

# Data science for everyone

Prof. Jones-Rooy & Prof. Policastro

Feb. 5, 2020

2.2: Course Technology & More Causality!

## ANNOUNCEMENTS

1. Homework 1 out now; due Tue., Feb. 18, 8p
2. Lab 0 out tonight; due Wed., Feb. 12, 8p
3. Sections this week: Practice assignment completion & submission; Lab 0
  - Bring laptops to section
  - You should never miss section but this week you should **really really really (etc.)** not miss section

# Outline

I. How to complete & submit all assignments in this course

2. Key concepts in causality

3. Principles & types of causality

# HOW TO COMPLETE AND SUBMIT ASSIGNMENTS FOR THIS COURSE

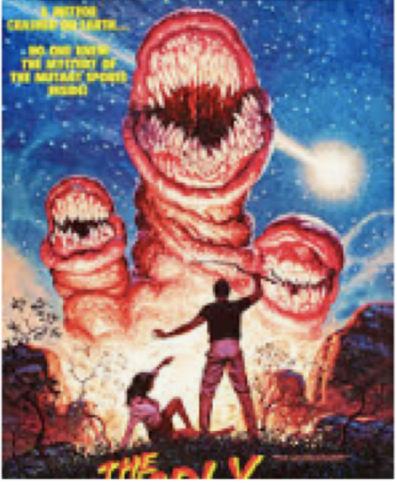
1. Fetch assignment on JupyterHub

2. Complete assignment in that notebook on JupyterHub

3. Submit assignment on JupyterHub (NB-grader)

4. Submit assignment on Gradescope

1. Access the assignment by fetching it under the Assignments tab on JupyterHub
2. Complete the assignment in the spaces provided in the same document you accessed
3. Run tests within the assignment to check your formatting
4. Optional but recommended: **Validate** the entire assignment to again check formatting and ensure you haven't missed any questions
  1. You do not need to validate to submit, but it's a way to make sure you don't lose points for silly mistakes
5. **Submit** the assignment on JupyterHub
6. Go back into the assignment, download it as html, turn the html into a PDF
7. Upload the PDF to **Gradescope**, assign questions to pages, it will also automatically validate when you try to submit
8. Submit the assignment on **Gradescope**



The Deadly Spawn (1987)  
imdb.com

## I. FETCH THE ASSIGNMENT

- All assignments (HWs, labs, project) will be completed in Jupyter notebooks on JupyterHub
- You can access JupyterHub through the tab on our Classes site or by going directly to: <https://dsua-111.rcnyu.org/> (click SPAWN)
- To get the assignments, go to Assignments, then **fetch**.
  - If you want to ever re-fetch (e.g., you're working on it and want to start over with a clean slate), just delete the assignment under **Files** and then re-fetch
- All assignments will be handed out on JupyterHub, and you can complete them directly INSIDE the assignment we give you (there will be space for answers within the document) – so everything happens in the same place
  - The questions are all Read Only so you cannot accidentally delete one
  - You're welcome to make a copy of the assignment to try things out separately before filling out the final version, or just creating your own file to use as scratch paper (I do this a lot!)
  - But, you must submit the version we handed out on the **Assignments tab**. Ultimately, that's where you'll submit assignments, too

# JupyterHub

<https://dsua-111.rcnyu.org>

Where to find all assignments  
for this course



[Logout](#) [Control Panel](#)

Files Running Clusters **Assignments**

Select items to perform actions on them.

[Upload](#) [New ▾](#)

0

/

Name

Last Modified

File size

class\_materials

an hour ago

lost+found

3 hours ago

shared

10 days ago

your\_materials

3 hours ago



[Logout](#) [Control Panel](#)

[Files](#) [Running](#) [Clusters](#) [Assignments](#)

Released, downloaded, and submitted assignments for course:



#### Released assignments

Homework1

dsua-111

[Fetch](#)

#### Downloaded assignments

**There are no downloaded assignments.**

#### Submitted assignments

**There are no submitted assignments.**



[Logout](#) [Control Panel](#)

[Files](#) [Running](#) [Clusters](#) [Assignments](#)

Released, downloaded, and submitted assignments for course: [dsua-111](#) ▾



Released assignments

**There are no assignments to fetch.**

Downloaded assignments

[Homework1](#) ▶

dsua-111

[Submit](#)

Submitted assignments

**There are no submitted assignments.**



[Logout](#) [Control Panel](#)

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Released, downloaded, and submitted assignments for course:

Released assignments

**There are no assignments to fetch.**

Downloaded assignments

[Homework1](#) ▾

dsua-111

[Submit](#)

[Homework1](#)

[Validate](#)

Submitted assignments

**There are no submitted assignments.**



Logout

Control Panel

File Edit View Insert Cell Kernel Widgets Help

Not Trusted

Python 3



## DS-UA 111: Homework One

This homework is due Tuesday, Feb. 18 by 8:00p. Late homework will be graded down, no exceptions. Improperly formatted homeworks also count as late. Note that the course academic honesty policy applies to every homework, including this one. Some of the questions refer to articles, which you can find by clicking on the links.

### Instructions

Work inside this, and ultimately this is what you'll submit  
You will not be able to submit anything you do on separate notebooks or copies (just like we don't grade scratch paper on exams!)

## 2. COMPLETE THE ASSIGNMENT

- The cells where your answers should be typed are clearly marked and will always be one of two possible types: **code** or **Markdown**
  - These types will be pre-set for you in assignments, but your TAs can also show you how to switch between them in your own notebooks (very useful!)
  - **Code** cells are for code (nice) and for multiple choice questions
  - **Markdown** is for short answer questions
- Once you've input your answer, you can run the cell (click RUN or shift+enter while in the cell) to confirm it worked
  - Note: This will only catch blatant programming errors, it will not catch whether you've done it right or wrong
- For **code** questions, you can also run the next cell below it, which is a **test** to make sure your **formatting** is correct.
  - Again, this is not about substantive correctness. It just tells you whether you've answered the question the right way
  - This is a big advantage for you over not using this format as it means you won't lose points for formatting errors, which can be common in programming courses



## **DS-UA 111: Homework One**

This homework is due Tuesday, Feb. 18 by 8:00p. Late homework will be graded down, no exceptions. Improperly formatted homeworks also count as late. Note that the course academic honesty policy applies to every homework, including this one. Some of the questions refer to articles, which you can find by clicking on the links provided. This homework is worth 40 points (one point per sub-question).

### **Instructions**

*Please complete your answers in the spaces provided. They will be either cells for code or Markdown, and we will make it clear within each question how to reply.*

*The submission process for this and all assignments is explained in separate documentation from Lecture 2.2. Make sure to submit your assignment in both NB grader and GradeScope as described in Lecture 2.2.*

---

### **Question 1**

*The following statements arise from various theories. In each case, correctly identify the **independent variable(s)** by typing the letter of your intended answer in place of 'X'. For example, if you want to indicate your answer is A, please type 'A' instead of the 'X' that is currently there. Note you must retain the quotation marks around 'A'.*

## Question 1

The following statements arise from various theories. In each case, correctly identify the **independent variable(s)** by typing the letter of your intended answer in place of 'X'. For example, if you want to indicate your answer is A, please type 'A' instead of the 'X' that is currently there. Note you must retain the quotation marks around 'A'.

**(a) Cholera infection is caused by drinking from the Broad Street pump.**

Type the letter of the option that represents the independent variable(s):

- A. Cholera
- B. Infection with cholera
- C. The Broad Street pump
- D. Drinking from the Broad Street pump
- E. None of the above

```
In [ ]: q1a_answer = 'X'
```

```
In [ ]: ### BEGIN PUBLIC TESTS
assert 'q1a_answer' in locals()
assert q1a_answer.upper() in ['A', 'B', 'C', 'D', 'E']
### END PUBLIC TESTS
```

**(b) Successful people are successful because they wake up early!**

Type the letter of the option that represents the independent variable(s):

Insert Cell Kernel Widgets Help



Or run from menu

wer in place of 'X'. For example, if you want to  
quotation marks around 'A'.

the quotation marks around 'A'.

