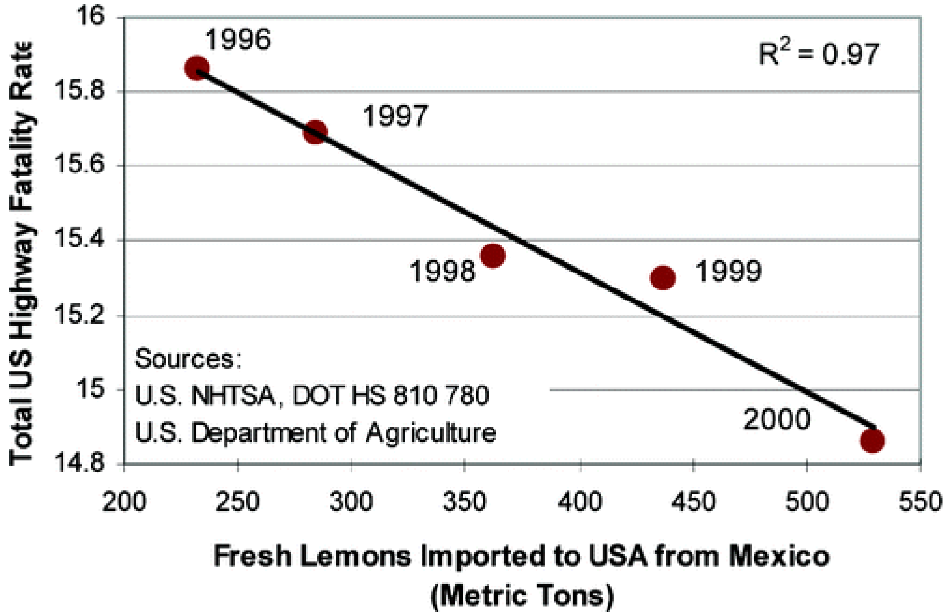
EDP 613 Chapter 3 Notes



CORRELATION DOES NOT PROVE CAUSATION!

(Johnson, 2007)

Measures of Centeral Tendency

Idea: The **average**

- is a measure of central tendency.
- can refer to a Mode, Median or the the Mean.

Notation:

1. If x is a bunch of numbers, then $\sum x$ is the sum of those numbers.

Example: If $x = \{1, 3, -1, 5\}$, find $\sum x$.

Solution:

$$\begin{aligned} \sum x &= 1 + 3 - 1 + 5 \\ &= 8 \end{aligned}$$

Definition:

1. **Raw data** is data that has is untouched since its been collected.

The Mode

- of a data set is the value or values that appear most frequently.
- can have more than one value if two or more data points are tied for most frequent.
- can have no value if no value appears more than once.
- gives you at least one number if it exists.

Example: Compute the mode for the following sample:

$$0 \quad 1 \quad 1 \quad 2 \quad 5 \quad 7$$

Solution:

The data point 1 appears twice whereas all other points appear once. Therefore the mode is 1.

On Your Own: Compute the mode for the following sample:

$$0 \quad 1 \quad 1 \quad 2 \quad 2 \quad 7$$

Solution:

The data points 1 and 2 appears twice whereas all other points appear once. Therefore modes are 1 and 2.

On Your Own: Compute the mode for the following sample:

$$0 \quad 1 \quad 3 \quad 2 \quad 5 \quad 7$$

Solution:

No data point appears more than once points appear once. Therefore there is no mode.

The Median

- the numerical value separating the higher half of a data set or distribution from the lower half.
- gives you the position of a number.

Steps to compute the median:

1. Sort your data points from least to greatest in numerical value.
2. Count the number data points. Call it n.
3. If n is
   - *odd*: The median is the middle number. This is in the position $\dfrac{n+1}{2}$.
   - *even*: The median is the average of the middle two numbers. This is the average of the two positions $\dfrac{n}{2}$ and $\dfrac{n}{2}+1$.

Example: Compute the median for the following sample:

$$2 \quad 5 \quad 5 \quad 7 \quad 7$$

Solution:

Since these data point are already in numerical order, we can use them as is without reordering. Thus we have $2, 5, 5, 7, 7$.

