ACALANES UNION HIGH SCHOOL DISTRICT
COURSE OF STUDY: Statistics and Data Science

COURSE TITLE:	Statistics and Data Science
DEPARTMENT:	Mathematics
GRADE LEVEL(S):	11-12
COURSE LENGTH:	Year
PREFERRED PREVIOUS COURSE OF STUDY:	Algebra 2 or equivalent
CREDITS PER SEMESTER:	5
STANDARDS & BENCHMARKS:	California Common Core State Standards, Mathematics; Computer Science Standards for California Public Schools
GRADUATION REQUIREMENT:	No
UC/CSU A-G DESIGNATION:	UC/CSU A-G approval pending: (C) -- Mathematics
ADOPTED by AUHSD GOVERNING BOARD:	Pending Adoption
INSTRUCTIONAL MATERIALS:	Textbook: *Statistics & Probability*, 3rd Edition, Bedford Freeman & Worth, (2017)

Supplemental Resource: CodeHS: *Data Science with Python*

COURSE DESCRIPTION:
Statistics and Data Science is an activity and project-based class that will familiarize students with the collection and analysis of current, real-world data. Students will learn reliable methods for obtaining sample data from a population, as well as various methods of visually and numerically representing findings. Emphasis will be placed on forming original hypotheses, testing them, and then constructing formal written presentations of conclusions. Students will also learn how to use statistical software and calculator applications to help facilitate their analysis. Students will apply statistical concepts to analyze data using both spreadsheets and computer programming

GRADING GUIDELINES: See AUHSD Grading Guidelines

COURSE CONTENT -- SCOPE and SEQUENCE

Units and Standards	Core Objectives and Topics
Unit 1: Data Collection and Sampling & Inferences CA Common Core State Standards for Mathematics -- Statistics and Probability	**Objectives** Students will develop knowledge and skills related to the following California State Standards for Mathematics -- Statistics and Probability: Making Inferences and Justifying Conclusions (S-IC) ● Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each (S.IC.B.3) ● Evaluate reports based on data (S.IC.B.6) **Topics** ● Sampling Methods & Studies a. Types of sample methods -- convenience sampling and voluntary response b. Observational Studies and Experiments -- definitions and differences ● Random Sampling Techniques ● Sampling Bias, including undercoverage and nonresponse ● Inference -- making meaning from random samples

Unit 2: Analyzing Variables in 1 Dimension CA Common Core State Standards for Mathematics -- Statistics and Probability Computer Science Standards for California Public Schools: Core Concept -- Data and Analysis	**Objectives** Students will develop knowledge and skills related to the following California State Standards for Mathematics -- Statistics and Probability: Interpreting Categorical and Quantitative Data (S-ID) ● Represent data with plots on the real number line -- dot plots, histograms, and box plots (S.ID.A.1) ● 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.2) ● 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.3) Students will also use applications to develop knowledge and skills relate to the following Computer Science Standards for California Public Schools: ● Core Concept: Data and Analysis ○ Collection ○ Visualization ○ Transformation **Topics** ● Visuals of Categorical Data -- Make and Interpret ○ Bar Charts ○ Pie Charts ○ Dotplots ○ Stemplots ○ Histograms ● Data Science/Analytics with Spreadsheets ○ Spreadsheet Basics ○ Conditional Formatting and Sorting ○ Data Visualizations

	○ Formulas, math operators ○ Summary Statistics ○ Z-Scores ● Computer Programming ○ Basic programming structure & syntax ○ Variables ○ Mathematical Calculations ○ Lists ○ Modules and Libraries
Unit 3: Analyzing Variables in Two Dimensions CA Common Core State Standards for Mathematics -- Statistics and Probability Computer Science Standards for California Public Schools: Core	**Objectives** Students will develop knowledge and skills related to the following California State Standards for Mathematics -- Statistics and Probability: Interpreting Categorical and Quantitative Data (S-ID) ● Represent data on two quantitative variables on a scatter plot, and describe how the variables are related (S.ID.B.6) ● Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. (S-ID.C.7) ● Compute (using technology) and interpret the correlation coefficient of a linear fit. (S.ID.C.8)

Concept - Data and Analysis and CTE Connections, Practice 3.1	● Distinguish between correlation and causation. (S-ID.C.9) Making Inferences and Justifying Conclusions (S-IC) ● Evaluate reports based on data (S.IC.B.6) Students will also use applications to develop knowledge and skills relate to the following Computer Science Standards for California Public Schools: ● Core Concept: Data and Analysis ○ Collection ○ Visualization ○ Transformation **Topics** ● Relationships between two categorical variables ○ Define explanatory and response variables ○ Understand associations between categorical variables ● Relationships between two quantitative variables ○ Using scatterplots to display relationships between quantitative variables ○ Describe direction, form, and strength of relationships between variables ● Correlation ○ Interpret correlation ○ Distinguish correlation from causation ○ Calculate correlation ○ Regression Lines ● Interpreting regression lines ○ Calculating regression lines ○ Fitting models based on residuals ● Data Science/Analytics -- Using Spreadsheets (or analogous spreadsheet) ○ Create scatterplots ○ Linear regression

