PUBLIC SCHOOLS OF EDISON TOWNSHIP

OFFICE OF CURRICULUM AND INSTRUCTION

Statistics – Levels AP, 1 and 2

Length of Course: Term

Elective/Required: Required

Schools: High School

Eligibility: Grade 12

Credit Value: 5 Credits

Date Approved: August 24, 2020

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*Unit 7 is OPTIONAL for Levels 1 and 2

Statement of Purpose

This course of study has been designed for AP Statistics, Statistics Level 1 and Statistics Level 2. The purpose is to teach students how to represent the world quantitatively through mathematics. The course introduces students to the major concepts and tools for collecting, analyzing, and drawing conclusions from data. With an increased emphasis and awareness of statistics in today's world, and an increased number of college majors requiring a basic statistics course in its curriculum, it is important for students to be statistically literate.

The course is activity-centered, with students actively engaged in the discovery and exploration of statistical realities and relationships. Lecture is held to a minimum, and the teacher facilitates and guides students in explorations and formations of hypotheses. Thinking and analyzing are emphasized, while the number crunching is left to technology. Students will use graphing calculators, computer programs, and/or statistical computer software on a daily basis.

Real world or current data is used covering many different fields of interest. The course will allow students to study topics that relate to non-mathematics courses that they have taken in high school. Students will need to express concepts verbally and in written form, and will learn to be critical thinkers in our ever-changing society.

Course Objectives

The student will be able to:

1. Display and describe categorical data.

2. Display and describe quantitative data.

3. Appropriately use the Normal curve to compute probabilities and draw conclusions.

4. Display and describe 2-variable data.

5. To design and critique sample surveys, experiments and observational studies, with an emphasis on the importance of randomness and causation.

6. Describe a probability model and use the laws of probability to predict outcomes.

7. Generate and interpret sampling distributions for sample proportions and sample means.

8. Generate and interpret confidence intervals for proportions and means

9. Test hypotheses about proportions and means, and differences of proportions and means.

10. Use Chi-Square and Regression tests for inference.

Suggested Timeline- Statistics Advanced Placement

Unit	**# of Periods**
Unit 3: Chapters 10 -12 - Gathering Data	25
Unit 1: Chapters 1 - 5 - Exploring and Understanding 1-Variable Data	15
End Quarterly 1 Material	
Unit 2: Chapters 6 - 9 - Exploring Relationships Between Two Variables	20
Unit 4: Chapters 13 - 16 - Randomness and Probability	25
End Quarterly 2 Material	
Unit 5: Chapters 17 - 21 - Inference About Proportions	18
Unit 6: Chapters 22 - 24 - Inference About Means	15
Unit 7: Chapter 25 - 26 - Inference using Chi-Square/Inferences for Regression	10
End Quarterly 3 Material - Unit 5 and 6 Only	
Unit Review: All Chapters	30
Unit Project: Inference Project	15
End Quarterly 4 Material - Unit 7 and Inference Review	

Note- The above suggested timeline is a rough guideline. Teachers must adjust their timing and pacing as they feel necessary to accommodate actual class periods available.

Suggested Timeline- Statistics Accelerated

Unit	**# of Periods**
Unit 1: Chapters 1-5 - Exploring and Understanding Data	35
End Quarterly 1 Material	
Unit 2: Chapters 6-8 - Exploring Relationships Between Variables	20
Unit 3: Chapters 10-12 - Gathering Data	25
End Quarterly 2 Material	
Unit 4: Chapters 13-16 - Randomness and Probability	30
Unit 5: Chapter 17 - From the Data at Hand to the World at Large	10
End Quarterly 3 Material	
Unit 5: Chapters 18-21 - From the Data at Hand to the World at Large	25
Unit 6: Chapters 22-24 - Learning about the World	20
End Quarterly 4 Material	

Unit 7 (OPTIONAL): Chapter 25 - Inference using Chi-Square

Note- The above suggested timeline is a rough guideline. Teachers must adjust their timing and pacing as they feel necessary to accommodate actual class periods available.

