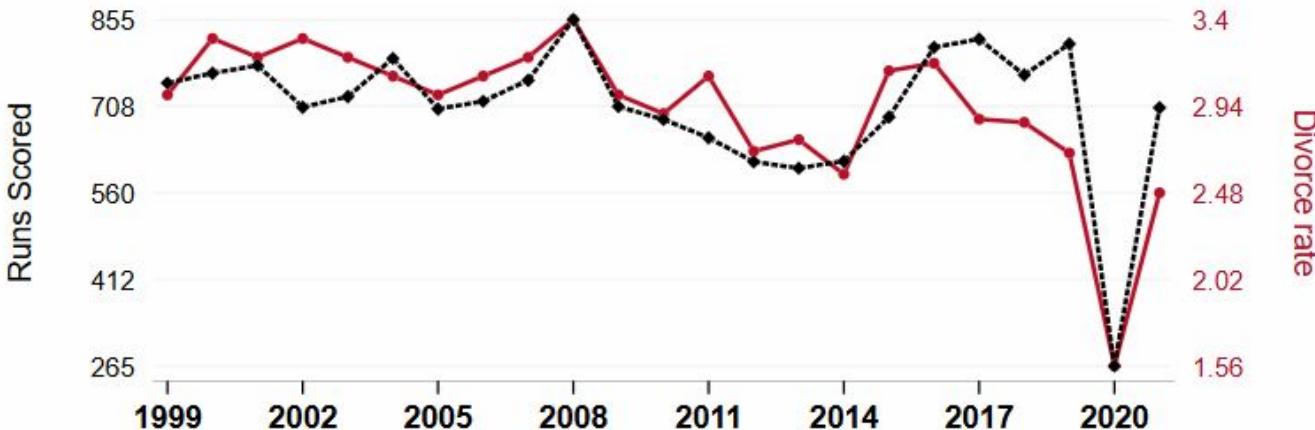
tylervigen.com/spurious-correlations

How Correlation and causation are Different:

Total Runs Scored by Chicago Cubs Team in National League (Central and East Division)

correlates with

The divorce rate in Connecticut



◆--- Total Runs Scored by Chicago Cubs Team in National League (Central and East Division) · Source: Baseball Reference

●— The divorce rate in Connecticut · Source: CDC National Vital Statistics

1999-2021, $r=0.799$, $r^2=0.638$, $p<0.01$ · tylervigen.com/spurious/correlation/1173

tylervigen.com/spurious-correlations

Algorithmic bias threatens legal fairness in AI era

SMALL BUSINESS

How AI's Hidden Data Bias Can Impact Your Data Privacy Program (And What To Do About It)

By [Jodi Daniels](#), Forbes Councils Member.

for [Forbes Business Council](#), COUNCIL POST | Membership (fee-based)

Published Jun 12, 2025, 09:45am EDT

Job Applicant's Algorithmic Bias Discrimination Lawsuit Survives Motion to Dismiss

QR Code for Lab:

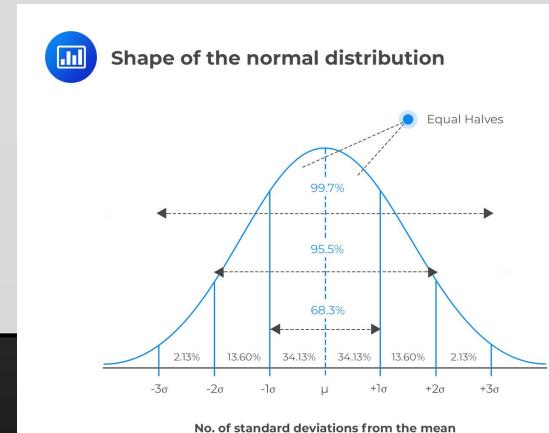


Hypothesis Testing

- H_0 - Null Hypothesis, there is no difference or change
 - Ex: The average height of a male in the US is equal to 70 inches.
- H_a - Alternative Hypothesis, there is a significant difference or change
 - Ex: The average height of a male in the US is not equal to 70 inches.

Hypothesis Testing (test statistic, z-value, t-value)

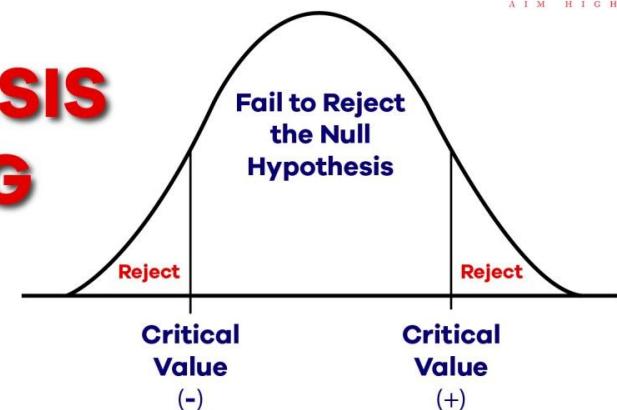
- Test statistic: quantity that is measured and compared
 - Mean, proportion, etc.
 - t-value, z-value, ...
- t-tests for means
- z-tests for proportion
- p-value: probability that the null hypothesis would produce the observed test statistic
- α : significance level
- Critical value: cutoff for test statistic



Drawing conclusions from a hypothesis test

- Use normal table or calculator to find p-value from the test statistic
- If $p\text{-value} < \alpha$, reject H_0
- Otherwise, you do NOT reject H_0

HYPOTHESIS TESTING



Type I and Type II errors

Type I error: You incorrectly reject the null hypothesis

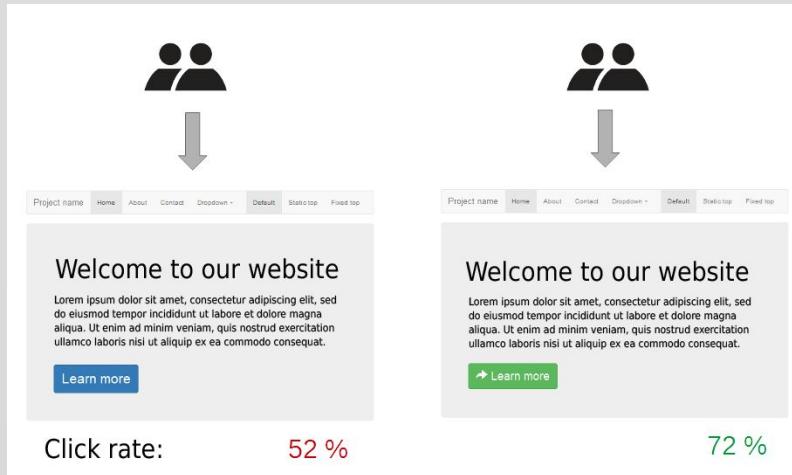
Type II error: You incorrectly accept the null hypothesis

	Fail to Reject H_0	Reject H_0
H_0 is True	Correct Decision	Type I Error (False Positive)
H_0 is False (H_1 is True)	Type II Error (False Negative)	Correct Decision

IMPORTANT:
Hypothesis testing can
find correlation but not
causation

A/B testing

- Application of two-sample hypothesis testing to user-experience research
 - Testing subject's response to two variants of something



Resources

<https://www.tylervigen.com/spurious-correlation>

<https://statisticsbyjim.com/basics/correlation-vs-causation/>

<https://www.statology.org/hypothesis-testing/>

<https://www.scribbr.com/statistics/type-i-and-type-ii-errors/>

Thank You