HILLSBOROUGH TOWNSHIP SCHOOL DISTRICT

MATHEMATICS CURRICULUM

Advanced Placement Statistics

July, 2020

Course Overview
AP Statistics

During this course students explore four broad conceptual themes as outlined in the *AP Statistics Course Description*: exploring data, sampling and experimentation, anticipating patterns and statistical inferences. The goal of this AP Statistics course is to introduce students to the major concepts and tools for collecting data, analyzing data, and drawing conclusions from this data; to utilize these methods, and then to apply them to the real world. Demonstrating and using the knowledge gained from this class is just as important as the classroom experience. Collecting and analyzing data is the foundation of our course. Interactive experiments and activities are used to exhibit the theory whenever it is feasible.

The concepts covered in the course and their presentation will provide students with the knowledge and skills to successfully complete the College Board AP Statistics Exam. Our course uses a variety of techniques to allow students to gain a fundamental knowledge of statistics that is aligned with the AP/College Board requirements.

Hillsborough Township Public Schools
AP Statistics Mathematics Curriculum

Unit Title: 1 Exploring and Understanding Data	**Timeframe/Pacing:** 22 days

Essential Questions

- What is data and how do we understand and communicate data?
- How can graphical displays be manipulated to present misleading information?
- How are diverse groups that have nothing in common compared?
- Why is the normal distribution essential to the study of statistics, and how does it apply to the real world?

Enduring Understandings

- The Who, What, Where, Why, and How of the data are important information that must be depicted in each given data set.
- The shape, center, and spread should be described for every distribution.
- The normal distribution is used to model the spread of data.

Standards Taught and Assessed

- 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.

Highlighted Interdisciplinary Connections

Computer Science & Design Thinking

- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.
- 8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data.
- 8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data
- 8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.

ELA

- SL.11-12.1. Initiate and participate effectively in a range of collaborative discussions (one on- one, in groups, and teacher-led) with

diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

- SL.11-12.2. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
- SL.11-12.4 Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
- SL.11-12.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Highlighted Career Ready Practices and 21st Century Themes and Skill

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive).
- 9.4.2.IML.2: Represent data in a visual format to tell a story about the data (e.g., 2.MD.D.10).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.

Social Emotional Learning Competencies

- 2.1.12.EH.3: Describe strategies to appropriately respond to stressors in a variety of situations (e.g., academics, relationships, shootings, death, car accidents, illness).
- 2.2.12.LF.4: Exhibit responsible social behavior by including and cooperating with classmates of all skill levels, assisting when needed, and collaborating respectfully to solve problems in groups, teams, and in pairs during physical activity {or mathematical activity}.

Pre-Assessment	**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)**
• Create a graph of categorical data. • Create a graph of quantitative data. • Calculate the average of a quantitative data set.	• Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Student Learning Objectives: We are learning to/that...	**Student Strategies (Mathematical Practices)**	**Formative Assessment**	**Activities and Resources**	**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)**

Find the who, what, where, why, and how for a given description of data.	SMP 1 Make sense of problems and persevere in solving them.	List the W's for the following description: A listing posted by Arby's restaurant chain gives, for each of the sandwiches it sells, the type of meat in the sandwich, the number of calories, and the serving size in ounces. The data might be used to assess the nutritional value of the different sandwiches.	Warm-up activity and class discussion.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Categorize variables as quantitative or categorical.	SMP 7 Look for and make use of structure.	Categorize the following variables as categorical or quantitative: height, hair color, gender, weight	Teacher-led discussion of new terminology and examples.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Display and describe categorical data.	SMP 5 Use appropriate tools strategically.	For a given data set, students will graph a dot plot, bar chart, segmented bar chart and calculate marginal and conditional distributions.	Class discussion and paired practice solving similar examples.	Extended time, use of calculator, challenge work and specific other accommodations and/or modifications per a student's IEP or 504 plan.

Display and summarize quantitative data.	SMP 5 Use appropriate tools strategically.	For a given data set, students will graph a histogram and stem and leaf plot and describe the distribution (shapte, center, spread).	Introduce stemplots by playing a game of Greed to collect data. Introduce histograms by collecting data from students (hand span length),	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Describe distributions numerically.	SMP 2 Reason abstractly and quantitatively.	For a given data set, students will graph a box plot and calculate the five number summary and interquartile range.	FRQ Partner Quiz: Have students work in pairs to answer 2017 FRQ 4. Have one student write and the other perform the calculations. (Although the first part of the question does not require any calculations, the second part requires calculations to justify the solution.) Discussing and crafting a solution with a partner may require more time than if students completed the FRQ individually.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Standardize values using z-scores and use z-scores to compare distributions.	SMP 4 Model with mathematics.	An incoming freshman took her college's placement exams in French and mathematics. In French, she scored 82 and in math 86. The overall results on the French exam had a mean of 72 and a stan dard deviation of 8, while	Reversing Interpretations: Give pairs of students four pictures of normal distributions with various parts shaded. Have students create the question that could have resulted in the picture shown (e.g., if a value of 15 is labeled and the distribution is shaded to the right of 15, students could write "What is	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504

		the mean math score was 68, with a standard deviation of 12. On which exam did she do better compared with the other freshmen ?	the probability that a value is more than 15?").	plan.
Understand what happens to measures of spread and position when data is shifted and or rescaled.	SMP 2 Reason abstractly and quantitatively.	Given a data set, describe how the summary statistics change when data is shifted and rescaled.	Discovery activity: For a given set of data, calculate the 5 number summary, mean, and standard deviation. Then 1) add a constant to each of the original data values. 2) Multiply constant to each of the original data values. 3) Do a combination of adding/multiplying by a constant. Note in each step: How do the summary statistics change?	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Use the z-score to calculate probability (using the 68-95-99.7 rule, table and calculator).	SMP 5 Use appropriate tools strategically.	The amount of time it takes for a pizza delivery is approximately normally distributed with a mean of 25 minutes and a standard deviation of 2 minutes. If you order a pizza, find the probability that the delivery time will be between 25 and 27 minutes.	Teacher-led discussion of z-scores and examples.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Find the z-score given a percentile and use that to	SMP 2 Reason abstractly and quantitatively.	Quality control studies for Dependable Dishwashers show the lifetime of a	Class discussion and paired practice solving similar examples.	Extended time, use of calculator, challenge work and specific

calculate a raw score.		dishwater follows a normal distribution with a mean of 8 years and a standard deviation of 1.2 years. The company will replace any dishwasher that fails during the guarantee period. How long should the dishwashers be guaranteed if the company wishes to replace no more than 2% of the dishwashers?		other accommodations/modifications per a student's IEP or 504 plan.

Benchmark Assessment

- Not Applicable

Summative Assessment(s)

- Exploring and Understanding Data Common Assessment

Performance Assessment:

- Collect data and then
  1) Display the distribution of the data with an appropriate graphical display.
  2) Describe the distribution of using appropriate statistical terminology.