**(a) Cholera infection is caused by drinking from the Broad Street pump.**

Type the letter of the option that represents the independent variable(s):

- A. Cholera
- B. Infection with cholera
- C. The Broad Street pump
- D. Drinking from the Broad Street pump
- E. None of the above

In [3]: `q1a_answer = 'A'`

Shift + Enter to run

In [ ]: `### BEGIN PUBLIC TESTS`  
`assert 'q1a_answer' in locals()`  
`assert q1a_answer.upper() in ['A', 'B', 'C', 'D', 'E']`  
`### END PUBLIC TESTS`

E. None of the above

In [4]: `q1a_answer = 'A'`  
`aa`

```
-----  
NameError                                     Traceback (most recent call last)  
<ipython-input-4-7ba1507086c7> in <module>  
      1 q1a_answer = 'A'  
----> 2 aa  
  
NameError: name 'aa' is not defined
```

This tells me my formatting is wrong

- A. Cholera
- B. Infection with cholera
- C. The Broad Street pump
- D. Drinking from the Broad Street pump
- E. None of the above

```
In [5]: q1a_answer = 'A'
```

```
In [6]: ### BEGIN PUBLIC TESTS
assert 'q1a_answer' in locals()
assert q1a_answer.upper() in ['A', 'B', 'C', 'D', 'E']
### END PUBLIC TESTS
```

Run

Run

## WE ARE GOOD ON FORMATTING!

But: Note this does **not** tell me if my answer is **correct**. It just helps as a failsafe against losing points for formatting/non-substantive or silly errors

Another failsafe!

In [7]: `q1a_answer = 'X'`

Technically my formatting is correct

In [8]: `### BEGIN PUBLIC TESTS  
assert 'q1a_answer' in locals()  
assert q1a_answer.upper() in ['A', 'B', 'C', 'D', 'E']  
### END PUBLIC TESTS`

But it's not one of the possible options

AssertionError Traceback (most recent call last)  
<ipython-input-8-5d96dd7976bd> in <module>

1 `### BEGIN PUBLIC TESTS`  
2 `assert 'q1a_answer' in locals()`  
----> 3 `assert q1a_answer.upper() in ['A', 'B', 'C', 'D', 'E']`  
4 `### END PUBLIC TESTS`

AssertionError:

## WE ARE GOOD ON TYPE OF ANSWER

```
In [9]: q1a_answer = 'A'

In [10]: ### BEGIN PUBLIC TESTS
          assert 'q1a_answer' in locals()
          assert q1a_answer.upper() in ['A','B','C','D','E']
### END PUBLIC TESTS
```

Again, this does not tell you whether the answer is correct.  
Your TAs will grade and then you'll know if it's correct!

## Markdown example

The screenshot shows a Jupyter Notebook interface with a purple header bar containing the title "Markdown example". Below the header is a toolbar with various icons for file operations, cell selection, and kernel management. The main content area contains a section titled "Question 3" followed by a text block and three numbered questions. The first question has a placeholder "YOUR ANSWER HERE" below it.

**Question 3**

*Read the article, “[New Study examines the effect of ‘open’ adoption on families](#),” which reports on*

**(a) What is the dependent variable in this study?**

YOUR ANSWER HERE

**(b) What is the independent variable(s) in this study?**

YOUR ANSWER HERE

**(c) In order to conduct an experiment, we need to have a treatment and a control group. Wh**

## **Question 3**

Read the article, "[New Study examines the effect of 'open' adoption on family members](#)"

**(a) What is the dependent variable in this study?**

YOUR ANSWER HERE

**(b) What is the independent variable(s) in this study?**

YOUR ANSWER HERE

**(c) In order to conduct an experiment, we need to have a treatment and a control group. Do you think this study had a treatment and a control group? Why or why not?**

YOUR ANSWER HERE

## **Question 3**

Read the article, "[New Study examines the effect of 'open' adoption on family members](#)"

**(a) What is the dependent variable in this study?**

here is my answer

**(b) What is the independent variable(s) in this study?**

YOUR ANSWER HERE

## **Question 3**

Read the article, "[New Study examines the effect of 'open' adoption on family members](#)"

**(a) What is the dependent variable in this study?**

here is my answer

Run, as before

**(b) What is the independent variable(s) in this study?**

YOUR ANSWER HERE

**(g) We learned in lecture that you cannot manipulate lists as much as arrays in Python. Yes or no?**

YOUR ANSWER HERE

## **End of Homework**

Please remember to submit it correctly -- as shown in Lecture 2.2 and practiced in Lab 0!

**We got to the end!**

### 3. SUBMIT THE ASSIGNMENT ON JUPYTERHUB

- Optional: Validate
  - Either within the notebook or under the Assignments tab
- Submit the assignment under the Assignments tab
- Observe the timestamp confirming you have submitted it
- You can submit many times, but we will **only** grade the most recent
- If the most recent is **after** the deadline, it counts as **late**
  - **NO exceptions**



File Edit View Insert Cell Kernel Widgets Help

Not Trusted



Run

Markdown

Validate

In [ ]: ages\_list = ...

ages\_mean\_list = ...

In [ ]: *### BEGIN PUBLIC TESTS*  
assert 'ages\_list' in locals()  
assert 'ages\_mean\_list' in locals()  
*### END PUBLIC TESTS*

(g) We learned in lecture that you cannot manipulate lists as much as arrays in Python. Yet, the mean calculation worked for this list. Why?

YOUR ANSWER HERE

## End of Homework

Please remember to submit it correctly -- as shown in Lecture 2.2 and practiced in Lab 0!

## Validation Results

X

The following cell failed:

```
### BEGIN PUBLIC TESTS
assert 'q1b_answer' in locals()
assert q1b_answer.upper() in ['A','B','C','D','E']
### END PUBLIC TESTS
```

```
AssertionError                                     Traceback (most recent call last)
<ipython-input-4-0b9629723ec6> in <module>
      1 ### BEGIN PUBLIC TESTS
      2 assert 'q1b_answer' in locals()
----> 3 assert q1b_answer.upper() in ['A','B','C','D','E']
      4 ### END PUBLIC TESTS
```

```
AssertionError:
```

The following cell failed:

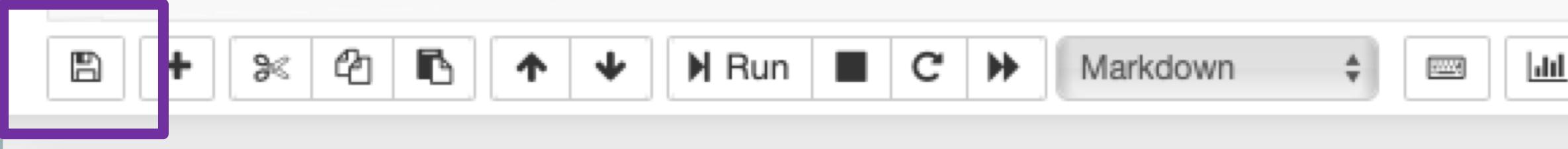
```
### BEGIN PUBLIC TESTS
assert 'q1c_answer' in locals()
assert q1c_answer.upper() in ['A','B','C','D','E']
### END PUBLIC TESTS
```

