Samples & Populations

(a modified CMP unit)

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Data and Statistics unit for 8th or 9th graders

Special note: The materials in this unit are copyright from CMP, 2nd edition, Samples and Populations unit. Most districts have transitioned to CMP3, the newest edition of the program.

In order to fully teach this unit, teachers would need access to the student pages of the program which can be found in the BSU Math Curriculum Library. Alternatively, CMP 2nd edition resources can be found quite inexpensively online through sites like Amazon.com.

In the interest of trying to stay within the fair use of copyrighted materials, the student pages have been excluded from this lesson set.

These 15 days address three Data and Statistics standards in both 8th grade and in High School statistics strands, with a focus on data sets that work with discrete mathematics ideas. The 15 days are composed of 4 different problem solving investigations. This table provides the links between which standards are addressed in which investigations and the overall goal of the lesson.

Since a majority of our materials are gathered from the CMP, 2nd edition, program, this table also provides the necessary reference for how the lesson objectives related to the MN standards.

Page	Days	MN Standard	Lesson		Lesson Objective	Sample MCA Question
pg. 3-8	**0**	**Pretest**				
pg 9	**1**	**9.4.3.8** Apply probability concepts to real-world situations to make informed decisions.	Inv. 1	1.1	Compare sample distributions using various data displays	See 11th Grade Item Sampler #21, 22, 23
pg 10	**2**			1.2		
pg 11-12	**3**			1.3		
pg 13-14	**4**	**9.4.2.3** Design simple experiments and explain the impact of sampling methods, bias and the phrasing of questions asked during data collection. **9.4.3.8** Apply probability concepts to real-world situations to make informed decisions.	Inv. 2	2.1	Use data from samples to make predictions about a populations.	
pg 15-16	**5**			2.2	Consider various ways of developing a sample plan	
pg 17-18	**6**			2.3	Apply elementary probability with spinners or calculators to choosing from random samples.	
pg 19-20	**7**			2.4	Use data from a sample to estimate a characteristic of a population.	
pg 21	**8-9**	**9.4.2.3** Design simple experiments and explain the impact of sampling methods, bias and the phrasing of questions asked during data collection. **9.4.3.8** Apply probability concepts to real-world situations to make informed decisions.	Inv. 3	3.1	Distinguish between samples and populations and use information drawn from samples to draw conclusions about populations.	
pg 22-23	**10-11**			3.2	Apply concepts from probability to select random samples from populations.	
pg 24-25	**12-13**	**8.4.1.1** Collect, display and interpret data using scatterplots. Use the shape of the scatterplot to informally estimate a line of best fit and determine an equation for the line. Use appropriate titles, labels and units. Know how to use graphing technology to display scatterplots and corresponding lines of best fit.	Inv. 4	4.1	Explore relationships between paired values of numerical attributes	See 8th Grade Item Sampler #26
pg 26-29	**14-15**			Review + Practice		
pg 30-35		**Postest**				

Name:_____

Pretest – Samples & Populations Unit

1.

A biologist is studying a system of rivers and lakes. He takes samples by netting a quantity of fish at different places and studying the fish caught. Some of the fish are diseased because of water pollution. The biologist looks at the distribution across all the samples before drawing any conclusions. If he suspects that the percent of diseased fish in the whole system is above 15%, he will recommend intervention.

a. The results of the biologist's samples are shown below. Complete the table.

Fish-Sampling Data

Sample	Diseased Fish in Sample	Total Number of Fish Caught	Percent of Diseased Fish in Total
1	5	15	33.3
2	8	25	32.0
3	2	12	16.7
4	3	28	10.7
5	2	40	5.0
6	2	22	
7	5	33	
8	3	27	
9	4	29	
10	4	31	
11	3	35	
12	5	40	
13	4	22	
14	1	11	
15	2	21	

d. Is Sample 1 typical of all the samples? Explain your answer.

e. From the evidence of these samples, how should the biologist describe the general condition of the water system and what, if any, action should he propose?

f. Suppose the biologist takes a new sample and it contains 2 diseased fish out of 2. Would this change your description of the situation? Explain.

g. Based on the samples in the table, what percent of fish in this entire system do you think are diseased?

9.4.3.8

2.

A group of students wondered how many raisins were in a bowl of a particular breakfast cereal. They filled 20 identical bowls with cereal and counted the raisins in each bowl. Their results are shown to the right.

Bowl	Number of Raisins	Bowl	Number of Raisins
1	14	2	18
3	21	4	13
5	22	6	20
7	19	8	24
9	19	10	22
11	21	12	12
13	19	14	17
15	14	16	11
17	10	18	23
19	25	20	12

a. Make a box plot or a histogram showing the number of raisins in each bowl.

b. Suppose the cereal boxes are filled from a large container that holds 400 bowl-size servings. Use your sampling distribution to estimate how many raisins are in one of these large containers.

c. Are you confident about your prediction? Explain why or why not.

9.4.2.3

3.

a. Some students were asked to randomly choose a number from 1 to 10. The results are shown. Make a circle graph of these data.

Random Number Choosing

Number	1	2	3	4	5	6	7	8	9	10
Percent of Students Who Chose Number	1	5	12	11	10	12	30	9	7	3

b. Make a bar graph of these data.

c. What is the mode of the numbers selected?