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Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)

- Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Hillsborough Township Public Schools
AP Statistics Mathematics Curriculum

Unit Title: 2 Exploring Relationships Between Variables	**Timeframe/Pacing:** 20 days

Essential Questions

- What is association? What is correlation? How are they connected?
- Does association imply causation?
- How can modeling data help us to understand patterns?

Enduring Understandings

- Correlation does not imply causation.
- A linear model can be used to represent relationships between bivariate data.

Standards Taught and Assessed

- S-ID.B.6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
- 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.

Highlighted Interdisciplinary Connections

Computer Science & Design Thinking

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- 8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data.
- 8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.

ELA

- SL.11-12.1. Initiate and participate effectively in a range of collaborative discussions (one on- one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
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- SL.11-12.4 Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization,

development, and style are appropriate to task, purpose, and audience.
- SL.11-12.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Highlighted Career Ready Practices and 21st Century Themes and Skill
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive).
- 9.4.2.IML.2: Represent data in a visual format to tell a story about the data (e.g., 2.MD.D.10).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.

Social Emotional Learning Competencies
- 2.1.12.EH.3: Describe strategies to appropriately respond to stressors in a variety of situations (e.g., academics, relationships, shootings, death, car accidents, illness).
- 2.2.12.LF.4: Exhibit responsible social behavior by including and cooperating with classmates of all skill levels, assisting when needed, and collaborating respectfully to solve problems in groups, teams, and in pairs during physical activity {or mathematical activity}.

Pre-Assessment	**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)**
• Graph a scatter plot of a set of data. • Describe trends in the scatterplot. • Find the equation of a line that can be used to model the relationships observed.	• Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Student Learning Objectives: We are learning to/that...	**Student Strategies (Mathematical Practices)**	**Formative Assessment**	**Activities and Resources**	**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)**
Create a scatterplot from bivariate data.	SMP 4 Model with mathematics.	Given a set of bivariate data, create a scatterplot.	Graphing Calculator Activity: Collect data from the class (i.e. Math and Verbal SAT scores). Graph the data and create a scatterplot (i.e. Math and Verbal SAT scores).	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or

				504 plan.
Describe association between explanatory and response variables.	SMP 2 Reason abstractly and quantitatively.	Given a set of bivariate data, create a scatterplot and describe the association observed.	Graphing Calculator Activity: Discuss association observed in scatterplot created from collection of class data (	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Calculate and interpret correlation between explanatory and response variables.	SMP 5 Use appropriate tools strategically.	For a given set of bivariate data, find and interpret the correlation coefficient.	Quickwrite: Give students a scatterplot and its associated computer output. Have them identify and describe the meaning of the following values in the context of the problem: slope, y-intercept, coefficient of determination, and standard error of the residuals. Also have them calculate the correlation and explain how they found it. Have students compare their write-ups in groups of three to four.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Use technology to find the Least Squares Regression Line (LSRL).	SMP 4 Model with mathematics.	For a given set of bivariate data, find the equation of the least squares regression line.	Build the Model Solution Provide students with strips of paper containing portions of the model solution for 2018 FRQ 1 and have them work to assemble the phrases into a solution for the FRQ. Words can be grouped for part a, as follows: [The estimate	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

			of the intercept is] [72.95]. [It is] [estimated that] [the average time to] [finish checkout] [if there are no other customers in line] [is 72.95 seconds]. Additional numbers or phrases for part a could include [174.40], [is 174.50 seconds], and [the time to].	
Interpret the slope and y-intercept of the LSRL.	SMP 2 Reason abstractly and quantitatively.	For a given set of bivariate data, find the equation of the least squares regression line and interpret the slope and y-intercept..	Class discussion and paired practice solving similar examples.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Create and interpret a residual plot.	SMP 4 Model with mathematics.	For a given set of bivariate data, find the equation of the least squares regression line and then examine the residual plot.	Reversing Interpretations: Instead of asking students to interpret a residual, give them the residual and the equation of the least-squares regression line and ask them to make a prediction for a particular observation (e.g., "One wolf in the pack had a length of 1.4 m and a residual of −9.87. What does that −9.87 tell us about that particular wolf?").	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Understand the concepts of lurking variables and causation as it relates to	SMP 3 Construct viable arguments and critique the reasoning of others.	Suppose a researcher studying health issues measures blood pressure	Class Activity: "Wandering Point Worksheet" from textbook's Resource Guide..	Extended time, use of calculator, challenge work and specific other

LSRL.		and the percentage of body fat for several adult males, finding a strong possible association. Describe three different possible cause-and-effect relationships that might be present.		accommodations/modifications per a student's IEP or 504 plan.
Re-express data in order to use a LSRL.	SMP 4 Model with mathematics.	For a given set of bivariate data, re-express data in order to use a LSRL.	Predict and Confirm: Have students toss a handful of M&Ms and record how many land M side up. This is trial 1. Then have them remove the ones that were M side up. For trial 2, have students toss the remaining candies (the ones left over after removing the ones that landed M side up) and record how many land M side up on the second toss. Ask students to think about the trend and make a prediction: Will it be linear? A scatterplot of many trials should show a nonlinear relationship.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Benchmark Assessment • AP Classroom Assessment (Units 1 & 2)		**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)** • Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.		

Summative Assessment(s) • Exploring Relationships Between Variables Common Assessment **Performance Assessment**: • Collect quantitative data and then create a linear model to describe the association.	**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)** • Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Hillsborough Township Public Schools
AP Statistics Mathematics Curriculum

Unit Title: 3 Gathering Data	**Timeframe/Pacing:** 16 days

Essential Questions

- How do we obtain data? Why is it important?
- How can bias be identified and prevented?
- To what extent does data collection methodology affect results?

Enduring Understandings

- Careful planning is essential to obtaining valid data.
- Clarifying the question leads to the appropriate methodology.
- The analysis is only as good as the data.
- Well-designed experiments can allow us to reach appropriate cause-and-effect conclusions.

Standards Taught and Assessed

- 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.

Highlighted Interdisciplinary Connections

Computer Science & Design Thinking

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Social Emotional Learning Competencies

- 2.1.12.EH.3: Describe strategies to appropriately respond to stressors in a variety of situations (e.g., academics, relationships, shootings, death, car accidents, illness).
- 2.2.12.LF.4: Exhibit responsible social behavior by including and cooperating with classmates of all skill levels, assisting when needed, and collaborating respectfully to solve problems in groups, teams, and in pairs during physical activity {or mathematical activity}.

Pre-Assessment

- Discuss methods in which data can be collected.
- Describe how to collect data at random.
- Describe biases that may occur when collecting data.

Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)

- Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Student Learning Objectives: We are learning to/that...	Student Strategies (Mathematical Practices)	Formative Assessment	Activities and Resources	Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)
Conduct a simulation using randomly generated numbers.	SMP 4 Model with mathematics.	20% of the cereal boxes contained a picture of Tiger Woods, 30% David Beckham, and the rest Serena Williams. Suppose you buy five boxes of cereal. Estimate the probability that you end up with a complete set of the pictures. Your simulation should have at least 20 runs.	Class discussion and paired practice solving similar examples.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Investigate statistical sampling methods.	SMP 5 Use appropriate tools strategically.	Through their Roper Reports Worldwide, GfK Roper conducts a global consumer survey to help multinational companies understand different consumer attitudes throughout the world. Within 30 countries, the researchers interview 1000 people aged 13–65. Their samples are designed so that they get 500 males and 500 females in each country.	Password-Style Games After completing the lessons on sampling and surveying, use the following 10 terms in a password-style game: census, simple random sample, stratified random sample, cluster sample, systematic random sample, bias, voluntary response bias, undercoverage, nonresponse bias, and	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

		a) Are they using a simple random sample? Explain. b) What kind of design do you think they are using?	response bias. The winner is the pair whose partner guesses the most terms correctly from the descriptions given.	
Distinguish between observational studies and experiments.	SMP 3 Construct viable arguments and critique the reasoning of others.	Researchers who examined health records of thousands of males found that men who died of myocardial infarction (heart attack) tended to be shorter than men who did not. Is this an experiment? If not, what kind of study is it?	Odd One Out: After modeling an odd one out example, have students form groups of four and give each of them a description of a statistical study. Explain that three of the studies are of the same type (observational or experimental) and one is different. Have students work together in their groups to determine which study is the odd one out and explain why.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Describe the elements of a statistical experiment.	SMP 3 Construct viable arguments and critique the reasoning of others.	An experiment that showed that subjects fed the DASH diet were able to lower their blood pressure by an average of 6.7 points compared to a group fed a "control diet." All meals were prepared by dieticians. a) Why were the subjects randomly assigned to the	Think-Pair-Share: Provide students with a description of a well-designed experiment (e.g., 2010 FRQ 1) and ask them to individually identify the type of design, the experimental units, the treatments, and how the study addresses the	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

		diets instead of letting people pick what they wanted to eat? b) Why were the meals prepared by dieticians? c) Why did the researchers need the control group? If the DASH diet group's blood pressure was lower at the end of the experiment than at the beginning, wouldn't that prove the effectiveness of that diet? d) What additional information would you want to know in order to decide whether an average reduction in blood pressure of 6.7 points was statistically significant?	principles of a well-designed experiment (including random assignment, control, blinding, and replication). Then have students share their thoughts with their neighbor.	
Conduct either an observational study or an experiment, and correctly interpret and present the results.	SMP 5 Use appropriate tools strategically.	Hoping to learn how to control crop damage by a certain species of beetle, a researcher plans to test two different pesticides in small plots of corn. A few days after application of the chemicals, he'll check the number of beetle larvae found on each plant. The researcher wants to know whether either pesticide works and whether there is a	Graphic Organizer Provide students with a table listing all possible combinations of whether a study involves random sampling (yes or no) and random assignment (yes or no). Ask them to fill in each cell with both the type of conclusion that is appropriate (association or causation) and the generalizability of the	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

		significant difference in effectiveness between them. Design an appropriate experiment.	results (to the population or to only those similar to the study participants).	

Benchmark Assessment

- Not Applicable.

Summative Assessment(s)

- Gathering Data Common Assessment

Performance Assessment:

- Collect data and discuss the possible biases that may have occurred during data collection.

Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)

- Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Hillsborough Township Public Schools
AP Statistics Mathematics Curriculum

Unit Title: 4 Randomness and Probability	**Timeframe/Pacing:** 23 days

Essential Questions

- How can we base decisions on chance?
- How can probability be used to simulate events and to predict future happenings?
- What are the benefits of simulating events as opposed to gathering real data?
- How can modeling predict the future?

Enduring Understandings

- Probability models are useful tools for making decisions and predictions.
- Probability is the basis of statistical inference.
- The notion and behavior of a random variable is foundational to understanding probability distributions.
- The Law of Large Numbers is an important concept when simulating probability experiments.
- Probability models are useful tools for making decisions and predictions.

Standards Taught and Assessed

- 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 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 or B) = P(A) + P(B) – P(A 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 and B) = P(A)P(B|A) = P(B)P(A|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. For example, find the theoretical probability distribution for the number of correct answers obtained by New Jersey Student Learning Standards for Mathematics 88 guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.
- 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. For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households?
- S-MD.A.5 (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.
- S-MD.A.5.a Find the expected payoff for a game of chance. For example, find the expected winnings from a state lottery ticket or a game at a fast food restaurant.
- S-MD.A.5.b Evaluate and compare strategies on the basis of expected values. For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.
- S-MD.A.6 (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
- S-MD.A.7 (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game)

Highlighted Interdisciplinary Connections

Computer Science & Design Thinking

- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.
- Computer Science & Design Thinking: 8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data.
- 8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data.
- 8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.

ELA

- SL.11-12.1. Initiate and participate effectively in a range of collaborative discussions (one on- one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
- SL.11-12.2. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
- SL.11-12.4 Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
- SL.11-12.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to

enhance understanding of findings, reasoning, and evidence and to add interest.

Highlighted Career Ready Practices and 21st Century Themes and Skill

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive).
- 9.4.2.IML.2: Represent data in a visual format to tell a story about the data (e.g., 2.MD.D.10).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.

Social Emotional Learning Competencies

- 2.1.12.EH.3: Describe strategies to appropriately respond to stressors in a variety of situations (e.g., academics, relationships, shootings, death, car accidents, illness).
- 2.2.12.LF.4: Exhibit responsible social behavior by including and cooperating with classmates of all skill levels, assisting when needed, and collaborating respectfully to solve problems in groups, teams, and in pairs during physical activity {or mathematical activity}.

Pre-Assessment	**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)**
• Find the probability of drawing a red card from a standard deck of cards. • Find the probability of a coin landing on heads when tossed 5 times. • Find the probability of rolling a 6 when rolling a fair die.	• Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Student Learning Objectives: We are learning to/that...	**Student Strategies (Mathematical Practices)**	**Formative Assessment**	**Activities and Resources**	**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)**
Understand and use basic rules of probability.	SMP 5 Use appropriate tools strategically.	In a large Introductory Statistics lecture hall, the professor reports that 55% of the students enrolled have never taken a Calculus course, 32% have taken only one semester of	Think-Pair-Share: Provide students with a set of five probability questions: one for the complement rule, the conditional probability formula, the general	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's