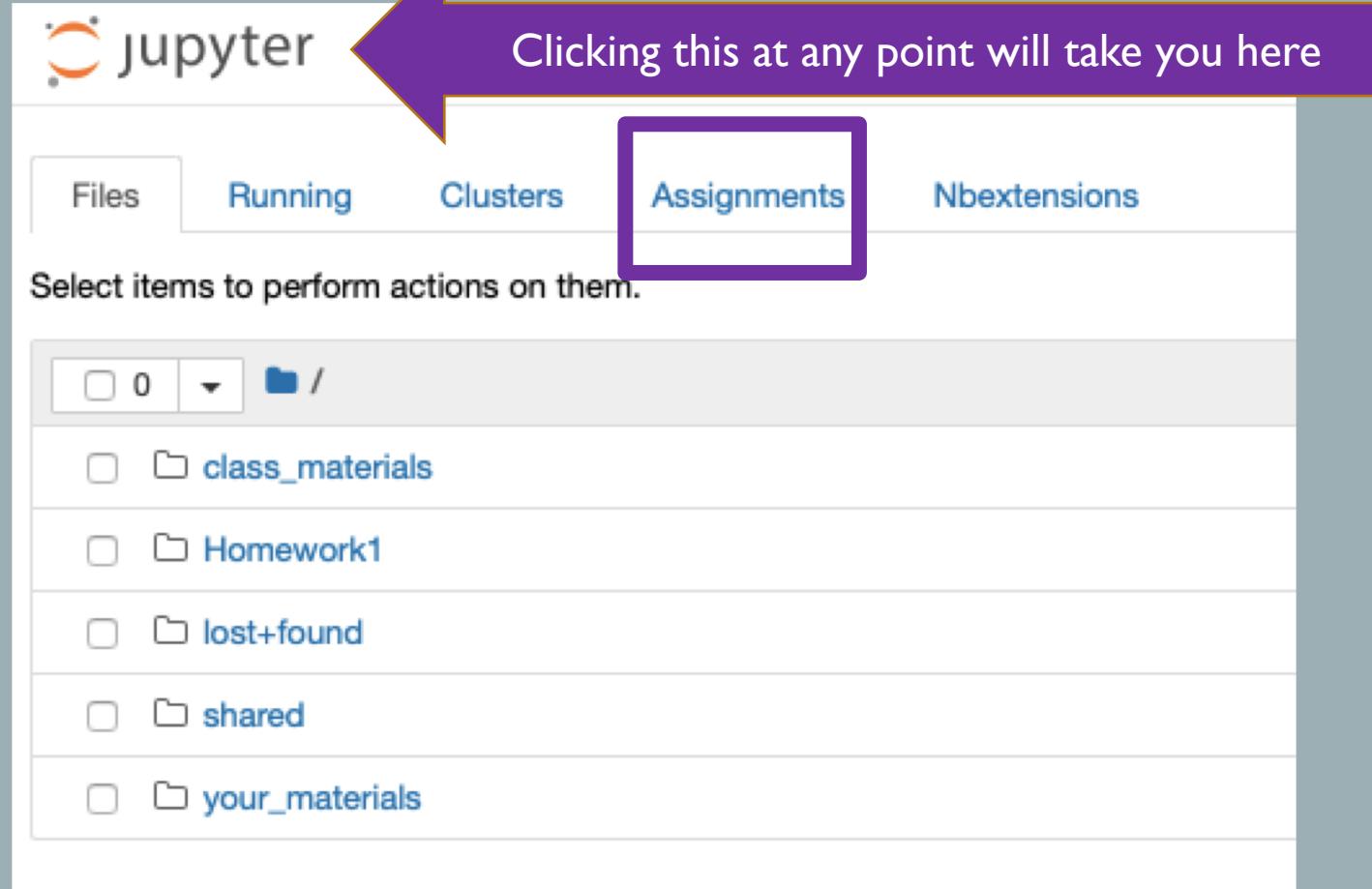
```
AssertionError                                     Traceback (most recent call
<ipython-input-6-d795c9f86ee4> in <module>
```

OK

# jupyter Homework1 Last Checkpoint: a few seconds ago (autosaved)

File Edit View Insert Cell Kernel Widgets Help





[Files](#) [Running](#) [Clusters](#) [Assignments](#) [Nbextensions](#)

Released, downloaded, and submitted assignments for course: dsua-111 ▾



## Released assignments

**There are no assignments to fetch.**

## Downloaded assignments

Homework1 ▾

[Homework1](#)

dsua-111

[Submit](#)[Validate](#)

Exact same as validating within the notebook

[Files](#)[Running](#)[Clusters](#)[Assignments](#)[Nbextensions](#)Released, downloaded, and submitted assignments for course: [dsua-111](#) ▾

Released assignments

**There are no assignments to fetch.**

Downloaded assignments

[Homework1](#) ▶

dsua-111

[Submit](#)

Submitted assignments

Homework1

dsua-111

[Fetch Feedback](#)

2020-02-04 17:15:00.415028 UTC

2020-02-04 17:15:04.650087 UTC

2020-02-04 17:15:07.408753 UTC

2020-02-04 17:16:56.691893 UTC (feedback available to fetch)

2020-02-04 17:19:09.327620 UTC

2020-02-04 19:33:29.833305 UTC

2020-02-05 18:17:33.481367 UTC

2020-02-05 18:17:36.858658 UTC

2020-02-05 18:17:40.458098 UTC

Don't worry, it's extremely unlikely and  
not recommended that you submit the  
assignment this many times!

## 4. SUBMIT TO GRADESCOPE

- Go back into the assignment you just submitted
- Go to File > Download as > HTML (.html)
- Download as html
- Find the file on your computer and open it
- Log into Gradescope and find the assignment (e.g., Homework1)
- Manually assign questions to pages
  - E.g., Question 1a appears on page 1, so click page 1
  - If a question spans more than one page, click both pages
- Submit (noting unmatched pages and questions and checking for errors)
  - E.g., if instructions are on page 1, Gradescope will say “you haven’t assigned any questions to page 1”
  - If you forgot to assign a question to a page, Gradescope will say “you haven’t assigned a page to this question”
- Again, this is a check for your protection from silly/non-substantive mistakes!



File

Edit View Insert Cell Kernel Widgets Help

New Notebook

Open...

Make a Copy...

Save as...

Rename...

Save and Checkpoint

Revert to Checkpoint

Print Preview

Download as

Trusted Notebook

Close and Halt



Markdown



## DS-UA 111: Homework One

homework is due Tuesday, Feb. 18 by 8:00p. Late homework will be graded down, no exceptions. Improper Note that the course academic honesty policy applies to every homework, including this one. Some of the by clicking on the links provided. This homework is worth 40 points (one point per sub-question).

AsciiDoc (.asciidoc)  
HTML (.html)

LaTeX (.tex)  
Markdown (.md)  
Notebook (.ipynb)  
PDF via LaTeX (.pdf)  
reST (.rst)  
Python (.py)  
Reveal.js slides (.slides.html)

spaces provided. They will be either cells for code or Markdown, and we v

all assignments is explained in separate documentation from Lecture 2.2. M  
ibed in Lecture 2.2.

### Question 1

The following statements arise from various theories. In each case, correctly identify the **independent variable** answer in place of 'X'. For example, if you want to indicate your answer is A, please type 'A' instead of the 'X' th

The screenshot shows a web browser window with the following details:

- Address Bar:** file:///Users/andreajones-rooy/Downloads/Homework1.html
- Header:** Home | Home Page - Select or create a notebook | Homework1 - Jupyter Notebook | Homework1

The main content area contains the following text:

## **DS-UA 111: Homework One**

This homework is due Tuesday, Feb. 18 by 8:00p. Late homework will be graded down, no exceptions. Improperly formatted homeworks also count as late. Note that the course academic honesty policy applies to every homework, including this one. Some of the questions refer to articles, which you can find by clicking on the links provided. This homework is worth 40 points (one point per sub-question).

### **Instructions**

*Please complete your answers in the spaces provided. They will be either cells for code or Markdown, and we will make it clear within each question how to reply.*

*The submission process for this and all assignments is explained in separate documentation from Lecture 2.2. Make sure to submit your assignment in both NB grader and GradeScope as described in Lecture 2.2.*

---

### **Question 1**

*The following statements arise from various theories. In each case, correctly identify the **independent variable(s)** by typing the letter of your intended answer in place of 'X'. For example, if you want to indicate your answer is A, please type 'A' instead of the 'X' that is currently there. Note you must retain the quotation marks around 'A'.*

**(a) Cholera infection is caused by drinking from the Broad Street pump.**

Safari File Edit View History Bookmarks Window Help

New Window ⌘N  
New Private Window ⌘⇧N  
New Tab ⌘T  
Open File... ⌘O  
Open Location... ⌘L  
Close Window ⌘W  
Close All Windows ⌘⌥W  
Close Tab ⌘W  
Save As... ⌘S  
Share ►  
Export as PDF... ►  
Import From ►  
Export Bookmarks... ►

file:///Users/andreajones-rooy/Downloads/Homework1.html

DS-UA 111: Homework One

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Please complete your answers in the spaces provided. They will be either cells for code or Markdown, and we will make it clear within each question how to reply.

