Name ____ Date ________________ Period

How Fast Can You Throw?

<u>Directions:</u> Find a spot 40 feet from a wall and mark it with a piece of chalk. From that point, you will throw the ball 5 times with your right hand, and then five times with your left hand. Your group's timer will call out "ready, set, throw." You need to release the ball when he/she says throw. Record the time it took the ball to hit the wall in the chart below.

Name:	**Trial 1 (time)**	**Trial 2**	**Trial 3**	**Trial 4**	**Trial 5**	***Mean* of 5 Trials**
Right Hand						
Left Hand						

Part 1: Finding Your Average Speed

1. Use your *mean* time and the distance you threw to calculate your throwing **speed** for each hand. Once you have found the speed for each hand, record your data on the class chart.

   Recall: Distance = ___________ x ___________

   <u>Right Hand</u> <u>Left Hand</u>

2. What are the units of your throwing speed?

3. How far will the ball go in 1 second if thrown with your right hand?

4. How far will the ball go in 2 seconds if thrown with your right hand?

5. Where do you think you rank in the class for throwing speed? Why?

Part 2: Analyzing the Data

1. Make a dot-plot of average speeds for all the students in the class. Use one color to represent right hand throwing and another color to represent left hand throwing.

Right hand color: _______________ Left hand color: _________________

Average Speed

2. Describe how the dot plot is skewed for each hand.

   Right hand: Left hand:

3. a) Describe the difference between the data for the right hand throwing as compared to the left hand throwing. Do we expect to see the same speed measurements from left hand throws as right hand throws?

   b) Doe we observe greater variation within the group of right hand throws, or from left hand throws?

4. If we were to find the *mean absolute deviation* (MAD) of both left handed and right handed throwing, which would have the greater absolute deviation? How do you know? (Hint: Look at the dot plot.)

5. Which distribution has the larger spread in values?

6. Below, make a box-and-whisker plot of average speeds for all the students in the class. Make one for right hand throwing and one for left hand throwing.

<u>Right Hand Average Throwing Speeds</u>

<u>Left Hand Average Throwing Speeds</u>

The terms ***variability*** and ***spread*** are synonyms, and refer to how spread out a distribution is. Just as when we learned about ***measures of central tendency*** where we discussed measures of the center using ***mean*** and ***median***, in this lesson we will solidify our understanding about ***measures of the variability*** of a distribution and how to assess the degree of visual overlap of two numerical data distributions with similar variabilities. (Wow! That's a mouthful!)

There are ***four*** frequently used ***measures of variability***:

a) the range,
b) interquartile range,
c) variance (MAD), and
d) standard deviation. (Note: You will learn about standard deviation in high school!)

7. In your box-and-whisker plot for right hand throwing speed, are there more people with *average speeds* in the minimum to 1^{st} quartile range, or in the 1^{st} quartile to median range? Why?

8. a) What is the *range* for each of the box-and-whisker plots?

   Right hand: Left hand:

   b) Does one of the box-and-whisker plots have a greater *range*? Why do you think that is?

9. a) What is the *interquartile range* for each of the box-and-whisker plots?

   Right hand: Left hand:

   b) Does one of the box-and-whisker plots have a greater *interquartile range*? Why do you think that is?

10. What similarities do you notice between the two box-and-whisker plots?

11. What differences do you notice between the two box-and-whisker plots?

12. Describe how each box-and-whisker plot is skewed.

    Right hand: Left hand:

13. Which box and whisker plot has the longest whisker? What causes this, and would you expect this to usually happen when a class does this activity?

14. In which quartile did your average speed fall for your right hand? What percent of the class can you say throws your speed or slower?

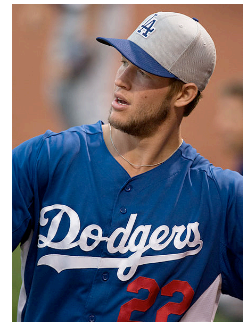
15. If someone's average speed was the upper quartile value, how many people threw faster than him/her?

16. If someone's average speed was the median, what percent of the people threw faster than him/her?

17. Are there any outliers? Why do you think this occurred?

18. What general statements can you make about your class, when comparing their average speed throwing with their right hand, versus their left hand?

Part 3: Are you the next Clayton Kershaw?



On average, Los Angeles Dodger's pitcher Clayton Kershaw throws 95 miles per hour. (Clayton throws left-handed.)

1. How fast is the average speed of each of your arms in miles per hour? How does this compare to Clayton Kershaw?

2. At your best arm's average speed, how long would it take you to throw the ball from home plate to second base, a distance of 127.28 feet (assuming you could maintain the average speed)? How long would it take someone whose average speed was at the lower quartile?