		Calculus, and the rest have taken two or more semesters of Calculus. The professor randomly assigns students to groups of three to work on a project for the course. What is the probability that the first groupmate you meet has studied a) two or more semesters of Calculus? b) some Calculus? c) no more than one semester of Calculus?	multiplication rule, the multiplication rule for independent events, and the general addition rule. Ask students to individually identify the formula needed to solve each problem, without doing the final calculations. Then have them share their thoughts with a partner.	IEP or 504 plan.
Use Venn diagrams, probability tables, and tree diagrams to determine probabilities.	SMP 5 Use appropriate tools strategically.	Real estate ads suggest that 64% of homes for sale have garages, 21% have swimming pools, and 17% have both features. What is the probability that a home for sale has a) a pool or a garage? b) neither a pool nor a garage? c) a pool but no garage?	Create Representations: Provide students with the scenario from 2018 FRQ 3. Ask them to create a tree diagram to organize the information in the problem. Then ask them to use the information in the problem to set up a hypothetical 100,000 table (to make the decimals easy to work with), such as the one below. Encourage students to try both representations when solving probability questions in the future.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

			<table><tr><th></th><th>Multiple Birth</th><th>Single Birth</th><th>Total</th></tr><tr><td>Left handed</td><td>770</td><td>10,615</td><td>11,385</td></tr><tr><td>Right handed</td><td>2,730</td><td>85,885</td><td>88,615</td></tr><tr><td>Total</td><td>3,500</td><td>96,500</td><td>100,000</td></tr></table>	
Calculate expected values of random variables.	SMP 1 Make sense of problems and persevere in solving them.	You draw a card from a deck. If you get a red card, you win nothing. If you get a spade, you win $5. For any club, you win $10 plus an extra $20 for the ace of clubs. a) Create a probability model for the amount you win. b) Find the expected amount you'll win. c) What would you be willing to pay to play this game?	Class discussion and paired practice solving similar examples.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Calculate binomial and geometric probabilities.	SMP 1 Make sense of problems and persevere in solving them.	Assume that 13% of people are left-handed. If we select 5 people at random, find the probability of each outcome described below. a) The first lefty is the fifth person chosen. b) There are some lefties among the 5 people. c) The first lefty is the second or third person. d) There are exactly 3 lefties in the group.	Odd One Out: After modeling an odd one out example, have students form groups of four and give each of them a description of either a binomial or a geometric random variable. Explain that three of their variables follow the same probability distribution and one is different. Have students work together in their groups to determine whose is the odd	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

		e) There are at least 3 lefties in the group. f) There are no more than 3 lefties in the group.	one out and explain why.	
Use a Normal approximation to a binomial model.	SMP 2 Reason abstractly and quantitatively.	An orchard owner knows that he'll have to use about 6% of the apples he harvests for cider because they will have bruises or blemishes. He expects a tree to produce about 300 apples. a) Describe an appropriate model for the number of cider apples that may come from that tree. Justify your model. b) Find the probability there will be no more than a dozen cider apples. c) Is it likely there will be more than 50 cider apples? Explain.	Class discussion and paired practice solving similar examples.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Benchmark Assessment • AP Classroom Assessment (Units 3 & 4)		**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)** • Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.		
Summative Assessment(s) • Randomness and Probability Common Assessment **Performance Assessment**: • Collect data from a random sample of students in your school on their favorite subject among math, science, and		**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)** • Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.		

English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.	

Hillsborough Township Public Schools
AP Statistics Mathematics Curriculum

Unit Title: 5 From the Data at Hand to the World at Large	**Timeframe/Pacing:** 25 days

Essential Questions

- How do you determine if there is a statistically significant difference between two claims?
- What does it mean to make an inference?

Enduring Understandings

- Significance tests determine the likelihood of a sample.
- Confidence intervals are effective tools for estimating the proportion or the mean of a population.
- Inference is a tool for validating a claim about a population parameter.
- Inference is a tool for estimating an unknown population parameter.

Standards Taught and Assessed

- 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.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.

Highlighted Interdisciplinary Connections

Computer Science & Design Thinking

- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.
- 8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data.
- 8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data.
- 8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.

ELA

- SL.11-12.1. Initiate and participate effectively in a range of collaborative discussions (one on- one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
- SL.11-12.2. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
- SL.11-12.4 Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
- SL.11-12.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Highlighted Career Ready Practices and 21st Century Themes and Skill

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive).
- 9.4.2.IML.2: Represent data in a visual format to tell a story about the data (e.g., 2.MD.D.10).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.

Social Emotional Learning Competencies

- 2.1.12.EH.3: Describe strategies to appropriately respond to stressors in a variety of situations (e.g., academics, relationships, shootings, death, car accidents, illness).
- 2.2.12.LF.4: Exhibit responsible social behavior by including and cooperating with classmates of all skill levels, assisting when needed, and collaborating respectfully to solve problems in groups, teams, and in pairs during physical activity {or mathematical activity}.

Pre-Assessment

- Calculate standard deviation of a given data set.
- Calculate a z-score.
- Find P(z<b) (where b is a constant).
- Find P(z>b) (where b is a constant).

Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)

- Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Student Learning Objectives: We are learning to/that...	Student Strategies (Mathematical Practices)	Formative Assessment	Activities and Resources	Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)
Describe and use a sampling distribution model.	SMP 2 Reason abstractly and quantitatively.	In a large class of introductory Statistics students, the professor has each person toss a coin 16 times and calculate the proportion of his or her tosses that were heads. The students then report their results, and the professor plots a histogram	Think Aloud: Group students into pairs within a larger group of four. Have each student individually read 2014 FRQ 3 and think aloud with their partner, brainstorming ways to begin each part of the question. Each student then independently	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504

		of these several proportions. a) What shape would you expect this histogram to be? Why? b) Where do you expect the histogram to be centered? c) How much variability would you expect among these proportions? d) Explain why a Normal model should not be used here.	completes all parts. Have the pairs compare answers within their groups, improving their individual responses as necessary. Groups can then compare their responses with other groups. Finally, have students score their responses according to the rubric.	plan.
Understand and use the Central Limit Theorem.	SMP 2 Reason abstractly and quantitatively.	It is generally believed that nearsightedness affects about 12% of all children. A school district has registered 170 incoming kindergarten children. a) Can you apply the Central Limit Theorem to describe the sampling distribution model for the sample proportion of children who are nearsighted? Check the conditions and discuss any assumptions you need to make.	Use Manipulatives: From a large container of pennies, have each student take two random samples of size 5, two of size 10, and two of size 25, and record the dates on those pennies. Have students calculate the mean of the dates in each sample and then construct four "dotplots" on the floor: one using the pennies, one using nickels placed at the mean of the student's sample size 5, one using dimes placed at the mean of the sample size 10, and one using quarters placed at the mean of the sample size 25.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Calculate and interpret confidence intervals for proportions.	SMP 7 Look for and make use of structure.	Direct mail advertisers send solicitations to thousands of potential customers in the hope that some will buy the company's product. The acceptance rate is usually quite low. Suppose a company wants to test the response to a new flyer, and sends it to 1000 people randomly selected from their mailing list of over 200,000 people. They get orders from 123 of the recipients. a) Create a 90% confidence interval for the percentage of people the company contacts who may buy something. b) Explain what this interval means. c) Explain what "90% confidence" means. d) The company must decide whether to now do a mass mailing. The mailing won't be cost-effective unless it produces at least a 5% return. What does your confidence interval suggest? Explain.	Class discussion and paired practice solving similar examples.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Calculate sample size required (given a proportion, a confidence level and a desired margin	SMP 6 Attend to precision.	It's believed that as many as 25% of adults over 50 never graduated from high school. We wish to see if this	Class discussion and paired practice solving similar examples.	Extended time, use of calculator, challenge work and specific

