Unit 4: Class Profile Overview

How can we use mathematics to compare what is typical and what is unique about our class?

Learning Task 1: Get Started on the Culminating Project

Check for Understanding • Statistical Questions

Learning Task 2: Measures of Central Tendency

Check for Understanding • How the Center Changes

Learning Task 3: Box Plots

Check for Understanding • Interpret Box Plots

Learning Task 4: Interpret Data

Check for Understanding • Compare Data Sets

Culminating Project: Class Profile

Students will compare data about the class with data about sixth graders across the country.

Individual Performance Task

Learning Objectives

Students will be able to

- Identify statistical questions.
- Create survey questions using statistical questions.
- Distinguish between categorical and numerical data.
- Describe, interpret, and draw conclusions from the central tendency of a data set.
- Represent data using box plots.
- Identify outliers and how they affect measures of central tendency.
- Determine how data sets can have similar centers but different distributions.
- Create data sets that meet specific constraints.
- Determine the ways in which measures change when new data is added to a set.
- Describe typical cases, distinguishing between what different measures of central tendency indicate about the data.
- Determine which statistics are best used to summarize different data sets.

Standards

Aligned Common Core State Standards for Mathematics

- 6.SP.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.*
- 6.SP.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.
- 6.SP.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.
- 6.SP.B.4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
- 6.SP.B.5. Summarize numerical data sets in relation to their context, such as by:
    - 6.SP.B.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.
    - 6.SP.B.5.D. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.

Class Profile Overview

Learning Task 1: Get Started on the Culminating Project

Who are we? Students will learn what a statistical question is, understand the difference between numerical and categorical data, and represent data using dot plots. Students will apply these concepts in the Class Profile Culminating Project, in which they will conduct surveys to learn more about their class, interpret and represent their data, and compare their class with other sixth-grade classes across the country.

Learning Task 2: Measures of Central Tendency

How can central tendency be used to summarize data? Students will work together to analyze data from a hypothetical class to help deepen their understanding of central tendency. They will use reasoning to "work backward" from the mean in order to find information about data sets. They will explore the effects of new data (especially outliers) on measures of central tendency.

Learning Task 3: Box Plots

How can variability be used to summarize data? Students will have two opportunities to create a five-number summary and box plot from a data set, thus giving them the opportunity to develop deeper conceptual understanding and stronger procedural fluency—they will "get" the reasons, and become stronger at creating the visual displays. When groups have a pair of box plots from different data sets that answer the same question (e.g., How many pets do you have in your home?) and are accurately graphed **using the same scale**, they will be able to compare and analyze across two data sets, make observations about what the statistics are, and draw inferences about what they mean.

Learning Task 4: Interpret Data

How are we similar to and different from classes across the country? Students will apply their statistical skills in order to compare their class data to a national data set. Depending on how the task is implemented, time, and resource availability, students will have the chance to practice real research skills and use technology software to handle larger sets of data.

Culminating Project: Class Profile

Students will use their knowledge of statistics and collected data to create a Class Profile and compare the class's profile with national data.

Individual Performance Task

Students will individually complete a performance task to display evidence of student mastery of the skills related to this unit.

Class Profile Culminating Project

For the Culminating Project, students will use their knowledge of statistics and collected data to create a Class Profile and compare the class's profile with national data.

Culminating Project Specifications

Students will be given the following checklist and rubric to prepare for their presentation. You will use the rubric to judge their project.

Make sure that your Class Profile Culminating Project includes:

- ❑ Two numerical statistical questions to analyze data for, with an explanation as to why these questions are statistical, why they are numerical, and why you chose to analyze them
- ❑ A picture of or link to your raw data that shows how you calculated the mean and five-number summary
- ❑ Dot plots to represent both of your questions; the dot plots should include:
  - ❑ Title
  - ❑ Appropriate labels
  - ❑ Mean, median, and mode, and an explanation of which measure would be the best summary of both dot plots and why
- ❑ Box plots to represent both of your questions; the box plots should include:
  - ❑ Title
  - ❑ Appropriate scale
  - ❑ Appropriate labels
  - ❑ Range, interquartile range, and the number of observations reported
  - ❑ An explanation of how the data is distributed using statistics vocabulary in context
- ❑ A comparison of your class data to national data (using a new question or one of the questions you already analyzed), including:
  - ❑ Two box plots to compare the data sets (with title, labels, and appropriate scale)
  - ❑ An explanation of the similarities and differences between your class data and the national data
  - ❑ A comparison of central tendencies and variability using statistics vocabulary in context

