

**Stat 218 - Day 3**  
**Measures of Center**

**Measures of Center: Mean, Median**

Mean: arithmetic average

Median: middle value

Position  $(n+1)/2$  if  $n$  is odd, average of position  $n/2$  and  $n/2+1$  if  $n$  is even

**Example: Rower weights** (`rowers04.mtw`)

- (a) Before doing any calculations, how do you expect the mean and median weights of the rowers to compare? Explain.
  
- (b) Calculate the mean and median of the rower weights (`MTB> mean c2, MTB> median c2`). How do they compare? Why does this make sense?
  
- (c) Eliminate the coxswain. How does this affect the mean and median?
  
- (d) Eliminate the lightweights. How does this affect the mean and median?
  
- (e) Make the heaviest rower much heavier, first by 20 pounds and then by 1000 pounds (as if the number entered were a typographical error). How does this affect the mean and median?

A numerical summary is **resistant** if it is not very affected by outliers.

- (f) Which is a resistant measure of center- mean or median?
  
- (g) If a distribution is skewed to the right, how do you expect the mean to compare to the median? Explain.
  
- (h) Repeat (f) for a distribution that is skewed to the left.

(i) Repeat (f) for a distribution that is symmetric.

**Example: Cancer pamphlets**

Researchers in Philadelphia investigated whether pamphlets containing information for cancer patients are written at a level that the cancer patients can comprehend. They applied tests to measure the reading levels of 63 cancer patients and also the readability levels of 30 cancer pamphlets (based on such factors as the lengths of sentences and number of polysyllabic words). These numbers correspond to grade levels, but patient reading levels of under grade 3 and above grade 12 are not determined exactly.

The tallies in the following table indicate the number of patients at each reading level and the number of pamphlets at each readability level.

patients' reading level	tally
under 3	6
3	4
4	4
5	3
6	3
7	2
8	6
9	5
10	4
11	7
12	2
above 12	17
TOTAL	63

Pamphlets' Readability	tally
6	3
7	3
8	8
9	4
10	1
11	1
12	4
13	2
14	1
15	2
16	1
TOTAL	30

- (a) Explain why the form of the data do not allow one to calculate the *mean* reading skill level of a patient.
- (b) Determine the *median* reading level of a patient and the median readability level of a pamphlet.
- (c) How do these medians compare? Are they fairly close?
- (d) Does the closeness of these medians indicate that the pamphlets are well matched to the patients' reading levels?

- (e) What proportion of the patients do not have the reading skill level necessary to read even the simplest pamphlet in the study?

**Example: Planetary measurements**

The following table lists the average distance from the sun (in millions of miles) and diameter (in miles) for the nine planets of our solar system.

planet	distance	diameter
Mercury	36	3,030
Venus	67	7,520
Earth	93	7,926
Mars	142	4,217
Jupiter	484	88,838
Saturn	887	74,896
Uranus	1,765	31,762
Neptune	2,791	30,774
Pluto	3,654	1,428

- (a) Calculate the median distance from the sun. (Be careful to report the appropriate units with your answer.)
- (b) Without doing any calculations, would you expect the mean distance to be close to, less than, or greater than the median distance? Explain.
- (c) If a classmate calculates the median diameter to be 88,838 miles, what do you think would be the most likely cause of his/her mistake?

**Example:**

- (a) A real estate agent notes that the mean housing price for an area is \$425,780 and concludes that half of the houses in the area cost more than that. Is this conclusion valid? Explain.

- (b) A businesswoman calculates that the median cost of the five business trips that she took in a month is \$600 and concludes that the total cost must have been \$3000. Is this conclusion valid? Explain. If it is not, demonstrate this with a hypothetical example.
- (c) A company executive concludes that an accountant must have made a mistake because she reported that 90% of the company's employees earn less than the mean salary. Is this conclusion valid? Explain. If it is not, demonstrate this with a hypothetical example.
- (d) I claimed that when I moved from Pennsylvania to California in 2001, the mean IQ dropped in both states. Is this possible? If so, how could it happen?
- (e) Does it make sense to calculate the mean day of the week on which students were born? Explain.