Suggested Timeline- Statistics Academic

Unit	# of Periods
Unit 1: Chapters 1-5 - Exploring and Understanding 1-Variable Data	35
End Quarterly 1 Material	
Unit 2: Chapters 6-8 - Exploring Relationships Between Two Variables	25
Unit 3: Chapters 10-12 - Gathering Data	25
End Quarterly 2 Material	
Unit 4: Chapters 13-16 - Randomness and Probability	30
Unit 5: Chapter 17 - From the Data at Hand to the World at Large	10
End Quarterly 3 Material	
Unit 5: Chapters 18-21 - From the Data at Hand to the World at Large	25
Unit 6: Chapters 22-23 - Learning about the World	20
(Ch 24 is Optional for Statistics Level 2)	
End Quarterly 4 Material	
Unit 7 (OPTIONAL): Chapter 25 - Inference using Chi-Square	

Note- The above suggested timeline is a rough guideline. Teachers must adjust their timing and pacing as they feel necessary to accommodate actual class periods available.

Unit Title: Unit 1: Chapters 1-5 - Exploring and Understanding Data

Essential Questions: What is the difference between categorical and quantitative data? What is the best way to graphically & numerically describe one-variable data? How can we effectively compare two or more data sets? How is the normal curve used to describe a data set, and why is it so important in the study of statistics? **Unit Assessment: Teacher-generated assessments will be used, including traditional tests/quizzes, projects and/or presentations. The "Just Checking" problems within each chapter and the chapter review problems can be used as formative assessments.**

Core Content Objectives		Instructional Actions	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies**	**Assessment Check Points**

1) Vocabulary including
● Data
● Quantitative variables
● Categorical variables
● Frequency table
● Distribution
● Bar graph
● Pie chart
● Marginal distribution
● Conditional distribution
● Independence
● Histogram
● Stem-and-leaf plot
● Dotplot
● Timeplot
● Shape
● Center
● Spread
● Mode
● Unimodal
● Uniform
● Symmetric
● Skewed
● Outliers
● Median
	1. Collect and/or read and transfer univariate quantitative data into graphical form
	    a. dotplot
	    b. stemplot
	    c. histogram
	    d. cumulative frequency plot
	    e. boxplot & modified boxplot
	
	2. Interpret graphical displays of distributions of univariate data
	    a. center and spread
	    b. clusters and gaps
	    c. outliers and other unusual features
	    d. shape
	
	3. Summarize distributions of univariate data
	    a. measuring center
	        1) median
	        2) mean
	    b. measuring spread
	        1) range
	        2) interquartile range
	        3) standard deviation
		● Give many examples of categorical vs. quantitative data, including numerical categorical data such as house numbers and student ID numbers
		● Emphasize labeling graphs
		● Quantitative data is described using shape, center and spread
		● Categorical data is best described by proportions or percents rather than counts
		● Students should use computer software and the graphing calculator to graph data
		● Have the students gather and analyze data from different sources and on different topics of interest
		● Have students present their data and analyses to the class using proper statistical vocabulary
			Chapter 1 – Just checking p.7
			
			Chapter 2 – Just checking p. 23
			
			Chapter 3 – Just checking p. 49, 59
			
			Chapter 4 – Just checking p. 83
			
			Chapter 5 – Just checking p. 105, 107, 111

Unit Title: Unit 1: Chapters 1-5 - Exploring and Understanding Data (continued)

Core Content Objectives		Instructional Actions	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies**	**Assessment Check Points**

1) Vocabulary (continued)
● Range
● Quartiles & IQR
● Percentile
● Minimum
● Maximum
● Boxplot
● Mean
● Variance
● Standard deviation
● Standardized scores
● Normal model
● Parameter
● Statistic
● Z-score
● 68-95-99.7% Rule
2) The difference between a categorical and a quantitative variable
3) How to describe categorical variables graphically and numerically
4) How to describe quantitative variables graphically and numerically
5) How to compare distributions graphically and numerically
6) When a normal model is appropriate to describe data
7) How to use the standard normal curve to describe and compare data
 	