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## Question 1

The following statements arise from various theories. In each case, correctly identify the **independent variable(s)** by typing the letter of your intended answer in place of 'X'. For example, if you want to indicate your answer is A, please type 'A' instead of the 'X' that is currently there. Note you must retain the quotation marks around 'A':

(a) Cholera infection is caused by drinking from the Broad Street pump.

Homework1.pdf (page 1 of 16)

Search

# **DS-UA 111: Homework One**

This homework is due Tuesday, Feb. 18 by 8:00p. Late homework will be graded down, no exceptions. Improperly formatted homeworks also count as late. Note that the course academic honesty policy applies to every homework, including this one. Some of the questions refer to articles, which you can find by clicking on the links provided. This homework is worth 40 points (one point per sub-question).

## **Instructions**

Please complete your answers in the spaces provided. They will be either cells for code or Markdown, and we will make it clear within each question how to reply

# Homework 1 | Assign Questions and Pages

SUBMITTED AT: FEBRUARY 5, 10:40 AM

Select questions and pages to indicate where your responses are located. Use **esc** to deselect all items and hold **shift** to select multiple questions.

## Question Outline

Select a question or a page.

TITLE	POINTS
-------	--------

**1 Question 1** 0.0 pts

**1.1 Q1A** 0.0 pts

**1.2 Q1B** 0.0 pts

**1.3 Q1C** 0.0 pts

**1.4 Q1D** 0.0 pts

**1.5 Q1E** 0.0 pts

**1.6 Q1F** 0.0 pts

**2 Question 2** 5.0 pts

**2.1 Q2A** 0.0 pts

**2.2 Q2B** 1.0 pt

**2.3 Q2C** 1.0 pt

**2.4 Q2D** 1.0 pt

**DS-UA 111: Homework One**

**Instructions**

Please complete your answers in the spaces provided. They will either call for code or text/drawings and we will grade it clear within each question here in your assignment.

The submission process for this and all exercises is outlined in separate documentation from Lecture 2. Make sure to submit your assignments in both MS Word and Google Sheets as described in Lecture 2.

**Question 1**

The following statements arise from various theories. In each case, correctly identify the independent variable by typing the letter of your selected answer in place of "X". For example, if you want to indicate your answer is A, type in "A" instead of "X" in one of the "X" that is currently there. Then you must enter the question meta exactly A.

(a) Cholera infection is caused by drinking from the Broad Street pump.

A. Cholera  
B. Infection with cholera  
C. The Broad Street pump  
D. Drinking from the Broad Street pump  
E. None of the above

1.1\_a  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"  
 **ANSWER** = "D"  
 **ANSWER** = "E"

**Question 2**

The following statements arise from various theories. In each case, correctly identify the independent variable by typing the letter of your selected answer in place of "X". For example, if you want to indicate your answer is A, type in "A" instead of "X" in one of the "X" that is currently there. Then you must enter the question meta exactly A.

(b) The state of the economy, the extent of foreign war, and the number of current political scandals tend to determine whether a president is re-elected.

A. Economy  
B. Foreign war  
C. Number of political scandals  
D. All of the above  
E. The president  
F. Presidential election

1.1\_b  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"  
 **ANSWER** = "D"  
 **ANSWER** = "E"  
 **ANSWER** = "F"

**Question 3**

Read the article, "New Study Examines the Effect of 'Open' Adoption on Families" (<https://www.your.org/article/new-study-examines-the-effect-of-open-adoption-on-families/>), which reports on recent research from the University of Massachusetts.

(a) What is the dependent variable in this study?

YOUR ANSWER HERE

(b) What is the independent variable in this study?

YOUR ANSWER HERE

(c) In order to conduct an experiment, we need to have a treatment and a control group. What is the treatment group in this case?

YOUR ANSWER HERE

(d) Assessment to the treatment group is not randomized in this case. Does that make this study observational or an experiment?

Take the letter of the option that represents your answer:

A. Observational  
B. Experiment  
C. Both  
D. Neither  
E. Not enough information to know

1.1\_c  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"  
 **ANSWER** = "D"  
 **ANSWER** = "E"

**Question 4**

Read the abstract of this study, "Change in the Rate of Biological Aggression in Response to Caloric Restriction" (<https://www.ncbi.nlm.nih.gov/pmc/articles/2853126/>).

(a) Is this an observational study or an experiment?

Take the letter of the option that represents your answer:

A. Observational  
B. Experiment  
C. Both  
D. Neither  
E. Not enough information to know

1.1\_d  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"  
 **ANSWER** = "D"  
 **ANSWER** = "E"

**Successful people are successful because they wake up early!**

Type the letter of the option that represents the independent variable.

A. People  
B. Successful people  
C. Good health  
D. All of the above  
E. None of the above

1.1\_a  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"  
 **ANSWER** = "D"  
 **ANSWER** = "E"

**Question 5**

The letter on the autism spectrum has a strong genetic basis, though the environment may matter as well.

Type the letter of the option that represents the independent variable.

A. Being on the autism spectrum  
B. Genetics  
C. Environment  
D. All of the above

1.1\_b  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"  
 **ANSWER** = "D"

**Question 6**

What is the causal mechanism in this theory?

A. Cholera outbreak  
B. The Broad Street Pump  
C. The Broad Street pump collected contaminated discharge from the River Thames  
D. The River Thames  
E. None of the above

1.1\_c  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"  
 **ANSWER** = "D"  
 **ANSWER** = "E"

**EEG activity during sleep**

Type the letter of the option that represents the causal mechanism.

A. Cholera outbreak  
B. The Broad Street Pump  
C. The Broad Street pump collected contaminated discharge from the River Thames  
D. The River Thames  
E. None of the above

1.1\_d  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"  
 **ANSWER** = "D"  
 **ANSWER** = "E"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_e  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_f  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_g  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_h  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_i  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_j  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_k  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_l  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_m  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_n  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_o  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_p  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_q  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_r  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_s  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_t  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_u  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_v  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_w  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_x  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_y  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_z  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_aa  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_bb  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_cc  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_dd  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_ee  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_ff  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_gg  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_hh  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_ii  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_jj  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_kk  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_ll  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_mm  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_nn  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_oo  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_pp  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_qq  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_rr  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_ss  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_tt  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_uu  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_vv  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_xx  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_yy  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_zz  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_aa  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_bb  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_cc  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_dd  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_ee  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_ff  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_gg  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_hh  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_ii  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_jj  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_kk  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_ll  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_mm  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_nn  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_oo  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_pp  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_qq  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_rr  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_ss  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_tt  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_uu  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_vv  **ANSWER** = "A"  
 **ANSWER** = "B"  
 **ANSWER** = "C"

**EEG causes public tests**

Type the letter of the option that represents the independent variable.

A. EEG  
B. Public tests  
C. All of the above

1.1\_xx  **ANSWER** = "A"  
 <b

## Question Outline

Select pages to assign to Question 1.3.

### TITLE

### POINTS

1 Question 1

0.0 pts

1.1 Q1A

0.0 pts

P1 ×

1.2 Q1B

0.0 pts

P1 ×

1.3 Q1C

0.0 pts

P1 ×

### DS-UA 111: Homework One

This homework is due Tuesday, Feb. 18 by 8:00p. Late homework will be graded down, no exceptions. Improperly formatted homeworks also count as late. Note that the course academic honesty policy applies to every homework, including this one. Some of the questions refer to articles, which you can find by clicking on the links provided. This homework is worth 41 points (one point per sub-question).

#### Instructions

Please complete your answers in the spaces provided. There will be other cells for code or Markdown, and we will make it clear within each question how to use.

The submission process for this and all assignments is explained in separate documentation from Lecture 2.2. Make sure to submit your assignment in both NEI grader and GradeScope as described in Lecture 2.2.

#### Question 1

The following statements arise from various experiments. In each case, correctly identify the independent variable by typing the letter of your choice followed by a choice of 'X'. For example, if you want to indicate your answer is A, please type 'A' instead of the 'X' that I currently have. Note you must retain the quotation marks around 'A'.

(a) Cholera infection is caused by drinking from the Broad Street pump.