STUDENT EDITION

Class Profile Culminating Project Rubric

MATH PRACTICE	MASTERS	ACHIEVES	APPROACHES	NOT YET
Model with mathematics (MP4) **Dot plots**	Our dot plots accurately represent our data. We include the correct mean, median, and mode. We accurately and thoroughly explain which measure of central tendency would be the best summary for each graph.	Our dot plots mostly represent our data. We include the correct mean, median, and mode. We partially explain which measure of central tendency would be the best summary.	Our dot plots mostly represent our data. We include the mean, median, and mode with some errors. Our explanation of which measure of central tendency would be best is incomplete or flawed.	Our dot plots do not represent our data. We do not include the correct mean, median, or mode. We do not explain which measure of central tendency would be the best summary.
Model with mathematics (MP4) **Box plots**	Our box plots accurately represent our data. We include the correct range, interquartile range, and number of observations. We accurately and thoroughly explain the distribution of each graph using math terms and real-life terms.	Our box plots accurately represent our data. We include the correct range, interquartile range, and number of observations. We mostly explain the distribution of each graph using math terms and real-life terms.	Our box plots mostly represent our data. We include the range, interquartile range, and number of observations with some errors. Our explanation of distribution is incomplete or flawed.	Our box plots do not represent our data. We do not include the correct range, interquartile range, or number of observations. We do not explain the distribution of the graphs.
Construct viable arguments (MP3) **Comparing graphs**	We use a consistent scale when comparing our class graph to the national graph. We thoroughly and accurately explain what is similar and what is different about the data sets. We thoroughly and accurately describe the data using math terms and real-life terms.	We use a consistent scale when comparing graphs. We mostly explain what is similar and what is different about the data sets. We mostly describe the data using math terms and real-life terms.	We use a consistent scale when comparing graphs. Our explanation of what is similar and different is incomplete or flawed. Our descriptions do not use both math terms and real-life terms.	We do not use a consistent scale when comparing graphs. We do not explain what is similar and what is different about the data sets.
Construct viable arguments (MP3) **Statistical questions and data**	We thoroughly explain why our questions are statistical and numerical. We show how we used our raw data to calculate the means and five-number summaries.	We mostly explain why our questions are statistical and numerical, **or** we partially show how we used our raw data to calculate the means and five-number summaries.	Our explanations for why our questions are statistical and numerical are incomplete or flawed, **or** we include links or pictures of our raw data but do not show how we used them.	We do not explain why our questions are statistical and numerical, **or** we do not include links or pictures of our raw data.
Attend to precision (MP6)	We make accurate calculations during our analysis. We use appropriate scales and labels. We correctly use math vocabulary in our descriptions.	We mostly make accurate calculations during our analysis, **or** we mostly use appropriate scales and labels, **or** we mostly use math vocabulary correctly.	We have errors in our calculations, **or** we do not use appropriate scales and labels, **or** we do not use math vocabulary correctly.	We do not use scales or labels, **or** we do not use math vocabulary.

Class Profile Assessments

Check for Understanding

At the end of each Learning Task, there is a Check for Understanding that reviews the math content in that Learning Task. Answer keys are provided in this Teacher Edition.

Learning Task 1: Check for Understanding • Statistical Questions

Learning Task 2: Check for Understanding • How the Center Changes

Learning Task 3: Check for Understanding • Interpret Box Plots

Learning Task 4: Check for Understanding • Compare Data Sets

Individual Performance Task (including a Group Preview)

You will administer a Group Preview and an Individual Performance Task at the end of the unit.

The Group Preview is an introduction to the Individual Performance Task that has students work in groups. It is meant to make the Individual Performance Task more accessible, but it is not meant to be a summative assessment in and of itself. You will find an answer key on page 7.

The Individual Performance Task should be administered to each student. You will find a rubric and answer key on pages 8–10.

GROUP PREVIEW • Transportation Statistics

Name _____ **Date** _____ **Team** _____

Ms. Garcia's students want to write letters to their city council in order to persuade the council to add a bus line that reaches their school. They decided to use data they collected as evidence to help support their claim.

Nia wants to create a statistical question about how students get to school so that she can collect data to use in her letter to the city council. Give an example of a statistical question that yields numerical data that she can use.

Answers will vary.

INDIVIDUAL PERFORMANCE TASK • Transportation Statistics

Name _____ **Period** _____ **Date** _____

Ms. Garcia's students want to write letters to their city council in order to persuade the council to add a bus line that reaches their school. They decide to use data they collected as evidence to help support their claim.

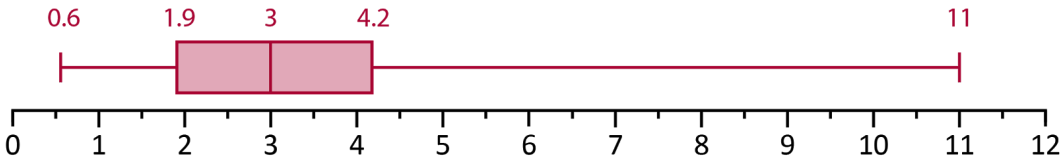
1. Nia collected the following data by surveying her classmates to see how far they travel (in miles) to get to school. Here are the responses she received:

{ 4.2, 1.9, 0.8, 4.6, 11, 2, 2.8, 3, 4.2, 0.6, 3.7 }

a. Create a five-number summary for Nia's data.

