FST Unit 3 - Statistics, Inference and Probability

Content Area: **Math**
Course(s):
Time Period: **Full Year**
Length: **60**
Status: **Published**

Unit Overview

Unit Summary	Unit Rationale
Students learn to analyze univariate and bivariate data distributions, design and evaluate sampling methods and experiments, build confidence intervals, and draw inferences using simulation. They also develop a full set of probability tools, including conditional probability, probability rules, counting techniques, random variables, and expected value, to help make and assess decisions when outcomes are uncertain.	Today, algorithms, polls, medical studies, and financial decisions shape much of our lives. Because of this, understanding statistics is key for making informed choices. High school students encounter data-driven claims every day, so it is important for them to learn to analyze, interpret, and evaluate information rather than simply accept it. This unit equips students with the math and logic skills they need to navigate a world full of data. It focuses on three main areas: Students move from just showing data to building mathematical models. They learn about measures of center and spread, residual analysis, and different types of regression models (linear, quadratic, exponential). This helps them spot patterns, see how variables are connected, and avoid mistakes such as assuming correlation implies causation. Students find out how data is created and sometimes misused. By looking at sampling methods, experimental design, bias, and margin of error, they learn to question media claims, spot weak research, and understand how randomness and statistical significance affect real-world conclusions. Probability helps students make decisions when things are uncertain. By learning about conditional probability, independence, conditional reasoning (such as evaluating medical tests and risk factors), and expected value, students can make smart choices about money, risk management, playing games, and planning ahead. By the end of this unit, students will go from simply taking in information to thinking critically. They will be able to make evidence-based choices, question statistics that seem misleading, and use math to solve real-world problems.

NJSLS

S.ID.A.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).
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.
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.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.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.
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.B.6.c	Fit a linear function for a scatter plot that suggests a linear association.
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.
S.ID.C.8	Compute (using technology) and interpret the correlation coefficient of a linear fit.
S.ID.C.9	Distinguish between correlation and causation.
S.IC.A.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
S.IC.A.2	Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.
S.IC.B.3	Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
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.
S.IC.B.5	Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
S.IC.B.6	Evaluate reports based on data (e.g., interrogate study design, data sources, randomization, the way the data are analyzed and displayed, inferences drawn and methods used; identify and explain misleading uses of data; recognize when arguments based on data are flawed).
S.CP.A.1	Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).
S.CP.A.2	Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.

S.CP.A.3	Understand the conditional probability of A given B as $P(A \text{ and } B)/P(B)$, and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.
S.CP.A.4	Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities.
S.CP.A.5	Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.
S.CP.B.6	Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.
S.CP.B.7	Apply the Addition Rule, $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$, and interpret the answer in terms of the model.
S.CP.B.8	Apply the general Multiplication Rule in a uniform probability model, $P(A \text{ and } B) = P(A)P(B \mid A) = P(B)P(A \mid B)$, and interpret the answer in terms of the model.
S.CP.B.9	Use permutations and combinations to compute probabilities of compound events and solve problems.
S.MD.A.1	Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.
S.MD.A.2	Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
S.MD.A.3	Develop a probability distribution for a random variable defined for a sample space in which theoretical probabilities can be calculated; find the expected value.
S.MD.A.4	Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value.
S.MD.B.5.a	Find the expected payoff for a game of chance.
S.MD.B.5.b	Evaluate and compare strategies on the basis of expected values.
S.MD.B.6	Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
S.MD.B.7	Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

Standards for Mathematical Practice

1	Make sense of problems and persevere in solving them
2	Reason abstractly and quantitatively
3	Construct viable arguments and critique the reasoning of others
4	Model with mathematics
5	Use appropriate tools strategically
6	Attend to precision
7	Look for and make use of structure
8	Look for and express regularity in repeated reasoning

Unit Focus

Enduring Understandings	Essential Questions
• The shape, center, and spread of a data set help you decide which summary statistics and models to use. • The way data is collected, including the sampling method and study design, affects what conclusions you can draw from it. • Probability quantifies uncertainty, and its rules, such as addition, multiplication, and conditional probability, help us understand compound and dependent events. • The expected value of a random variable sums the product of each value and its probability, much like the mean does for a data set. It helps compare decisions when there is uncertainty.	• How can the shape of a distribution help you decide which statistics are most reliable? • Why is the way data is collected just as important as what the data shows? • How can you tell if two events are independent, and why is it important to know the difference? • How does understanding expected value help you make better choices when you are not sure what will happen?

Instructional Focus

Learning Targets

Lesson 12 — Data Distributions and Normal Curves

- I can represent data using a dot plot, histogram, or box plot.
- I can decide whether the mean or median better describes a data set, based on its shape.
- I can compare the spread of two or more data sets using range, IQR, or standard deviation.
- I can describe how outliers affect the shape, center, and spread of a distribution.
- I can describe the normal distribution and use the 68-95-99.7 rule.
- I can use the mean and standard deviation of a normal distribution to estimate population percentages.

Lesson 13 — Statistical Sampling and Experimental Design

- I can identify and evaluate different sampling methods for bias.
- I can distinguish between an observational study and an experiment, and explain why randomization matters.

Lesson 14 — Linear Regression and Residuals

- I can fit a linear function to a scatter plot that shows a linear association.
- I can decide whether a linear, quadratic, or exponential model best fits a data set.
- I can interpret the slope and intercept of a linear model in context.
- I can plot residuals and use them to judge how well a model fits the data.
- I can compute and interpret a correlation coefficient using technology.
- I can explain why a strong correlation does not prove causation.

