



MIAMI HERBERT
BUSINESS SCHOOL

ECO212 Principles of Macroeconomics

Chapter 2

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August 21, 2022

Overview



1. The Scientific Method

2. Causation and Correlation

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The Scientific Method



The Scientific Method

Introductions:

Recall the third principle of economics - using data to analyze the world.

Scientific Method is the name for the ongoing process that economists, other social scientists, and natural scientists use to:

- ▶ Develop models of the world.
that explain some part of the world.
- ▶ Test those models with data.
Testing those models using data to see how closely the model matches what we actually observe



The Scientific Method

Definition of model:

A model is a simplified description, or representation, of the world.

A model is an approximation. A model makes predictions that can be tested with data.

Example 1: Maps are models:

Exhibit 2.1 Flying from New York to Tokyo Requires More Than a Flat Map

This flat map is a model of part of the earth's surface. It treats the world as perfectly flat, which leads the map maker to exaggerate distances in the northern latitudes. It is useful for certain purposes—for instance, learning geography. But you wouldn't want to use it to find the best air route across the Pacific Ocean. For example, the shortest flight path from New York to Tokyo is not a straight line through San Francisco. Instead, the shortest path goes through Northern Alaska! The flat-earth model is well suited for some tasks (geography lessons) and ill-suited for others (intercontinental flight navigation).



Exhibit 2.2 New York City Subway Map

This is a model of the subway system in New York City. It is highly simplified—for example, it treats New York City as a perfectly flat surface and it also distorts the shape of the city—but it is nevertheless very useful for commuters and tourists.





The Scientific Method

All scientific models make predictions that can be checked with data - facts, measurements, or statistics that describe the world.

Process of empirical analysis:

Data are used to create empirical evidence. When conducting empirical analysis, economists refer to a model's predictions as hypothesis. Whenever such hypotheses are contradicted by the available data, economists return to the drawing board and try to come up with a better model that yields new hypothesis,

- ▶ **Assumption** - one more year of education results in a 10% increase in future earnings.
- ▶ **Hypothesis** - Each additional year of education increases wages by 10%.
True or False?



The Scientific Method - Models and data

A simple benefit-cost analysis:

Example 2: Is college worth it?

- ▶ **Cost:**

- ▶ **Tuition** - \$2,500/year for a community college, \$5,000/year for a public college, \$25,000/year for a private college.
- ▶ **Opportunity cost** - \$10/hr or more, hence \$20,000/year.

- ▶ **Benefit:** Estimate how the college education will payback (*Normative economics*).



The Scientific Method - Models and data

Example 2: Is college worth it? - Modeling

Now, let's make assumptions about the benefit:

- ▶ Investing in one extra year of education increases your future wages by 10%.
original wage $\times (1 + 10\%) =$ current wage - from t_0 to t_1 .
- ▶ According to the assumption above, we can test:
 - ▶ If you would earn \$15 per hour with 12 years of education, with one more year of education (your first year t_1 of college) you would earn:
 $\$15 \times (1 + 10\%) = \$15 \times 1.1 = \$16.50$.
 - ▶ At your second year t_2 of college, you would earn:
 $(\$15 \times (1 + 10\%)) \times (1 + 10\%) = \$15 \times 1.1^2 = \$18.15$.
 - ▶ At your fourth year t_4 of college, you would earn:
 $(((\$15 \times (1 + 10\%)) \times (1 + 10\%)) \times (1 + 10\%)) \times (1 + 10\%) = \$15 \times 1.1^4 = \$21.97$.

★ Please recover the wage you would earn at the third year.



The Scientific Method - Models and data

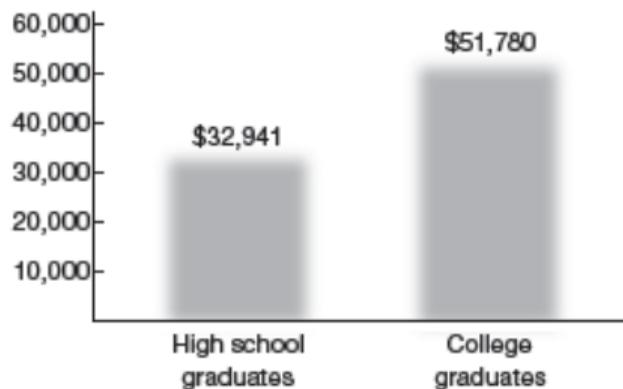
Empirical part with the real data. - Testing

Data collected from the Current Population Survey (CPS).