8) How linear transformations affect the center and spread of a variable.
	c. Measuring positions
	  1) quartiles
	  2) percentiles
	  3) standardized scores (z-scores)
	  d. the effects of changing units on summary measures
	
	4. Directly compare distributions of univariate data graphically and numerically
	
	5. Explore categorical data in the form of frequency tables
	  a. marginal and joint frequencies for two-way tables
	  b. conditional relative frequencies and association
	6. Use the normal distribution as model for measurements
	  a. properties
	  b. tables
		● Have students use the graphing calculator to discover how linear transformations on a data set affect the center and spread
		● Gather and discuss data that is approximately normal in shape. Use websites and applets that will simulate events and provide a graph for data that is difficult to gather by students
		● Use Advanced Placement free response questions to practice concepts
		● "Against All Odds: Inside Statistics" video modules #1-9	

Unit Title: Unit 1: Chapters 1-5 - Exploring and Understanding Data (continued)

Resources: Essential Materials, Supplementary Materials, Links to Best Practices	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings
Textbook, graphing calculator and/or computer software are essential. Real-life data can be found via the internet. The College Board website apcentral.collegeboard.com contains many practice problems, teaching ideas and guidelines, and links to best practices for teaching statistics.	At the end of each chapter in the textbook is the "What Can Go Wrong?" section. This is a list of common mistakes that students make and is very helpful to both the teacher and student. Individual accommodations will be made based on student's Individualized Education Plan or 504 Plan

Unit Title: Unit 2: Chapters 6-9 - Exploring Relationships Between Variables
(Chapter 9 for AP only)

Essential Questions: What is the best way to graphically & numerically describe the relationship between two quantitative variables? Is association the same as correlation?

Unit Assessment: Teacher-generated assessments will be used, including traditional tests/quizzes, projects and/or presentations. The "Just Checking" problems within each chapter and the chapter review problems can be used as formative assessments.

Core Content Objectives		Instructional Actions	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies**	**Assessment Check Points**

1) Vocabulary including
   ● Scatterplots
   ● Association
   ● Explanatory variable
   ● Response variable
   ● Correlation
   ● Lurking variable
   ● Linear model
   ● Residuals
   ● Predicted value
   ● Slope
   ● Intercept
   ● Line of best fit (least squares regression line)
   ● Extrapolation
 	
 2) When and how to use a line of best fit to describe 2-variable data
 3) How to graph 2-variable data using a scatterplot
 4) How to describe linear data in context
	1. Collect bivariate quantitative data, and explore and analyze the association between the variables using form, strength and direction.
	
	 2. Analyze patterns in scatterplots
	   a. Generally linear
	   b. Generally curved
	   c. No pattern
	
	 3. Describe linear data
	   a. Using a scatterplot
	   b. Using the correlation coefficient
	   c. Using the least-square regression line
	   d. Response vs. explanatory variables
		● It may be necessary to review properties of lines from Algebra I
		 ● Emphasize labeling graphs
		 ● Students should be able to graph a scatter plot by hand, by using a graphing calculator and by using computer software
		 ● Students should be able to draw an approximate line of best fit on a scatter plot, but the actual equation of the LSRL should be found using the graphing calculator or computer software
		 ● Students should be able to use computer output to determine the slope and y-intercept of a regression equation
		 ● Emphasize the meaning of the slope and y-intercept in the context of the problem
			Chapter 6 – Just checking p.154
			
			 Chapter 7 – Just checking p. 176, 178, 181, 186
			
			 Chapter 8 – Just checking p. 212
			
			 Chapter 9 – Just checking p. 234

Unit Title: Unit 2: Chapters 6-9 - Exploring Relationships Between Variables (continued)
(Chapter 9 for AP only)

