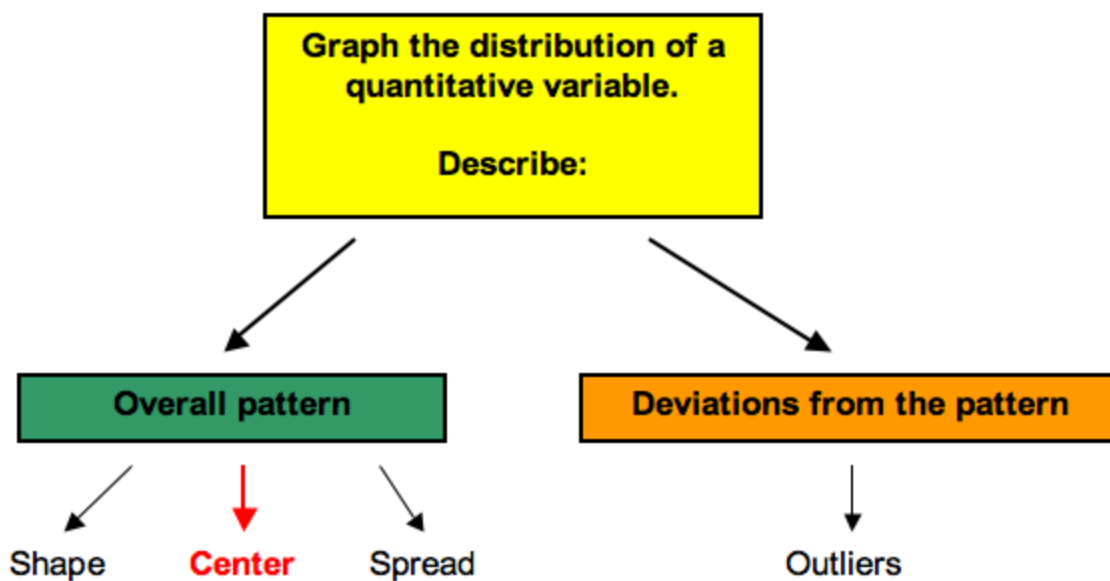


[See this page in the course material.](#)

Learning OUTCOMES

- Use mean and median to describe the center of a distribution.

Recall that when we describe the distribution of a quantitative variable, we describe the overall pattern (shape, center, and spread) in the data and deviations from the pattern (outliers). In our previous discussion of patterns in quantitative data, we identified a typical value in the distribution. We used this single value of the variable to represent the entire group. This is an informal way to think about the center of the distribution. In “Measures of Center,” we focus on describing the center of a distribution more precisely.



We develop two different measurements for identifying the center of a distribution: the mean and the median. Each measure has special properties.

Mean

The **mean** is the average. It is written as $\bar{x}$ and pronounced “x-bar.” To calculate the mean, we add the data values and divide by the number of data points.

We can write this as a formula.

$$\bar{x} = \frac{\sum x}{n}$$

In this formula, the symbol $\sum$ means sum (add up the values). The x represents the data values. The letter “n” represents the number of data values.

Example

Calculating the Mean

Let’s find the mean of a set of three quiz scores: 70, 85, 82. In this situation, n is 3 because there are 3 quiz scores. We add the “x” values, 70 + 85 + 82 to get 237, then divide by 3 to get a mean of 79.

We could write this calculation using the formula:

$$\bar{x} = \frac{\sum x}{n} = \frac{70+85+82}{3} = \frac{237}{3} = 79$$

Example

Average Homework Score

Suppose Beth’s homework scores are 70, 80, 80, 80, 85, 86, 90, 90, 95. There is variability in her homework scores, but the mean represents her typical performance on homework.

The mean of her scores is

$$\bar{x} = \frac{70+80+80+80+85+86+90+90+95}{9} = \frac{756}{9} = 84$$

So Beth’s performance on homework varies, but on average, she makes an 84 on each assignment. In other words, we can understand the mean as the score Beth would have on every assignment if she always made the same grade – that is, if she made an 84 on all nine homework assignments.

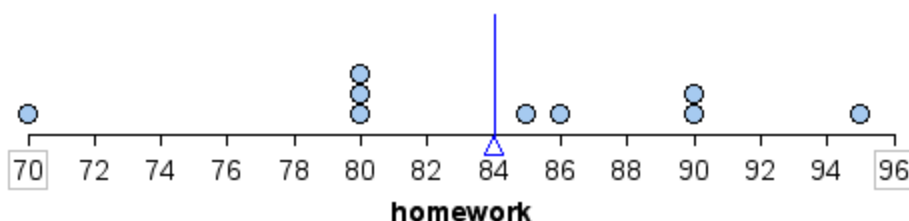
Her mean score is 84, since

$$\bar{x} = \frac{84 + 84 + 84 + 84 + 84 + 84 + 84 + 84 + 84}{9} = \frac{756}{9} = 84$$

From this viewpoint, the mean is the **fair share** measure of center.

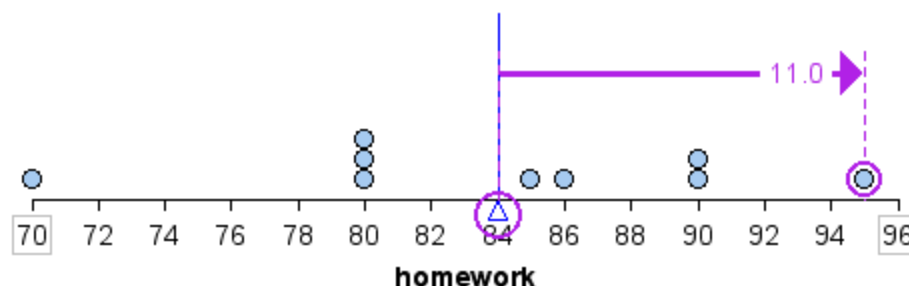
Notice, however, that Beth did not actually make an 84 on any assignment. The mean does not give us information about any individual homework score or about how the homework scores vary. It only gives us a sense of her performance by averaging the values across all the assignments.