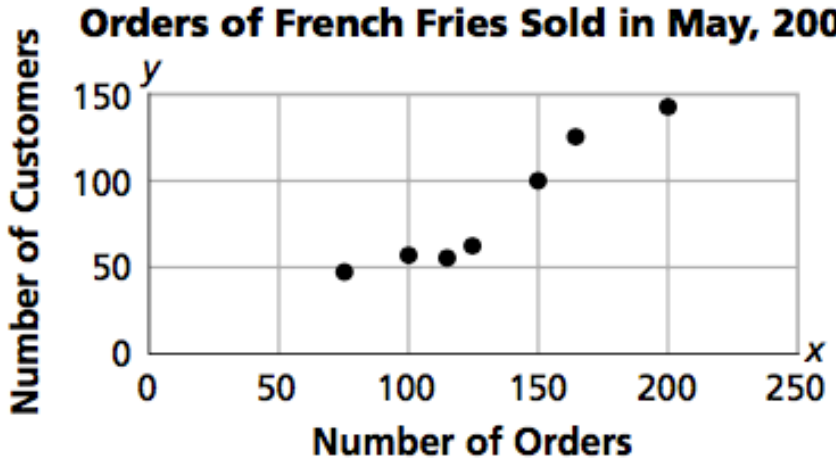
d. Based on the results, do you think the students actually chose the numbers at random?

e. Nine students chose 5 as their number. How many students are in the seventh grade?

9.4.3.8

4.

The following scatterplot depicts the relationship between the number of orders of French fries sold and the number of customers. Which statement below accurately describes this relationship?



F. As the number of customers decreases, the number of French fries increases

G. As the number of customers increases, the number of French fries increases

H. As the number of customers increases, the number of French fries decreases

J. There is no clear relationship between the number of customers and number of French fries.

8.4.1.1

5.

Multiple Choice After testing many samples, a milk shipper determines that approximately 3 in every 100 cartons of milk leak. The company ships 200,000 cartons of milk every week. About how many of these cartons leak?

A. 3 **B.** 600 **C.** 2,000 **D.** 6,000

9.4.3.8

5.

The math club at Farwell Middle School decided to sell magazines, sub sandwiches, or golf coupon books for a fundraiser project. Four students conducted a survey of local adults and the results are displayed in the table below. The table shows the number of people in each surveyor's group and the percent of people who preferred each of three types of fundraisers. The club president decided to sell magazines, but McKenna feels the club should sell sub sandwiches. Which of the following is the best reason for McKenna's choice?

Surveyor	Number of Students Surveyed	Percent Choosing		
		Magazines	Sub Sandwiches	Golf Coupon Books
McKenna	30	20	70	10
Jordyn	18	67	22	11
Marcus	20	50	45	1
Tye	60	40	45	5

F. The greatest percentage of all those surveyed chose sub sandwiches

G. In Tye's group, the greatest percentage chose sub sandwiches

H. Sub sandwiches would be more fun to sell than magazines

J. Jordan interviewed too few people

9.4.2.3

1.1 From Line Plots to Histograms

At a Glance

PACING 1 day

Mathematical Goal

- Compare sample distributions using measures of center (mean, median), measures of variability (minimum and maximum values, range), and data displays that group data (histograms)

Launch

Read the introduction up to Getting Ready. Then put up Transparency 1.1A. See the extended Launch for a discussion of a peanut butter taste test that you may want to have your students do. Distribute Labsheet 1.1 and have the students look at these data. Ask them to consider the questions in the Getting Ready.

Problem 1.1 begins with an introduction to histograms by asking students to apply their knowledge of data analysis to compare quality ratings for natural and regular brands of peanut butters. The comparison helps them to determine the category of peanut butter having an overall higher quality rating. Use Transparencies 1.1C and D to work through the development of how histograms can be made. Some graphs are in the students' edition. Ask students to explain the relationship between these three graphs.

- *How is the interval stacked line plot developed from the shaded-intervals line plot?*

Ask students to think about what is alike or different in the two versions of the data in the merged intervals plot and the histogram. Have students work on the problem in pairs.

Materials

- Transparencies 1.1A–D
- Labsheet 1.1
- Graphing calculator
- Computers and statistical software (optional)

Vocabulary

- distribution

Explore

As you circulate, you may need to review strategies for making histograms and locating specific data values.

Summarize

The main points about the structure of a histogram should be discussed: how are data organized once an interval width is chosen and what happens to *border* data points—in which interval is a border data point placed?

Materials

- Student notebooks
- Overhead graphing calculator

1.2 Using Histograms

At a Glance

PACING 1 day

Mathematical Goal

- Compare samples using measures of center (mean, median), measures of variability (range, percentiles), and data displays that group data (histograms)

Launch

Discuss the questions in the Getting Ready. Then move to working on Problem 1.2.

Ask students if they could describe a process for making a histogram that displays data grouped in intervals of 5. Use quality ratings for regular peanut butter.

- *What would be the first interval?*
- *What numbers would be in the interval of 10 to 15?*
- *What numbers would be in the interval of 15 to 20?*
- *What numbers would be in the interval of 20 to 25?*

Show students how to make a frequency table. See the extended Launch for table and discussion. Continue with the students to fill in the chart. Then display the histogram, asking students to relate the frequency table to the structure of the histogram. Have students work on the problem in pairs.