of error).		percentage is the same among the 25 to 30 age group.How many of this younger age group must we survey in order to estimate the proportion of non-grads to within 6% with 90% confidence?		other accommodations/modifications per a student's IEP or 504 plan.
Conduct a one proportion z-test.	SMP 5 Use appropriate tools strategically.	A magazine is considering the launch of an online edition. The magazine plans to go ahead only if it's convinced that more than 25% of current readers would subscribe. The magazine contacted a simple random sample of 500 current subscribers, and 137 of those surveyed expressed interest. What should the company do? Test an appropriate hypothesis and state your conclusion.	Give student pairs a worksheet with 20 sets of hypotheses (including hypotheses for a population proportion and for the difference of two proportions), each with a common student mistake. Have students circle the incorrect part, write why the circled component is incorrect, and then write the correct hypotheses. Include errors such as using statistics instead of parameters, and interchanging the = and > in the two hypotheses.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Calculate and interpret Type I and Type II errors and the power of a test.	SMP 3 Construct viable arguments and critique the reasoning of others.	Highway safety engineers test new road signs, hoping that increased reflectivity will make them more visible to drivers. Volunteers drive through a test course with	Class discussion and paired practice solving similar examples.	Extended time, use of calculator, challenge work and specific other accommodations/modi

		several of the new- and old-style signs and rate which kind shows up the best. a) Is this a one-tailed or a two-tailed test? Why? b) In this context, what would a Type I error be? c) In this context, what would a Type II error be? d) In this context, what is meant by the power of the test? e) If the hypothesis is tested at the 1% level of significance instead of 5%, how will this affect the power of the test? f) The engineers hoped to base their decision on the reactions of 50 drivers, but time and budget constraints may force them to cut back to 20. How would this affect the power of the test? Explain.		fications per a student's IEP or 504 plan.
Conduct a two proportion z-test.	SMP 5 Use appropriate tools strategically.	A survey of 430 randomly chosen adults found that 21% of the 222 men and 18% of the 208 women had purchased books online. Is there evidence that men are more likely than women to make online purchases of books? Test an appropriate	Sentence Starters For a given question, provide students with a set of hypotheses, p-value, significance level, and context. Have them compare the p-value to the significance level to determine whether or not to reject the null	Extended time, use of calculator, challenge work and specific other accommodations/modi fications per a student's IEP or 504

		hypothesis and state your conclusion in context.	hypothesis. Using a given sentence starter with blanks to fill in, have students write a sentence in context explaining if they have enough evidence to "reject H_0", or if they will "fail to reject H_0." Make sure students avoid the common mistake of implying that evidence supports an "accept H_0" conclusion or a "reject H_a" conclusion.	plan.
Construct a two proportion z-interval.	SMP 5 Use appropriate tools strategically.	A new vaccine was recently tested to see if it could prevent the painful and recurrent ear infections that many infants suffer from. The Lancet, a medical journal, reported a study in which babies about a year old were randomly divided into two groups. One group received vaccinations; the other did not. During the following year, only 333 of 2455 vaccinated children had ear infections, compared to 499 of 2452 unvaccinated children in the control group. a) Are the conditions for	Have students work with a partner to construct and interpret a confidence interval for a population proportion. Only one partner is allowed to use the calculator, and only the other partner is allowed to write. When a calculation needs to be made, the scribe can only describe to the calculator operator which buttons to push; when writing needs to be done, the calculator operator can only describe to the scribe what needs to be written. Have students switch roles when constructing and interpreting a confidence interval for the	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

		inference satisfied? b) Find a 95% confidence interval for the difference in rates of ear infection. c) Use your confidence interval to explain whether you think the vaccine is effective.	difference of two population proportions.	
Benchmark Assessment		**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)** • Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.		
Summative Assessment(s) • From the Data at Hand to the World at Large Common Assessment **Performance Assessment**: • Students should test a claim about a proportion by collecting data and then conducting the appropriate hypothesis test and confidence interval.				

Hillsborough Township Public Schools
AP Statistics Mathematics Curriculum

Unit Title: 6 Learning About the World	**Timeframe/Pacing:** 14 days

Essential Questions

- How do you determine if there is a statistically significant difference between two claims?
- What does it mean to make an inference?

Enduring Understandings

- Significance tests determine the likelihood of a sample.
- Confidence intervals are effective tools for estimating the proportion or the mean of a population.
- Inference is a tool for validating a claim about a population parameter.
- Inference is a tool for estimating an unknown population parameter.

Standards Taught and Assessed

- 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.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.

Highlighted Interdisciplinary Connections

Computer Science & Design Thinking

- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.
- 8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data.
- 8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data.
- 8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.

ELA

- SL.11-12.1. Initiate and participate effectively in a range of collaborative discussions (one on- one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
- SL.11-12.2. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
- SL.11-12.4 Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
- SL.11-12.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Highlighted Career Ready Practices and 21st Century Themes and Skill

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive).
- 9.4.2.IML.2: Represent data in a visual format to tell a story about the data (e.g., 2.MD.D.10).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.

Social Emotional Learning Competencies

- 2.1.12.EH.3: Describe strategies to appropriately respond to stressors in a variety of situations (e.g., academics, relationships, shootings, death, car accidents, illness).
- 2.2.12.LF.4: Exhibit responsible social behavior by including and cooperating with classmates of all skill levels, assisting when needed, and collaborating respectfully to solve problems in groups, teams, and in pairs during physical activity {or mathematical activity}.

Pre-Assessment

- Find mean and standard deviation of a given data set (using a graphing calculator).
- Calculate the mean and standard deviation of a sampling distribution.
- Calculate a z-score.
- Calculate a one proportion z confidence interval.
- Calculate a two proportion z confidence interval.

Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)

- Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Student Learning Objectives: We are learning to/that...	Student Strategies (Mathematical Practices)	Formative Assessment	Activities and Resources	Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)
Use the t-distribution.	SMP 4 Model with mathematics.	Using the t tables, software, or a calculator, estimate a) the critical value of t for a 90% confidence interval with df=17. b) the critical value of t for a 98% confidence interval with df=88	Class discussion and paired practice solving similar examples.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

		c) the P-value for $t > 1.78$ with 4 degrees of freedom.		
Calculate a one-sample t-interval for means.	SMP 1 Make sense of problems and persevere in solving them.	Some students checked 6 bags of Doritos marked with a net weight of 28.3 grams. They carefully weighed the contents of each bag, recording the following weights (in grams): 29.2, 28.5, 28.7, 28.9, 29.1, 29.5. Create a 95% confidence interval for the mean weight of such bags of chips.	Team Challenge: Give each team of three to four students a copy of 2004 FRQ 6, which focuses on the connection between a one-sample t-interval, a one-sample t-test, and the unfamiliar concept of a one-sided confidence interval. Challenge teams to collaboratively produce a model solution in 30 minutes.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Conduct a one-sample t-test for the means.	SMP 5 Use appropriate tools strategically.	A tire manufacturer is considering a newly designed tread pattern for its all-weather tires. Tests have indicated that these tires will provide better gas mileage and longer tread life. The last remaining test is for braking effectiveness. The company hopes the tire will allow a car	Discussion Groups: Ask each group of three to four students to identify the conditions for performing a test about a population mean. For each condition, have them explain why	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

		traveling at 60 mph to come to a complete stop within an average of 125 feet after the brakes are applied. They will adopt the new tread pattern unless there is strong evidence that the tires do not meet this objective. The distances (in feet) for 10 stops on a test track were 129, 128, 130, 132, 135,123, 102, 125, 128, and 130. Should the company adopt the new tread pattern? Test an appropriate hypothesis and state your conclusion.	the condition is required and what would go wrong with the test if the condition were violated. Have groups pair up and compare answers.	
Conduct a two-sample t-test for means (two independent groups).	SMP 8 Look for and express regularity in repeated reasoning.	Researchers investigated how the size of a bowl affects how much ice cream people tend to scoop when serving themselves. At an "ice cream social," people were randomly given either a 17 oz or a 34 oz bowl (both large enough that they would not be filled to capacity). They were then invited to scoop as much ice cream as they liked. Did the bowl size change the selected portion size? Here are the summaries: Small Bowl: $n = 26$, $\bar{y} = 5.07$ oz, $s = 1.84$ oz Large Bowl: $n = 22$, $\bar{y} = 6.58$ oz, $s = 2.91$ oz	Team FRQ: Give each team of four students copies of a free-response question that involves performing a two-sample t-test (e.g., 2011 FRQ 4). Have each team member take responsibility for writing one part of the model solution (hypotheses, procedure and conditions, calculations, conclusion) with	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

		Test an appropriate hypothesis and state your conclusions.	group input.	
Construct a two-sample t-interval for the difference between means.	SMP 5 Use appropriate tools strategically.	The data below show the sugar content (as a percentage of weight) of several national brands of children's and adults' cereals. Create and interpret a 95% confidence interval for the difference in mean sugar content. **Children's cereals:** 40.3, 55, 45.7, 53.5, 43, 44.2, 44, 47.4, 44, 33.6, 55.1, 48.8, 50.4, 43.3, 50.3, 45.9, 37.8, 60.3, 46.6 **Adults' cereals:** 20, 30.2, 2.2, 7.5, 14.5, 21.4, 3.3, 6.6, 7.6, 10.6, 16.2, 4.4, 22.2, 16.6, 14.5, 4.1, 15.6, 4.1, 2.4, 35, 8.5, 10, 1, 4.4, 1.3, 8.1, 4.7, 18.4	Class discussion and paired practice solving similar examples.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Conduct a matched-pairs t-test for the means.	SMP 3 Construct viable arguments and critique the reasoning of others.	A company institutes an exercise break for its workers to see if it will improve job satisfaction, as measured by a questionnaire that assesses workers' satisfaction. Scores for 10 randomly selected workers before and after the implementation of the exercise program are shown in the table below.	Graphic Organizer: Have students work in teams of two to three to develop a flowchart for determining which inference procedure from Units 5 and 6 to use in a given setting.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

		<table><tr><th rowspan="2">Worker Number</th><th colspan="2">Job Satisfaction Index</th></tr><tr><th>Before</th><th>After</th></tr><tr><td>1</td><td>34</td><td>33</td></tr><tr><td>2</td><td>28</td><td>36</td></tr><tr><td>3</td><td>29</td><td>30</td></tr><tr><td>4</td><td>45</td><td>41</td></tr><tr><td>5</td><td>26</td><td>37</td></tr><tr><td>6</td><td>27</td><td>41</td></tr><tr><td>7</td><td>24</td><td>39</td></tr><tr><td>8</td><td>15</td><td>21</td></tr><tr><td>9</td><td>15</td><td>20</td></tr><tr><td>10</td><td>27</td><td>37</td></tr></table> a) Identify the procedure you would use to assess the effectiveness of the exercise program, and check to see if the conditions allow the use of that procedure. b) Test an appropriate hypothesis and state your conclusion.		
Construct a matched-pairs t-interval for the means.	SMP 1 Make sense of problems and persevere in solving them.	The table below gives the average high temperatures in January and July for several European cities. Write a 90% confidence interval for the mean temperature difference between summer and winter in Europe. Be sure to check conditions for inference, and clearly explain what your interval means.	Class discussion and paired practice solving similar examples.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

		Mean High Temperatures (°F) City | Jan. | July Vienna | 34 | 75 Copenhagen | 36 | 72 Paris | 42 | 76 Berlin | 35 | 74 Athens | 54 | 90 Rome | 54 | 88 Amsterdam | 40 | 69 Madrid | 47 | 87 London | 44 | 73 Edinburgh | 43 | 65 Moscow | 21 | 76 Belgrade | 37 | 84		

Benchmark Assessment

- Not Applicable.

Summative Assessment(s)

- Learning About the World Common Assessment

Performance Assessment:

- Students should test a claim about a mean by collecting data and then conducting the appropriate hypothesis test and confidence interval.

Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)

- Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Hillsborough Township Public Schools
AP Statistics Mathematics Curriculum

Unit Title: 7 Inference When Variables are Related	**Timeframe/Pacing:** 14 days

Essential Questions
- How can we verify that two variables are independent?
- How do you find critical values for a chi-square test?

Enduring Understandings
- Significance tests can determine the likelihood of a sample from a series of proportions.
- Significance tests can determine whether two variables are independent.
- Confidence intervals can estimate the variation in a bivariate sample's slope.

Standards Taught and Assessed
- 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.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.

Highlighted Interdisciplinary Connections
Computer Science & Design Thinking
- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.
- 8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data.
- 8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data.
- 8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.

ELA
- SL.11-12.1. Initiate and participate effectively in a range of collaborative discussions (one on- one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
- SL.11-12.2. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
- SL.11-12.4 Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
- SL.11-12.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Highlighted Career Ready Practices and 21st Century Themes and Skill
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.

- 9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive).
- 9.4.2.IML.2: Represent data in a visual format to tell a story about the data (e.g., 2.MD.D.10).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.

