# POLI 30 D: Political Inquiry

Professor Umberto Mignozzetti
(Based on DSS Materials)

## Lecture 07 | Measuring Population Characteristics II

# Before we start

**Announcements:**

- Quizzes and Participation: On Canvas.
- Github page: https://github.com/umbertomig/POLI30Dpublic
- Piazza forum: https://piazza.com/ucsd/winter2023/17221
- In a midst of a mailbox disaster now. Will check all your emails by Thursday evening!
- If you don't see me wearing a mic, tell me!

# Before we start

**Recap:** We learned:

- The definitions of theory, scientific theory, and hypotheses.
- Data, datasets, variables, and how to compute means.
- Causal effect, treatments, outcomes, and randomization.
- Sampling, descriptive statistics, and descriptive plots for one variable.

**Great job!**

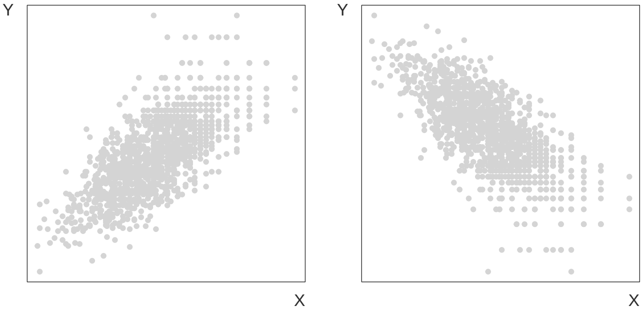
- Do you have any questions about these contents?

## Plan for Today

- Exploring the Relationship Between Two Variables
  - Scatter plots
  - Correlations

# Scatter Plots

- A **scatter plot** enables us to visualize the relationship between two variables by plotting one against the other



# Scatter Plots

Imagine we have two variables:

| X | Y |
|---|---|
| 4 | 2 |
| 8 | 5 |
| 10 | 3 |

We can create the scatter plot by plotting one point at a time.

# Scatter Plots

Imagine we have two variables:

| X | Y |
|---|---|
| 4 | 2 |
| 8 | 5 |
| 10 | 3 |

>> First, let's plot this point: $(x_1, y_1) = (4,2)$

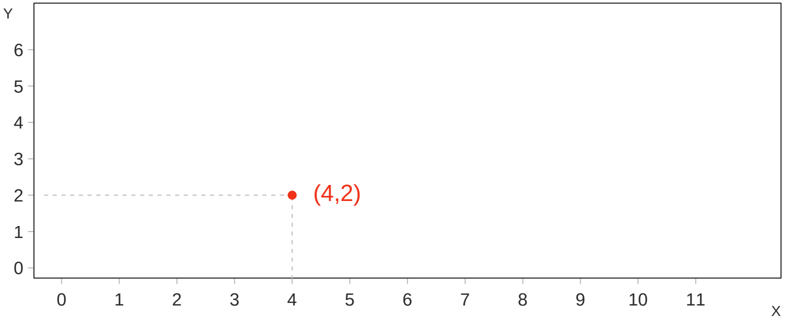
# Scatter Plots

Imagine we have two variables:

| X | Y |
|---|---|
| 4 | 2 |
| 8 | 5 |
| 10 | 3 |

>> First, let's plot this point: $(x_1, y_1) = (4,2)$

# Scatter Plots

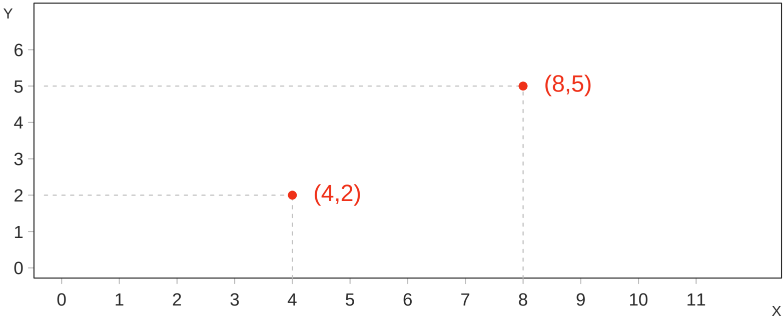


# Scatter Plots

Imagine we have two variables:

