YData: An Introduction to Data Science

Lecture 21: Examples

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Credit: data8.org

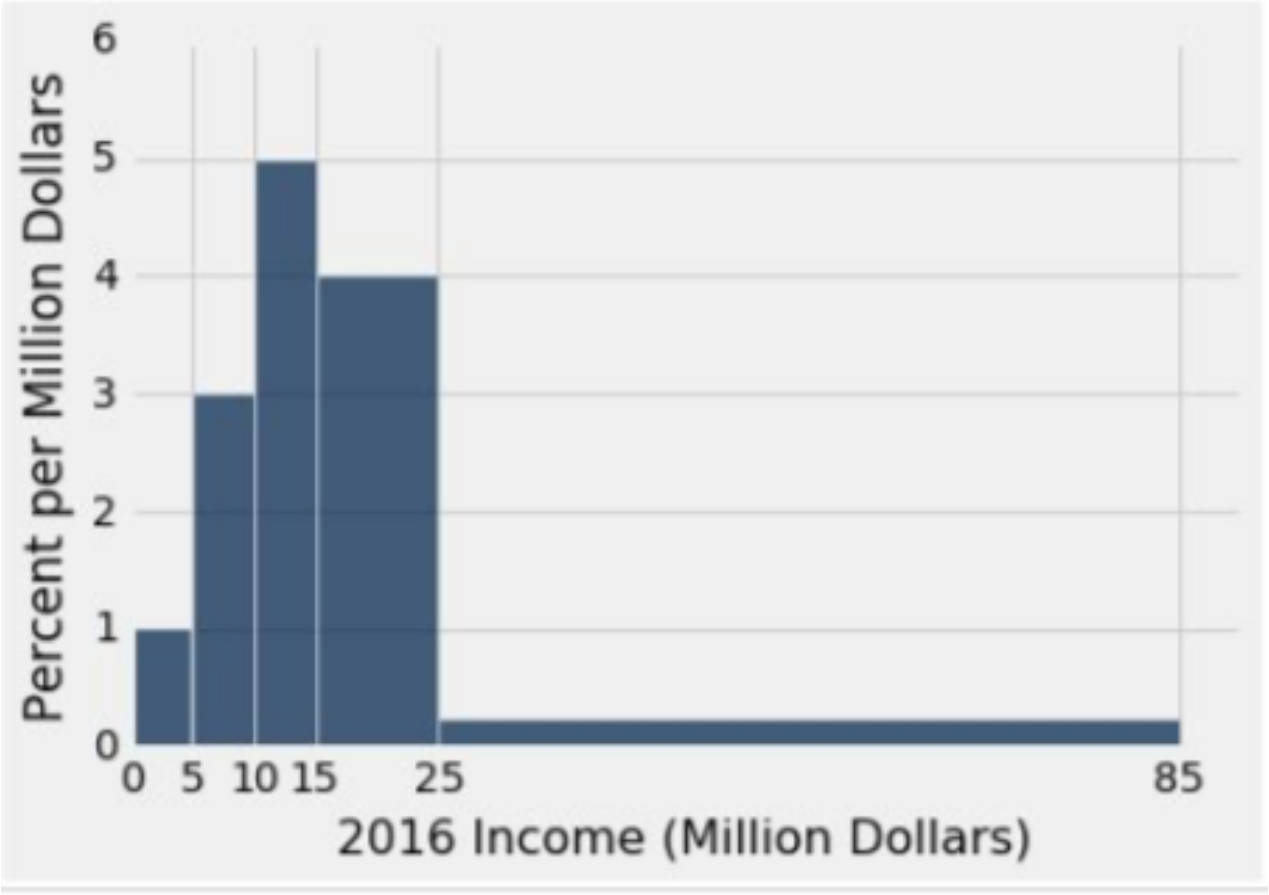
Announcements

- No class on Wednesday – break day
- Midterm on Friday

Histograms

Using the Density Scale

(a) Which bin has more people: [10, 15) or [15, 25)?
(b) What percent of incomes are in the [25, 85) bin?
(c) If you draw one bar over [10, 25), how tall will it be?
(d) Find (or give bounds for) the median income.



Answers

(a) [15, 25)

(b) 15%

(c) 4.33 percent per million dollars

(d) At least 15 and less than 25

Probability

Exercise 1

I pick one of the 12 months at random. Independently, you pick one of the 12 months at random.

