High School Statistics: Summarize, Represent and Interpret data

Common Core State Standards

Content Standards to meet

Summarize, represent, and interpret data on a single count or measurement variable

CCSS.MATH.CONTENT.HSS.ID.A.1
Represent data with plots on the real number line (dot plots, histograms, and box plots).

CCSS.MATH.CONTENT.HSS.ID.A.2
Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

CCSS.MATH.CONTENT.HSS.ID.A.3
Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

Mathematical Practices (MP)

CCSS.MATH.PRACTICE.MP4
Model with mathematics.
CCSS.MATH.PRACTICE.MP5
Use appropriate tools strategically.
CCSS.MATH.PRACTICE.MP6
Attend to precision.
CCSS.MATH.PRACTICE.MP7
Look for and make use of structure.

The present learning progression was designed for 11th and 12th grade high school students as they are being introduced to statistics for the first time. The text book used in this classroom is Understandable statistics: concepts and methods - 9th edition by Charles Henry Brase. The Common Core State Standards that will be satisfying are HSS.ID.A.1, HSS.ID.A.2, and HSS.ID.A.3. The math practices that students will make use of are MP4, MP5, MP6 and MP7.

To meet the common core state standards, students will complete selected activities from the textbook that include organizing sets of data, analyzing and computing measurements of central tendencies and using technology (calculator and computer). Since this content is introductory to the course, students will be introduced to different definitions and concepts such as box and whiskers plot and outliers. In this learning progression, there will be a total of three lessons. Formative assessment will during instruction by asking students to rate their understanding, give the correct answer to a problem and/or answer questions. Summative assessment will be activity sheets, warm-ups, exit slips and a final project.

By the end of this learning progression, students will also complete a project base assignment that will assess their understanding of the whole unit and that they will work independently. For this project, students will analyze a given complete set of data (find mean, mode, median, and range), organize the data in a box-and-whiskers plot (identify the outliers) and write a report with their conclusions and observations from their results.

Lesson 1

CCSS.MATH.CONTENT.HSS.ID.A.2

Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets

CCSS.MATH.PRACTICE.MP6

Attend to precision.

Critical Thinking (adapted from textbook)

Consider a data set of 10 distinct measurements with mean A and median B.

(a) If the highest number were increased, what would be the effect on the median and mean? Explain.

(b) If the highest number were decreased to a value still larger than B, what would be the effect on the median and mean?

(Figure 1)

Lesson 2

CCSS.MATH.CONTENT.HSS.ID.A.1
Represent data with plots on the real number line (dot plots, histograms, and box plots).

CCSS.MATH.PRACTICE.MP4
Model with mathematics.

CCSS.MATH.PRACTICE.MP5
Use appropriate tools strategically.

Lesson 1 will introduce students to the concepts of mean, median, mode, and range (HSS.ID. A.2). At the beginning of the lesson, there will be a small student activity that will prepare students to review the material learned the previous day. For lesson 1, the warm-up activity will ask students to evaluate the given scenario: Sara has five test scores for this semester: 80, 75, 90, 80, 85. What can we learn from those scores? Explain your answer. Students will have the opportunity to work with their peers to explain their reasoning and draw conclusions. This activity will take approximately 15 minutes. After this activity is being discussed, direct instruction and modeling will be done to define concepts, show procedures, and discourse with the students as well as to clear any misconceptions. I will give the students the mathematical definitions of those concepts as well as the formulas to find them. Students will receive a worksheet with scenarios and data sets that students will be asked to analyze (find mean, median, mode, and range) and answer questions that will help them develop critical thinking (figure 1). In this assignment, students will make use of MP6 with accurate and precise answers. By the end of the class, I will give students an exit slip, where I will ask students questions such as what does the mean, median and mode tell us? Why is the range important? This will be the benchmark assessment, if students meet answers are correct, then they are ready to move into the next lesson, if not then review and clarifications need to be done.