- Type the letter of the option that represents the independent variable(s).  
A. Cholera  
B. Infection with cholera  
C. The Broad Street pump  
D. Drinking from the Broad Street pump  
E. None of the above

In 1\_1\_a g1a\_answer = 'X'

In 1\_1\_a ## BEGIN PUBLIC REGION  
assert g1a\_answer.islower()  
assert g1a\_answer.upper() in ('A','B','C','D','E')  
## END PUBLIC REGION

1

Q1.1 ×

Q1.2 ×

Q1.3 ×



24/260 Homework  
X Natural experiments aren't possible in every case. What was the crucial element in this case that allowed Snow to reasonably assign treatment and control groups?

## Question Outline

Select pages to assign to Question 1.4.

**TITLE**                    **POINTS**

1 Question 1            0.0 pts

1.1 Q1A                0.0 pts

P1 x

1.2 Q1B                0.0 pts

P1 x

1.3 Q1C                0.0 pts

P1 x

1.4 Q1D                0.0 pts

P2 x    P3 x

1.5 Q1E                0.0 pts

**DS-UA 111: Homework One**

This homework is due Tuesday, Feb. 18 by 8:00pm. Late homework will be graded down, no exceptions. Improperly formatted homework also count as late. Note that the course academic honesty policy applies to every homework, including this one. Some of the questions refer to articles which you can find by clicking on the links provided. This homework is worth 41 points (one point per sub-question).

**Instructions**

Please complete your answers in the spaces provided. They will be either cells for code or Markdown, and we will make it clear within each question how to reply.

The submission process for this and all assignments is explained in separate documentation from Lecture 2.2. Make sure to submit your assignment in both NB grader and GradeScope as described in Lecture 2.2.

**Question 1**

The following statements arise from various theories. In each case, correctly identify the independent variable(s) by typing the letter of your intended answer in place of 'X'. For example, if you want to indicate your answer is A, please type 'A' instead of the 'X' that is currently there. Note you must retain the quotation marks around 'A'.

(a) Cholera infection is caused by drinking from the Broad Street pump.

Type the letter of the option that represents the independent variable(s).  
 A. Cholera  
 B. Infection with cholera  
 C. The Broad Street pump  
 D. Drinking from the Broad Street pump  
 E. None of the above

```
In [1]: n1a_answer = 'X'

In [1]: ## BEGIN PUBLIC TESTS
assert 'n1a_answer' in locals()
assert n1a_answer.upper() in ('A', 'B', 'C', 'D', 'E')
## END PUBLIC TESTS
```

**1**    **Q1.1 x**    **Q1.2 x**    **Q1.3 x**    **C**

(b) Successful people are successful because they wake up early.

Type the letter of the option that represents the independent variable(s).  
 A. People  
 B. Successful people  
 C. Waking up early  
 D. All of the above  
 E. None of the above

```
In [1]: n1b_answer = 'X'

In [1]: ## BEGIN PUBLIC TESTS
assert 'n1b_answer' in locals()
assert n1b_answer.upper() in ('A', 'B', 'C', 'D', 'E')
## END PUBLIC TESTS
```

**2**    **Q1.4 x**    **C**

(c) If Trump can motivate his base, he will win re-election.

Type the letter of the option that represents the independent variable(s).  
 A. Trump  
 B. Trump's base  
 C. Trump motivating his base  
 D. Trump winning re-election  
 E. None of the above

```
In [1]: n1c_answer = 'X'

In [1]: ## BEGIN PUBLIC TESTS
assert 'n1c_answer' in locals()
assert n1c_answer.upper() in ('A', 'B', 'C', 'D', 'E')
## END PUBLIC TESTS
```

(d) The state of the economy, the extent of foreign wars, and the number of current political scandals tend to determine whether a president gets re-elected.

Type the letter of the option that represents the independent variable(s).  
 A. State of the economy  
 B. Extent of foreign wars  
 C. Number of political scandals  
 D. A and B  
 E. A, B, and C  
 F. The president  
 G. Re-election  
 H. Presidential re-election

**3**    **Q1.4 x**    **C**

(e) Being on the autism spectrum has a strong genetic basis, though the environment may matter as well.

Type the letter of the option that represents the independent variable(s).  
 A. Being on the autism spectrum  
 B. Genetics  
 C. Environment  
 D. Genetics and environment  
 E. All of the above

```
In [1]: n1e_answer = 'X'

In [1]: ## BEGIN PUBLIC TESTS
assert 'n1e_answer' in locals()
assert n1e_answer.upper() in ('A', 'B', 'C', 'D', 'E')
## END PUBLIC TESTS
```

**Question 2**

After John Snow examined the epidemiological effect of the Broad Street pump, he had a theory that the cholera outbreak was due to the fact that the water collected by the S&V company was collected downstream of sewage discharge into the River Thames.

**1**    **Q1.1 x**    **Q1.2 x**    **Q1.3 x**    **C**

(f) Natural experiments aren't possible in every case. What was the crucial element in this case that allowed Snow to reasonably assign treatment and control groups?

**2**    **Q1.4 x**    **C**

(g) If we did try to randomize treatment in this case, why would it be difficult in terms of "compliance"?

35

## Unmatched Pages & Questions

 You haven't matched all pages and questions.

**Pages 2, 3, 6, 10, and 11** don't have associated questions.

**Questions 1.4, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 5.1, 5.2, 5.3, 6.1, 6.2, 7.1, 7.2, 7.3, 8.1, 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, and 10** don't have associated pages.

You can still submit your assignment without these pages associated, however we recommend matching all pages so that graders can easily find your work.

[Continue Matching](#)

[Submit Assignment](#)

## SUMMARY OF THE ENTIRE PROCESS

1. Fetch assignment  
on JupyterHub

2. Complete  
assignment in that  
notebook on  
JupyterHub

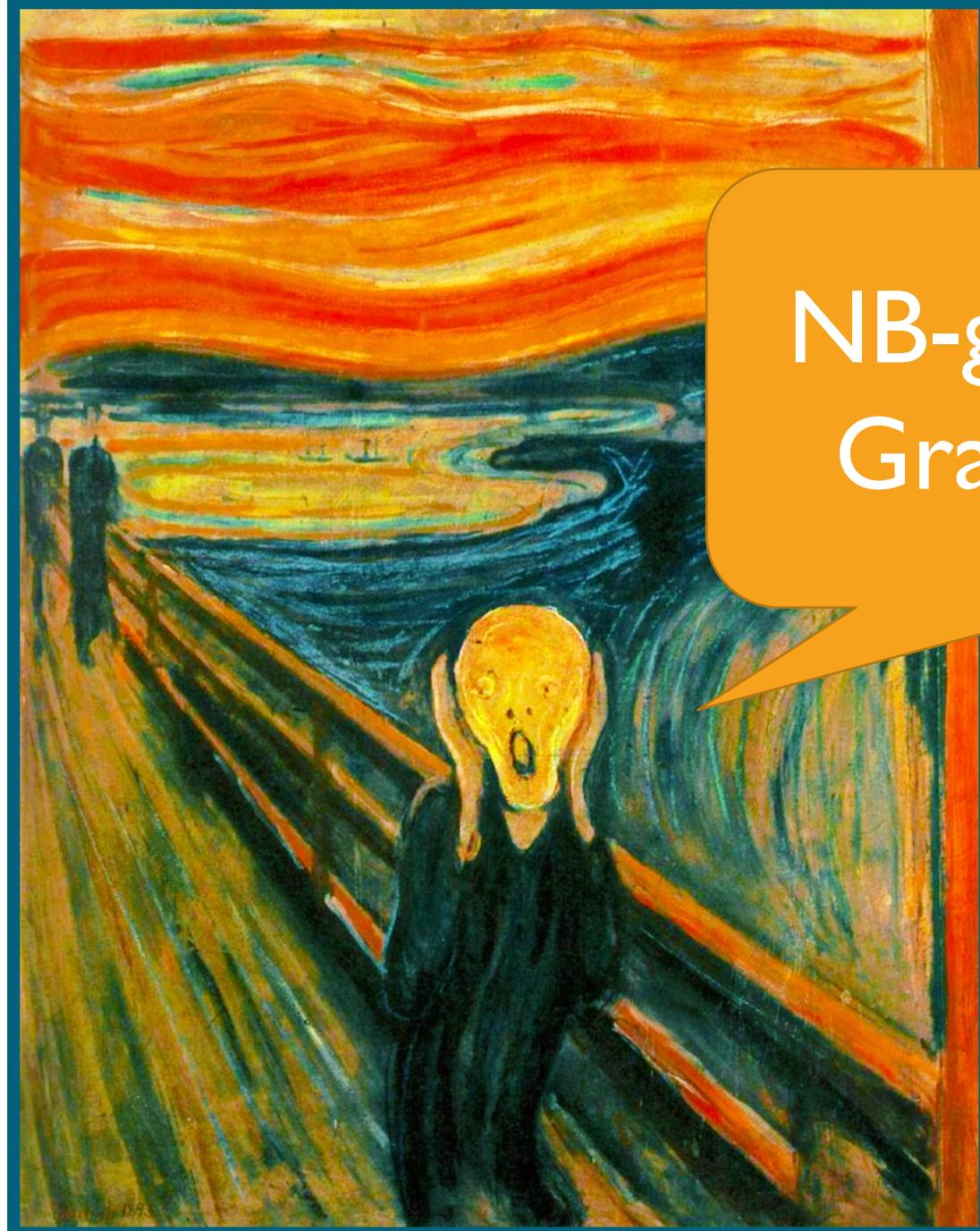
3. Submit  
assignment on  
JupyterHub  
(NB-grader)