Social Emotional Learning Competencies

- 2.1.12.EH.3: Describe strategies to appropriately respond to stressors in a variety of situations (e.g., academics, relationships, shootings, death, car accidents, illness).
- 2.2.12.LF.4: Exhibit responsible social behavior by including and cooperating with classmates of all skill levels, assisting when needed, and collaborating respectfully to solve problems in groups, teams, and in pairs during physical activity {or mathematical activity}.

Pre-Assessment

- Perform a one proportion z test.
- Find the equation of a line (given a set of data).
- Interpret the slope of the linear model.
- Interpret the y-intercept of the linear model.
- Describe the residual plot.

Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)

- Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Student Learning Objectives: We are learning to/that...	**Student Strategies (Mathematical Practices)**	**Formative Assessment**	**Activities and Resources**	**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)**
Use the Chi-square distribution.	SMP 3 Construct viable arguments and critique the reasoning of others.	For each of the following situations, state whether you'd use a chi-square goodness-of-fit test, a chi square test of homogeneity, a chi-square test of independence, or some other statistical test: a) A brokerage firm wants to see whether the type of account a customer has (Silver, Gold, or Platinum) affects the type of trades that	Simulation: Prepare several bags with an identical mix of at least 250 chips or beads of three colors in different proportions (e.g., red = 0.5, white = 0.3, blue = 0.2). Have each student take a random sample of 25 chips or beads from the bag, calculate $\sum \frac{(Observed\ count - Expected\ count)^2}{Expected\ count}$	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

		a customer makes (in person, by phone, or on the Internet). It collects a random sample of trades made for its customers over the past year and performs a test. b) That brokerage firm also wants to know if the type of account affects the size of the account (in dollars). It performs a test to see if the mean size of the account is the same for the three account types. c) The academic research office at a large community college wants to see whether the distribution of courses chosen (Humanities, Social Science, or Science) is different for its residential and nonresidential students. It assembles last semester's data and performs a test.	and plot their value on a class dotplot. Use this graph to introduce the chi-square distribution with df = 2.	
Perform a Chi-square goodness of fit test .	SMP 4 Model with mathematics.	Many people know the mathematical constant π is approximately 3.14. But that's not exact. To be more precise, here are 20 decimal places: 3.14159265358979323846. Still not exact, though. In fact, the actual value is irrational, a decimal that	Class discussion and paired practice solving similar examples.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

<table>
<tr>
<td></td>
<td></td>
<td>goes on forever without any repeating pattern. But notice that there are no 0's and only one 7 in the 20 decimal places above. Does that pattern persist, or do all the digits show up
with equal frequency? The table shows the number of times each digit appears in the first million digits.
Test the hypothesis that the digits 0 through 9 are uniformly distributed
in the decimal representation of π.

The first million digits of π
<table><tr><th>Digit</th><th>Count</th></tr><tr><td>0</td><td>99,959</td></tr><tr><td>1</td><td>99,758</td></tr><tr><td>2</td><td>100,026</td></tr><tr><td>3</td><td>100,229</td></tr><tr><td>4</td><td>100,230</td></tr><tr><td>5</td><td>100,359</td></tr><tr><td>6</td><td>99,548</td></tr><tr><td>7</td><td>99,800</td></tr><tr><td>8</td><td>99,985</td></tr><tr><td>9</td><td>100,106</td></tr></table></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perform a Chi-square test for homogeneity.</td>
<td>SMP 1 Make sense of problems and persevere in solving them.</td>
<td>Two different professors teach an introductory
Statistics course. The table shows the distribution of final</td>
<td>Discussion Groups
Give each group of three to four students an example of a chi-square test</td>
<td>Extended time, use of calculator, challenge work and specific other</td>
</tr>
</table>

		grades they reported. We wonder whether one of these professors is an "easier" grader. Test your hypothesis about the two professors, and state an appropriate conclusion.	involving a two-way table. Have students work together to state appropriate hypotheses, describe a Type 1 and Type 2 error in context, and give a possible consequence of each of those errors.	accommodations/modifications per a student's IEP or 504 plan.
Perform a Chi-square test of independence.	SMP 5 Use appropriate tools strategically.	A poll conducted by the University of Montana classified respondents by whether they were male or female and political party, as shown in the table. We wonder if there is evidence of an association between being male or female and party affiliation. a) Is this a test of homogeneity or independence? b) Write an appropriate hypothesis. c) Are the conditions for inference satisfied? d) Find the P-value for your	Graphic Organizer Have students work in teams of two to three to develop a chart that summarizes the three types of chi-square tests, including when each is appropriate, as well as the hypotheses, conditions, and degrees of freedom.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

	Prof. Alpha	Prof. Beta
A	3	9
B	11	12
C	14	8
Below C	12	3

	Dem	Rep	Ind
Male	36	45	24
Female	48	33	16

		test. e) State a complete conclusion.		
Construct a t-interval for the slope of a LSRL.	SMP 4 Model with mathematics.	A business analyst was interested in the relationship between a company's sales and its profits. She collected data (in millions of dollars) from a random sample of Fortune 500 companies and created the regression analysis and summary statistics shown. **Profits** **Sales** Count 79 79 Mean 209.839 4178.29 Variance 635,172 49,163,000 Std Dev 796.977 7011.63 **Dependent variable is: Profits** R-squared = 86.2% s = 466.2 **Variable** **Coefficient** **SE(Coeff)** Intercept −176.644 61.16 Sales 0.092498 0.0075 Find a 95% confidence interval for the slope of the regression line. Interpret your interval in context.	Note-Taking: Begin by having students use a chart to record the symbols for statistics and parameters that have been used previously to construct confidence intervals: **Statistic** **Parameter** $\hat{p}$ p $\bar{x}$ μ s σ Then, when constructing a confidence interval for the population slope parameter, have students add a new row for the symbols for the sample slope and population slope: b and β, respectively. This will reinforce that the slope of the least-squares regression line is a sample statistic and can be used to estimate the population parameter slope.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