Lesson 15 — Inference and Simulations

- I can explain how statistics lets us make inferences about a population from a sample.
- I can use a simulation to decide whether a model matches real results.
- I can evaluate a statistical claim or report I encounter in the media.

Lesson 16 — Confidence Intervals

- I can use simulation to build a margin of error for a population mean or proportion.
- I can use simulation to decide whether a difference between two treatments is significant.

Lesson 17 — Foundations of Probability

- I can describe a sample space and its events using unions, intersections, and complements.
- I can build and read a two-way frequency table for categorical data.
- I can use a two-way table as a sample space to find probabilities.
- I can determine whether two events are independent.
- I can find the conditional probability of one event given another.
- I can explain independence and conditional probability in plain, everyday language.

Lesson 18 — Independence, Conditional Probability, and the Rules of Probability

- I can find a conditional probability as a fraction of outcomes.
- I can use the Addition Rule to find the probability that one event or another occurs.
- I can use the General Multiplication Rule to find the probability that two events both occur.

Lesson 19 — The Addition Rule and Complex Tables (Applications)

- I can solve a multi-step probability problem using a two-way table.
- I can apply the rules of probability to real-world scenarios such as medical testing or quality control.

Lesson 20 — Counting, Random Variables, and Expected Value

- I can use permutations and combinations to count outcomes and find probabilities.
- I can define a random variable and graph its probability distribution.
- I can calculate the expected value of a random variable and explain what it means.
- I can build a probability distribution from data or from a model and find its expected value.
- I can find the expected payoff of a game of chance.
- I can compare two strategies using their expected values.
- I can use probability to make fair decisions and analyze real-world decisions or strategies.

Prerequisite Skills
• Basic descriptive statistics: mean, median, range (Algebra 1) • Reading and constructing simple graphs of categorical and quantitative data (Algebra 1 / Geometry) • Intuitive reasoning about the probability of a single event • Fraction, decimal, and percent fluency
Common Misconceptions
• Students often use the mean to describe a skewed distribution rather than recognizing the median is more appropriate. • Students frequently believe that a larger sample size or a method that merely sounds random automatically eliminates bias, without evaluating the actual sampling method used. • Students often equate a strong correlation with causation. • Students commonly confuse independence with mutual exclusivity, two very different concepts. • Students often add probabilities without first checking whether events are mutually exclusive, leading to double-counting. • Students frequently confuse permutations and combinations, or forget which applies when order does or doesn't matter. • Students often think expected value represents “the most likely outcome” rather than understanding it as a long-run average.

Spiraling For Mastery

Current Unit Content/Skills	Spiral Focus	Activity
Model-fitting foundations — exponential/log modeling (Unit 1, Lessons 6–7)	Reapplied directly in Lesson 14 when choosing among linear/quadratic/exponential models for bivariate data	Review problem at the start of Lesson 14 revisiting Unit 1's exponential model-building
Solving/assessing graphically with technology (Unit 1, Lesson 7)	Reapplied when assessing model fit visually via residual plots (Lesson 14)	Residual-plot interpretation task explicitly referencing prior graphical-analysis skills
Key features of graphs / comparing representations (Unit 1, Lesson 2)	Reapplied when comparing distribution shapes across dot plots, histograms, and box plots (Lesson 12)	Bell-ringer comparing the “key features” of a data distribution to those of a function graph
Two-way frequency tables (Lesson 17)	Connects forward within the same unit to conditional probability and the Addition/Multiplication Rules (Lessons 17–19)	A single running two-way-table example is reused across the Lesson 17, 18, and 19 quizzes
Counting techniques and expected value (Lesson 20)	Culminating application of the course's entire probability strand,	Final unit project: design a “fair game” using

	drawing on independence (Lesson 17) and the rules of probability (Lesson 18)	permutations/combinations and verify fairness using expected value

Assessment

Formative Assessment	Summative Assessment
• Homework • Lesson Checks • Quizzes • Exit Tickets • Lesson Reflections • Performance Tasks	• Topic Tests and Quizzes • Benchmark 3 (Link-it) - Covers Unit 2, Lesson 10 - 11 and Unit 3, Lessons 12 - 13 • Benchmark 4 (Link-it) - Covers Unit 4, Lessons 14 - 18

Resources

Key Resources	Supplemental Resources
Saavas Algebra 2 Math Medic	iXL Delta Math Desmos Khan Academy Math Medic Skew the Script Teacher-made worksheets FST Pacing Guide

Career Readiness, Life Literacies, and Key Skills

9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).

9.4.12.DC.4	Explain the privacy concerns related to the collection of data (e.g., cookies) and generation of data through automated processes that may not be evident to users (e.g., 8.1.12.NI.3).
9.1.12.RM.3	Compare the cost of various types of insurance (e.g., life, homeowners, motor vehicle) for the same product or service, strategies to lower costs, and the process for filing an insurance claim.

Interdisciplinary Connections

8.1.12.AP.5	Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.
HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
9.1.12.RM.7	Evaluate individual and family needs for insurance protection using opportunity -cost analysis to determine if the amount of protection is adequate or over -insured.
6.1.12.CivicsPD.16.a	Construct a claim to describe how media and technology has impacted civic participation and deliberation.