3. Would Clayton Kershaw be an outlier in your class? Why or why not?

4. If you added Clayton's average speed to the left-handed box-and-whisker plot
   a) How would the display change?

   b) How would the *mean* change?

   c) How would the *mean absolute deviation* change?

Teacher Directions: How Fast Can You Throw?

Materials

Copies: How Fast Can You Throw? (1 per student)

Supplies:
Chalk (1 piece per group)
Stop Watches (10)
Rubber Balls or Tennis Balls (10)
100′ Tape Measure
Area where kids can throw a ball from 40′ away from a wall/fence
Calculators (1 per student)

Overview:

Students will collect data for speeds of throwing a ball with their right and left arms. Students will solve for average speed, create and interpret a dot plot, box-and-whisker plot, and analyze results using measures of central tendency and measures of variability.

Activity Notes:

Prior to going outside, you need to measure a 40′ distance to a wall where students will be able to throw balls at. Mark the distance for each group using a piece of chalk.

Pass out activity sheet *How Fast Can You Throw*? Put students in groups of three. Each group needs a stopwatch and a ball. Model the following in the classroom, before going outside:

> From the 40′ point marked with chalk, **each group member will throw the ball 5 times with the right hand and 5 times with the left hand**. While one group member is throwing, one is retrieving and the other is timing. The timer needs to call out "ready, set, throw." The thrower should release the ball on the word throw. The timer stops the watch when the ball hits the wall. The retriever gives the ball back and records the time. Repeat this process until each person has 10 times recorded.

NOTE: It may be easier to throw the ball *underhand* if a student has a difficult time throwing 40 feet. If a student cannot throw the ball 40 feet, have him/her move up to a point where the ball can reach the wall. Make sure he/she measures the distance and uses that number when calculating average speed.

Once data has been collected, ask each student to calculate the means of their 5 trials.

Part 1: Finding Your Average Speed

The next section, finding your throwing speed, asks the students to use their average time and distance to solve for their average throwing speed. They are in effect solving the equation $D=RT$ for rate, but the formula is not necessary. Make sure the students are aware of the units of this measurement. As they are answering questions 3-5, on the board, make two columns, one for right hand average speed and one for left hand average speed. Have one representative from each team write the average speeds for each group member on the board. **Ask students to round their speeds to the nearest whole number.**

Note: You can print out a class roster with 3 columns, student name, right hand speed, left hand speed. (See sample at the end of this document.)

Part 2: Analyzing the Data

Once all the class data has been brought up, have students make a dot plot for each set of data, using one color for right hand speed and another color for left hand speed. Students may work alone, or in their groups of 3; it is your choice. You will need to have a class discussion about the type of intervals that should be used along the number line. Allow 10-15 minutes for students to make the dot plot and to answer questions 2 through 5. Have students share their answers to these questions.

Question 4 is a review of MAD from grade 6. Although students are not calculating the mean for the entire class, they should be able to see the distribution of speeds amongst the class, and if these distributions are relatively close to the "center" or not. If you have time, you can calculate the mean for the class and find the MAD to show students if their predictions were correct or not.

Students will now make a box-and-whisker plot for the right arm and one for the left arm. Ask students what they will need to do with the class data in order to construct the box-and-whisker plot. A hint would be to use the dot-plot to help them put the data in order, instead of trying to rewrite from the class chart at the front. You may want to do the right arm together to reach consensus and to review how to make a box-and-whisker plot, and then let them make the left hand one on their own or in their groups of three.

Once the box and whisker plots are made, discuss vocabulary: box, whisker, mean, and quartile. Have a student read the description regarding *measures of variability*, which include range, interquartile range, variance and standard deviation. Note: Standard deviation will be done in a high school math course.

Have the students answer questions 7-18. You may want to break this up into smaller chunks, bring the class together and then have them continue on. Give them about 10 - 15 minutes for this, and then discuss the answers as a class.

Part 3: Are you the next Clayton Kershaw?

Students will now compare their average speed to that of LA Dodger's pitcher, Clayton Kershaw. You might want to also compare the distance students were throwing, versus the distance a professional pitcher throws, from the mound to home plate, 60.5 ft.

This part of the activity requires the comparison and conversion of units. Make sure the students are aware of the units being used when comparing their speed to Clayton Kershaw's. Give them the fact that 1 mile equals 5280 feet. Question 1requires dimensional analysis, so you may want to model this for the students.

If time allows, have students find the MAD for left arm average throwing speed to see if their prediction about how Clayton Kershaw's data would change the mean and the MAD.

Sample Table to Record Student Data

Student Name	Right Hand	Left Hand