What is the chance that we both pick the same month?

(i) (1/12) * (1/12) (ii) (1/12) + (1/12) (iii) 1/12

Exercise 1

I pick one of the 12 months at random. Independently, you pick one of the 12 months at random.

What is the chance that we both pick the same month?

(i) (1/12) * (1/12) (ii) (1/12) + (1/12) (iii) 1/12

(iii) = (12/12) * (1/12) Also (iii) = 12 * (i)

Exercise 2

Marbles: G, G, G, G, R, R, R, B, B, Y.
Draw 4 at random.

P(no G) = ?

P(all G) = ?

Exercise 2

Marbles: G, G, G, G, R, R, R, B, B, Y.
Draw 4 at random.

P(no G) = ?

If with replacement:
(6/10)*(6/10)*(6/10)*(6/10)

If without replacement:
(6/10)*(5/9)*(4/8)*(3/7)

P(all G) = ?

If with replacement:
(4/10)*(4/10)*(4/10)*(4/10)

If without replacement:
(4/10)*(3/9)*(2/8)*(1/7)

Exercise 3

Marbles: G, G, G, G, R, R, R, B, B, Y.
Draw 4 times at random with replacement.

P(at least one G) = ? P(all four are the same color) = ?

Exercise 3

Marbles: G, G, G, G, R, R, R, B, B, Y.
Draw 4 times at random with replacement.

P(at least one G) = ? P(all four are the same color) = ?

1 - (6/10)*(6/10)*(6/10)*(6/10)
is the chance of: at least one G

(4/10)**4 + (3/10)**4 + (2/10)**4 + (1/10)**4
is the chance of: all four are the same color

Testing Hypotheses

Before You Compute Anything

- Figure out the viewpoint the question wants to test, and formulate:
  - Null hypothesis: Completely specified chance model under which you can simulate data
  - Alternative hypothesis: Viewpoint comes from the question
  - Test statistic: to help you choose one viewpoint
- Say what kind of values of the statistic will make you lean towards each alternative

Categorical Data

Null Hypothesis

The sample is drawn at random from a specified categorical distribution.

- Swain's jury panel was drawn at random from a population that had 26% black men
- Each pea plant has 75% chance of being purple flowering, regardless of other plants
- The Alameda County jury panels were drawn at random from the specified distribution of eligible jurors

Swain v. Alabama

- **Null**: Swain's jury panel was drawn at random from a population that had 26% black men
- **Alternative**: There were too few black men on the panel for it to look like a random sample
- **Test statistic**:

  Number of black men in panel

  P-value direction: to the left

Mendel's Model

- **Null**: Each pea plant has 75% chance of being purple flowering, regardless of other plants

- **Alternative**: The model isn't good.

- **Test statistic**:

  |percent purple in sample - 75|

  P-value direction: to the right

  Could also have used TVD; direction is still to the right

  TVD = (|prop. purple - 0.75| + |prop. white - 0.25|)/2

Alameda County Jury Panels

- **Null**: The Alameda County jury panels were drawn at random from the specified distribution of eligible jurors

- **Alternative**: The panels were not drawn at random from the specified distribution.

- **Test statistic**:

  TVD

  P-value direction: to the right

Numerical Data

GSI's Defense

- **Null**: Section 3 scores are like a sample drawn at random without replacement from the whole class.
- **Alternative**: The Section 3 average is too low for the section to be a random sample from the class.
- **Test statistic**:

  Section 3 average

  P-value direction: to the left

Comparing Two Samples

Birthweights

- **Null**: In the population, the distributions of the birth weights of the babies in the two groups are the same.

- **Alternative**: In the population, the babies of the mothers who didn't smoke (B) were heavier, on average, than the babies of the smokers (A).

- **Test statistic**:

  Group B sample average - Group A sample average

  P-value direction: to the right

Deflategate

- **Null**: Each group is like a sample drawn at random without replacement from all 15 footballs.
- **Alternative**: The Patriots' drop in ball pressures were too large for them to look like a random sample from the 15 balls.
- **Test statistic**:

  Colts' average - Patriots' average

  P-value direction: to the left

RCT

- **Null**: The distribution of all the potential control scores is the same as the distribution of all the potential treatment scores.

- **Alternative**: The distribution of all the potential control scores is different from the distribution of all the potential treatment scores.

- **Test statistic**:

  | control group average - treatment group average |

  P-value direction: to the right