	○ Residual calculations and plots ○ Pivot Tables ○ Advanced Formulas (e.g. vlookup, count, conditionals) ○ Spreadsheets as an analysis tool ● Computer Programming ○ Data Visualizations (scatterplot and linear regression) ○ Normal Distribution
Unit 4: Probability CA Common Core State Standards for Mathematics -- Statistics and Probability Computer Science Standards for California Public Schools: Core Concept -- Data and Analysis	**Objectives** Students will develop knowledge and skills related to the following California State Standards for Mathematics -- Statistics and Probability: Interpreting Categorical and Quantitative Data (S-ID) ● 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.5) Conditional Probability and the Rules of Probability (S-CP) ● 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.1) ● 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.2) ● 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. (S.CP.A.3) Using Probability to Make Decisions (S-MD) ● Calculate the expected value of a random variable; interpret it as the mean of the probability distribution (S.MD.A.2) ● Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values (S.MD.B.5) Students will also use applications to develop knowledge and skills relate to the following Computer Science Standards for California Public Schools: ● Core Concept: Data and Analysis ○ Inference ○ Models **Topics** ● Randomness, Probability & Simulation ○ Interpret probability as long-run relative frequency ○ Distinguish truths from myths about randomness ○ Use simulation to model chance behavior ● Basic Probability ○ Describe probability models for chance processes and use it to calculate probability ○ Use the complement rule to calculate probabilities ○ Use the addition rule for mutually exclusive events to calculate probabilities ● Two Way Tables & Venn Diagrams ○ Use a Two-way table to calculate probability ○ Use the general addition rule to calculate probabilities ○ Use a Venn Diagram to calculate probabilities ● Conditional Probability & Independence

	○ Find and interpret conditional probabilities ○ Determine whether 2 events are independent ○ Multiplication Rule for Probability ○ Determine whether two events are independent ○ Use the general multiplication rule to calculate probabilities ● Data Science/Analytics -- Computer Programming for simulation of probabilities (*e.g.* lottery)
Unit 5: Normal Distribution CA Common Core State Standards for Mathematics -- Statistics and Probability Computer Science Standards for California Public Schools: Core Concept -- Data and Analysis	**Objectives** Students will develop knowledge and skills related to the following California State Standards for Mathematics -- Statistics and Probability: Interpreting Categorical and Quantitative Data (S-ID) ● 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.A.4) Students will also use applications to develop knowledge and skills relate to the following Computer Science Standards for California Public Schools: ● Core Concept: Data and Analysis ○ Inference ○ Models **Topics** Types of Random Variables ● Verify the distribution of a discrete random variable and use it to calculate probabilities ● Classify a random variable as discrete or continuous Continuous Random Variables and the Normal Distribution

	● Verify the distribution of a discrete random variable and use it to calculate probabilities ● Draw a normal probability distribution with a given mean and standard deviation Data Science/Analytics ● Spreadsheets -- Z-score calculation and distribution ● Computer Programming -- Z-score calculation
Unit 6: Sampling Distributions & Confidence Intervals CA Common Core State Standards for Mathematics -- Statistics and Probability	**Objectives** Students will develop knowledge and skills related to the following California State Standards for Mathematics -- Statistics and Probability: Making Inferences and Justifying Conclusions (S-IC) ● Understand statistics as a process for making inferences about population parameters based on a random sample from that population. (S.IC.A.1) ● 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.4) **Topics** ● Sampling Distributions ● Central Limit Theorem ● Confidence Intervals ● Margin of Error ● Estimating Means ○ Means ○ Paired Data ● Data Science/Analytics -- Spreadsheets for data analysis for calculating confidence intervals
Unit 7: Significance Testing	**Objectives** Students will develop knowledge and skills related to the following California State Standards for Mathematics -- Statistics and Probability:

CA Common Core State Standards for Mathematics -- Statistics and Probability	Making Inferences and Justifying Conclusions (S-IC) ● Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. (S-IC.B.5) **Topics** ● Significance Test Overview ● Testing Claims about Means ● Significance Tests for Means ● Paired Data Significance Tests ● Confidence Intervals for means ● Significance Test for Two Means ● Data Science/Analytics -- Spreadsheets for data analysis and t-test calculations