4. Submit  
assignment on  
Gradescope

# WHY ARE WE MAKING YOU DO ALL THIS CRAP?

1. You get more feedback more quickly
2. You get more coding practice
  - In a course this size, we cannot assign this many labs without these platforms, so you get more practice
3. You will encounter these platforms in other courses across NYU, and will definitely encounter them in the data science program (e.g., IDS uses the same workflow)
4. When you have jobs as data scientists (companies, government, universities, think tanks, non-profits): You **will** be navigating multiple platforms, some of which are public/you know and some of which are unique to that company
5. You can easily & quickly ask for question-specific regrades rather than have to wait for office hours or exchange a bunch of emails/meetings.
  - That said, do not abuse this power!
6. The alternative is just as complex and less useful to you
  - Write own notebook/doc, often take screenshots, create PDF, upload to Classes, resubmission is very hard, resubmission is very difficult on Classes, regrade requests are much more time-consuming
7. It's **exactly** the same for **all** assignments, and will get easy, we promise! (and TAs have done this in their own courses)





NB-grader AND  
Gradescope?!??!

# Outline

I. How to complete & submit all assignments in this course

2. Key concepts in causality

3. Principles & types of causality

# KEY CONCEPTS IN CAUSALITY

## Lecture 2.1

- Theory
- Good theory
- Observable implication
- Hypothesis
- Causal mechanism
- Association
- Causation
- Experiment
- Treatment
- Control
- Randomization
- Natural experiment

Happening now!

- Independent variable
- Dependent variable
- Confounders
- Deterministic vs. Probabilistic causality
- Selecting on the dependent variable
- Endogeneity
- Necessary and. sufficient conditions

# OBSERVATIONAL VS. EXPERIMENTAL STUDIES

- **Observational:** We look at data from the world and test hypotheses as best we can, but we cannot infer causality
  - Typically our inferences are limited to associations
- **Experimental:** Treatment and control groups where subjects have been randomized into the groups. Ideally double-blind
  - We still can't **conclude** causality, and we cannot **prove**, but we can make much stronger inferences
  - We like experimental studies because they help us more rigorously explore the **counterfactual** (it isn't the counterfactual exactly, but it's as close as we can get)
  - We like randomization because it protects us (hopefully) against selection bias
  - When we can't do a randomized, controlled experiment, we can creatively think about natural experiments
  - Does this mean observational studies are useless?
    - No, but it means being cautious and humble when interpreting results
    - And following good principles, like not selecting on the dependent variable

Uncertainty is a  
big part of this  
process!

And that's ok!  
Often good,  
even!

# EXAMPLES OF NATURAL EXPERIMENTS



- The US military service draft lottery
  - During the Vietnam war, young men were drafted by a lottery that pulled birthdays
  - This means it was random and presumably unrelated to relevant features of who ended up serving in the army
  - This means after the war, we can study things like the effect of war on, e.g., mental health, income, family status, etc. etc.
- A new highway in India
  - Does living within easy access to a hospital lead to better health outcomes?
- The *NYTimes* science section
  - Does publication in the *New York Times* science section increase citations of scientific papers?
- Air pollution effects on health in Beijing
  - Does exposure to air pollution from vehicle traffic lead to more trips to the hospital with lung issues?

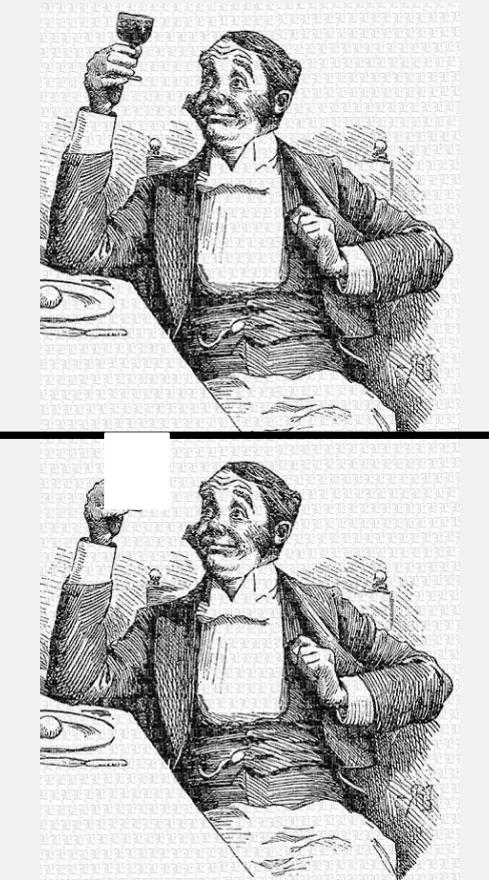


# CONFOUNDING AND CONFOUNDERS

- Snow couldn't control the assignment of the treatment.
  - E.g., he couldn't randomize
  - So, he had to worry about **confounders**: factors that are different between treatment and control groups that could be affecting their outcomes (separate to the treatment).
  - E.g., we observe that people who attend church regularly tend to be more optimistic about life than those that don't. Is this the **causal effect** of church? What might be a **confounder**?

## SAME RULES APPLY FOR OBSERVATIONAL STUDIES

- To test a ***hypothesis***, we need to compare units with different values on the ***independent variables*** (treatment status) in terms of whether this results in different values on their ***dependent variables*** (outcomes)
- Obviously, the variables must ***vary!*** People need to have different values of X (and Y).
- Less obviously, ***don't select on the dependent variable*** and try to draw conclusions about what generates that outcome!



# INDEPENDENT & DEPENDENT VARIABLES

- **Dependent variable:** The thing we are trying to explain
- **Independent variable(s):** The thing(s) we think explain the dependent variable
- Example: My grandmother used to tell me that if I went outside in the winter with wet hair I would catch a cold
  - **Independent variable (IV):** Going outside with wet hair
  - **Dependent variable (DV):** Catching a cold
    - Catching a cold **depends** on me going outside with wet hair
    - Is it the **only** way to catch a cold? Hold that thought for necessary & sufficient conditions!
- **Causal mechanism:** I'm not sure, but I think it was something like it weakens my immune system



## REMINDER: CAUSAL MECHANISMS

- Snow didn't know exactly how consuming bad water lead to cholera, but he understood that fecal-oral transmission was part of the problem. This was not politically popular at the time!
- So, Snow had a **causal mechanism** in mind: ***a sequence of processes leading from X to Y.***
- We ***need mechanisms***, so we know **what** to test.
- Later, scientists (Pacini, Koch) would ***refine*** the mechanism, and understand the importance of the cholera bacterium.



# WHAT'S WRONG WITH THIS DESIGN?

The New York Times

I've Interviewed 300 High Achievers About Their Morning Routines. Here's What I've Learned.

Your morning routine should suit your needs, but there are some habits everyone should try.