Core Content Objectives		Instructional Actions	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies**	**Assessment Check Points**
5) How to determine which variable is explanatory and which is response 6) How to use the least squares regression line for prediction 7) How to describe the strength and direction of a linear relationship 8) How to compute and interpret the correlation coefficient 9) How to make the distribution of a variable more symmetric 10) How to make the spread across difference groups more similar 11) How to make the form of a scatterplot straighter 12) How to make the scatter around the line in a scatterplot more consistent	4. Find a re-expression of non-linear data using logarithms, square roots, the reciprocal that leads to a useful linear model	● Emphasize that the regression equation is used for prediction ● Residuals should be introduced, and students can discover that the sum of the residuals is zero, but there is no need to study residual plots ● Not all data is linear, but it is beyond the scope of this course to transform non-linear data (skip Chapter 9 Level 1 and 2 only) ● Use Advanced Placement free response questions as practice ● Have students gather and analyze 2-variable data of interest, and present their findings to the class ● "Against All Odds: Inside Statistics" video modules #10-12	

Unit Title: Unit 2: Chapters 6-9 - Exploring Relationships Between Variables (continued)
(Chapter 9 for AP only)

Resources: Essential Materials, Supplementary Materials, Links to Best Practices	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings
Textbook, graphing calculator and/or computer software are essential. Real-life data can be found via the internet. The College Board website apcentral.collegeboard.com contains many practice problems, teaching ideas and guidelines, and links to best practices for teaching statistics.	At the end of each chapter in the textbook is the "What Can Go Wrong?" section. This is a list of common mistakes that students make and is very helpful to both the teacher and student. A thorough review of properties of lines from Algebra I should be provided. Individual accommodations will be made based on student's Individualized Education Plan or 504 Plan

Unit Title: Unit 3: Chapters 10-12 - Gathering Data

Essential Questions: Why is randomness important in the data collection process? How can simulation be useful in modeling random behavior in the real world?   How can proper sampling be used to estimate population parameters from sample statistics? What is the difference between an experiment and an observational study, and how can they be used to draw conclusions? What is bias, and how can it be avoided when gathering data? What is the best design for an experiment?

Unit Assessment: Teacher-generated assessments will be used, including traditional tests/quizzes, projects and/or presentations. The "Just Checking" problems within each chapter and the chapter review problems can be used as formative assessments.

Core Content Objectives		Instructional Actions	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies**	**Assessment Check Points**

1) Vocabulary including
  ● Random
  ● Simulation
  ● Outcome
  ● Trial
  ● Response variable
  ● Sample
  ● Bias
  ● Sample size
  ● Census
  ● Population parameter
  ● Sample statistic
  ● Representative
  ● Simple random sample (SRS)
  ● Sampling frame
  ● Sampling variability
  ● Stratified random sample
  ● Cluster sample
  ● Systematic sample
  ● Voluntary response bias
	1) Recognize and interpret the different methods of data collection in planning a study
	  a) Census
	  b) Sample survey
	  c) Experiment
	  d) Observational study
	
	2) Plan and conduct surveys
	  a) Identify the characteristics of a well-designed and well-conducted survey
	  b) Identify the population in a sampling situation
	  c) Recognize the characteristics of and choose the most appropriate sample design(s)
	   1) Voluntary response sample
	   2) Convenience sampling
	   3) Simple random sample
	   4) Probability sample
	   5) Stratified random sample
	   6) Multistage sampling
		● Develop an effective method for your students to practice the vocabulary (flash cards, graphic organizers, quizlets, etc.)
		