Exhibit 2.3 Average Annual Earnings of 30-Year-Old Americans by Education Level (2013 data)

Average annual earnings of 30-year-old Americans show that people who stop going to school after earning their high school diplomas earn \$32,941 per year, whereas those who go on to college earn \$51,780 per year.

Source: Current Population Survey.



$$\frac{\text{average salary of 30-year-olds with 16 years of education}}{\text{average salary of 30-year-olds with 12 years of education}} = \frac{\$51,780}{\$32,941} = 1.57$$

The Scientific Method - Models and data



Data shows:

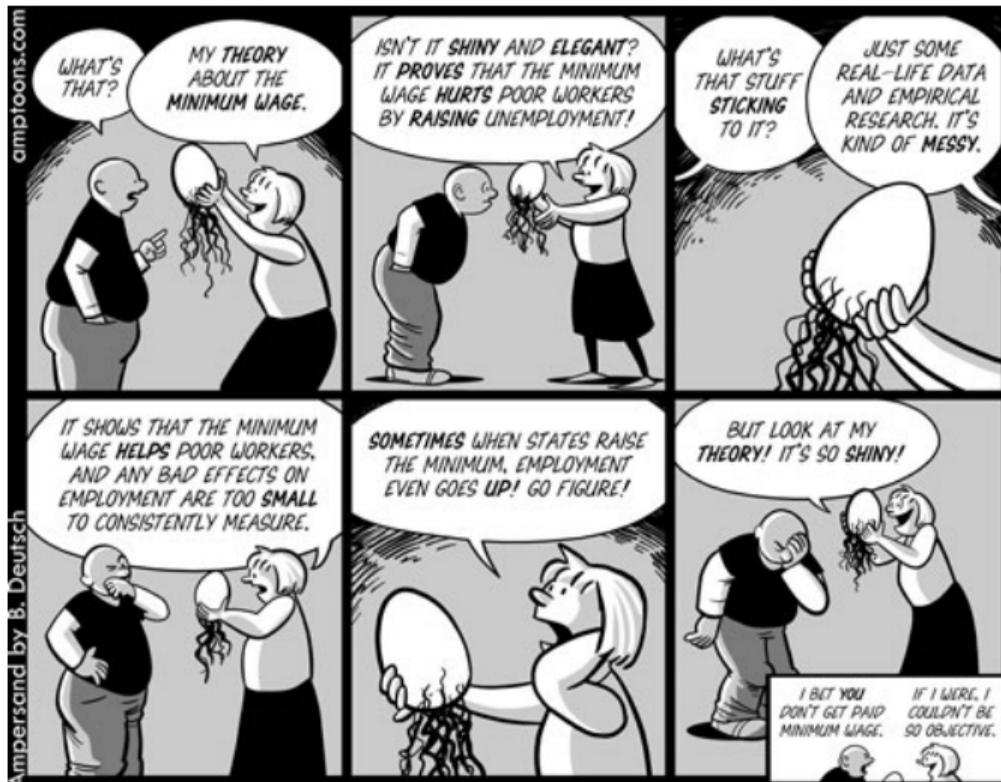
$$\frac{\text{average salary of 30-year-olds with 16 years of education}}{\text{average salary of 30-year-olds with 12 years of education}} = \frac{\$51,780}{\$32,941} = 1.57$$

Model predicts:

$$(1.10)^4 = 1.46$$

Model is an approximation of the real world, not exactly the same.

The Scientific Method - Models and data



The Scientific Method - Statistics



Definition of Means:

The mean (or average) is the sum of all the different values divided by the number of values and is a commonly used technique for summarizing data.

Why we care means?



The Scientific Method - Statistics

Example 3: Means

Say that there are five people: Mr.Kwon, Ms.Littleton, Mr.Locke,Ms.Reye, and Mr.Shephard, each with a different hourly wage:

Kwon = \$26 per hour

Littleton = \$24 per hour

Locke = \$8 per hour

Reye = \$35 per hour

Shephard = \$57 per hour



The Scientific Method - Statistics

Example 3: Means

The mean of there wages.

$$\frac{\$26 + \$24 + \$8 + \$35 + \$57}{5} = \$30$$

The larger the data, the more precise our statistics will be.

Features in data:

- ▶ Observation
- ▶ Waves

Data format:

- ▶ Cross-sectional data
- ▶ Panel data

The Scientific Method - Argument by anecdote



Speaking of Bill Gates.

How does his level of education affect his income?

Bill Gates, Mark Zuckerberg both dropped out from Harvard.



