Unit 2: Data Collection

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 1**
Length: **2 weeks**
Status: **Published**

Summary of Data Collection

This course explores the science of collecting, organizing, analyzing, and interpreting data. Data is information that comes from observations, measurements, or responses, and this information comes from samples of populations. The population is the entire group of individuals in which we are interested but cannot assess directly. A sample is a subset of the population that we actually examine and for which we have data. How well the sample represents the population depends on the sample design. Data must be collected according to a well-developed plan that minimizes bias. In this unit, students will learn about various sampling methods, be able to identify the population and sample in a sample survey, and will be able to explain how bad sampling leads to bias. Bias is a prejudice in favor of, or against, one thing or person, or group compared with another; bias occurs in a statistical study when the sampling method fails to represent its population. A key component of this unit is to have students actually design and conduct their own statistical study. This project will be an ongoing learning activity in which students will have the opportunity to directly experience the process of posing a statistical question, identifying a population, devising a sampling method to gather unbiased data from a subset of the population, and then ultimately analyzing the data with the statistical tools developed in the next unit of study in this course.

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Analyzing various sets of data will allow students to explore studies about people from different backgrounds. Statistical studies and analysis provides students an opportunity to read about historical statistics about people's cultures. Embracing the diversity within society incorporates the following:

Amistad Commission

This unit also reflects the goals of the Department of Education and the Amistad Commission including the infusion of the history of Africans and African-Americans into the curriculum in order to provide an accurate, complete, and inclusive history regarding the importance of of African-Americans to the growth and development of American society in a global context.

Asian American and Pacific Islander History Law

This unit includes instructional materials that highlight the history and contributions of Asian Americans and Pacific Islanders in accordance with the New Jersey Student Learning Standards in Social Studies.

New Jersey Diversity and Inclusion Law

In accordance with New Jersey's Chapter 32 Diversity and Inclusion Law, this unit includes instructional materials that highlight and promote diversity, including:

economic diversity, equity, inclusion, tolerance, and belonging in connection with gender and sexual orientation, race and ethnicity, disabilities, and religious tolerance.

Commission on Holocaust Education

This unit further reflects the goals of the Holocaut Education mandate where students are able to identify and analyze applicable theories concerning human nature and behavior; understand that genocide is a consequence of prejudice and discrimination; understand that issues of moral dilemma and conscience have a profound impact on life; and understand the personal responsibility that each citizen bears to fight racism and hatred whenever and wherever it happens.

S.ID	Interpreting Categorical and Quantitative Data
S.ID.A	Summarize, represent, and interpret data on a single count or measurement variable
S.ID.A.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
S.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.
P.4	Demonstrate creativity and innovation.
P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
S.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).
S.ID.A.4	Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.
S.ID.B	Summarize, represent, and interpret data on two categorical and quantitative variables
S.ID.B.5	Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
S.ID.B.6	Represent data on two quantitative variables on a scatter plot and describe how the variables are related.
S.ID.B.6.a	Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.

9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
S.ID.B.6.b	Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.
S.ID.C	Interpret linear models
S.IC	Making Inferences and Justifying Conclusions
S.IC.B	Make inferences and justify conclusions from sample surveys, experiments, and observational studies
RL.MF.11–12.6	Synthesize complex information across multiple sources and formats to develop ideas, resolve conflicting information, or develop an interpretation that goes beyond explicit text information (e.g., express a personal point of view, new interpretation of the author's message).
9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).
SL.II.11–12.2	Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

Essential Questions / Enduring Understandings

- What constitutes a statistical question?
- What is data, and what are the different types of data?
- How does a researcher gather data?
- What is bias, and how can a bad sampling design lead to bias?
- How do statistics help us make inferences about the population of interest?
- Data is information that comes from observations, measurements, or responses, and it may be categorized as quantitative or qualitative.
- A statistic is a number that describes a characteristic of a sample, a parameter is a number that describes a characteristic of the population, and statistics are used to infer conclusions about parameters.
- The process of data analysis has three main steps: collect the data, describe the data, and then make an inference about the data.
- Statistical inference is the process of drawing a conclusion about a population based on the data from a sample, however, there is an element of uncertainty with such a conclusion because a researcher does not have access to all of the information about the entire population.
- Data may be collected through observations, experiments, sampling, and surveys.
- Sampling methods include: convenience sample, cluster sample, stratified sample, systematic sample, voluntary response sample, and simple random sample.