		● Emphasize that causation can only be implied from a well-designed experiment, not from an observational study
		
		● Have students design and carry out their own observational studies and experiments, and present their findings to the class
		
		● Have students read about and discuss famous studies, such as the Physicians' Health Study
		
		● Students must read very carefully. It may be worthwhile to review strategies such as underlining and highlighting key words and phrases.
			Chapter 10 – Just checking p. 270
			
			Chapter 11 – Just checking p. 283, 288
			
			Chapter 12 – Just checking p. 312, 317

Resources: Essential Materials, Supplementary Materials, Links to Best Practices	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings
Textbook, graphing calculator and/or computer software are essential. Real-life studies can be found via the internet. The College Board website apcentral.collegeboard.com contains many practice problems, teaching ideas and guidelines, and links to best practices for teaching statistics.	At the end of each chapter in the textbook is the "What Can Go Wrong?" section. This is a list of common mistakes that students make and is very helpful to both the teacher and student. Students must be trained to become critical readers. Individual accommodations will be made based on student's Individualized Education Plan or 504 Plan

Unit Title: Unit 4: Chapters 13-16 - Randomness and Probability

Essential Questions: How are probabilities calculated? How does a tree diagram help compute conditional probabilities? How does a Venn diagram help compute probabilities involving non-disjoint events? What is an expected value? How can we determine if events follow a binomial model, and how do we describe the model and compute probabilities using it?

Unit Assessment: Teacher-generated assessments will be used, including traditional tests/quizzes, projects and/or presentations. The "Just Checking" problems within each chapter and the chapter review problems can be used as formative assessments.

Core Content Objectives		Instructional Actions	
Concepts	**Skills**	**Activities/Strategies**	**Assessment Check Points**
1) Vocabulary including • Probability • Event • Independent events • Law of large numbers • Complement rule • Disjoint events • Addition rule • Multiplication rule • Sample space • Conditional probability • Tree diagram • Discrete and continuous random variables	1) Apply the Law of Large Numbers 2) Apply the addition and multiplication rules for probability 3) Compute conditional probabilities 4) Use Venn diagrams to compute probabilities 5) Numerically prove events independent 6) Compute binomial and geometric probabilities 7) Simulate random behavior and compute probabilities using simulation 8) Compute the mean (expected value) and standard deviation of a random variable 9) Compute the mean (expected value) and standard deviation of a linear transformation of a random variable	• Simulation is a very effective tool in discovering patterns and probabilities • Students should be able to compute binomial probabilities using the binompdf and binomcdf functions on the graphing calculator • Use Advanced Placement free response questions as practice	Chapter 13 – Just checking p. 346, 353 Chapter 14 – Just checking p. 364,371, 376 Chapter 15 – Just checking p. 391, 398 Chapter 16 – Just checking p. 413, 421, 424

Unit Title: Unit 4: Chapters 13-16 - Randomness and Probability (continued)

Core Content Objectives		Instructional Actions	
Concepts	**Skills**	**Activities/Strategies**	**Assessment Check Points**

1) Vocabulary (continued)
   ● Probability models
   ● Expected value
   ● Variance
   ● Standard deviation
   ● Bernoulli trials
   ● Geometric probability model
   ● Binomial probability model
   ● Success/failure condition
2) The implications of the Law of Large Numbers
3) Find the probability that an event OR another event happen
4) Find the probability that an event AND another event happen
5) Apply the rules associated with conditional probabilities
6) The difference between mutually exclusive and independent events
		● Do not emphasize complicated probability questions
		● It is not necessary for the students to know the standard deviation of the distribution generated by adding or subtracting random variables (in Ch 16)
		● "Against All Odds: Inside Statistics" video modules #13 & 18-21	

Unit Title: Unit 4: Chapters 13-16 - Randomness and Probability (continued)

Core Content Objectives		Instructional Actions	
Concepts	**Skills**	**Activities/Strategies**	**Assessment Check Points**
7) How the mean, variance and standard deviation of a random variable are affected by a linear transformation 8) Know when to use the geometric and binomial models to compute probabilities			

Resources: Essential Materials, Supplementary Materials, Links to Best Practices	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings
Textbook, graphing calculator and/or computer software are essential. The College Board website apcentral.collegeboard.com contains many practice problems, teaching ideas and guidelines, and links to best practices for teaching statistics.	At the end of each chapter in the textbook is the "What Can Go Wrong?" section. This is a list of common mistakes that students make and is very helpful to both the teacher and student. There is no need to teach students advanced probability concepts. Individual accommodations will be made based on student's Individualized Education Plan or 504 Plan

Unit Title: Unit 5: Chapters 17-21 - From the Data at Hand to the World at Large (Inference with Proportion)

Essential Questions: What is a sampling distribution, and why is it important in the study of statistics? Why is the Central Limit Theorem important in the study of statistics? How can we learn about a population proportion of interest from only a sample of data? How do we judge whether or not a sample proportion is unusual? What are the consequences of drawing the wrong conclusion when performing a significance test, and how can we decrease our chances of making errors?

