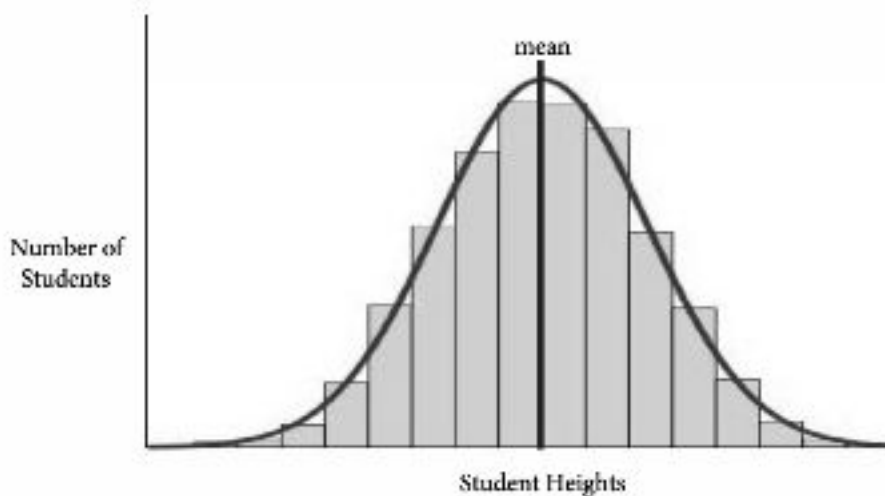


Measuring Spread

Name: _____

Date: _____ Per: _____

A **normal distribution** is a data set that is single-peaked, symmetric, and does not have outliers. The student height data you collected in the Entry Task is normally distributed.



One way to measure spread of any data set is to use the Interquartile Range (IQR). For normally distributed data, another measure of spread is called the standard deviation.

The **standard deviation** is the square root of the average of the distances to the mean, after the distances have been made positive by squaring. For example, consider this data set:

10, 12, 14, 16, 18 kilograms (kg)

- The **mean** is 14 kg (sum of values divided by number of values: $\frac{10+12+14+16+18}{5}$).
- The table below shows how to find the distances to the mean, and the distances squared.

Data values	Distance of each data value to the mean	Distances squared
10	$10 - 14 = -4$	$(-4)^2 = 16$
12	$12 - 14 = -2$	$(-2)^2 = 4$
14	$14 - 14 = 0$	$(0)^2 = 0$
16	$16 - 14 = 2$	$(2)^2 = 4$
18	$18 - 14 = 4$	$(4)^2 = 16$

- The average of distances squared is 8 kg² (mean of distances squared: $\frac{16+4+0+4+16}{5}$).
- The square root of this average is 2.83 kg ($\sqrt{8} = 2.83$).

So the standard deviation of this data set is 2.83 kg.

1. The Five Seconds data you collected a few days ago are also normally distributed. Find the standard deviation of your group data using the table below.

	Data values (seconds)	Distance of each data value to the mean	Distances squared
Sum of data values =		Sum of distances squared =	
Mean of data values =		Mean of distances squared =	
		Square root =	

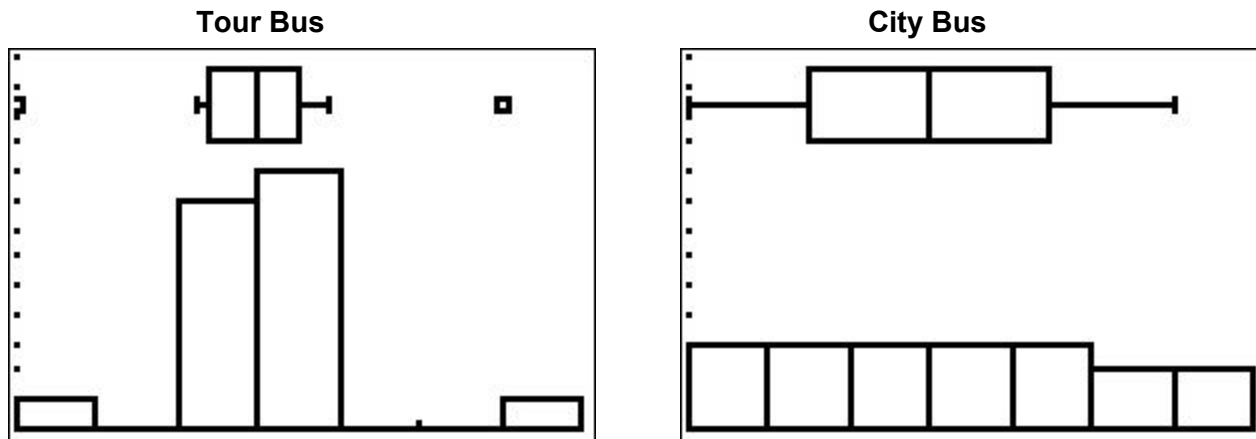
The standard deviation of our group data for Five Seconds is _____.

2. Two buses are each carrying 19 passengers. The ages of the people riding on each bus are below.

Tour Bus: 10, 32, 32, 34, 34, 36, 37, 39, 39, 40, 41, 43, 43, 44, 45, 46, 46, 49, 70

City Bus: 10, 10, 15, 20, 25, 28, 30, 32, 35, 40, 45, 48, 50, 52, 55, 60, 65, 70, 70

Below are the histograms (using bins of 10 years) and box plots for each bus:



- Using the histograms and box plots, describe the similarities and differences in shape, center, and spread of the passenger data for each bus.
- Find the median and mean of the passenger data for each bus. What do you notice?
- Find the IQR and standard deviation of the passenger data for each bus. How do they compare?
- What do the IQR and standard deviation tell you about a data set?

Extension

3. Use a Google sheet to find the mean and standard deviation of your class data for Five Seconds.

Start by copying the class data into the first column. Then use formulas to find other values:

- sum of data values
- mean of data values
- distance of each data value to the mean
- distance squared
- sum of distances squared
- mean of distances squared
- square root (of the mean of distances squared)

To enter a formula into a cell, use the Functions menu (Σ) or create your own formula by typing the equal sign (=) followed by operations using other cells in the table (click on a cell to enter it into the formula). Here are some examples:

- =SUM(A2:A21)
Calculates the sum of all values in the column from cell A2 through cell A21.
- =AVERAGE(A2:A21)
Calculates the mean average of all values in the column from cell A2 through cell A21.
- =A2-B2
Calculates the difference between cell A2 and cell B2.
- =SQRT(C23)
Calculates the square root of the value in cell C23.

When you copy a formula and paste it into another cell, the new formula uses the cells that are in the same relative position. For example, let's say the formula in cell C2 is =A2-B2. If you paste it into cell C3, the formula will update to =A3-B3.

If you want to keep a specific cell when pasting a formula so that it does not use relative position (for example, the mean of the values), then include dollar signs (\$) in front of the row and column.

- =A2-\$A\$23
Calculates the difference between cell A2 and cell A23. When pasted into another cell, the A2 will change to the cell with the same relative position, but \$A\$23 will not change.

Mean of class data for Five Seconds = _____

Standard deviation of class data for Five Seconds = _____

How do the mean and standard deviation of the class data compare to the mean and standard deviation of your group data?