*Unit 1- Experimental Design

Content Area: **Mathematics**
Course(s):
Time Period: **September**
Length: **12 Blocks**
Status: **Published**

Enduring Understandings

Data collection can be utilized to make summative statements or inferences about a population.

Observational studies can be used to demonstrate correlation or association.

Well-designed, controlled experiments can be used to make cause and effect conclusions.

Essential Questions

How can we describe data?

To what extent can statistics help us make predictions and inferences about our world?

How can we determine the validity of our interpretation of the statistics?

Content

Topics Addressed:

Introduction to Data Analysis

Sampling and Surveys

Experiments

Skills

Introduction to Data Analysis:

Identify the individuals and variables in a set of data.

Classify variables as quantitative or categorical.

Sampling and Surveys:

Identify the population and sample in a statistical study.

Identify voluntary response samples and convenience samples and explain how these sampling methods can lead to bias.

Describe how to obtain a random sample using slips of paper, technology, or a table of random digits.

Distinguish a simple random sample from a stratified random sample or cluster sample.

Give the advantages and disadvantages of each sampling method.

Explain how undercoverage, nonresponse, question wording, and other aspects of a sample survey can lead to bias.

Experiments:

Distinguish between an observational study and an experiment.

Explain the concept of confounding and how it limits the ability to make cause-and-effect conclusions.

Identify the experimental units, explanatory and response variables, and treatments in an experiment.

Explain the purpose of comparison, random assignment, control, and replication in an experiment.

Describe a completely randomized design for an experiment, including how to randomly assign treatments using slips of paper, technology, or a table of random digits.

Describe the placebo effect and the purpose of blinding in an experiment.

Interpret the meaning of statistically significant in the context of an experiment.

Explain the purpose of blocking in an experiment.

Describe a randomized block design or a matched pairs design for an experiment.

Describe the scope of inference that is appropriate in a statistical study.

Resources

Rossman-Chance Applet Collection

StatsMonkey

Rice Virtual Lab in Statistics

Khan Academy Mission: AP Statistics

Standards

NJSLS 2016

Statistics and Probability

MAKING INFERENCES AND JUSTIFYING CONCLUSIONS

B. Make inferences and justify conclusions from sample surveys, experiments, and observational studies

3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

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.

5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

6. Evaluate reports based on data.

Mathematics | Standards for Mathematical Practice

1 Make sense of problems and persevere in solving them.

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

4 Model with mathematics.

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a

school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

5 Use appropriate tools strategically.

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
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.