| X | Y | |
|---|---|---|
| 4 | 2 | >> First, let's plot this point: $(x_1, y_1) = (4,2)$ |
| 8 | 5 | >> Now, let's plot this point: $(x_2, y_2) = (8,5)$ |
| 10 | 3 | |

# Scatter Plots

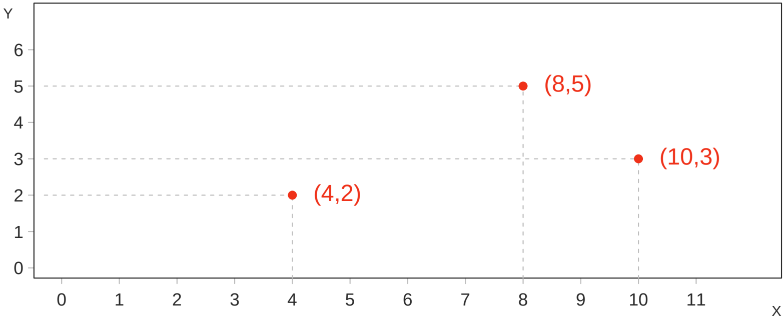


# Scatter Plots

Imagine we have two variables:

| X | Y | |
|---|---|---|
| 4 | 2 | >> First, let's plot this point: $(x_1, y_1) = (4,2)$ |
| 8 | 5 | >> Now, let's plot this point: $(x_2, y_2) = (8,5)$ |
| 10 | 3 | >> Finally, let's plot this point: $(x_3, y_3) = (10,3)$ |

# Scatter Plots



# Scatter Plots

- R functions: `plot()`or `ggplot() + geom_point()`
- How many arguments are required?
  - two; the two variables

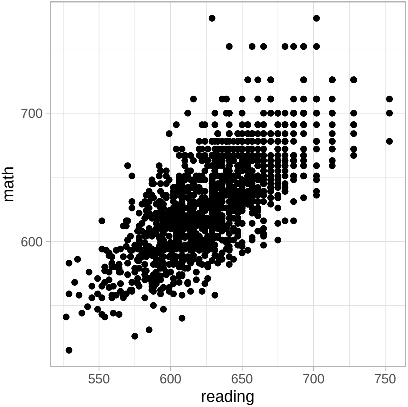
# Scatter Plots

- Let us use the data from Project STAR:

```
head(star, 3) # shows first observations
##   classtype reading math graduated
## 1     small     578  610         1
## 2   regular     612  612         1
## 3   regular     583  606         1
```

- Unit of observation?
  - students; each observation represents a student
- Unit of measurement of *reading* and *math*?
  - points

# Scatter Plots



- What can we learn from this scatter plot?

# Correlation Coefficient

- The **correlation coefficient**is a statistic that summarizes the relationship between two variables with a number
    - denoted as cor(X,Y)
- cor(X,Y) summarizes the **direction** and the **strength** of the **linear association** between X and Y
- cor(X,Y) ranges from -1 to 1

# Correlation Coefficient

The sign reflects the **direction** of the linear association:

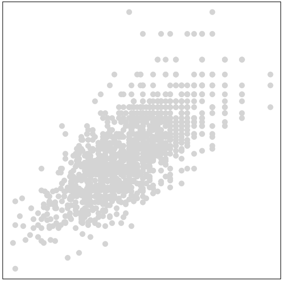
- cor(X,Y) $>$ 0 (tends to see one **in**creasing when the other increases)
- cor(X,Y) $<$ 0 (tends to see one **de**creasing when the other increases)

