Unit 1: Collecting and Exploring Data

Content Area: **Mathematics**
Course(s): **Traditional Statistics**
Time Period: **September**
Length: **~8 weeks**
Status: **Published**

Unit Overview:

Unit 1 introduces students to data and the vocabulary of statistics. Students also learn to talk about data in real-world contexts. Variability in data may seem to suggest certain conclusions about the data distribution, but not all variation is meaningful. Statistics allows us to develop shared understandings of uncertainty and variation. In this unit, students will define and represent categorical and quantitative variables, describe and compare distributions of one-variable and two-variable data, and interpret statistical calculations to assess claims about individual data points or samples. For quantitative data students will be describing the data based on its form, direction, strength and any unusual features. Students will also begin to apply the normal distribution model as an introduction to how theoretical models for populations can be used to describe some distributions of sample data. Furthermore key concept students will learn is the ability to interpret the least-squares regression line in context, analyze prediction errors (residuals), and explore departures from a linear pattern. The last part to this unit is learning how to plan a study. Factors like deciding what to and how to measure our critical for the rest of this chapter. Depending on how data are collected, we may or may not be able to generalize findings or establish evidence of causal relationships. For example, if random selection is not used to obtain a sample from a population, bias may result and statistics from the sample cannot be assumed to generalize to the population. For data collected using well-designed experiments, statistically significant differences between or among experimental treatment groups are evidence that the treatments caused the effect. Students learn important principles of sampling and experimental design in this unit; they will learn about statistical inference in Units 4.

Essential Questions:

- Can we use extrapolation to predict the future?

- Can you lie with statistics? How and to what extent?

- Does association imply causation?

- Does sample size matter?

- How can modeling data help us understand patterns?

- How can we use data analysis be used to predict the future happenings?

- How do density curves relate to probability?

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- How do we assess normality?

- How do we communicate and understand data?

- How do you know what graph to use when?

- How does the normal distributions apply to the real world?

- To what extent is data biased? To what extent can data be purposely biased?

- What can we conclude about the data presented in graphical representation?

- What does it mean to regress?
- What is association and correlation? How do they connect and how do they differ from each other?

Enduring Understandings:

- Given that variation may be random or not, conclusions are uncertain.
- Graphical representations and statistics allow us to identify and represent key features of data.
- Regression models may allow us to predict responses to changes in an explanatory variable.
- The difference between causation and correlation.
- The normal distribution can be used to represent some population distributions.
- The question to be answered determines the data to be collect and how best.
- The way that data is collected, organized, analyzed and displayed influences interpretations.
- Well-designed experiments can allow us to reach appropriate cause-and-effect conclusions.

Standards/Indicators/Student Learning Objectives (SLOs):

MA.S-ID	Interpreting Categorical and Quantitative Data
MA.S-ID.A	Summarize, represent, and interpret data on a single count or measurement variable
MA.S-ID.A.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).
MA.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.
MA.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).
MA.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.
MA.S-ID.B	Summarize, represent, and interpret data on two categorical and quantitative variables
MA.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.
MA.S-ID.B.6	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
MA.S-ID.B.6a	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.
MA.S-ID.B.6b	Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.
MA.S-ID.B.6c	Fit a linear function for a scatter plot that suggests a linear association.
MA.S-ID.C	Interpret linear models
MA.S-ID.C.7	Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
MA.S-ID.C.8	Compute (using technology) and interpret the correlation coefficient of a linear fit.

MA.S-ID.C.9	Distinguish between correlation and causation.
MA.S-IC	Making Inferences and Justifying Conclusions
MA.S-IC.B	Make inferences and justify conclusions from sample surveys, experiments, and observational studies
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.

Lesson Titles:

- Bivariate (Two-variable) Data Analysis
- Categorical Data, Graphing and Analysis
- Density Curves and Normal Distributions
- Identify and Implements the appropriate types of sampling methods
- One-Variable (Univariate) Data and Analysis
- Quantitative Data, Graphing and Analysis
- Regression Line

Inter-Disciplinary Connections:

LA.K-12.NJSLSA.R1	Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
LA.K-12.NJSLSA.R2	Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
LA.K-12.NJSLSA.R4	Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
LA.K-12.NJSLSA.R5	Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text (e.g., a section, chapter, scene, or stanza) relate to each other and the whole.
LA.K-12.NJSLSA.R7	Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
SOC.6.1.12.EconGE.1.a	Explain how economic ideas and the practices of mercantilism and capitalism conflicted during this time period.
SOC.6.1.12.EconNE.9.a	Explain how economic indicators are used to evaluate the health of the economy (i.e., gross domestic product, the consumer price index, the national debt, and the trade deficit).
SCI.HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

SCI.HS-ETS1-4	Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Instructional Strategies, Learning Activities, and Levels of Blooms/DOK:

For instructional strategies and learning activities please see formative and summative assessment.

Below is the levels of Blooms/DOK:

- Apply the Empirical Rule to various examples.

- Calculate the expected value (or mean) and standard deviation for a normal distribution.

- Collect and display the data of a study using the appropriate graph.

- Connect how creating an experiment and observations correlates with science labs and psychology.

- Define the various ways data sampling can occur.

- Define what is a Normal Distribution.

- Define what is and how to find the mean, median and mode.

- Design an experiment to collect data for a situation and apply your knowledge about graphical analysis, normal distributions, and data analysis to provide a justified conclusions.

- Interpret information from a graph to describe the shape, symmetry, outliers/any unusual features, and center.

- Select the most appropriate sampling method based on the experiment provided.

- Translate your data between tables, graphs, words and symbolic notation.

- Using the information from a graph or data provided make and justify your conjectures.

- Using the linear regression model and equation, make predictions about what can happen in the future.