Materials

- Transparencies 1.2A–C
- Labsheet 1.1
- Graphing calculator
- Grid paper

Explore

As you circulate, you may need to review strategies for finding the median, mean, and range. You also may need to help students review the distinction between using a frequency scale that is reported as counts and one that is reported as relative frequencies (percents).

Summarize

Have pairs of students report and justify their findings and conclusions. Use the information reported to review the statistics of the mean, the median, and the range. Discuss with students the information they see with each graph and how each type of graph helps or hinders making comparisons. Ask students to think of other questions or comparisons interesting to investigate using a different analysis of the data. Review median and mean as two ways to summarize data. Spend time distinguishing between counts and percents as frequencies, and discuss the reason for using relative frequencies.

Materials

- Student notebooks
- Overhead graphing calculator

1.3 Box-and-Whisker Plots

At a Glance

PACING 1–2 days

Mathematical Goal

- Compare sample distributions using measures of center (mean, median), measures of variability (range, percentiles), and data displays that group data (box-and-whisker plots).

Launch

Walk students through the graphing of a box plot (Transparency 1.3A). Ask students to construct a box plot showing the distribution of quality ratings for the regular brands on the same scale as the box plot for the natural brands (Transparency 1.3B). Compare their box plots to those shown in their books. Review the Getting Ready (Transparency 1.3C). Have students work in pairs to answer the questions in the problem. Save Question D until you summarized the problem and discussed how to determine outliers.

Materials

- Transparencies 1.3A–D

Vocabulary

- box–and–whisker plot
- five-number summary
- upper quartile
- lower quartile

Explore

As you circulate, ask questions to help students focus on the percent divisions of data in a box plot (Transparency 1.3D).

- *About what percent of the data is before the median? Above the median?*
- *About what percent of the data is before the lower quartile? Above the upper quartile?*
- *About what percent of the data are between the median and the lower quartile? Between the median and the upper quartile?*

Summarize

Review with students the procedure for making a box plot for a set of data. Ask students how the numbers that summarize the data separate the data into standard percent groupings. Ask:

- *What percent of the data in a box plot fall above the lower quartile? Below the upper quartile?*

Ask students to explain how they used the box plots to decide whether regular or natural brands of peanut butter are higher priced.

Materials

- Student notebooks

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Summarize *continued*

The interquartile range (IQR) is the difference between the upper and lower quartiles. Explain how to calculate and use the IQR to find outliers in a set of data values. Outliers are defined as follows:
values > 1.5 · IQR + upper quartile OR
values < lower quartile − 1.5 · IQR. Ask students how we can use IQR to describe the variability of a data set.

At a Glance

PACING 1 day

2.1 Asking About Honesty

Mathematical Goals

- Distinguish between a sample and a population
- Use data from samples to make predictions about a population

Launch

Read the introduction to Investigation 2 and have students discuss the Getting Ready. Explain that we can often study a large population by analyzing only part of the population called a sample.

Introduce the survey about honesty. Ask students to read through the survey and to consider how it describes honesty. Ask the class how they think students in their school might respond to each of the survey questions.

- *If you wanted to use this survey to study the honesty of the students in our school, how would you collect the data?*
- *In order to draw conclusions about the students in our school, is it necessary to ask everyone in the school to complete the survey?*

Explain what a sampling plan is.

- *If you wanted to gather information from a sample of students in our school, how would you decide whom to ask? In other words, what would your sampling plan be?*

Have students work in groups of 2–4.

Materials
- Transparency 2.1

Vocabulary
- census
- sample
- population

Explore

Circulate as groups work. Remind students to be prepared to present their answers and to describe the strategies they used.

Summarize

Questions B, C, and D are rather straightforward mathematically. However, take time to discuss students' various solution strategies. If more than one answer is presented, analyze the different interpretations to resolve any questions about working with percents.

Have students share their responses to Question E, which asks why the results of this survey may not apply to all Americans. Students might offer some insight in the problem of drawing valid generalizations from such surveys. If so, they are identifying questions related to what makes a sample a good predictor of a population, which will be considered later in this investigation.

Materials
- Student notes

continued on next page

Summarize *continued*

Students will have a variety of ideas about revising the sampling plan in response to Question F. Ask them to provide reasons for how they propose to revise the plan and to identify the problems they are trying to remedy by using a plan other than the one developed by the magazine. Gently challenge each suggestion by asking the following:

- *Will that approach be likely to give results that are predictive of the entire population?*

2.2 Selecting a Sample

At a Glance

PACING 1 day

Mathematical Goal

- Consider various ways of developing a sample plan

Launch

Introduce the topic by reading the two questions in the hypothetical research project. Ask:

- *How might you word each of these as a survey question to ask students?*
- *Do you think your questions are clear?*
- *What would happen if you asked students in your school each question?*

If students do not see that the questions might be ambiguous, point out, for example, that asking how many hours of sleep a student gets each night raises issues about including weekends.

- *What kind of sampling plan might you design to conduct this research?*
- *Suppose there are more students in one grade than another and you want to include both grades. How will you address this in your sampling plan?*
- *What are some of the ways you might represent and analyze the data you collect?*
- *When you are finished with the research project, what might you be able to say about the lives of the students in the school?*

It is not necessary to bring closure to these questions; they simply help students think about the many issues that must be considered in such a study.