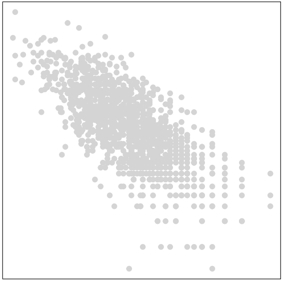
The absolute value reflects the **strength** of the linear association:

- $|$cor(X,Y)$| = 0$ if there is no linear association
- $|$cor(X,Y)$| = 1$ if there is a perfect linear association
- $|$cor(X,Y)$|$ increases as the linear association becomes stronger

# Correlation Coefficient

**Direction** of the linear association between two variables:

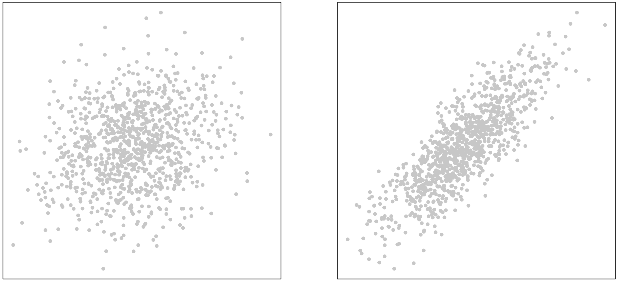




positive linear association vs. negative linear association
positive correlation vs. negative correlation

# Correlation Coefficient

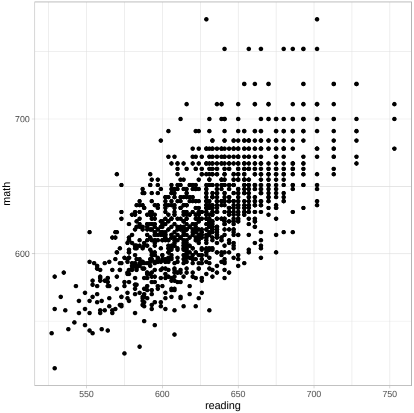
Strength of the linear association between two variables:



**weak** linear association vs. **strong** linear association

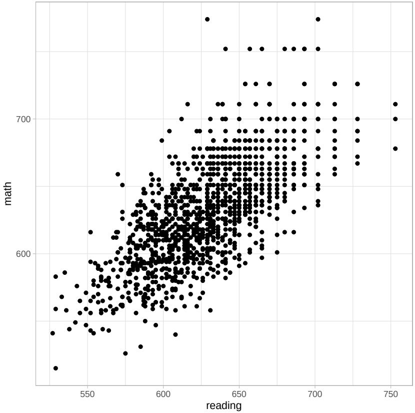
absolute value closer to 0 vs. absolute value closer to 1

# Correlation Coefficient



- Do you expect the correlation between *reading* and *math* grades to be positive or negative?

# Correlation Coefficient



- Do you expect the absolute value of the correlation between *reading* and *math* to be closer to 1 or to 0?

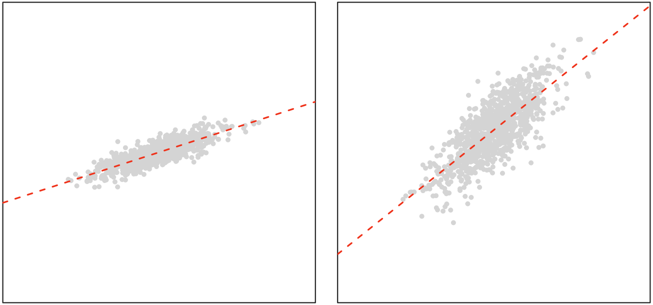
# Correlation Coefficient

- R function: `cor()`
- How many required arguments?
  - two; the two variables
- Does the order of the arguments matter?
  - no; cor(X,Y) = cor(Y,X)
- What is the code to compute the correlation between *reading* and *math*?
  - Answer:

    ```
    cor(star$reading, star$math)
    ## [1] 0.7161218
    ```

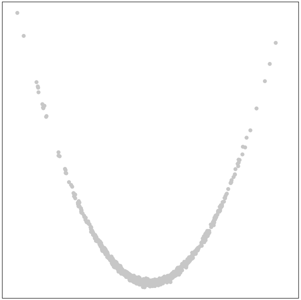
  - Is the correlation what we expected?

