
Coal City Unit District #1
Statistics
Math Curriculum

Unit 1: Data Collection & Design of Studies

HSS-IC: Making Inferences and Justifying Conclusions

- HSS-IC.A: Understand and evaluate random processes underlying statistical experiments
 - HSS-IC.A.1: Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
 - HSS-IC.A.1.DC1: Identify appropriate sampling methods (e.g., simple random, stratified, cluster, systematic).
 - HSS-IC.A.1.DC2: Determine under what circumstances statistical results can be generalized to the population.
- HSS-IC.B: Make inferences and justify conclusions from sample surveys, experiments, and observational studies
 - HSS-IC.B.3: Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
 - HSS-IC.B.3.DC1: Define data collection techniques including observational studies and design of experiments.
 - HSS-IC.B.3.DC2: Determine under what circumstances cause-and-effect conclusions can be inferred from a statistical study (e.g., the role of random assignment vs. random sampling).
 - HSS-IC.B.6: Evaluate reports based on data.
 - HSS-IC.B.6.DC1: Recognize and be able to explain the central role of randomness in designing studies and drawing conclusions.

Unit 2: Descriptive Statistics for Univariate Data

HSS-ID: Interpreting Categorical and Quantitative Data

- HSS-ID.A: Summarize, represent, and interpret data on a single count or measurement variable
 - HSS-ID.A.1: Represent data with plots on the real number line (dot plots, histograms, and box plots).
 - HSS-ID.A.1.DC1: Differentiate qualitative and quantitative data graphically. This includes graphs such as bar plots, histograms, and dot plots.
 - HSS-ID.A.2: Use statistics appropriate to the shape of the data distribution to compare the center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
 - HSS-ID.A.2.DC1: Calculate measures of central tendency for data.
 - HSS-ID.A.2.DC2: Determine measures of dispersion for data (range, variance, standard deviation).
 - HSS-ID.A.2.DC3: Decide which measure of central tendency to report for various data sets based on distribution shape.
 - HSS-ID.A.3: Interpret differences in shape, center, and spread in the context of the data sets, accounting for the possible effects of extreme data points (outliers).
 - HSS-ID.A.3.DC1: Explain the concept of resistance and how outliers impact different summary statistics.
 - HSS-ID.A.3.DC2: Determine standard scores (z-scores), percentiles, and quartiles.
 - HSS-ID.A.3.DC3: Identify outliers using quartiles (the 1.5 IQR rule) and interpret boxplots.
 - HSS-ID.A.3.DC4: Recognize and be able to explain the central role of variability in the field of statistics.
 - HSS-ID.A.3.DC5: Produce graphical displays and numerical summaries and interpret what these do and do not reveal.

Unit 3: Bivariate Data (Regression & Categorical Association)

HSS-ID: Interpreting Categorical and Quantitative Data

- HSS-ID.B: Summarize, represent, and interpret data on two categorical and quantitative variables
 - HSS-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.
 - HSS-ID.B.5.DC1: Describe the association between two qualitative variables using conditional distributions.
 - HSS-ID.B.5.DC2: Explain Simpson's Paradox.
 - HSS-ID.B.6: Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
 - HSS-ID.B.6.DC1: Evaluate the linear correlation coefficient (r) for bivariate quantitative data.
 - HSS-ID.B.6.DC2: Explain the difference between correlation and causation.
 - HSS-ID.B.6.DC3: Graphically analyze bivariate quantitative data for outliers and influential observations.
- HSS-ID.C: Interpret linear models
 - HSS-ID.C.7: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
 - HSS-ID.C.7.DC1: Determine the least-squares regression equation for a given set of bivariate data.
 - HSS-ID.C.7.DC2: Predict values of the dependent variable using the least-squares regression equation.
 - HSS-ID.C.7.DC3: Interpret the slope and intercept of the least-squares regression equation.
 - HSS-ID.C.8: Compute (using technology) and interpret the correlation coefficient of a linear fit.
 - HSS-ID.C.8.DC1: Evaluate whether the linear correlation coefficient is significant at a given level.
 - HSS-ID.C.8.DC2: Determine and interpret the coefficient of determination (R^2).
 - HSS-ID.C.9: Distinguish between correlation and causation.
 - HSS-ID.C.9.DC1: Test the requirements of the least-squares regression model using residual analysis.