Have students work on the problem in groups of 2 to 4.

Materials

- Student notes
- Large sheets of paper (optional)

Explore

If students have trouble understanding a particular sampling method, ask them to focus on the name of the strategy. Each title—*convenience sampling, systematic sampling, voluntary-response sampling,* and *random sampling*—is descriptive of the important feature of that method.

Vocabulary

- convenience sampling
- systematic sampling
- voluntary-response sampling
- random sampling

Summarize

One way to summarize the sampling methods used by the four groups of students in Problem 2.2 is to post, at the front of the classroom, four large sheets of paper divided into two halves titled "Advantages" and "Disadvantages." Add to the charts as students share their ideas about each sampling method.

After the class has reviewed the four sampling plans used by the groups, ask students to share their ideas about which plan would give the most

Vocabulary

- bias

continued on next page

Summarize

continued

representative sample. Make reference to the summary notes that the class has developed. Ask students to explain their ideas and to critique the ideas of the other students.

As you review Question C, add the name of each sampling method to the appropriate chart. For Question D, review the ideas of good sampling methods. A random sample reduces the possibility of bias, unintended or otherwise.

2.3 Choosing Random Samples

At a Glance

PACING 1 day

Mathematical Goals

- Select a random sample from a population
- Use sampling distributions, measures of center, and measures of variability to describe and compare samples
- Apply elementary probability with spinners or calculators to choosing from random samples

Launch

Introduce the problem using the Getting Ready. Discuss sampling plans that produce random samples. Have students work in pairs on the Getting Ready.

Introduce the data set of 100 students shown in the student edition. Discuss selecting a random sample of students rather than calculating statistics and making statistical representations for the entire set of data.

The student edition proposes three ways of choosing random samples.

Have 10-sided solids and 10-section spinners available for students. Distribute Labsheet 2.3C to each student. Provide Labsheet 2.3A to each group of three. Have them decide upon a scale, and work on the problem in groups of three. Consider doing Question C after summarizing Questions A and B.

Materials

- Transparencies 2.3A, 2.3B
- Labsheet 2.3A or transparency of it (optional: 1 per group)
- Labsheet 2.3C (optional)
- Labsheet 10-section spinners
- 10 sided number cubes
- Paper clips or bobby pins

Explore

Every student in each group of three should select a random sample of 30 students from the database.

Have groups draw the line plots of the three distributions on Labsheet 2.3A. Look to see if students are paying attention to scaling in order to compare line plots. Together, each group can prepare a response to part (4) of Questions B and C of the problem to present when displaying their line plots in the class discussion.

Vocabulary

- random sample

Summarize

As the class views sets of line plots of the groups, ask them to evaluate the plots from this perspective:

- *Are there any apparent differences in the variability of the samples drawn by each group of students?*

Once students have seen other groups' line plots, ask them to again address Question B, part (4).

- *What can you conclude about the movie-watching behavior of the population of 100 students based on the patterns you have seen in the samples selected by the various groups?*

Materials

- Labsheet 2.3B or transparency of it (optional)

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Summarize

continued

Once students consider the results from several samples, choose data and a line plot from a single sample. Ask:

- *What can you say about the population if we had data from only a single sample?*
- *What can you conclude about the movie-watching behavior of the population of 100 students?*

Have students work in groups to explore Question C. Distribute Labsheet 2.3B.

Have students share their answers to Question C, part (4).

- *What can you conclude about the hours of sleep of the population of 100 students based on the patterns in your samples?*
- *Why might it be difficult to gather accurate data on these topics?*

2.4 Choosing a Sample Size

At a Glance

PACING 1 day

Mathematical Goals

- Use data from a sample to estimate a characteristic of a population
- Use sampling distributions, measures of center, and measures of variability to describe and compare samples

Launch

Introduce the problem.

- *In the last problem, you analyzed samples of 30 students. Do you think you would arrive at similar estimates for the behavior of the students in this population if you were to analyze smaller sample sizes?*

Have students do Questions A and B in groups of three. (Students will need their data for a sample size of 30 from Problem 2.3). For Question B, part (2) record on the board the means and medians for the movie data and hours of sleep data found by the groups.

Hand out Labsheet 2.4A (or transparency of) to each student. Have students work in groups of three for Question C, part (1) and do part (2) as a class. Ask:

- *What do you observe about the overall distribution of the means?*
- *How do the three distributions of sample means for each sample size compare?*

Hand out Labsheets 2.4B, 2.4C, and 2.4D. Have students work in groups on Questions D and E. Save Question F until after the summary.

Materials

- Labsheet 2.3C (1 per student)
- Labsheets 2.4A–D (optional: 1 per student)
- Transparencies of Labsheet 2.4A–D (optional: 1 per student)
- Spinner and number cubes from Problem 2.3 (optional)

Explore

Allow students to choose methods for generating random samples. Designate sections of the board for groups to record the movie data and the hours slept data. For each sample size, let the class know when all groups have recorded their results so that students can make their line plots. Post the median number of movies and the mean and median number of hours slept for Questions D, part (2) and E.

Summarize

For Question D, display class line plots of the distributions of sample medians of the movie data for sample sizes of 5, 10, and 30.

Once these are displayed, students can discuss their observations about the three line plots.