# Correlation Coefficient



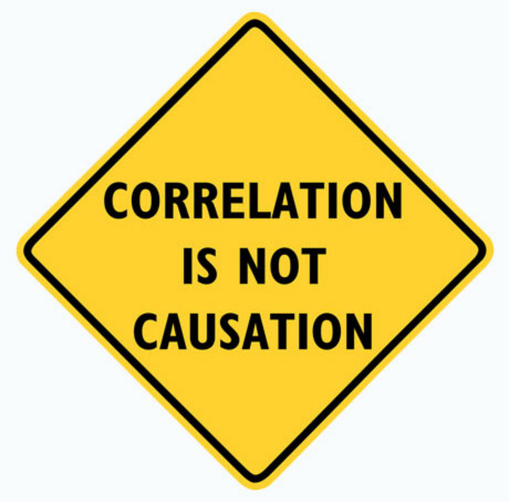
- Line of best fit is steeper in the first or second scatterplot?
- Is correlation higher in the first or second scatterplot?

# Correlation Coefficient



- cor(X,Y) $\approx$ 0
- Does this mean that there is no relationship between the two variables? No. Check the dino!

# Correlation does not necessarily imply causation

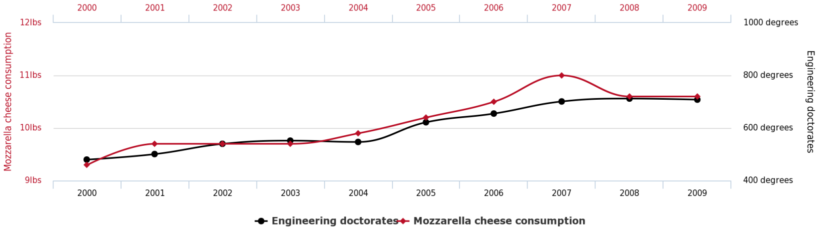


# Correlation does not necessarily imply causation

- Just because two variables have a strong correlation does not mean that changes in one variable cause changes in the other
- Example: *reading* and *math* are highly correlated.
    - Does that mean that if you study *math* you learn *reading*?!

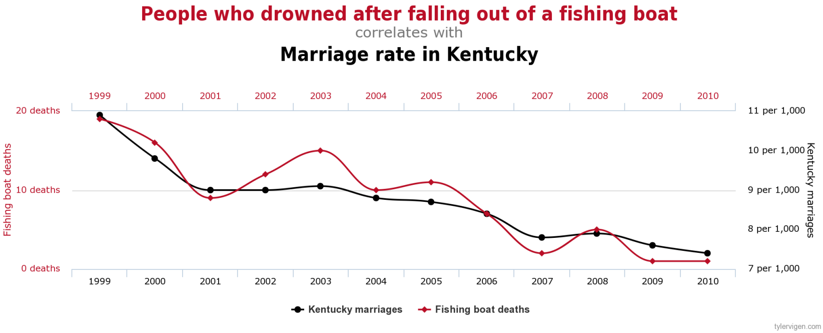
# Correlation does not necessarily imply causation

**Per capita consumption of mozzarella cheese**
correlates with
**Civil engineering doctorates awarded**



tylervigen.com

# Correlation does not necessarily imply causation



- More on this later in the semester!

# Summary

- **Today's Class:**
  - Exploring the Relationship Between Two Variables
    - Scatterplots
    - Correlations

- Next class:
  - Prediction and Linear Regression

Questions?

See you in the next class!