Unit Assessment: Teacher-generated assessments will be used, including traditional tests/quizzes, projects and/or presentations. The "Just Checking" problems within each chapter and the chapter review problems can be used as formative assessments.

Core Content Objectives		Instructional Actions	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies**	**Assessment Check Points**

1) Vocabulary including
  ● Sampling distribution model for a proportion and for a mean
  ● Central Limit Theorem
  ● Standard error
  ● Confidence interval
  ● Margin of error
  ● Critical value
  ● Null hypothesis
  ● One- and two-sided alternative hypotheses
  ● P-value
  ● One-proportion z-test
  ● Statistically significant
	1) Describe and use a sampling distribution of sample proportions and the difference between two independent sample proportions
	  a) Mean
	  b) Standard deviation
	  c) Compute probabilities using the normal model
	2) Compute and interpret a large sample confidence interval for a proportion
	  a) Meaning of interval in context
	  b) Meaning of confidence level
	  c) Compute and interpret margin of error
		● Generating sampling distributions through simulation may help students better understand and visualize the concept of the Central Limit Thm
		● Emphasize that null and alternative hypotheses are always written in terms of the population parameter, not the sample statistic
		● A sketch of the sampling distribution with the P-value shaded (done on calculator) will help students understand the meaning of the P-value
			Chapter 17 – Just checking p. 449, 460
			
			Chapter 18 – Just checking p. 474, 478
			
			Chapter 19 – Just checking p. 497, 506
			
			Chapter 20 – Just checking p. 526, 534
			
			Chapter 21 – Just checking p. 550, 555

Unit Title: Unit 5: Chapters 17-21 - From the Data at Hand to the World at Large (continued)

Core Content Objectives		Instructional Actions	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies**	**Assessment Check Points**

1) Vocabulary (continued)
• Type I error
• Type II error
• Power
 	
2) When the number of trials is sufficiently large, proportions and means found in different samples vary according to an approximately Normal model
3) The variability of sample statistics decreases as sample size increases
4) Statistical inference procedures are based on the Central Limit Theorem
5) Confidence intervals use sample statistics to approximate a range of values for the parameter of a population model
6) Higher confidence results in a greater margin of error and smaller sample sizes result in a smaller margin of error
7) Hypothesis tests propose a model for the population, then examine the observed statistics to see if that model is plausible
8) The P-value of a test is the probability that the null model could produce results at least as extreme as those observed in the sample or the experiment just as a result of sampling error
	3) Perform a large sample z-test for a proportion and interpret the results
	  a) Write null and alternative hypotheses
	  b) Compute and interpret the P-value
	  c) Set and interpret an alpha-level (significance level)
	  d) State a conclusion about the parameter based on the P-value or the critical value
	  e) Interpret Type I and II errors, describe the consequence of each error in context, and describe ways to minimize each type of error
	  f) Interpret the power of a test, and describe ways to maximize it in context
	4) Compare the difference in two proportions
	  a) Compute and interpret a large sample z-interval for the difference between two proportions (independent groups)
	  b) Perform a large sample z-test for the difference between two proportions (independent groups) and interpret the results
		• Emphasize that we never "accept the null hypothesis"; we fail to reject the null hypothesis
		• Conditions for generating a confidence interval and performing a significance test should be discussed and students must know that they exist, but it is not necessary to emphasize this concept
		• "Against All Odds: Inside Statistics" video modules #22-25 & 28	