<table>
<tr>
<td>Conduct a t-test for the slope of the LSRL.</td>
<td>SMP 4 Model with mathematics.</td>
<td>Ads claimed instructional videos would improve the performances of Little League pitchers. To test this claim, 20 Little Leaguers threw 50 pitches each, and we recorded the number of strikes. After the players participated in the training program, we repeated the test. The table shows the number of strikes each player threw before and after the training.
<table>
<tr><th colspan="4">Number of Strikes (out of 50)</th></tr>
<tr><th>Before</th><th>After</th><th>Before</th><th>After</th></tr>
<tr><td>28</td><td>35</td><td>33</td><td>33</td></tr>
<tr><td>29</td><td>36</td><td>33</td><td>35</td></tr>
<tr><td>30</td><td>32</td><td>34</td><td>32</td></tr>
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<tr><td>32</td><td>31</td><td>35</td><td>34</td></tr>
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<tr><td>32</td><td>34</td><td>36</td><td>33</td></tr>
<tr><td>32</td><td>35</td><td>37</td><td>35</td></tr>
<tr><td>33</td><td>36</td><td>37</td><td>32</td></tr>
</table>
A test of paired differences failed to show that this training improves ability to throw strikes. Is there any evidence that the effectiveness of the video (After – Before) depends on the player's initial ability to throw strikes (Before)? Test an appropriate hypothesis and state your conclusion.</td>
<td>Error Analysis:
Give students some raw data on the distance and cost to fly from their hometown to various major cities. For example:
<table>
<tr><th colspan="2">Flying from ____ to ____</th></tr>
<tr><th>Distance</th><th>Cost</th></tr>
<tr><td>512 miles</td><td>$179</td></tr>
<tr><td>1256 miles</td><td>$257</td></tr>
<tr><td>3256 miles</td><td>$387</td></tr>
</table>
Then introduce some questions justifying a claim and error analysis. For example, how could you refute a claim that the average cost per mile (the population slope) is $0.50 per mile if you believe it to be false?</td>
<td>Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.</td>
</tr>
</table>

		Propose an explanation for what you find.		
Read and interpret computer output for a t-test for the slope of the LSRL.	SMP 1 Make sense of problems and persevere in solving them.	A healthy cereal should be low in both calories and sodium. Data for 77 cereals were examined and judged acceptable for inference. The 77 cereals had between 50 and 160 calories per serving and between 0 and 320 mg of sodium per serving. Here's the regression analysis: Dependent variable is: Sodium R-squared = 9.0% s = 80.49 with 77 − 2 = 75 degrees of freedom Variable Coefficient SE(Coeff) t-ratio P-value Intercept 21.4143 51.47 0.416 0.6786 Calories 1.29357 0.4738 2.73 0.0079 a) Is there an association between the number of calories and the sodium content of cereals? Explain. b) Do you think this association is strong enough to be useful? Explain.	Notation Read Aloud: Have students read AP Exam questions aloud (e.g., 2011 FRQ 5, 2010 Form B FRQ 6, 2005 Form B FRQ 5, and 2001 FRQ 6), including the given notation. Remind students that the computer output provides the two-sided p-value, and that there are two different p-values in the chart: The top p-value is for the intercept, and the bottom p-value is for the slope. Then have students discuss each of the values in the computer output and carry out a test for the slope of a regression model.	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Benchmark Assessment • AP Classroom Assessment (Units 5, 6, & 7)		**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)** • Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.		

Summative Assessment(s) • Inference When Variables are Related Common Assessment **Performance Assessment**: • Students should test a claim by collecting data and then conducting the appropriate hypothesis test and confidence interval.	**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)** • Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Hillsborough Township Public Schools
AP Statistics Mathematics Curriculum

Unit Title: 8 Connections between Statistics Topics	**Timeframe/Pacing:** 46 days

Essential Questions

- How can we determine whether differences between measures represent random variation or meaningful distinctions?
- How are patterns in data useful?
- How do we make data based decisions?

Enduring Understandings

- Statistical methods based on probabilistic reasoning provide the basis for shared understandings about variation and about the likelihood that variation between and among measures, samples, and populations is random or meaningful.
- Simulation and probabilistic reasoning allow us to anticipate patterns in data and to determine the likelihood of errors in inference.
- Data-based regression models describe relationships between variables and are a tool for making predictions for values of a response variable.

Standards Taught and Assessed

- 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.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.

Highlighted Interdisciplinary Connections

Computer Science & Design Thinking

- 8.1.5.DA.1: Collect, organize, and display data in order to highlight relationships or support a claim.
- 8.1.5.DA.3: Organize and present collected data visually to communicate insights gained from different views of the data.
- 8.1.5.DA.5: Propose cause and effect relationships, predict outcomes, or communicate ideas using data.
- 8.1.8.DA.1: Organize and transform data collected using computational tools to make it usable for a specific purpose.

ELA

- SL.11-12.1. Initiate and participate effectively in a range of collaborative discussions (one on- one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
- SL.11-12.2. Integrate multiple sources of information presented in diverse media or formats (e.g., visually, quantitatively, orally) evaluating the credibility and accuracy of each source.
- SL.11-12.4 Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.

Key: ■ Major Cluster ☐ Supporting Cluster ◎ Additional Cluster

- SL.11-12.5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Highlighted Career Ready Practices and 21st Century Themes and Skill

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.2.CT.3: Use a variety of types of thinking to solve problems (e.g., inductive, deductive).
- 9.4.2.IML.2: Represent data in a visual format to tell a story about the data (e.g., 2.MD.D.10).
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Social Emotional Learning Competencies

- 2.1.12.EH.3: Describe strategies to appropriately respond to stressors in a variety of situations (e.g., academics, relationships, shootings, death, car accidents, illness).
- 2.2.12.LF.4: Exhibit responsible social behavior by including and cooperating with classmates of all skill levels, assisting when needed, and collaborating respectfully to solve problems in groups, teams, and in pairs during physical activity {or mathematical activity}.

Pre-Assessment

- Describe the distribution for a given data set.
- Design an experiment/study.
- Perform a hypothesis test.
- Calculate a confidence interval.

Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)

- Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Student Learning Objectives: We are learning to/that...	Student Strategies (Mathematical Practices)	Formative Assessment	Activities and Resources	Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)
Select methods for collecting and/or analyzing data for statistical inference.	SMP 5 Use appropriate tools strategically.	2016 Exam - Question 3	Past AP Statistics Free-Response Questions	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Key: ■ Major Cluster □ Supporting Cluster ◎ Additional Cluster

Describe patterns, trends, associations, and relationships in data.	SMP 4 Model with mathematics.	2018 Exam - Question 1	Past AP Statistics Free-Response Questions	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Explore random phenomena.	SMP 2 Reason abstractly and quantitatively.	2019 Exam - Question 3	Past AP Statistics Free-Response Questions	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Develop an explanation or justify a conclusion using evidence from data, definitions, or statistical inference.	SMP 1 Make sense of problems and persevere in solving them.	2019 Exam - Question 4	Past AP Statistics Free-Response Questions	Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.
Benchmark Assessment • Past AP Exam Multiple Choice Simulation.		**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)** • Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.		

Key: ■ Major Cluster □ Supporting Cluster ◎ Additional Cluster

Summative Assessment(s) • See Benchmark. **Performance Assessment**: • Culminating project.	**Modifications/Accommodations (ELL, Special Education, Gifted, At-Risk of Failure, 504)** • Extended time, use of calculator, challenge work and specific other accommodations/modifications per a student's IEP or 504 plan.

Key: ■ Major Cluster □ Supporting Cluster ◎ Additional Cluster

Bibliography
AP Statistics

Primary Textbook

Bock, David E., Paul F. Velleman and Richard D. DeVeaux.(2019). *Stats: Modeling the World: AP Edition.* Boston: Savvas.

Digital Platform

www.mymathlab.com