Objectives for Data Collection

Students Will Know

- A variety of sampling methods, including techniques to minimize bias.
- The difference between an experiment and an observation, and that causation cannot be inferred from an observational study.
- Correlation may be inferred from an observational study.
- There are four methods of data collection: observations, experiments, sampling, and surveys.
- The difference between qualitative and quantitative data.
- Bad sampling designs lead to biased data.
- Common errors of bias include undercoverage of the population, relying on voluntary response, nonresponse bias, and response bias.

Objectives for Data Collection

Students Will Be Skilled At

- Posing a statistical question.
- Designing and using a data collection method for an original statistical study.
- Writing survey questions that minimize biased responses.
- Recognizing various sampling techniques, including: convenience sample, cluster sample, stratified sample, systematic sample, voluntary response sample, and simple random sample.
- Critiquing the sampling designs of others.

Learning Plan for Data Collection

The act of taking a sample from a population to gather data seems easy to understand on the surface; however, in practice, the implementation of data collection methods are often fraught with error. For all students, especially those without prior experience in sampling techniques, the instructor will need to carefully preview the essential questions for the unit and connect each lesson to fundamental principles. During instruction, the teacher will define and develop students' comprehension of relevant terms by consistently integrating models and real-life examples to illustrate key ideas surrounding the process of sampling a population. Class time will be used by the instructor to present content, clarify concepts, and respond to students' questions. Most of the time devoted to this unit will be allocated to the students' individual projects, for which they will apply textbook concepts to their original idea. Beginning with a statistical question, students will demonstrate that they are motivated by a question of interest, and then outline a plan to gather the data necessary to answer that question. Accordingly, the instructor will meet with students individually, monitor their progress, and ensure they are on track to properly implement their plans. Throughout the unit, students will engage in note-taking and small group discussions as they develop and reinforce their understanding of how to acquire unbiased data to represent a larger population. Each student will play the role of a researcher attempting to make a statistical inference about a population, and will intermittently share progress on their individual projects, providing one another with peer feedback.

Evidence/Performance Tasks for Data Collection

During this unit, students will be administered formative written assessments as entrance and exit tickets, along with homework assignments to be completed outside of class time. Short exercises in class will be given as opportunities to practice identifying different types of sampling methods and potential sources of bias with sampling designs. The instructor will gauge student comprehension based on their written answers along with their participation in class discussions. To facilitate more verbal participation at the individual level, students will frequently be divided into smaller groups for more speaking opportunities with their peers. The dominant performance task of this unit is the individual project required of each student. As a summative assessment, students will apply the instructional content to a real-life application of their choice, be able to see the relevance of the course material, and directly experience the process of data collection. The data they gather will be used again and further explored with tools of data analysis that are developed in the following unit of study. Evidence of student learning will be apparent when the students meet with the instructor to discuss their work, and will also present itself when students share their projects with their peers.

Assessments

- Formative: Daily assessments using examples from class notes, NJSLA test bank problems, and/or Albert/AP Classroom assessments
- Summative: Teacher-created assessments, NJSLA test bank problems, Big Ideas Math online platform problems, Albert/AP Classroom and/or Big Ideas Math unit assessments
- Benchmark: IXL or teacher created diagnostic assessments in addition to unit assessments
- Alternative Assessments: Student-centered activities such as scavenger hunts, various projects involving real world applications, and differentiated learning tasks in Khan Academy, DeltaMath, and IXL

Materials for the Data Collection

Core instructional materials: Core Book List including Mathematical Ideas 14E, Miller, Heeren, & Hornsby, Savvas

Supplemental materials:

Lecture notes and classroom activities designed by instructor

Internet resources, including Khan Academy, YouTube instructional videos and teacher-recommended math education websites