- *What do you observe about the overall distributions of the medians?*
- *How do the three distributions of sample medians for each sample size compare?*

Materials

- Student notes

continued on next page

Summarize *continued*

Do the same for Question E. Display three line plots for the sleep data and find the median. Repeat the same process of reporting and discussing for the mean. Answer Question F as a class.

3.1 Solving an Archeological Mystery

At a Glance

PACING 1–2 days

Mathematical Goal

- Distinguish between samples and populations and use information drawn from samples to draw conclusions about populations

Launch

Introduce the problem by talking about archaeology and some of the methods people use to seek information about ancient civilizations.

Discuss the archaeological digs and the tables of data about the Native American arrowheads that were unearthed at each of six sites. Allow students time to familiarize themselves with the tables, which list arrowhead lengths, widths, and neck widths.

Ask students to think about how they might approach this problem.

- *How could you use the data from the known sites to help you estimate the time period during which each of the two new sites was settled?*
- *Do you think you have enough data to make comparisons?*

Have students explore the problem in groups of two or three. Point out that, in real-world situations, people often work in teams to solve problems.

Materials

- Transparencies 3.1A–F
- Labsheets 3.1A–D
- Student notes
- Overhead graphing calculator (optional)

Explore

Give students Labsheets 3.1A–D. Students can use box plots and/or summary statistics such as means, medians, and ranges to make their comparisons.

Students should make summary displays of their analyses. One such display could be six parallel box plots, one for each data set (Labsheets 3.1A–D have the box plots or summary statistics already completed for the known sites).

Summarize

Ask students to discuss their findings and conclusions and to justify their answers. An examination of the box plots students have created will yield two distinct groups of data, one with generally higher medians than the other (see answers on Transparencies 3.1C–F). These data provide a way to identify the time periods during which the new sites may have been settled.

You might ask the following questions to help students think about the applications of what they have learned.

- *How confident are you about your predictions?*
- *We have compared different sample sizes in this problem. Why are we able to make comparisons among samples of different sizes?*

Materials

- Graphing calculator (optional)
- Grid paper
- Chart paper and magic markers

continued on next page

3.2 Simulating Cookies

At a Glance

PACING 2 days

Mathematical Goal

- Apply concepts from probability to select random samples from populations

Launch

Materials
- Transparency 3.2

Present the problem of Jeff and Ted's cookie business. Direct students' attention to the illustration in their books of a batch of cookies.

- *Does each cookie have five chips?*
- *What do we want to find out?*
- *Describe Ted's reasoning about the total number of chips to be added.*
- *What is wrong with his reasoning?*

Ask students to think about ways that they might explore this problem. Discuss with them why combining the results of many simulations—each being one sample—is needed in order to predict the typical number of chips.

It is essential that students combine their work with other students' to get a large enough set of samples of the *total number of chips* data to make any conclusions with confidence.

Have students work in pairs.

Explore

Materials
- Graphing calculators
- 1 12-section spinners (optional)
- Blank transparencies (optional)

Work with students to develop ways to generate random numbers for their simulations. For example, they might generate random integers from 1 to 12 using a calculator or by spinning a 12-section spinner (provided as a Labsheet). Students conduct their simulations; each person records his/her results in a central list. Each group prepares both a histogram and a box plot using these data. Students use these representations and their analyses to answer Question C. In order to continue with Question D, you will need to do a first summary up to and including D, part (1) (see summary below). Then students can work on the rest of Question D. See the extended Explore for the results of two actual simulations.

Summarize

Materials
- Student notes
- Overhead graphing calculator (optional)

Have pairs share their responses and reasoning to Question C, including their displays of the class data. Students should recognize that, to address this particular problem, finding the mean or the median is not sufficient. Some important ideas that may emerge in discussing the problem:

- *How did you decide on the number of chips to put in a batch?*
- *Did you use the simulation that results in the greatest number of chips, or did you decide that using a number less than that would be close enough? Why?*

continued on next page

Summarize

continued

Ask students to reflect on the meaning of their results—what they mean in terms of the actual situation:

- *Were you surprised by the results of the simulations?*
- *Is adding this many chips to a batch of a dozen cookies practical?*
- *How do your results compare to the 60 chips that Jeff has been mixing into each batch of a dozen cookies?*
- *What is the average number of chips per cookie that would result from your recommendation?*
- *In each simulation, the cookie with the fewest chips contained 5 chips. How many chips did the cookie(s) with the most chips contain? Is this many chips in a cookie realistic?*

Ask students to reflect on the representation used for their data:

- *What kinds of displays are possible to make with this data?*
- *Which displays do you think are the most useful for addressing the problem? Why?*
- *What might the data look like if it was displayed as a box plot?*

Then have students discuss what happened with Question D.

4.1 Are Quality Ratings and Prices Related?

At a Glance

PACING 1 day

Mathematical Goal

- Explore relationships between paired values of numerical attributes.

Launch

Direct the class's attention to the scatter plot displaying the (quality rating, price) data, which is reproduced on Transparency 4.1.

You may want to have students create this scatter plot on their calculators by entering the quality ratings and price-per-serving data. On the TI-83 calculator this can be done by entering the quality ratings and price data for natural brands as pairs in two companion lists and the data for regular brands in the next two lists. Then, pairs of data for natural and regular brands would be plotted on the same graph, with different symbols chosen to show the data pairs. For more assistance using the graphing calculator to make scatter plots, see the technology section in the Unit Introduction.