The model depicts a general result, not outliers. - Too cool for school

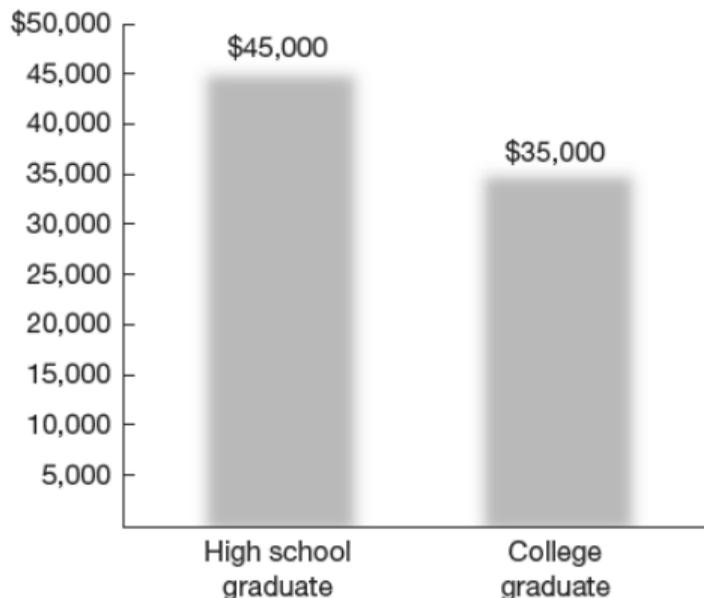
The Scientific Method - Argument by anecdote

