Perris Union High School District
Course of Study

A. COURSE INFORMATION

Course Title:
Statistical Reasoning in Sports
❑ New
☒ Revised

Transcript Title/Abbreviation:
(To be assigned by Educational Services)

Transcript Course Code/Number:
(To be assigned by Educational Services)

Subject Area:
❑ Social Science
❑ English
x Mathematics
❑ Laboratory Science
❑ World Languages
❑ Visual or Performing Arts
❑ College Prep Elective
❑ Other

Is this classified as a Career Technical Education course?
❑ Yes
x No

Grade Level
❑ MS
❑ HS
❑ 5
❑ 6
❑ 7
❑ 8
❑ 9
x 10
x 11
x 12

Required for Graduation:
❑ Yes
x No

Meets UC/CSU Requirements?
☒ Yes
❑ No

Was this course *previously approved by UC* for PUHSD?
☒ Yes
❑ No
(Will be verified by Ed Services)

Meets "AP" Requirements?
❑ Yes
✓ No

Submitted by: Amanda Darton
Site: SSC
Date:

Credential Required to teach this course:
Mathematics
To be completed by Human Resources only.
Signature 5/3/17 Date

Meets "Honors" Requirements?
❑ Yes
❑ No

Unit Value/Length of Course:
❑ 0.5 (half year or semester equivalent)
x 1.0 (one year equivalent)
❑ 2.0 (two year equivalent)
❑ Other:

Approvals	Name/Signature	Date
Director of Curriculum & Instruction		5/1/17
Asst. Superintendent of Educational Services		5.4.17
Governing Board		

Prerequisite(s) (REQUIRED):

Algebra 2 is required

Corequisite(s) (REQUIRED):

None

Brief Course Description (REQUIRED):

This course teaches students how to use four-steps of the statistical process in the context of sports: ask questions, collect data, analyze data, and make conclusions. Each chapter will begin with a sports-related statistical question (e.g., Is there a home field advantage in the NFL?) and then students will learn how to collect appropriate data, how to analyze the data, and how to make reasonable conclusions. Although the context of the examples and exercises will be sports related, the primary focus of the class will be to teach students the basic principles of statistical reasoning. Major statistical topics include: analyzing distributions of univariate and bivariate data, both categorical and numerical, using graphs and summary statistics; correlation and least squares regression; using simulations to estimate probability distributions; theoretical probability distributions, including the binomial and normal distributions; rules of probability, including conditional probability and expected value; the logic of hypothesis testing, including stating hypotheses, calculating and interpreting *p*-values, drawing conclusions, and Type I and Type II errors; using confidence intervals to estimate parameters; and proper methods of data collection, including sampling and experimentation. Use of technology, including online applets and the graphing calculator will be prominent in the course. Throughout the course, students will complete investigations that require students to complete the four-step statistical process using athletes of their choice.

B. COURSE CONTENT

Course Purpose (REQUIRED):
What is the purpose of this course? Please provide a brief description of the goals and expected outcomes. Note: More specificity than a simple recitation of the State Standards is needed.

Course goals and major student outcomes

- Students are able to formulate statistical questions and identify statistical claims made by others.
- Students can collect appropriate data to answer statistical questions, including designing experiments and using available data from the internet and other sources.
- Students can use a wide variety of tools to analyze and summarize distributions of data.

- Students understand the role of variability in the data collection process and incorporate this understanding when drawing conclusions about statistical questions.
- Students critically reflect on their own conclusions and conclusions made by others, including the limitations of these conclusions.

Course Outline (REQUIRED):
Detailed description of topics covered. All historical knowledge is expected to be empirically based, give examples. Show examples of how the text is incorporated into the topics covered.

Students will be able to:

- Ask statistical questions and decide which type of data collection procedure is most appropriate in a given situation
- Collect data using online databases in an efficient and effective manner
- Describe the importance of random sampling and the difference between samples and populations
- Design experiments and understand the purpose of control, randomization, replication, and blinding
- Explain how using paired data can provide better results in experiments and observational studies
- Understand when it is appropriate to conclude that changes in one variable cause changes in another variable
- Critically reflect on the limitations of their own conclusions and conclusions made by others
- Summarize distributions of data with appropriate visual displays, including pie charts, bar charts, segmented bar charts, dot plots, histograms, box plots, and time plots
- Calculate and interpret summary statistics for numerical data, including the mean, median, range, quartiles, interquartile range, mean absolute deviation and standard deviation.
- Identify unusual values (outliers) in a distribution and understand their effect on summary statistics
- Compare distributions of numerical data, including comparisons of shape, center and spread.
- Use standardized scores to compare athletic performances measured on different scales
- Summarize the relationship between two quantitative variables, using scatter plots, the correlation coefficient, least squares regression lines, and standard deviation of the residuals, and how these measures are affected by unusual values (outliers)
- Explain the principle of least squares
- Describe the concept of regression to the mean
- Use multiple regression to model the relationship between a response variable and several explanatory variables
- Use residual plots to assess the appropriateness of a model
- Use quadratic and exponential functions to model nonlinear associations between two numerical variables
- Use logistic functions to model the relationship between a numerical explanatory variable and a categorical response variable
- Design and conduct simulations to estimate probability distributions, by hand and with technology
- Describe the law of large numbers and its role in simulation
- Explain the concept of independence
- Use the Normal distribution and binomial distribution to estimate probabilities
- Use basic counting rules, including the fundamental counting principle, permutations, and combinations
- Use probability rules, including the addition, multiplication, and complement rules
- Calculate and interpret conditional probabilities
- Calculate and interpret the expected value of a random variable
- Use conditional probability and expected values to evaluate strategies in sports