Have students work in pairs to explore the questions posed in the problem.

Materials

- Transparency 4.1
- Graphing calculators
- Grid paper

Explore

If students have trouble with Question A, ask:

- *Have you looked back at the original data shown? How might this help you to answer the questions here?*

For Question B, you might ask:

- *Locate a peanut butter with a high quality rating in the original data. What is its quality rating and cost?*
- *Where is this point on the scatter plot?*
- *Now do the same for one with a low quality rating and one with a middle quality rating. How can this help you to answer the question?*

For Question C, you might ask:

- *What does it mean when we say a (quality rating, price) data value is* unusual*? If* usual *means that the higher the quality rating, the greater (lower) the cost, when would a data pair be unusual?*

For Question D, you might ask:

- *Locate the axis that is identified as being quality ratings. Now look at that axis and locate the natural peanut butters and the regular peanut butters. How can you compare the two kinds of peanut butters and their quality ratings?*

Do the same thing for comparing prices.

Vocabulary

- scatter plot

Summarize

Talk about students' findings and their reasoning.

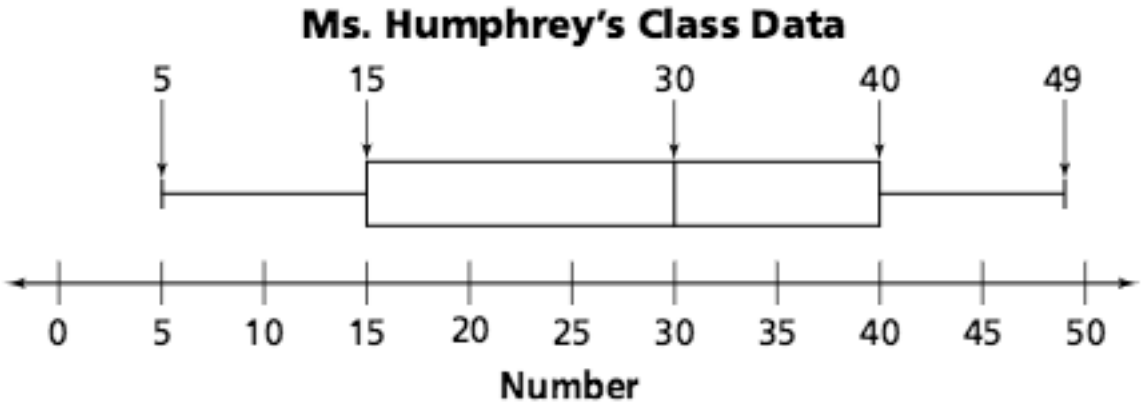
Materials

- Student notes
- Overhead graphing calculator (optional)

Review and Practice

Investigation 1

Ms. Humphrey asked each of the 21 students in her class to choose a number between 1 and 50. Ms. Humphrey recorded the data and made this box plot:



1. What is the median number that was chosen?
2. What percent of students in Ms. Humphrey's class chose numbers above 15? Explain your reasoning.
3. About how many students chose numbers between 30 and 40? Explain.
4. What were the least and the greatest numbers chosen?
5. Is it possible to determine from the box plot whether one of the students chose the number 27? Explain.
6. Is it possible to determine from the box plot whether one of the students chose the number 4? Explain.

7. Make a box-and-whisker plot for each set of data.

Cargo Airlines in the U.S. (1991)	
Airline	Freight ton-miles (1,000,000s)
Federal Express	3,622
Northwest	1,684
United	1,214
American	884
Delta	668
Continental	564
Pan American	377
Trans World	369
United Parcel Service	210

Immigration to the U.S. (1981–1990)	
Country	Number (1,000s)
Mexico	1,656
Philippines	549
China	347
Korea	334
Vietnam	281
Dominican Republic	252
India	251
El Salvador	214
Jamaica	208
United Kingdom	159

Investigation 2

You want to survey students in your school about their exercise habits. Tell whether Exercises 1–2 are likely to give a random sample of the population. Explain.

1. You select every tenth student on an alphabetical list of the students in your school. You survey the selected students in their first-period classes.

2. At lunchtime you stand by a vending machine. You survey every student who buys something from the vending machine.

3.