Minimum:	1st Quartile:	Median:	3rd Quartile:	Maximum:
0.6	*1.9*	*3*	*4.2*	*11*

b. Create a box plot for Nia's data.



c. What is the mean of Nia's data? Why is it different from the median?

The mean of Nia's data is 3.527.... Students in her class travel an average of about 3.527 miles to get to school.

The mean is greater than the median because of the outlier 11. Outliers have a bigger effect on the mean than on the median.

2. Henry collects data by surveying his classmates to see how far they travel (in miles) to get to school. Here are Henry's responses:

   { 9.1, 0.8, 0.6, 5.9, 1, 12, 2.3, 7.7, 3, 0.3, 8.3 }

   Henry says his school is just like Nia's because he found the median and concluded that everyone he surveyed travels about 3 miles to get to school.

   Do you agree with his conclusion? Why or why not?
   No, I do not agree with Henry. Reasoning may vary. The interquartile range of Nia's data is 2.3 miles. The IQR of Henry's data is 7.5 miles. Even though the data sets have the same median of 3 miles, Henry's data set is much more spread out.

3. The city council writes Ms. Garcia's class back and says they need to see more data. In order to add a bus, they require that the average distance students travel to get to school be 4 miles or more.

   If a new student joins the class, what is the closest she or he could live to school that would raise the mean above 4 miles? Show your work.

   The closest a new student could live to school is 9.2 miles.

   Student work may vary. Example:.

$$\frac{38.8+x}{12} \geq 4$$

$$\cancel{12} \cdot \frac{38.8+x}{\cancel{12}} \geq 4 \cdot 12$$

$$38.8+x \geq 48$$

$$38.8+x-38.8 \geq 48-38.8$$

$$x \geq 9.2$$

Class Profile Individual Performance Task Rubric

MATHEMATICAL PRACTICE	MASTERS	ACHIEVES	APPROACHES	NOT YET
Construct viable arguments (MP3)	Achieves Plus: I provide more than one way to verify that my argument is correct.	I support my arguments and claims with evidence. I evaluate and improve incomplete or flawed arguments.	I provide partial or inconsistent evidence to support my conjectures, arguments, and claims.	I am still working to provide evidence (that someone else will understand) to support my conjectures, arguments, and claims.
Critique the reasoning of others (MP3)	Achieves Plus: I provide more than one way to verify the reasoning of others.	I explain how I tested the reasoning of others. If there is a flaw, I can identify it. I use evidence to support or refute others' arguments and claims.	I provide partial or inconsistent evidence to support or refute others' conjectures, arguments, and claims.	I need assistance to provide evidence to support or refute others' conjectures, arguments, and claims.
Model with mathematics (MP4)	Achieves Plus: I describe the conditions for which my model is valid.	I represent situations, questions, and problems in multiple and effective ways (pictures, diagrams, charts, graphs, expressions, numbers, words, and so on). I adjust, revise, and update my model when I receive new information, and document that I did this.	I start to represent situations, questions, and problems, but I am not sure how to use my model to find my answer.	I need assistance showing how to represent the given situation. I am unsure what information I should use in my model.

Materials, Supplies, and Technology

Learning Task 1: Get Started on the Culminating Project

- Computers with internet access if available
- Census at School Questionnaire (if students have internet access they can fill this out online; if not, use the questionnaire provided in Handouts and Assessments)
- Measuring tape
- Examples of dot plots
- Chart paper
- Pencils and colored markers
- Copies of Check for Understanding • Statistical Questions (see Handouts and Assessments)

Learning Task 2: Measures of Central Tendency

- Cheerios™ (or other small objects)
- Copies of Check for Understanding • How the Center Changes (see Handouts and Assessments)

Learning Task 3: Box Plots

- Computers with internet access if available
- Chart paper
- Sticky notes
- Index cards
- Graphing calculators or graphing/statistical software
- Graph paper
- Chart paper
- Markers
- You may wish to make several copies of the dot plots that students created in Task 1 so students can draft box plots on top of the existing scale and plotted data set. This will help students to bridge from a representation of every data point to an abstracted version that includes only the *five number summary.*
- Sticky notes each with one piece of data from a data set (you may want to use the data from one of the "Who Are We?" survey questions)
- Copies of Check for Understanding • Interpret Box Plots (see Handouts and Assessments)

Learning Task 4: Interpret Data

- Computers with internet access if available
- In addition to productivity software such as Excel or free online graphing calculators like Desmos, students will have an opportunity to use search engines to find national data. Students will also formulate a data query for the Census at School website.
- http://www.amstat.org/censusatschool/about.cfm (to create a sample data set for students; if you are unable to access national data, create a sample based on data from other classes in the school)
- https://tuvalabs.com/
- Copies of Check for Understanding • Compare Data Sets (see Handouts and Assessments)
- Copies of Group Preview • Transportation Statistics (see Handouts and Assessments)
- Copies of Individual Performance Task • Transportation Statistics (see Handouts and Assessments)