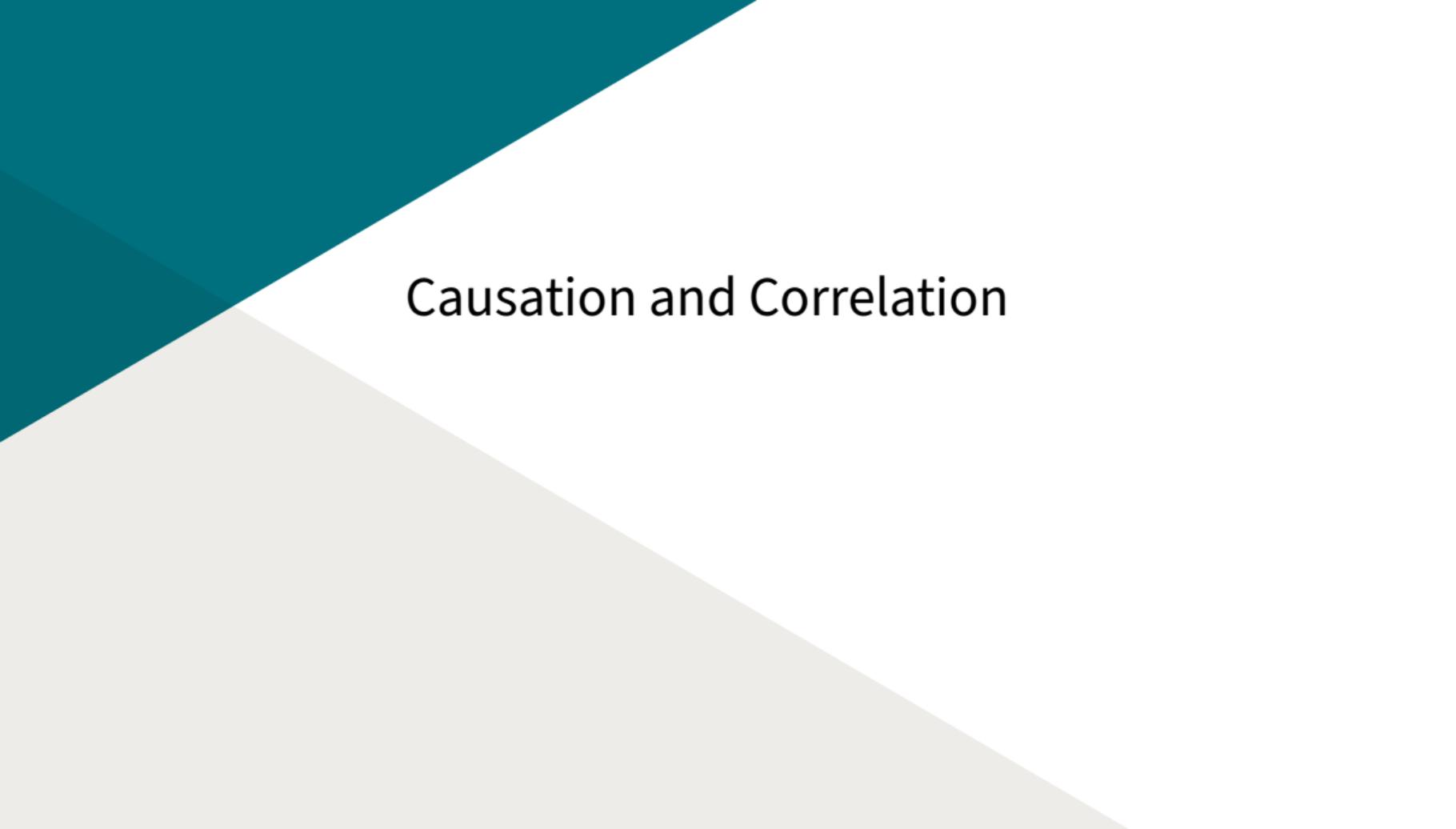


How data can mislead you:

Exhibit 2.4 Annual Earnings for Two 30-Year-Old Americans by Education

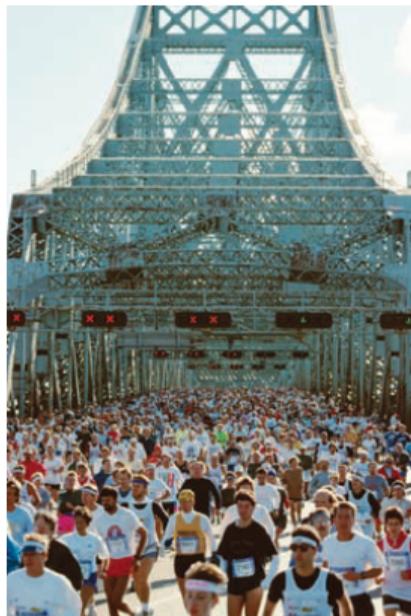
Even though Exhibit 2.3 taught us that the average annual earnings of college graduates is 57 percent higher than those of high school graduates, it is not difficult to find specific examples where a high school graduate is actually earning more than a college graduate. Here we learn of one such example: the high school graduate earns \$45,000 per year, whereas the college graduate earns \$35,000.



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Causation and Correlation

Think about causality



Does jogging cause people to be healthy? Does good health cause people to jog? In fact both kinds of causation are simultaneously true.

- ▶ Correlation may come from different reasons.
 - ▶ Omitted variables
(story about education and income)
 - ▶ Reverse causality
(Entrepreneurship and wealth)
- ▶ Causality is always a concept defined by “what would happen if certain things were changed while others were held fixed”.



Causation and Correlation

Definition of Correlation:

Correlation means that there is a mutual relationship between two things - as one thing changes, the other changes as well.

When two things are related (causation could not be present)

- ▶ **Positive correlation:** they both change in the same direction.
- ▶ **Negative correlation:** they change in opposite directions.
- ▶ **Zero correlation:** In the book, it says when two variables are not related. However, zero correlation is much more mystery.
fixed number is orthogonal to a series of variables. vs. True irrelevant.



Causation and Correlation

Definition of Omitted variables:

An omitted variable is something that has been left out of a study, if included, would explain why two variables are correlated.

Exhibit 2.5 An Example of an Omitted Variable

The amount of red content in Walmart's ads is positively correlated with the growth of Walmart's revenue. In other words, when ads are red-themed, Walmart's month-over-month sales revenue tends to grow the fastest. However, the redness does not cause Walmart's revenue to rise. The Christmas season causes Walmart's ads to be red and the Christmas season also causes Walmart's sales revenue to rise. The Christmas season is the omitted variable that explains the positive correlation between red ads and revenue growth.

Cause: Christmas



(Omitted variable)

Effect: red ads



Effect: rising revenue





Causation and Correlation

Definition of Reverse causality:

Reverse causality is the situation in which we mix up the direction of cause and effect.



Causation or Correlation?



Causation and Correlation

How can we tell the difference between causality and correlation?

▶ **Controlled:**

subjects are randomly put into treatment (something happens) and control (nothing happens) groups by the researcher.

Difficult to do with economic studies.

- ▶ Randomize control trial (RCT) - avoid selection bias. (example of selection bias - job trainer)



Causation and Correlation

Example 4: Lottery for medicaid in Oregon



In

2008, the state of Oregon drew names by lottery for its Medicaid program for low-income, uninsured adults, generating just such an opportunity. This ongoing analysis represents a collaborative effort between researchers and the state of Oregon to learn about the costs and benefits of expanding public health insurance.



Causation and Correlation

How can we tell the difference between causality and correlation?

► **Natural:**

subjects end up in treatment or control groups due to something that is not purposefully determined by the researcher.

Rare to find.