Lesson 2 will introduce students to organizing data points into histograms, steam-and-leaf-plot and Box-and-Whisker Plot (HSS.ID.A.1). For this lesson, as an introductory activity, students will receive a data set that they need to find the mean, median, mode and range. Students will also

Exit slip (adapted from textbook)

Clayton and Timothy took different sections of Introduction to Economics. Each section had a different final exam. Timothy scored 83 out of 100 and had a percentile rank in his class of 72. Clayton scored 85 out of 100 but his percentile rank in his class was 70. Who performed better with respect to the rest of the students in the class, Clayton or Timothy? Explain your answer

Health Care: Nurses at Center Hospital there is some concern about the high turnover of nurses. A survey was done to determine how long (in months) nurses had been in their current positions. The responses (in months) of 20 nurses were: 23 2 5 14 25 36 27 42 12 8 7 23 29 26 28 11 20 31 8 36

Make a box-and-whisker plot of the data.

(Figure 2)

Lesson 3

CCSS.MATH.CONTENT.HSS.ID.A.3
Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

CCSS.MATH.PRACTICE.MP4
Model with mathematics.

CCSS.MATH.PRACTICE.MP6
Attend to precision.

CCSS.MATH.PRACTICE.MP7
Look for and make use of structure.

be asked to manipulate the data points to make the mean and the median be the same number. This will help students have a better understanding of what mean, median mode and range, and how they affect the data sets. After this activity, students will be ready to be introduced to the concept of box-and-Whiskers plot. To teach this lesson, I will model an example in front of the class, I will perform all the calculations using data that will be collected from the students in the classroom responses to the question: how many cities have you visited? Then I will assign groups and give them a data set that they need to make the calculations and explain the boxplot to the rest of the class. By making students part of the activity, I am helping them increase their self-efficacy and the students will be more engage in the learning environment (Boykin & Noguera, 2011). Discourse will help students explain their ideas and also have them work in groups will benefit students with peer support for students that need help understanding this concept. In this lesson, formative assessment will be the students' responses and participation in the group discussion/presentation. In this lesson, students will make use of models and different tools to compute the necessary information from the data to complete the report (MP4-5). The benchmark assessment will be the exit slip (figure 2). This will help me assess students understanding of the concept and use of the box-and-whiskers plot when analyzing data. If students do not meet the benchmark assessment, then the review will be the warm-up activity for the next day.

For the next day, students will start class with a short warm up activity to assess their understanding of previous days' material. For this activity I will use "my favorite no", I will ask students to find the mean and median, the upper and lower quartiles of a given set of data and to make a prediction of how the box-and-whiskers plot will look like with the given information.

Critical Thinking (adapted from text book)

Students from a statistics class were asked to record their heights in inches. The heights (as recorded) were 65 72 68 64 60 55 73 71 52 63 61 74 69 67 74 50 4 75 67 62 66 80 64 65

(a) Make a box-and-whisker plot of the data.

(b) Find the value of the interquartile range (IQR).

(c) Multiply the IQR by 1.5 and find the lower and upper limits.

(d) Are there any data values below the lower limit? above the upper limit? List any suspected outliers. What might be some explanations for the outliers?

(Figure 3)

Data Project (data)

The following data represent total air movement in miles per day over a weather station in Hawaii as determined by a continuous anemometer recorder. The period of observation is January 1 to February 15, 1971. 26 14 18 14 113 50 13 22 27 57 28 50 72 52 105 138 16 33 18 16 32 26 11 16 17 14 57 100 35 20 21 34 18 13 18 28 21 13 25 19 11 19 22 19 15 20

(Figure 4)

In this lesson, students will learn about outliners and how they affect the measures of central tendency and the box-and-whiskers plot (HSS. ID. A.3.). To teach this lesson, I will start by using the same data from the warm up activity and asking students to draw the box-and-whiskers plot for this data. Then I will ask them how is this box different from the ones done in the previous days. At this point, I will introduce the concept of outliers, define it and work different cases with students. After instruction, students will be assigned a handout that will contain a set of data that students need to find the mean, median and mode, and draw a box-and-whiskers plot and answer some questions about the data (figure 3). In this assignment, students will make use of different mathematical practices MP4, MP6 and MP7. This activity will be the benchmark assessment for this lesson, if students complete their work correctly and are able to explain their reasoning in the questions, then they will be ready for the final project.

The last day of this unit, I will explain to the students their final project for this unit Students will work individually in this project. I will give them a dataset (figure 4) then they need to find the mean, median, mode, minimum, maximum, upper and lower quartiles, and the outlines. Then using this information, students will write a report, answer the questions and explain the data. This project will be the benchmark for the whole unit. If students are able to compute all the calculations correctly, answer all the questions and explain the data with complete sentences, then they will meet the benchmark and will be ready to move into the next unit.