Math 243

Day 2

Traffic Fatalities and Federal Speed Limit Laws – Inv. A

Announcements

- HW 1 and Quiz 1 are due on Monday, Oct. 1st.
- Complete initial course survey in Blackboard by 3pm on Monday, Oct. 1st as part of HW.
- Buy the workbook by Rossman and Chance following the link on my website.
- Use the RossmanChance glossary to learn statistical definitions for the quiz.

Learning Objectives – Day 2

1. State **the five steps of using data to answer a question**

2. Calculate **the mean, median, and standard deviation of a dataset**, by hand or with an applet.

3. Describe **the *center*, *shape* and *spread* of a distribution,** from a **dotplot** or **histogram**

4. Determine **whether a particular observation is unusual compared to a distribution**

Purple = a statistical term whose definition you should memorize (use the glossary!)

What is “statistics”?

Statistics = using data (pieces of information) to answer a research question

Five steps:

1. Have a research question
2. Make a plan to collect and analyze data
3. Gather data
4. Analyze data
5. Draw an appropriate conclusion

1. State the five steps of using data to answer a question

Investigation A, page 4

Today, we'll analyze a single, numerical variable, US traffic fatalities per year.

1. Have a research question:

Did a federal speed limit law reduce traffic fatalities?

2. Make a *plan* to collect and analyze data

3. Gather data

Wikipedia: list of motor vehicle deaths in the US by year

4. Analyze the data

   parts b, d, e, g and h

5. Draw an appropriate conclusion

Read the "study conclusions" box on page 9 and the discussion on page 10.

Activity – Inv. A

- Form small groups
- Try at least parts b, d, e, g and h
- Be prepared to discuss your findings with the class in 10-15 minutes.

It's okay if you don't know the "right" answer – remember that learning is more effective if you guess before being told an answer

Tools for describing a single *numerical* variable

Graph

- Dotplot (part h)
- Histogram

Numerical Summaries (box on page 7)

- Mean
- Median
- Standard Deviation

Dotplot – each value in the dataset is represented by a dot above a horizontal axis

Ex: Suppose we observe the heights of 14 OIT statistics students in inches:

62, 62, 62, 62.5, 65, 65, 65, 67, 68, 69, 70, 70, 70, and 72

Histogram – dataset is “binned” and the height of a “bar” represents # of data points in a bin

Ex: Suppose we observe the heights of 14 OIT statistics students in inches:

62, 62, 62, 62.5, 65, 65, 65, 67, 68, 69, 70, 70, 70, and 72

Numerical Summaries

Mean = average of **n** data points

$$\frac{x_1 + x_2 + x_3 + \cdots + x_n}{n}$$

Interpretation: a "typical" observation

$$\frac{62+62+62+62.5+65+65+65+67+68+69+70+70+70+72}{14} = 66.393$$

2. Calculate the mean, median, and standard deviation of a dataset, by hand or with an applet.

Numerical Summaries

Median = Value so that 50% of the data is above and 50% of the data is below

Interpretation: a "typical" observation

62, 62, 62, 62.5, 65, 65, **65, 67**, 68, 69, 70, 70, 70, and 72

(**65+67**)/2=66

2. Calculate the mean, median, and standard deviation of a dataset, by hand or with an applet.

Numerical Summaries

Standard deviation=

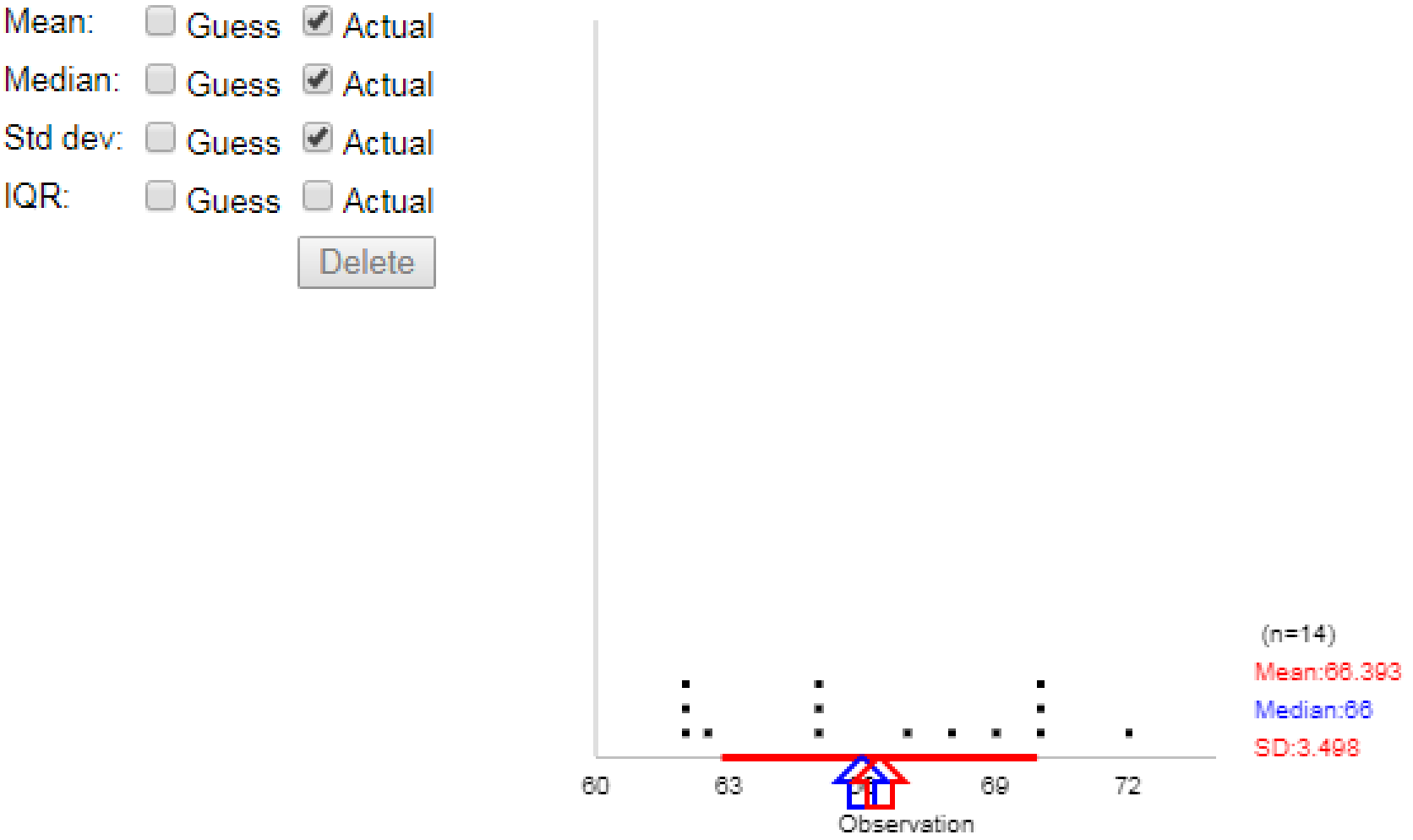
$$\sqrt{\frac{(x_1-mean)^2+(x_1-mean)^2+\cdots+(x_n-mean)^2}{n-1}}$$

Interpretation: a "typical" deviation from the mean

$$\sqrt{\frac{(62-66.393\ )^2+(62-66.393)^2+\cdots+(72-66.393)^2}{14-1}}=3.498$$

2. Calculate the mean, median, and standard deviation of a dataset, by hand or with an applet.

Using the Descriptive Statistics Applet



2. Calculate the mean, median, and standard deviation of a dataset, by hand or with an applet.

Describing ***center, spread*** and ***shape*** of a distribution

Numerical summaries of ***center***:

Mean (average) or **Median** (middle value) give us an idea of a "typical value" of the variable.