Unit Title: Unit 5: Chapters 17-21 - From the Data at Hand to the World at Large (continued)

Core Content Objectives		Instructional Actions	
Concepts *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies**	**Assessment Check Points**
A low P-value indicates evidence against the null model. If it is sufficiently low, the null hypothesis is rejected 9) An error in rejecting or not rejecting the null hypothesis results in Type I or II errors 10) A large sample size helps increase the power of a significance test			

Resources: Essential Materials, Supplementary Materials, Links to Best Practices	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings
Textbook, graphing calculator and/or computer software are essential. Real-life data can be found via the internet. Real-life studies involving inference for proportions should be analyzed. Many applets exist online that will generate sampling distributions. It is suggested that simulation via manipulatives and random number generators also be used to improve student understanding. The College Board website apcentral.collegeboard.com contains many practice problems, teaching ideas and guidelines, and links to best practices for teaching statistics.	At the end of each chapter in the textbook is the "What Can Go Wrong?" section. This is a list of common mistakes that students make and is very helpful to both the teacher and student. It may be helpful to review the properties of the normal curve. Individual accommodations will be made based on student's Individualized Education Plan or 504 Plan

Unit Title: Unit 6: Chapters 22-24 - Learning about the World (Inference with Mean)

Essential Questions: How can we learn about a population mean of interest from only a sample of data? How do we judge whether or not a sample mean is unusual?

Unit Assessment: Teacher-generated assessments will be used, including traditional tests/quizzes, projects and/or presentations. The "Just Checking" problems within each chapter and the chapter review problems can be used as formative assessments.

Core Content Objectives		Instructional Actions	
Concepts	**Skills**	**Activities/Strategies**	**Assessment Check Points**
1) Vocabulary including • Sampling distribution model for a proportion and for a mean • Student's t • Degrees of freedom • One-sample t-test • Two-sample t-test • One-sample t interval • Two sample t-interval • Pooling • Paired t-test • Paired t-interval	1) Describe and use a sampling distribution of sample means and the difference between two independent sample means a) Mean b) Standard deviation c) Compute probabilities using the normal model and the t-distribution 2) Compute and interpret a large sample confidence interval for a mean a) Meaning of interval in context b) Meaning of confidence level c) Compute and interpret margin of error	• Generating sampling distributions through simulation may help students better understand and visualize the concept of the Central Limit Thm • Emphasize that null and alternative hypotheses are always written in terms of the population parameter, not the sample statistic • A sketch of the sampling distribution with the P-value shaded (done on calculator) will help students understand the meaning of the P-value	Chapter 22 – Just checking p. 583, 592 Chapter 23 – Just checking p. 613, 617 Chapter 24 – Just checking p. 645

Unit Title: Unit 6: Chapters 22-24 - Learning about the World (continued)

Core Content Objectives		Instructional Actions	
Concepts	**Skills**	**Activities/Strategies**	**Assessment Check Points**

2) A confidence interval uses a sample statistic to estimate a range of possible values for a parameter of interest.
 	
3) Hypothesis tests propose a model for the population, then examine the observed statistics to see if that model is plausible
4) Statistical inference for means are based on the Central Limit Theorem, and we use a t-distribution to take into account the uncertainty associated with estimating the unknown standard deviation
5) When analyzing two groups of data, use a two sample t-test when the groups are independent, but use a paired t-test for a matched pairs design
	3) Perform a large sample z or t-test for a mean and interpret the results
	  a) Write null and alternative hypotheses
	  b) Compute and interpret the P-value
	  c) Set and interpret an alpha-level (significance level)
	  d) State a conclusion about the parameter based on the P-value or the critical value
	  e) Interpret Type I and II errors, describe the consequence of each error in context, and describe ways to minimize each type of error
	  f) Interpret the power of a test, and describe ways to maximize it in context
	4) Compare the difference in two means
	  a) Compute and interpret a large sample z or t-interval for the difference between two means
	    i) Independent groups
	    ii) Dependent groups (matched pairs)
	  b) Perform a large sample z or t-test for the difference between two means (independent groups) and interpret the results
	    i) Independent groups
	    iii) Dependent groups (matched pairs)
		● Emphasize that we never "accept the null hypothesis"; we fail to reject the null hypothesis
		● Conditions for generating a confidence interval and performing a significance test should be discussed and students must know that they exist, but it is not necessary to emphasize this concept
		● Make sure that students are able to interpret computer output
		● It is helpful to read some existing studies that compare two means and that use matched pair designs
		● "Against All Odds: Inside Statistics" video modules #26-27	