So $n = 5$ (*odd*) implying we must take the number in the

$$\frac{n+1}{2} = \frac{5+1}{2} = \frac{6}{2} = 3^{\text{rd}}$$

position as our median.

$$\text{Median} \quad = \quad 5$$

On Your Own: Compute the median for the following sample:

$$21.3 \quad 31.4 \quad 12.7 \quad 41.6$$

Solution:

Reordering from least to greatest, we have $12.7, 21.3, 31.4, 41.6$.

So $n = 4$ (*even*) implying we must take the mean of the middle two numbers in the

$$\frac{n}{2} = \frac{4}{2} = 2^{\text{nd}}$$

and

$$\frac{n}{2} + 1 = \frac{4}{2} + 1 = 2 + 1 = 3^{\text{rd}}$$

positions.

$$\begin{aligned} \text{Median} &= \frac{21.3 + 31.4}{2} \\ &= 26.35 \end{aligned}$$

The Mean

- is known as the arithmetic mean.
- typically used to describe central tendency in interval-ratio variables.

Notation:

Y	is a set of raw data points.
$\sum Y$	is the sum of all raw data points.
N	is the number of raw data points.
$\overline{Y}$	is the mean of the raw data points.

Steps to compute the mean:

1. Create a fraction.
2. In the top (*numerator*) add up all of the raw data points and put that number here: aka $\sum Y$
3. In the bottom (*denominator*) count up the number of raw data points and put that number here: aka N.
4. Do arithmetic.
5. Resulting number is the arithmetic mean of all raw data points: aka $\overline{Y}$.

Example: Compute the mean for the following sample:

$$Y = \quad 21.3 \quad 31.4 \quad 12.7 \quad 41.6$$

Solution:

$$\begin{aligned}
\overline{Y} &= \frac{\sum Y}{N} \\
&= \frac{21.3 + 31.4 + 12.7 + 41.6}{4} \\
&= \frac{107}{4} \\
&= 26.75
\end{aligned}$$

On Your Own: Compute the mean for the following sample:

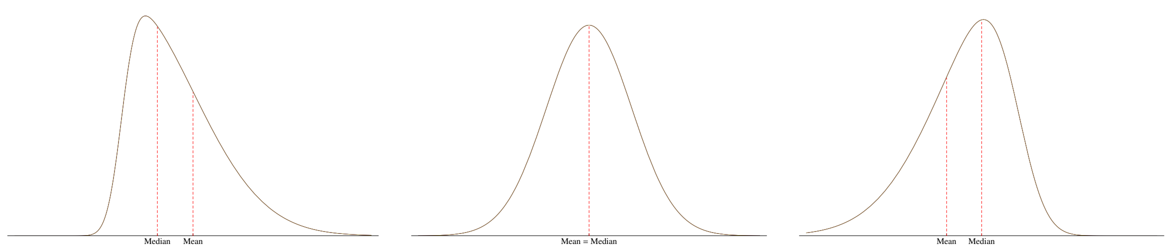
$$Y = \quad 2 \quad 5 \quad 5 \quad 7 \quad 7 \quad 8 \quad 9$$

Solution:

$$\begin{aligned}
\overline{Y} &= \frac{\sum Y}{N} \\
&= \frac{2+5+5+7+7+8+9}{6} \\
&= \frac{43}{7} \\
&\approx 6.14
\end{aligned}$$

Idea:

- A statistic is **resistant** if its value is not affected by extreme values (large or small) in the data set.



Skewed right
Mean > Median

Normal
Mean = Median

Skewed left
Mean < Median

Table I

Advantages and Disadvantages of Mean and Median

	Advantages	Disadvantages
Mean	Takes every value into account.	Not resistant.
Median	Resistant.	Dependent on middle value or mean of middle two values.

References

Johnson, S. R. (2007). The trouble with QSAR (or how I learned to stop worrying and embrace fallacy). *Journal of Chemical Information and Modeling, 48*(1), 25-26.

Moore, D.S., McCabe, G.P., & Craig, B. (2010). *Introduction to the practice of statistics.* New York, NY: Freeman.