Here is the mean marked on a dotplot of the distribution of homework scores. For this set of scores, the mean appears to be a pretty good measure of how Beth performed overall.



The mean is also referred to as the **balancing point** of a distribution. If we measure the distance between each data point and the mean, the distances are balanced on each side of the mean.

For example, a homework score of 95 is 11 points above the mean, as shown.



A homework score of 80 is 4 points below the mean. In the table, we calculate the sum of the distances above and below the mean. Notice that the sum of the distances above and below the mean are equal. In this way, the mean is a balancing point for the distribution.

Homework scores	70	80	80	80	85	86	90	90	95
Distance from the mean of 84	14	4	4	4	1	2	6	6	11
	 Distances below the mean $14+4+4+4 = 26$				 Distances above the mean $1+2+6+6+11 = 26$				

We can also view the distances below the mean as negative and the distances above the mean as positive. When we add these “signed” distances together, we get 0

$$(-14) + (-4) + (-4) + (-4) + 1 + 2 + 6 + 6 + 11$$

$$(-26) + 26$$

The mean is the only measure of center with this special property.

Try It

Jose wants to have an average of 80 for his 4 exams. Each exam is scored on a scale of 0 to 100. His first three exam scores are: 87, 72, 85. What does Jose need to score on the 4th exam to have a mean of 80 on all 4 exams?

Check Answer

[See this interactive in the course material.](#)

Try It

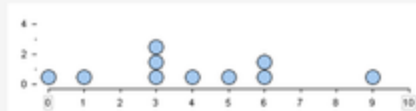
The school committee of a small town wants to determine the average number of children per household in their town. There are 50 households in the town. They divide the total number of children in the town by 50 and determine that the average number of children per household is 2.2. Which of the following must be true?

- ☐ Half of the households in the town have more than 2 children.

[See this interactive in the course material.](#)

Try It

What is the mean of the dotplot pictured?



- ☐ 4

[See this interactive in the course material.](#)

Try It

Demonstrate with the data set in the dotplot that the mean is the “balancing point” for the distribution.

Write your essay resp

Check Answer

[See this interactive in the course material.](#)

Median

The **median** is another way to identify a typical value. The median is the middle of the data when all the values are listed in order. The median divides the data into two equal-sized groups. There is as much data below the median as above it.

Example

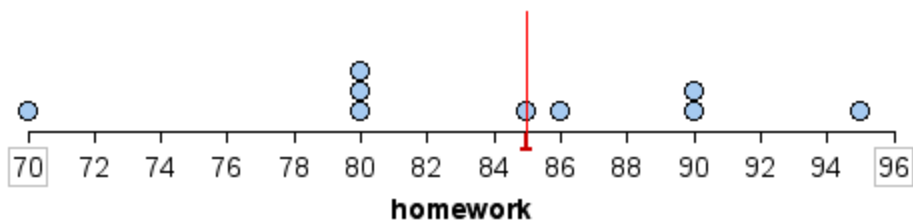
Median Homework Score

Let's return to Beth's homework scores: 70, 80, 80, 80, **85**, 86, 90, 90, 95.

The median score is 85. This is the center score. There are four homework scores below 85 and four homework scores above 85.

For this data set, the median was one of the homework scores. This will not always be the case. So, like the mean, the median does not give us information about any individual homework score or about how the homework scores vary. It only gives us a sense of Beth's performance by locating a value that is the middle of the actual scores.

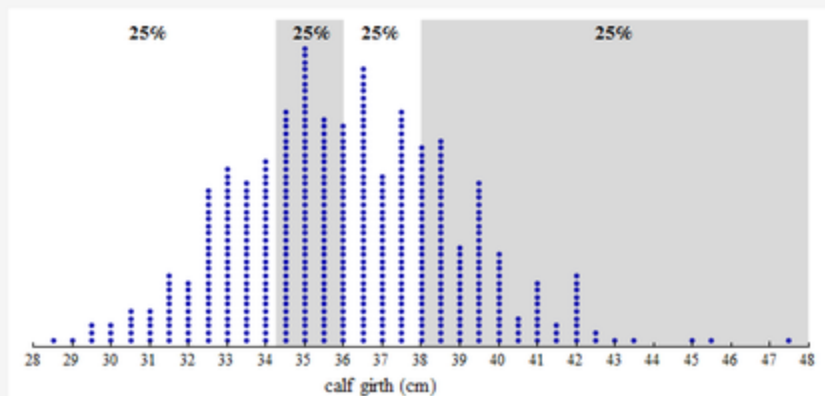
Here is the median marked on a dotplot of the distribution of homework scores. For this set of scores, the median is also a pretty good measure of how Beth performed overall.



Try It

The dotplot below shows the distribution of calf measurements for 507 adults who attend a local gym. The data is divided into equal-sized subgroups with 25% of the adults in each subgroup.

Which measure of center can you most accurately estimate from this information?



☐ mean

[See this interactive in the course material.](#)

What is your estimate for the measure of center you chose?

☐ 34 cm

[See this interactive in the course material.](#)

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