Unit Title: Unit 6: Chapters 22-24 - Learning about the World (continued)

Resources: Essential Materials, Supplementary Materials, Links to Best Practices	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings
Textbook, graphing calculator and/or computer software are essential. Real-life data can be found via the internet. Real-life studies involving inference for means should be analyzed. Many applets exist that will generate sampling distributions. It is suggested that simulation via manipulatives and random number generators also be used to improve student understanding. The College Board website apcentral.collegeboard.com contains many practice problems, teaching ideas and guidelines, and links to best practices for teaching statistics.	At the end of each chapter in the textbook is the "What Can Go Wrong?" section. This is a list of common mistakes that students make and is very helpful to both the teacher and student. It may be helpful to review the properties of the normal curve. Individual accommodations will be made based on student's Individualized Education Plan or 504 Plan

Unit Title: Unit 7: Chapter 25 - 26 (OPTIONAL for Accelerated/Academic) - Inference When Variables Are Related

Essential Questions: How can we determine if a table of data is generally the same or different from what we would expect by chance? How can we determine if two categorical variables are independent?

Unit Assessment: Teacher-generated assessments will be used, including traditional tests/quizzes, projects and/or presentations. The "Just Checking" problems within each chapter and the chapter review problems can be used as formative assessments.

Core Content Objectives		Instructional Actions	
Concepts	**Skills**	**Activities/Strategies**	**Assessment Check Points**
1) Vocabulary including • Chi-square statistic • Two-way table • Cell • Chi-square test for goodness of fit • Chi-square test for homogeneity • Chi-square test for independence • Expected value 2) Chi-square tests are used with categorical data in a table 3) When to use a Chi-square test for goodness of fit vs. homogeneity/independence	1) Describe and use the Chi-square sampling distribution 2) Perform a Chi-square significance test (goodness of fit, homogeneity of proportions, and independence using one- and two-way tables) and interpret the results a) Write null and alternative hypotheses b) Compute the Chi-square statistic c) Compute and interpret the P-value d) Set and interpret an alpha-level (significance level) e) State a conclusion about the parameter based on the P-value or the critical value	• The null and alternative hypotheses are generally written in words and not symbols • Conditions for the Chi-square tests should be discussed and students must know that they exist, but it is not necessary to emphasize this concept • Let students know that this test is often used in Biology	Chapter 25 – Just checking p. 670, 672, 677, 683, 690 Chapter 26 – Just checking p. 713

Unit Title: Unit 7: Chapter 25 - 26 (OPTIONAL for Accelerated/Academic) - Inference When Variables Are Related (continued)

Core Content Objectives		Instructional Actions	
Concepts	**Skills**	**Activities/Strategies**	**Assessment Check Points**

4) How to read a regression printout
 	
5) How to apply inference to regression models
	3) Perform a regression slope t-test which includes
	   a) checking the necessary conditions
	   b) understanding the residual standard deviation
	   c) calculating the standard error for the slope
	   d) using those calculations to find the test statistic and make correct decision about null hypothesis
	   e)
	4) Construct and interpret a regression slope t-interval which includes
	   a) checking the necessary conditions
	   b) calculating the interval
	   c) interpreting the interval in context of the situation
		● Students will need to be taught how to use the MATRIX function on the graphing calculator
		● "Against All Odds: Inside Statistics" video module #29	

Resources: Essential Materials, Supplementary Materials, Links to Best Practices	**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings
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