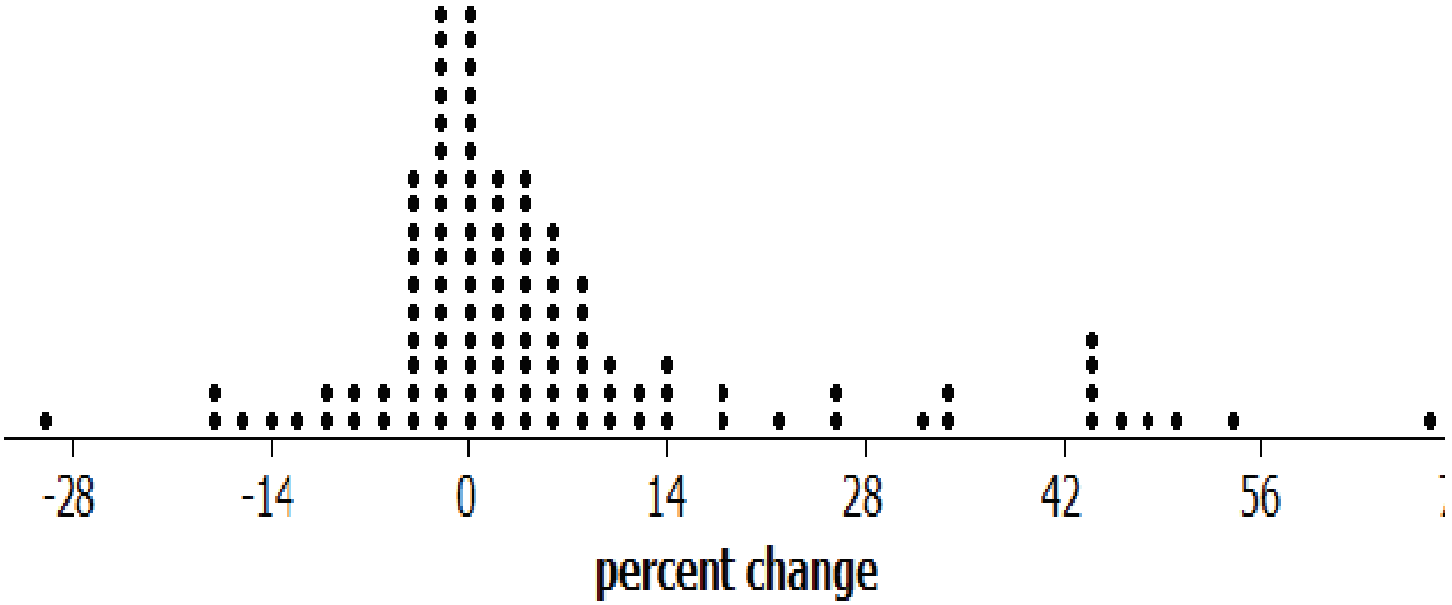
Numerical summary of ***spread***:

Standard deviation gives us an idea of a "typical deviation" from the mean of the variable, i.e. how much *variation* there is.

Words to describe ***Shape*****:**

- Symmetric, skewed right or skewed left
- Bell shaped (one hill), bimodal (two hills) , uniform (rectangle)….

Visualizing Center, Shape and Spread



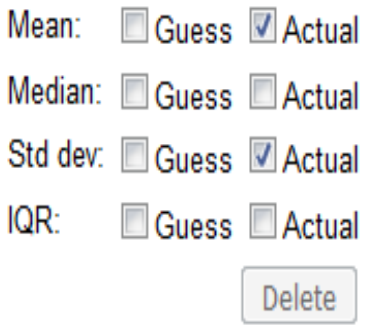
3. Describe the *center*, *shape* and *spread* of a distribution, from a dotplot

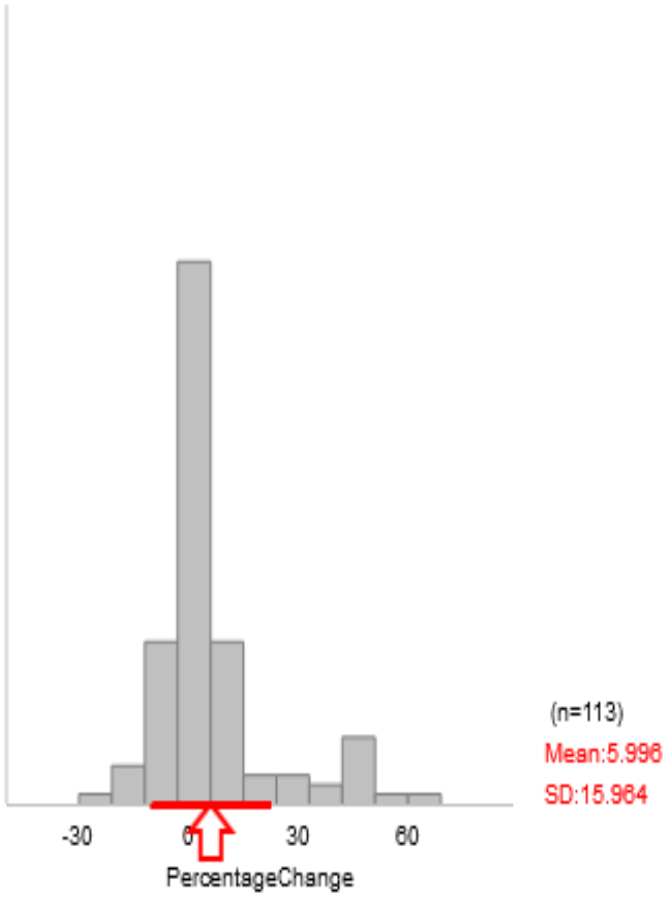
Describing the distribution of percent changes in traffic fatalities