Unit 4: Foundations of Probability & Probability Distributions

HSS-CP: Conditional Probability and the Rules of Probability

- HSS-CP.A: Understand independence and conditional probability and use them to interpret data
 - HSS-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”).
 - HSS-CP.A.1.DC1: Apply probability rules for union, intersection, and complementary events.
 - HSS-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.
 - HSS-CP.A.2.DC1: Differentiate between dependent and independent events.
 - HSS-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...
 - HSS-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.
 - HSS-CP.A.5: Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.
- HSS-CP.B: Use the rules of probability to compute probabilities of compound events in a uniform probability model
 - HSS-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.
 - HSS-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.
 - HSS-CP.B.8: Apply the general Multiplication Rule in a uniform probability model, $P(A \text{ and } B) = P(A)P(B|A) = P(B)P(A|B)$, and interpret the answer in terms of the model.
 - HSS-CP.B.9: Use permutations and combinations to compute probabilities of compound events and solve problems.

HSS-MD: Using Probability to Make Decisions

- HSS-MD.A: Calculate expected values and use them to solve problems
 - HSS-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.
 - HSS-MD.A.1.DC1: Determine mean, variance, and standard deviation for given discrete probability distributions.
 - HSS-MD.A.2: Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.
 - HSS-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.
 - HSS-MD.A.3.DC1: Determine probabilities of events using binomial distributions.
 - HSS-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.
 - HSS-MD.A.4.DC1: Determine probabilities of events using the normal model.
- HSS-MD.B: Use probability to evaluate outcomes of decisions
 - HSS-MD.B.5: Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.
 - HSS-MD.B.6: Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
 - HSS-MD.B.6.DC1: Estimate probabilities using simulations.
 - HSS-MD.B.7: Analyze decisions and strategies using probability concepts.

Unit 5: Sampling Distributions & Statistical Inference

HSS-IC: Making Inferences and Justifying Conclusions

- HSS-IC.A: Understand and evaluate random processes underlying statistical experiments
 - HSS-IC.A.2: Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.
 - HSS-IC.A.2.DC1: Describe sampling distributions of the sample mean and sample proportion.
 - HSS-IC.A.2.DC2: Determine probabilities corresponding to random variables using the appropriate distribution (incorporating the Central Limit Theorem).
- HSS-IC.B: Make inferences and justify conclusions from sample surveys, experiments, and observational studies
 - HSS-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.
 - HSS-IC.B.4.DC1: Interpret confidence intervals for one population proportion.
 - HSS-IC.B.4.DC2: Interpret confidence intervals for one population mean.
 - HSS-IC.B.4.DC3: Interpret confidence intervals for two population proportions.
 - HSS-IC.B.4.DC4: Interpret confidence intervals for two population means.
 - HSS-IC.B.5: Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
 - HSS-IC.B.5.DC1: Define Type I and Type II errors. Explain a Type I or Type II error in context of a problem.
 - HSS-IC.B.5.DC2: Construct hypothesis tests for one population mean.
 - HSS-IC.B.5.DC3: Construct hypothesis tests for one population proportion.
 - HSS-IC.B.5.DC4: Construct hypothesis tests for two population proportions.
 - HSS-IC.B.5.DC5: Construct hypothesis tests for two dependent population means.
 - HSS-IC.B.5.DC6: Evaluate Goodness-of-Fit tests.
 - HSS-IC.B.5.DC7: Evaluate Chi-Square tests for independence

between two qualitative variables.

- HSS-IC.B.5.DC8: Evaluate Chi-Square tests for the homogeneity of proportions.
- HSS-IC.B.5.DC9: Demonstrate an understanding of, and ability to use, basic ideas of statistical inference, both hypothesis tests and interval estimation, in a variety of settings.

Course-Wide Software and Laboratory Requirements

- HSS.K-12.MP.5 (Tool Integration): Use appropriate tools strategically.
 - HSS.MP.5.DC1: Use StatCrunch and online applets to analyze data and perform simulations.
 - HSS.MP.5.DC2: Interpret and draw conclusions from standard output from statistical software.