Basically, they get up early.

But this is *selecting on the dependent variable* Y=“successful”. Maybe unsuccessful people also get up early? (maybe they get up earlier)

We cannot know if this is a causal factor or not!

# WHAT'S WRONG WITH THIS DESIGN?

≡ EXPLORE **Health**

HOME > MIND & BODY > FAMILY TOGETHERNESS

## 12 Secrets of People Who've Lived to 100

By Lindsey Murray | September 25, 2015

1 of 14

 View All →

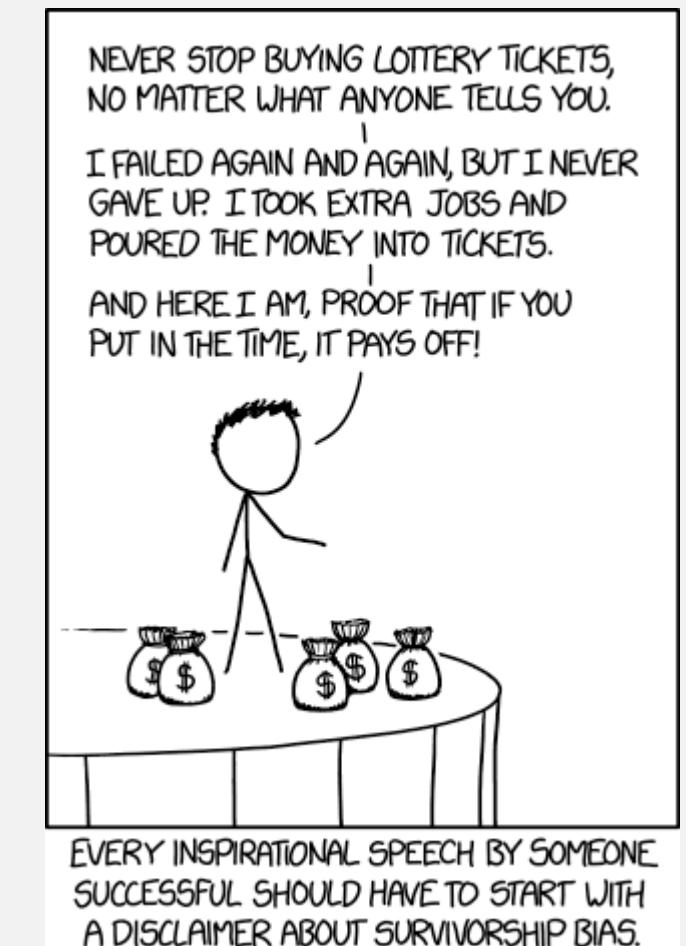
**Live-longer tips**

Science says that your diet, how much you exercise, and your genes all play a role in determining how long you'll live. Those who have lived to blow out 100 candles, however, say they've used other strategies for achieving their old age. Here, longevity tips from 11 centenarians around the world—some legit, some hilarious, and some downright bizarre.

PHOTO: GETTY IMAGES

# SURVIVOR BIAS

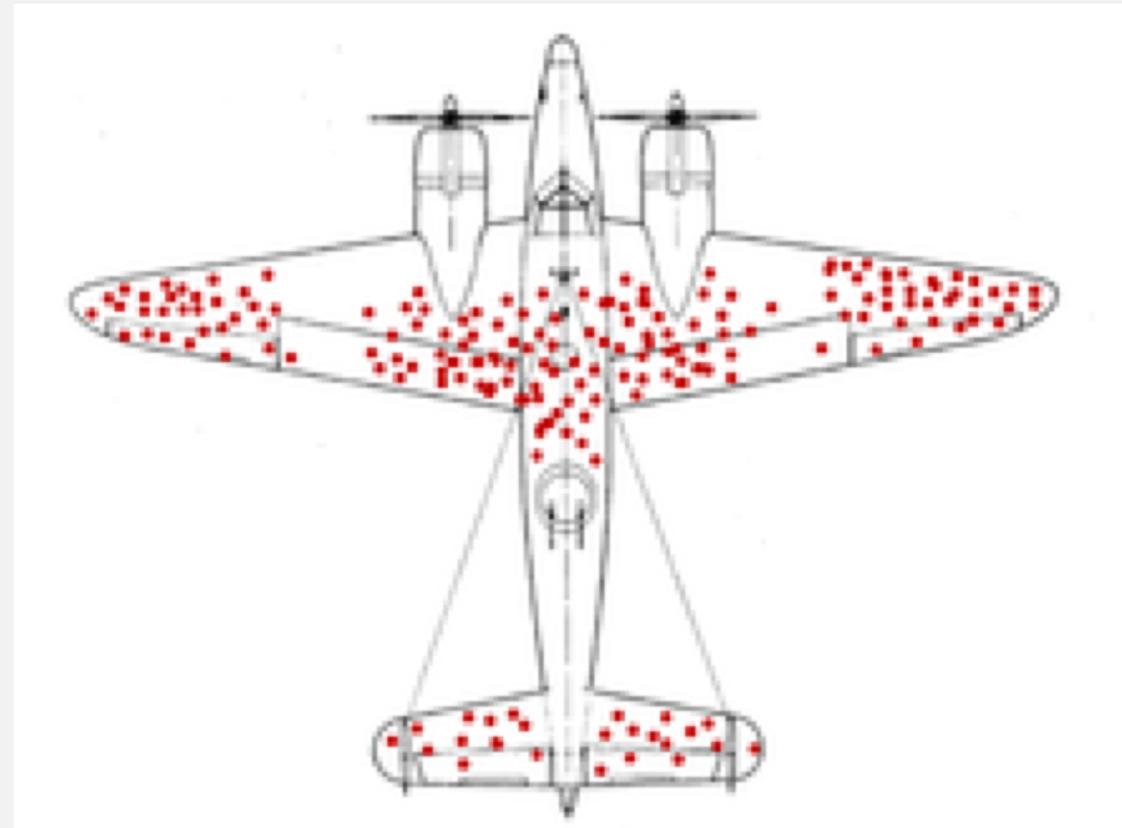
- Looking only at units who **survived** a certain process leads to biased inferences. We don't get to see those who didn't survive this process.
- what do very old people have in common (what about those who didn't survive to old age)?
- what do very successful people have in common (what about those who weren't successful)?
- **Wald's problem:** WW2, bombers return from raids. Where should we put extra armor?



# SURVIVOR BIAS

We (only) get to look at the bombers that survived the raid. **Red spots** are damage.

Where should we put the extra armor, next time?



# Outline

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## GENERAL PRINCIPLES OF CAUSALITY

COVARIATION

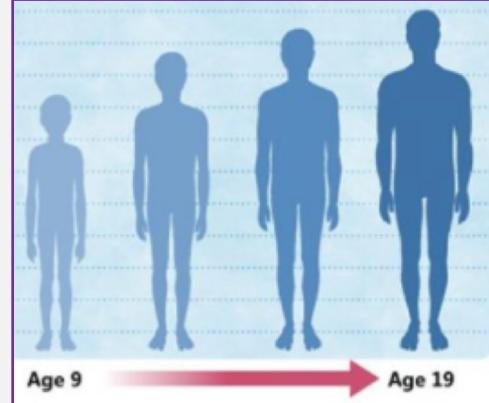
TEMPORAL  
PRECEDENCE

CONTROL FOR  
THIRD VARIABLES

NECESSARY BUT NOT SUFFICIENT

# COVARIATION

- generally, we can **objectively determine** the statistical association between variables
- but as we've seen, association **does not** imply causation
- and, actually, we can sometimes have a causal link **without** obvious association



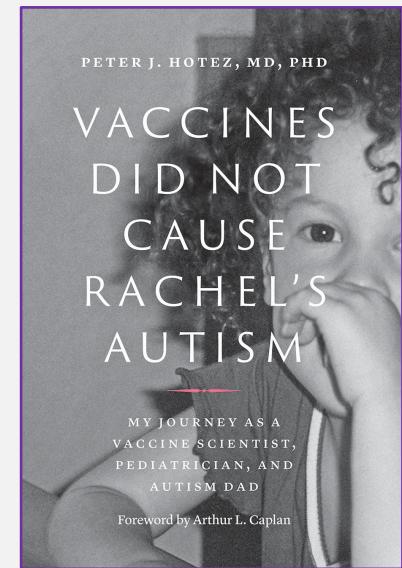
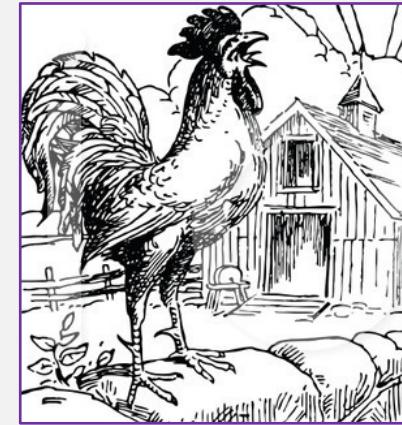
Height **is** correlated with spelling ability. Why?

