**Data Distributions**

This lesson is designed for students in 6th grade, as well as any students working on data analysis skills. In this collaborative lesson, students will graph, determine measures of center and variability, and describe data sets related to the Summer 2020 Olympics in Tokyo, Japan (held during the summer of 2021). Students will determine the mean, median, mode, and range for given data sets, identify any outliers, and describe the shape and distribution of graphs they create using accurate and precise mathematical language. A large focus of this lesson should be on the second mathematical practice: reason abstractly and quantitatively. Students should work to contextualize and decontextualize to deeply understand the story behind the data. At the conclusions of this lesson, students will demonstrate their understanding by completing an independent assignment related to data analysis.

**Standards:**

**Common Core State Standards:**

* **Mathematical Practices**
  + **CCSS.Math.Practice.MP1** – Make sense of problems and persevere in solving them.
  + **CCSS.Math.Practice.MP2** – Reason abstractly and quantitatively.
  + **CCSS.Math.Practice.MP3** – Construct viable arguments and critique the reasoning of others.
  + **CCSS.Math.Practice.MP4** – Model with mathematics.
* **6th Grade**
  + **CCSS.Math.Content.6.S.A.1** – Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. *For example, “How old am I?” is not a statistical question, but “How old are the students in my school?” is a statistical question because one anticipates variability in students’ ages.*
  + **CCSS.Math.Content.6.S.A.2** – Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.
  + **CCSS.Math.Content.6.S.A.3** – Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.
  + **CCSS.Math.Content.6.S.A.4** – Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
  + **CCSS.Math.Content.6.S.A.5** – Summarize numerical data sets in relation to their context, such as by:
    - **CCSS.Math.Content.6.S.A.5.A** – Reporting the number of observations.
    - **CCSS.Math.Content.6.S.A.5.B** – Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
    - **CCSS.Math.Content.6.S.A.5.C** – Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.
    - **CCSS.Math.Content.6.S.A.5.D** – Relating the choice of measures of center and variability to the shape of the data distribution and the content in which the data were gathered.
  + **CCSS.ELA-Literacy.W.6.4** – Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
  + **CCSS.ELA-Literacy.W.6.10** – Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) or a range of discipline-specific tasks, purposes, and audiences.

**Objectives:**

* Students will be able to make dot plots to represent given data sets.
* Students will be able to determine measures of center and variability for a given set of data.
* Students will be able to describe the distribution of a data set, including its center, spread, and overall shape.

**Lesson Duration:** approximately 55-70 minutes

**Materials:**

* The Building Blocks of Math: Moving Beyond Foundations series, specifically Data and Statistics
* 2020 Olympics Data and Questions Student Version (1 per student)
* 2020 Olympics Data and Questions Answer Key
* Assignment: Tall Drops and Long Rides (1 per student)
* Pencils
* Optional: scratch paper
* Optional: calculators (see Differentiation Considerations section)

**Requisite Prior Knowledge:**

* Prior to engaging in this lesson, it would be beneficial for students to have experience graphing (specifically using dot plots) as well as finding the measures of central tendency and variability for a given data set.
* Students should also understand the idea that data tells a story. Being able to understand what specific values stand for can help us better interpret and describe the shape of a distribution. Good mathematicians both contextualize and decontextualize frequently.

**Vocabulary:**

* Data – a collection of facts, such as numbers, words, measurements, or observations; information
* Dot plot (line plot) – a graphical way of representing data in which each of the data points is represented by a dot above its value on a number line
* Measures of central tendency – describes the central or middle value of a data set
* Measures of variability – describes how alike or different the values in a data set are
* Mean – the sum of the data divided by the number of data values; often called the average
* Median – the value in the middle of a data set when that data set is organized from least to greatest
* Mode – the most common value in a data set
* Range – represents the difference between the least and greatest values of a data set
* Distribution – the shape of a data set that reveals information about it
* Outlier – an unusually large or small data value compared to the others in a data set

**Differentiation Considerations:**

* Consider using strategic grouping during this lesson. Heterogenous pairs can be used to help engage and benefit all learners during this activity.
* Consider allowing students to use calculators throughout this lesson as the focus should be on how to interpret data distributions rather than on how to complete calculations with decimal numbers.
* Consider pulling a small group to provide support for determining measures of central tendency, finding measures of variability, and describing the distribution of a data set during both the Application Activity and the Independent Application portions of this lesson plan.

**Lesson and Instruction:**

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| **Lesson Components and Time Guidelines** | **Teacher Actions** |
| **Introduction/Hook**  Approximately 5 | Pique students’ interest by asking them if they have watched the Olympics in the past. What sports or events have they seen? What do they enjoy the most? Explain that today they will have an opportunity to analyze data about the results of some 2020 Olympic swimming races. The 2020 Summer Olympics took place during the summer of 2021 in Tokyo, Japan, as a result of the COVID-19 Pandemic.  Explain to students that they will work to determine measures of central tendency, such as the mean, median, and mode, as well as measures of variability, such as range and shape, to describe distributions of data. They will have an opportunity to work in the whole group setting as well as in pairs before applying what they know independently. |
| **Direct Instruction and Modeling**  Approximately 15-20 minutes | Provide students a copy of the 2020 Olympics Data and Questions worksheet. Read through the introduction and model how to create a dot plot (also called a line plot) for the data provided. Consider your students’ needs here. If they are proficient with graphing, skip the modeling portion and provide time for students to create their own dot plots using the provided data.  Use the 2020 Olympics Data and Questions Answer Key to guide you through this portion of the lesson.  Next, review how to find the following measures of central tendency:   * Mean 🡪 add up the values of the data and divide by the total number of data points * Median 🡪 list the data from least to greatest and determine the middle value; if there are two middle values, average them to determine the median * Mode 🡪 the data point that occurs the most; is no data point occurs more frequently than others, there is no mode   Then, review how to find the following measures of variability:   * Range 🡪 subtract the minimum value from the maximum value * Outliers 🡪 data points that are unusually large or small * Shape 🡪 how the data looks on a graph, whether it skews left or right, or whether it bunches together   Finally, discuss what students notice about the data and what the different measures of center and variability mean in context of the story situation. |
| **Application Activity**  Approximately 15-20 minutes | Transition to the next phase of the lesson, partnering students to complete the second half of the 2020 Olympics Data and Questions worksheet. Here, students will collaborate to create a dot plot, determine measures of center and variability, and to describe the shape of the distribution.  Provide students work time and consider circulating the room for support or pulling a small group of students for additional support or enrichment.  Prior to transitioning to independent work, bring students back to the whole group setting to discuss what they noticed about the data from this set and what the different measures of center and variability mean in the context of this story situation. |
| **Independent Application and Demonstration of Learning**  Approximately 15-20 minutes | Transition to the independent setting and have students complete the Tall Drops and Long Rides worksheet. Consider collecting this as a form of assessment.  Again, consider circulating the room or pulling a small group of students for additional support or enrichment. |
| **Closure**  Approximately 5-10 minutes | Return to the whole group setting to reflect on the objectives. Today, students were able to graph data using a dot plot, determine measures of center and variability, and use writing to describe the distribution of the data in context. These are tricky skills to combine, but thinking about them together helps us better understand the story behind the data! |

**Next Steps and Reflection:**

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| What went well? |  |
| What changes might be beneficial? |  |
| Reteaching needs |  |
| Extension needs |  |