HIGH SCHOOL

STATISTICS (Geometry Semester 2)

Statistics' focus on variability sets it apart from mathematics and students need to improve their statistical thinking. The wave of technology has made this area easily accessible for students. With the use of technology, such as DESMOS, students are able to learn to think critically about the data. There are 4 focus areas that the authors support in this domain - quantitative literacy, visualizing and summarizing data, statistical inference, and probability. Each focus has a prescribed list of essential concepts that should be covered extensively within its domain.

Fluency 1: Quantitative Literacy

- Statistical reasoning is crucial when students need to evaluate conclusions and assess risks.
- A quantitative literate person must be able to make and defend informed data-based decisions.

Standards	Strand	Goals and Performance Objectives
HSS.ID.2	Statistics & Probability	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.
HSS.ID.3	Statistics & Probability	Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers)
HSS.ID.4	Statistics & Probability	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, and Montana American Indian data sources to estimate areas under the normal curve.

Students should be able to recognize that data traditionally is viewed in two different types - quantitative and categorical. They should also know that analyzing these types of data are not similar. Quantitative data can be interpreted in one variable with multiple forms of variation and distribution, and two variable data should be analyzed with variation correlations in order to learn about regression equations. This process is greatly enhanced by technology use and students can delve deeper into the analysis when they are able to use the technology to display the data properly.

Fluency 2: Visualizing and Summarizing Data

- Data can be viewed in two types - quantitative and categorical. Technology can be used to keep the "messiness" from interfering with the students' ability to analyze it.
- Students should be able to look at the distributions of data (continuous or discrete) and evaluate them according to shape, deviation, and outliers.
- Two categorical variables are usually represented by two-way tables or segmented bar graphs.
- Scatterplots reveal patterns, trends, clusters, and gaps and these can aid in analyzing between contextual variables
- Two quantitative variables should be analyzed according to the sum of squared deviations within linear models, patterns should be discussed in generating a least-squares regressions line and finding a correlation, and differentiating between causation and correlation.
- Data analysis techniques should be used to evaluate possible solutions to real problems.

Standards	Strand	Goals and Performance Objectives
HSS.ID.1	Statistics & Probability	Represent data with plots on the real number line (dot plots, histograms, and box plots)
HSS.ID.5	Statistics & Probability	Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joining, marginal, and conditional frequencies). Recognize possible associations and trends in the data.

HSS.ID.6	Statistics & Probability	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data; 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, quadratic, and exponential models. b. Informally assess the fit of a function by plotting and analyzing residuals. c. Fit a linear function for a scatter plot that suggests a linear association.
HSS.ID.7	Statistics & Probability	Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

It is the responsibility of mathematics teachers to train students to use the proper tools to summarize data distributions and develop the ability to statistically infer as they develop quantitative literacy.

Fluency 3: Statistical Inference

- There are 3 main types of study designs: sample survey, experiment, and observational study.
- There is a difference between randomly selected samples and in randomly assigning subjects to experimental treatment groups.
- The scope and validity of statistical inferences are dependent on the randomization in study design.
- Bias may occur in surveys and they will yield results that are not representative of the population of interest.
- The expected variability in the sampling distribution of a sample statistic is proportional to the size of the sample - larger is better.
- Repeated samples for a given sample size can lead to a plausible set of values for the general population, using margin of error to describe the sampling variability.
- Simulations can determine whether the statistic is significant or whether it is surprising or unlikely to happen under the assumption of random chance.

Standards	**Strand**	**Goals and Performance Objectives**
HSS.ID.8	Probability & Statistics	Computer (using technology) and interpret the correlation coefficient of a linear fit.
HSS.IC.1	Probability &	Understand statistics as a process for making inferences about population parameters

	Statistics	based on a random sample from that population.
HSS.IC.2	Probability & Statistics	Decide if a specified model is consistent with results from a given data-generating process, e.g. using simulation
HSS.IC.3	Probability & Statistics	Recognize the purpose of and differences among samples surveys, experiments, and observational studies; explain how randomizations relate to each.
HSS.IC.4	Probability & Statistics	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.
HSS.IC.5	Probability & Statistics	Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
HSS.IC.6	Probability & Statistics	Evaluate reports based on data.

For high school students, their experiences with probability should extend beyond theoretical and empirical probabilities of outcomes. They should be able to determine independence and conditional probability, both have many applications in real-life decision making. Geometric and two way table probabilities are excellent tools for high school students to use.

Fluency 4: Probability

- The definition of independent probability events as defined by definition and also by recognizing the relationship between the events.
- Conditional probabilities can be computed by organizing data in contingency tables. Students should recognize that conditions or assumptions can affect the computation of the probability.

Standards	Strand	Goals and Performance Objectives
HSS.CP.1	Statistics & Probability	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")
HSS.CP.2	Statistics &	Understand that two events A and B are independent if the probability of A and B

	Probability	occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
HSS.CP.3	Statistics & Probability	Understand the conditional probability of A given B as P(A 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.
HSS.CP.4	Statistics & Probability	Construct and interpret two-way frequency tables of data including information from Montana American Indian data sources 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.
HSS.CP.5	Statistics & Probability	Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.
HSS.CP.6	Statistics & Probability	Find the conditional probability of A given B and the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.
HSS.CP.7	Statistics & Probability	Apply the Addition Rule, P(A or B) = P(A) + P(B) - P(A and B), and interpret the answer in terms of the model.

Resources

Big Ideas Math, Geometry, 2015 -	Chapter 12 - Probability
Big Ideas Math, Algebra I, 2015 -	Chapter 11 - Data Analysis
Big Ideas Math, Algebra II, 2015 -	Chapter 10 - Probability
	Chapter 11 - Data Analysis