Height does **not** predict salary in the NBA. Does that mean height doesn't matter for ability?



## TEMPORAL PRECEDENCE

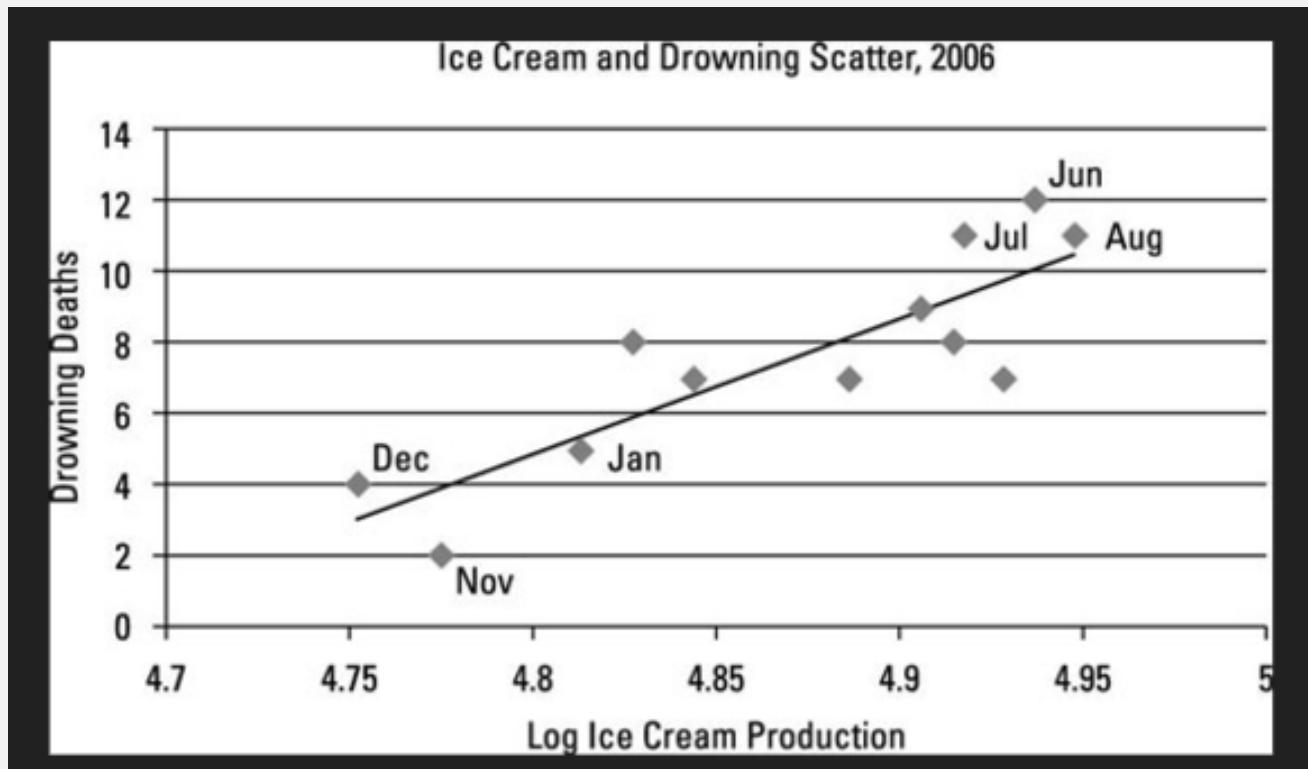
- we want X (treatment) to **precede** the Y (outcome)
- but just because X came before Y does **not** mean it X caused Y!



## CONFOUNDERS AND CONTROLS

*What should we control for?*

- like Snow, we must be careful about **confounders**.
- if we can't randomize (and it's implausible), we may need to “**control**” for that Z



## TALKING ABOUT CAUSALITY

1. Deterministic vs. probabilistic causality
2. Endogeneity (reciprocal causation)
3. Necessary and sufficient conditions

## DETERMINISTIC V PROBABILISTIC

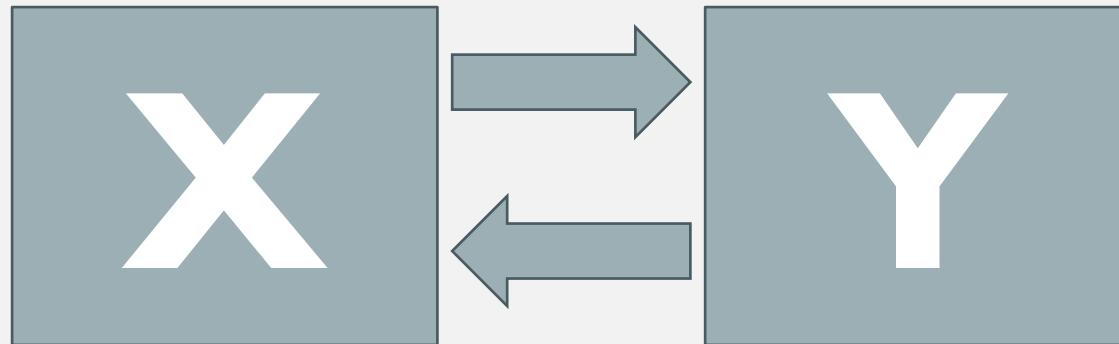
### Deterministic

- if X occurs, Y occurs with certainty
- common in physical sciences (e.g. laws of gravity)

### Probabilistic

- if X occurs, Y is *more likely* to occur
- arguably true of all causal relations: we simply can't observe all the factors, so it "looks" probabilistic

# ENDOGENEITY



X and Y cause each other, though  
may not be simultaneous in  
practice

“Reciprocal”  
causality

- Democracy and development
- Stress and illness
- Grade and how much you like a course

# CAUSAL CONDITIONS

## Necessary Condition

- X is necessary for Y
- X must be there for Y to happen
- If X is not there, you will not see Y

Being a US citizen is a *necessary* but not sufficient condition for registering to vote.

## Sufficient Condition

- X is sufficient for Y
- Every time you see X, you will see Y
- If X then Y, but Y can occur without X

Birth in the US is a *sufficient* but not necessary condition for being a US citizen.

## NECESSARY VS. SUFFICIENT: EXAMPLES

Showing up for the exams in this course is a necessary but not sufficient condition for earning an A

Getting a perfect score on all assignments is a sufficient but not necessary condition for earning an A

Completing all of NYU's requirements is a necessary and sufficient condition for getting a degree

A college degree is neither necessary nor sufficient for getting a job

A job is neither necessary nor sufficient for happiness

## NECESSARY VS. SUFFICIENT: EXAMPLES

Showing up for the exams in this course is a [ ] but not [ ] condition for earning an A

Getting a perfect score on all assignments is a [ ] but not [ ] condition for earning an A

Completing all of NYU's requirements is a [ ] and [ ] condition for getting a degree

A college degree is neither [ ] nor [ ] for getting a job

A job is neither [ ] nor [ ] for happiness

# SUMMARY

- Thinking like a scientist:
  - Asking good questions
  - Following the scientific method: theory, hypothesis, data, conclusions.
  - Iterative process
- Causality: The goal of most scientific exercises
  - is hard! Think counterfactually.
  - Experiments good, but often not available.
  - Many kinds and directions and causal relationships
  - Thinking of conditions of causality can be useful

# Outline

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Thank you!