Center: mean is 5.995

Spread: SD=15.964

Shape: One hill, skewed right



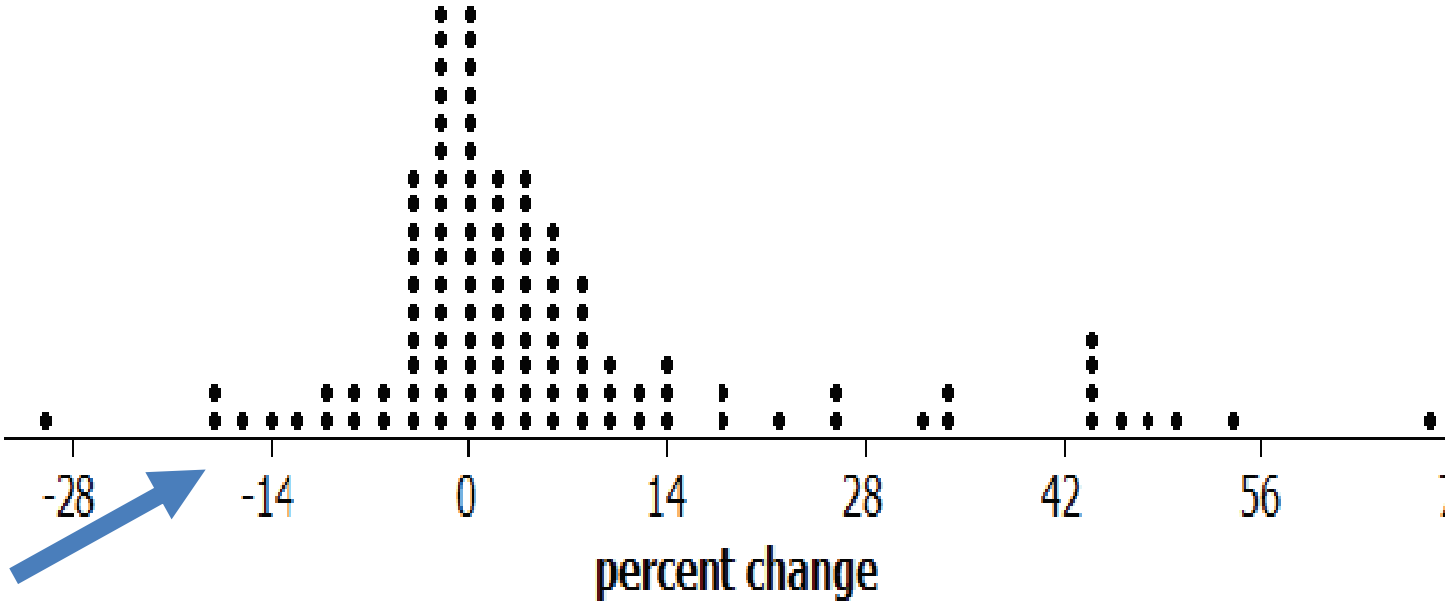


Most percent changes were clustered around 6% with a typical deviation from 6% of about 16%. There are a few extremely large percent changes.

3. Describe **the *center*, *shape* and *spread* of a distribution,** from a dotplot or histogram

Did traffic fatalities decrease after the Federal Speed Limit Law?

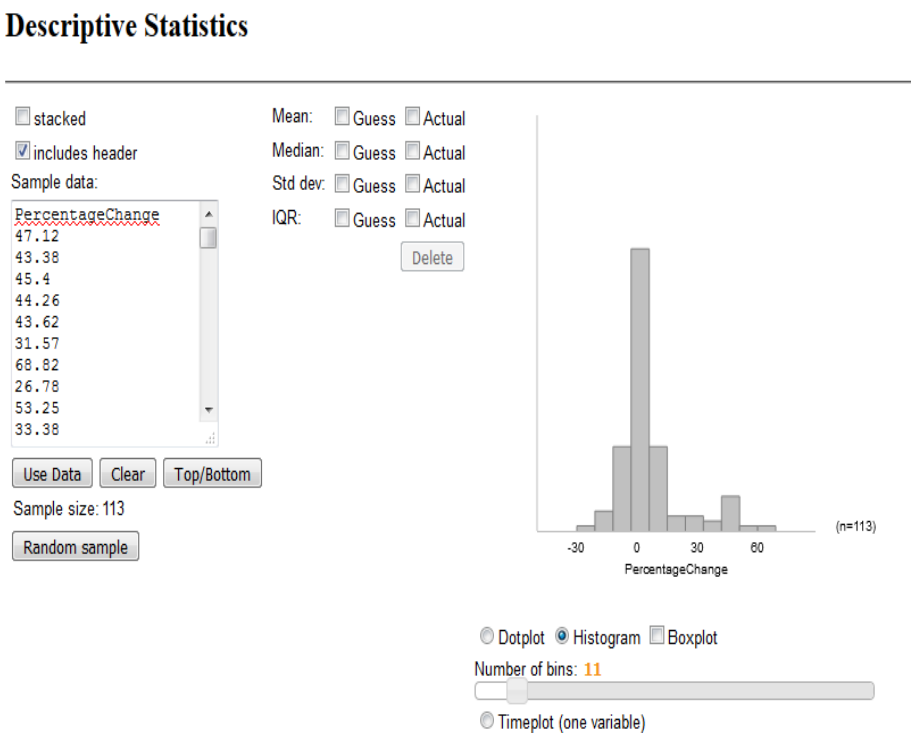
- You found the percent change in fatalities dropped by 17.14% after the law was passed.