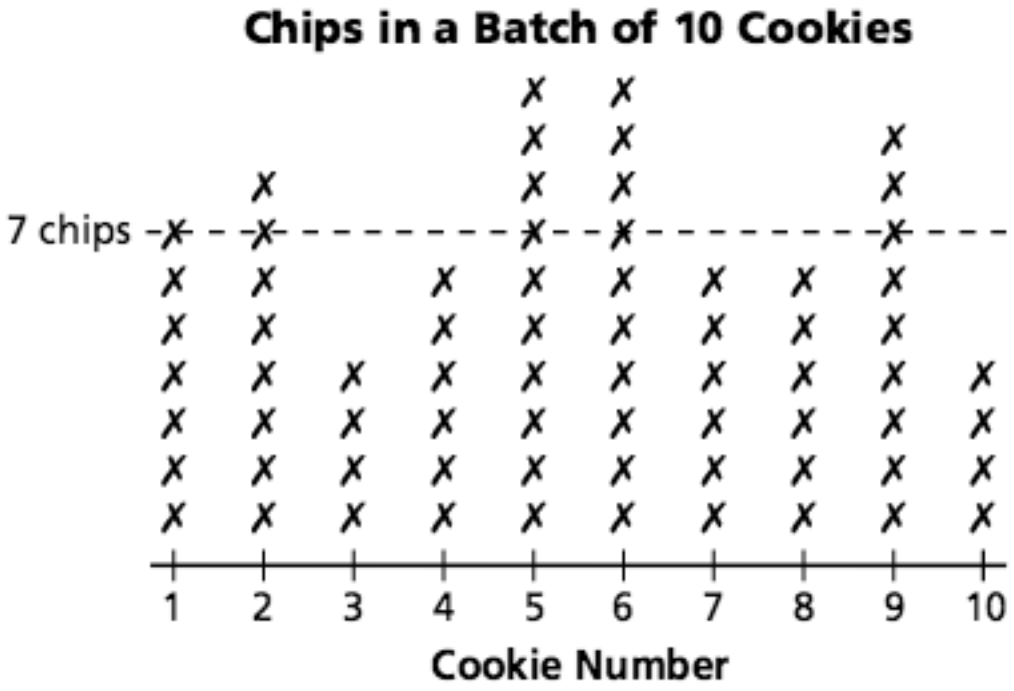
The principal of a nearby school, Megalopolis Middle School, decided to conduct a survey of the 1,107 enrolled students. She asked three teachers how many students they thought should be surveyed. One teacher said to survey 200 girls and 100 boys, the second said to randomly select and survey 50 students, and the third said to survey the first 100 students to enter the building one morning next week.

a. Explain which of the three samples will produce data that may best represent all the students at Megalopolis.

b. Explain why you feel that the other two samples would not be as representative of all the students as the one you chose in part a.

Investigation 3

1. Suppose Jeff and Ted decide to change their advertising slogan to "Seven giant chips in every cookie!" They mix 70 chips into a batch of dough and make 10 cookies from the dough. When they remove the cookies from the oven and inspect them, they count the number of chips in each cookie. Their results are shown below. Notice that only 5 of the 10 cookies contained 7 chips or more.



a. Conduct a simulation to determine the number of chips needed to be added to a batch of 10 cookies until each cookie has at least 7 chips. Carry out the simulation five times so that you have five data values for the number of chips needed.

b. What is the minimum number of chips Jeff and Ted should use to be confident that each cookie will have at least 7 chips? Support your answer with statistics and graphs.

Investigation 4

Chicken Sandwiches From Restaurant Chains

Size (oz)	Calories	Fat (g)	Carbohydrates (g)
8	360	7	44
10	370	8	53
8	380	4	57
9	400	5	57
8	400	16	37
8	470	20	51
8	470	20	46
10	500	24	52
8	510	19	57
10	540	30	42
9	550	23	55
10	550	30	46
10	570	25	48
12	580	19	58
11	640	29	61
13	660	29	56
12	720	30	65
13	740	30	78
12	910	40	86
15	950	56	76

1. Make scatterplots relating the following variables:
    a) Sandwich size vs. Calories
    b) Sandwich size vs. Fat
    c) Sandwich size vs. Carbohydrates

2. Describe any relationships you see among your three scatterplots. Explain your answers.

Name:_____

Post-test – Samples & Populations Unit

For Exercises 1–4, describe the population and the sampling method.

1. A magazine for teenagers asks its readers to write in with information about how they solve personal problems.
2. An eighth-grade class wants to find out how much time middle school students spend on the telephone each day. Students in the class keep a record of the amount of time they spend on the phone each day for a week.
3. Ms. Darnell's class wants to estimate the number of soft drinks middle school students drink each day. They obtain a list of students in the school and write each name on a card. They put the cards in a box and select the names of 40 students to survey.
4. A survey found that 52% of American adults believe that global warming is a serious threat. The editors of the school paper want to find out how students in their school feel about this issue. They select 26 students for their survey—one whose name begins with A, one whose name begins with B, one whose name begins with C, and so on.

5.

The principal of a nearby school, Megalopolis Middle School, decided to conduct a survey of the 1,107 enrolled students. She asked three teachers how many students they thought should be surveyed. One teacher said to survey 200 girls and 100 boys, the second said to randomly select and survey 50 students, and the third said to survey the first 100 students to enter the building one morning next week.

a. Explain which of the three samples will produce data that may best represent all the students at Megalopolis.

b. Explain why you feel that the other two samples would not be as representative of all the students as the one you chose in part a.

6.

Alyssa chooses one girl and one boy from each grade. She asks each, "Which would you prefer, a machine with healthful snacks or a machine with candy?" Base your answers to Exercises a - d on her results below.

Vending Machine Survey Results

	Grade 6	Grade 7	Grade 8
Girl	healthful snack	healthful snack	healthful snack
Boy	candy	candy	healthful snack

a. Predict how many sixth-grade students prefer a machine with healthful snacks.

b. Predict how many students in the whole school prefer a machine with healthful snacks.

c. What is the probability that a student chosen at random from the whole school is an eighth-grader who prefers machine with healthful snacks?

d. What advice would you give Alyssa's principal about Alyssa's data and the two vending machines? Explain.

7.

