# Unit 2: Producing Data: Samples, Experiments and Simulations

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 2**
Length: **3 weeks**
Status: **Published**

## Brief Summary of Unit

In this unit, students will be able to identify the population and sample in a sample survey. Students will explain how bad sampling leads to bias. Students will distinguish between simple random sample, stratified random sample and cluster sample. Students will distinguish between an observational study and an experiment.

## Standards

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.

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| MA.K-12.1 | Make sense of problems and persevere in solving them. |
| MA.K-12.2 | Reason abstractly and quantitatively. |
| MA.K-12.3 | Construct viable arguments and critique the reasoning of others. |
| MA.K-12.4 | Model with mathematics. |
| MA.K-12.5 | Use appropriate tools strategically. |
| MA.K-12.6 | Attend to precision. |
| MA.K-12.7 | Look for and make use of structure. |
| MA.K-12.8 | Look for and express regularity in repeated reasoning. |
| MA.S-IC.B.3 | Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. |
| MA.S-IC.B.4 | Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling. |
| MA.S-IC.B.5 | Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. |
| MA.S-IC.B.6 | Evaluate reports based on data. |
| LA.K-12.NJSLSA.L4 | Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate. |
| LA.K-12.NJSLSA.L5 | Demonstrate understanding of word relationships and nuances in word meanings. |
| | Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. |
| | Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories. |
| | Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. |
| CS.K-12.3.a | Identify complex, interdisciplinary, real-world problems that can be solved |

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| | computationally. |
| CS.K-12.3.b | Decompose complex real-world problems into manageable sub-problems that could integrate existing solutions or procedures. |
| TEC.K-12.8.1 | All students will use computer applications to gather and organize information and to solve problems. |
| TEC.K-12.8.2 | All students will develop an understanding of the nature and impact of technology, engineering, technological design, and the designed world as they relate to the individual society, and the environment. |
| WORK.K-12.9.1 | All students will develop career awareness and planning, employability skills and foundational knowledge necessary for success in the workplace. |
| WORK.K-12.9.2 | All students will develop career awareness and planning, employability skills and foundational knowledge necessary for success in the workplace. |

## Transfer

Demonstration of how/why/where/when statistics are used and misused in real life application. Data must be collected according to a well-developed plan if valid information on a conjecture is to be obtained. This plan includes clarifying the question and deciding upon a method of data collection and analysis. These methods are used every day in the areas of science, medicine, politics, etc. and are valuable to understanding the information that is presented to society in the media.

## Essential Questions

- How can bad sampling lead to bias?
- How can one distinguish between the simple random sample, stratified random sample, and cluster sample?
- How can statistics help us make inferences about the population of interest?
- What aspects of the data collection process are important?
- Why is the data collection process vital to the success of the data analysis process?

## Essential Understandings

- Students will be able to identify the population and sample in a sample survey.
- Students will explain how bad sampling leads to bias.
- Students will distinguish between simple random sample, stratified random sample and cluster sample.
- Students will distinguish between an observational study and an experiment.

## Students Will Know

- Key concepts - population, sample, census, descriptive statistics, inferential statistics, categorical data,

numeric data, discrete data, continuous data, relative frequency, selection bias, measurement/response bias, nonresponse bias, simple random sample, stratified sampling, cluster sampling, sampling with replacement, sampling without replacement, extraneous factors, blocking, direct control, randomization, replication, control, and blind.
- What variability looks like and why it is essential to the discipline of statistics?
- What conclusions can be drawn from an observational versus an experimental study?

## Students Will Be Skilled At

- Conducting simple experimental and observational studies using sampling methods and design elements to reduce bias and confounding variables.
- Identifying different types of data sets.
- Calculating relative frequency.

## Evidence/Performance Tasks

- 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 from Big Ideas Math
    - 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
- Answer essential questions
- Class discussion of daily topic
- Teacher Observation
- Tests and quizzes that assess the essential questions
- Classwork and homework that assess the essential questions
- Written assignments that assess the essential questions that involves providing explanations
- Provide alternative means of assessments for certain students
- Variability is an important aspect of statistical analysis.
- There is a difference between a census and a sample.
- Data collection can be utilized to make summative statements or inferences about a population.
- Observational studies can be used to demonstrate correlation or association.

- Designed experiments can be used to prove causation.

## Learning Plan

- Method of Data Collection: census, sample survey, experiment observational study.
- Planning and conducting surveys: simple random samplings (SRS)
- Characteristics of a well-designed and conducted survey
- Sampling error: the variation inherent in a survey
- Sources of bias in surveys
- Stratifying to reduce variation
- Planning and conducting experiments
- Comparing experiments to observational studies and surveys
- Confounding, control groups, placebo effects, blinding
- Treatments, experimental units, randomization
- Completely randomized design for two treatments
- Randomized paired comparison design
- Replication, blocking and application of results

## Materials

Core Book List including Practice of Statistics

Supplemental materials: AP Classroom, Khan Academy, Edia, and DeltaMath

- District approved textbook
- Khan Academy
- Supplemental Materials – worksheets, guided notes
- Teacher created activiites
- Teacher created notes
- TI-84 Graphing Calculator

## Suggested Strategies for Modifications

Possible accommodations/modification for AP Statistics