Is 17.14% a **large** change compared to the changes between other years?

How large is “large”?

When deciding whether particular value is extreme or not, it is helpful to consider the ***distribution*** of all values of the variable.

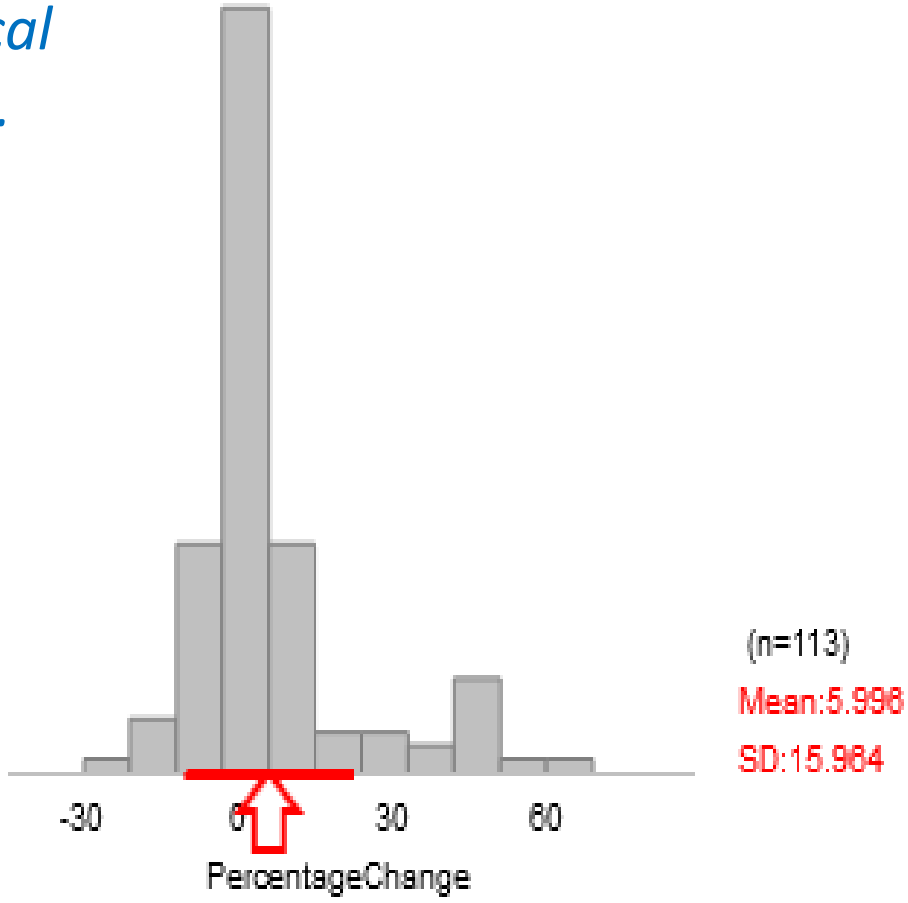


In particular, consider the ***center, spread*** and ***shape*** of the distribution**.**

Is a change of -17.14% unusual?

Most percent changes were clustered around 6% with a typical deviation from 6% of about 16%. There are a few extremely large percent changes.

Typically changes were between
6-16=-10% and
6+16=24%
so a change of -17.14% ***was*** *unusual.*



4. Determine whether a particular observation is unusual compared to a distribution

A “big” idea

If the shape of the distribution is roughly bell-shaped, then the **mean** and **standard deviation** (SD) can be used to determine whether a value is “unusual” or not.

A general rule of thumb is that observations that are more than 2 SD from the mean are “unusual”

Along with me or at home, try

parts i), j), k), and l).

Part m) is on the first homework assignment.