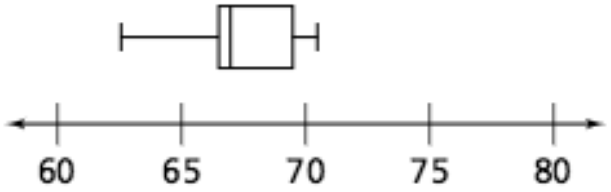
a. A baker makes raisin muffins in batches of four dozen. She pours a box of raisins into each batch. How could you use a sample from a batch of muffins to estimate the number of raisins in a box?

b. There are 1,000 raisins in a box. How many raisins would you expect to find in a typical muffin? Explain.

8.

a. This box plot shows the heights in inches of girls on a freshmen basketball team. What would you say is a typical height of a team member? Give evidence to support your answer.

Heights of Girl Basketball Players



b. Listed below are the heights in inches of boys on an 8th grade basketball team. Make a box plot of these data using the same scale as used in part (a).

60 60 66 66 66 67 68 69 69 69 69 70 70 71 71 71

c. Which statement do you agree with? Use the box plots to help you decide.

Statement 1: The players on the boys' team are taller than those on the girls' team.

Statement 2: The players on the girls' team are taller than those on the boys' team.

9.

From a shipment of 500 batteries, a sample of 25 was selected at random and tested. If 2 batteries in the sample were found to be dead, how many dead batteries would be expected in the entire shipment?

A. 2 B. 40 C. 250 D. 460

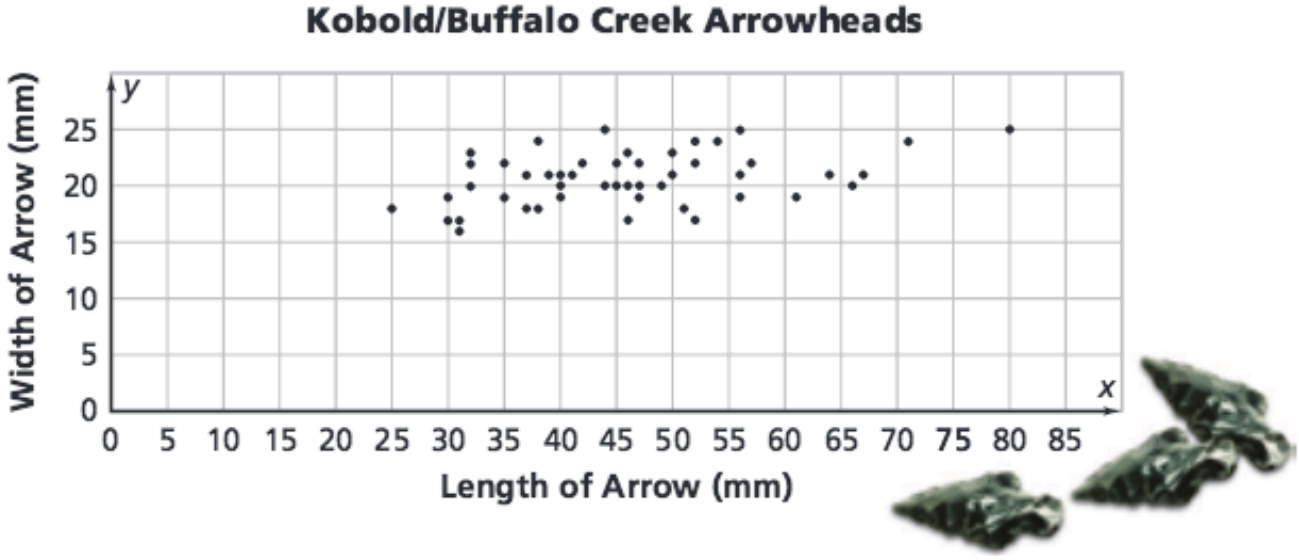
10.

After testing many samples, an egg shipper determined that approximately 3 in every 100 cartons of eggs will contain at least one cracked egg. The company ships 200,000 cartons of eggs every month. Estimate how many cartons of eggs each month will contain at least one cracked egg.

A.166 B. 2003 C. 6000 D. 66,000

11.

This scatter plot shows (*length*, *width*) data for the arrowheads found at Kobold/Buffalo Creek (see Problem 3.1).



Suppose you find have an arrowhead from this site that is not on the scatterplot, with a length of 40 mm. Predict that width of this arrowhead from the given data set.

A. 15 mm B. 17 mm C. 20 mm D. 25 mm

12.

In Mr. Niebling's first hour math class, the following scores were obtained on the last math test. What would be the first and third quartiles in a box-and-whisker plot?

$$100, 95, 91, 89, 87, 83, 80, 76, 60$$

A. 95 and 75 **B.** 87 **C.** 93 and 78 **D.** 91 and 80

Extra Credit

For a class project, students collect data about the number of boys or girls in the families of their classmates.

Name	Number of Boys in the Family	Number of Girls in the Family
Anya	0	2
Brian	8	0
Charlie	1	2
Diane	0	1
Elisha	1	1
Felix	2	0
Gloria	0	2
Han	1	2
Ivan	1	1
Jorge	4	1

Anya wants to make a Venn diagram with the groups "Has Boys in the Family" and "Has Girls in the Family." She begins by placing herself on the diagram. Copy and complete her diagram below.