- Using your knowledge from this unit, formulate an original problem and proceed to solve it.

Summative Assessment:

- Benchmark
- Individual Assignment
- Marking Period Assessment
- Performance Task
- Projects
- Quizzes

Formative Assessment:

- Answer Avalanche

- Anticipatory Set
- Closure/Exit-Tickets
- Partner Answer/Analyze Questions
- Polling Questions
- Statistical Activities
- Think-Pair-Share
- Warm-Up

Career Readiness, Life Literacies, & Key Skills:

WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.6	Model integrity, ethical leadership and effective management.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
WRK.K-12.P.9	Work productively in teams while using cultural/global competence.

Equity Considerations

Amistad Mandate

Topic:

 Not Applicable

Materials Used:

Addresses the Following Component of the Mandate:

Holocaust Mandate

Topic:

Biased Sampling and SRS: WWII Airplane Extra Metal Problem

Materials Used:

- A portion from the hand out on [Skew the Script](#) site.
- Pencil

Addresses the Following Component of the Mandate:

- Bias
- Holocaust Studies

LGBTQ and Disabilities Mandate

Topic (Person and Contribution Addresses):

We will be discussing the life and work of Florence Nightingale and/or Sara Josephine Baker (aka Doctor Jo). Both women are responsible for stopping the spread of deadly diseases.

Materials Used:

- Note packet

Addresses the Following Component of the Mandate:

- Social

Climate Change

Not Applicable

Asian American Pacific Islander Mandate

Topic (Person and Contribution Addresses):

We will be analyzing the population difference in Vietnam in 2010 as well as the projected population of China in 2050. This is textbook problem on page 48 #64 and 66. It is about using the graphs and our knowledge about describing graphs to see what is happening to their populations and what predictions can we make.

I will also introduce the students to Kalpana Chawla. Chawla is an Indian-born American astronaut and mechanical engineer. She first flew on the space shuttle Columbia in 1997 as a mission specialist and primary robotic arm operator. Sadly she lost her life during her second mission.

Materials Used:

- Note packet (problems will be transferred there)

Addresses the Following Component of the Mandate:

- Social

Modifications

ELL Modifications:

- Continue practicing vocabulary
- Focus on domain specific vocabulary and keywords
- Provide study guides prior to tests
- Read directions to the student
- Read test passages aloud (for comprehension assessment)
- Tutoring during Delsea One
- Vary test formats

IEP & 504 Modifications:

*All teachers of students with special needs must review each student's IEP. Teachers must then select the appropriate modifications and/or accommodations necessary to enable the student to appropriately progress in the general curriculum.

Possible Modifications/Accommodations: (See listed items below):

- Allow for redos/retakes
- Assign fewer problems at one time (e.g., assign only odds or evens)
- Differentiated center-based small group instruction
- Extra time on assessments
- Highlight key directions
- If a manipulative is used during instruction, allow its use on a test
- Opportunities for cooperative partner work
- Provide a word bank
- Provide reteach pages if necessary
- Provide several ways to solve a problem if possible
- Provide visual aids and anchor charts
- Test in alternative site
- Tiered lessons and assignments
- Tutoring during Delsea One
- Use of a graphic organizer
- Use of concrete materials and objects (manipulatives)
- Use of word processor

G&T Modifications:

- Alternate assignments/enrichment assignments
- Encourage Peer Leadership or mentoring
- Extension activities
- Higher-level cooperative learning activities
- Pairing direct instruction with coaching to promote self-directed learning
- Provide additional rigorous challenge problems for advance students
- Provide higher-order questioning and discussion opportunities
- Provide texts at a higher reading level
- Tiered assignments
- Tiered centers

At Risk Modifications

The possible list of modifications/accommodations identified for Special Education students can be utilized for At-Risk students. Teachers should utilize ongoing methods to provide instruction, assess student needs, and utilize modifications specific to the needs of individual students. In addition, the following may be considered:

- Additional help during tutoring/Delsea One
- Additional time for assignments
- Adjusted assignment timelines
- Agenda book and checklists
- Answers to be dictated
- Assistance in maintaining uncluttered space
- Books on tape
- Concrete examples
- Extra visual and verbal cues and prompts
- Follow a routine/schedule
- Graphic organizers
- Have students restate information
- No penalty for spelling errors or sloppy handwriting
- Peer or scribe note-taking
- Personalized examples
- Preferential seating
- Provision of notes or outlines
- Reduction of distractions
- Review of directions
- Review sessions

- Space for movement or breaks

- Support auditory presentations with visuals

- Teach time management skills

- Use of a study carrel

- Use of mnemonics

- Varied reinforcement procedures

- Work in progress check

Resources & Materials:

- AP Sample Questions

- Data investigations

- Each student will participate from either their seats or at one of the boards

- Formula Sheet

- Google Slide lessons

- Independent/Co-operative Learning explorations

- Teacher Generated Worksheets

- TI-84 Calculators

- White board and markers

Technology Materials and Standards

Computer Science and Design Thinking Standards

TECH.8.1.12	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
TECH.8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
TECH.8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.
TECH.8.1.12.A.CS1	Understand and use technology systems.
TECH.8.1.12.C.CS2	Communicate information and ideas to multiple audiences using a variety of media and formats.
TECH.8.1.12.C.CS3	Develop cultural understanding and global awareness by engaging with learners of other cultures.
TECH.8.1.12.D.CS2	Demonstrate personal responsibility for lifelong learning.
TECH.8.1.12.F.CS1	Identify and define authentic problems and significant questions for investigation.

TECH.8.1.12.F.CS2	Plan and manage activities to develop a solution or complete a project.
TECH.8.1.12.F.CS3	Collect and analyze data to identify solutions and/or make informed decisions.