- Describe the relationship between statistics and parameters in the context of sports
- Explain the concept of sampling variability in the context of sports and its role in the decision making process
- State hypotheses, including a null and alternative hypothesis, about a single proportion, the difference between two proportions, independence of athletic performances, the difference between two means or medians, the mean difference, the difference between two standard deviations, the correlation coefficient, and the slope of a least squares regression line
- Use hands-on methods and technology to simulate the distribution of a single proportion, the difference between two proportions, the longest streak, the number of streaks, the difference between two means or medians, the mean difference, the difference between two standard deviations, the correlation coefficient, and the slope of a least squares regression line
- Estimate and interpret *p*-values using the results of simulations
- Use *p*-values to make appropriate conclusions about hypotheses
- Describe a Type I and Type II error in the context of a study and how to reduce the probability that they occur
- Calculate and interpret a confidence interval for a single proportion, a single mean (or mean difference), the difference between two proportions, and the difference between two means
- Use confidence intervals to make decisions

Writing Assignments (REQUIRED):
Give examples of the writing assignments and the use of critical analysis within the writing assignments.

- Justification/Explanation of problems
- Individual and Group Investigations contain components of writing to demonstrate understanding of the application

INSTRUCTIONAL MATERIALS (REQUIRED)	
Textbook #1	
Title: Statistical Reasoning in Sports	Edition: 1st
Author: Josh Tabor Christine Franklin	ISBN: 1-4292-7437-9
Publisher: Bedford, Freeman and Worth	Publication Date: 2012
Usage: x Primary Text ❑ Read in entirety or near	
Textbook #2	
Title:	Edition:
Author:	ISBN:
Publisher:	Publication Date:

Usage: ❑ Primary Text ❑ Read in entirety or near	

Supplemental Instructional Materials *Please include online, and open source resources if any.*

Estimated costs for classroom materials and supplies (REQUIRED). *Please describe in detail.* If more space is needed than what is provided, please attach backup as applicable.	
Cost for class set of textbooks: $ 3626	Description of Additional Costs: All teacher resources are free
Additional costs:$ 0	
Total cost per class set of instructional materials:	$ 3626

Key Assignments (REQUIRED):
Please provide a detailed description of the Key Assignments including tests, and quizzes, which should incorporate not only short answers but essay questions also. How do assignments incorporate topics? Include all major assessments that students will be required to complete
• Tests (one per chapter—15 total) • Individual and Group Investigations (one per chapter—15 total) • Comprehensive final exam (one per semester)
Instructional Methods and/or Strategies (REQUIRED):
Please list specific instructional methods that will be use.
The organization of the content in this course is very different from a traditional statistics course. Instead of taking the first half of the course to build the skills needed to do inference, we will complete the four step statistical process in each chapter. Beginning with the first chapter, we will learn how to ask a statistical question, learn how to collect the appropriate data, learn the skills needed to analyze the data and draw conclusions from the data. In subsequent chapters we will repeat this process, each time with a new focus or type of data. To make it possible to do inference early in the course, we will be using randomization tests rather than tests using approximations based on a normal model. Although this technique is relatively new in an introductory level statistics course, it is extremely powerful because of its versatility and ability to be easily understood by students while still being theoretically correct. It also enables students to understand the reasoning of hypothesis testing rather than having students memorize a set of algorithms and formulas. For each new type of test, we will begin with hands-on simulations and then follow with technology.

Students will also spend time during each chapter working on projects where they collect data through experimentation or online research. Frequently allowing the students the opportunity to investigate statistical questions of their own choosing will make the material more relevant to the students and also more likely to be remembered.

Finally, technology will play a big part in this day-to-day instruction. Not only will students be using graphing calculators to create graphs and calculate summary statistics, they will be using online applets to run simulations and spend time online doing research and collecting data.

Assessment Methods and/or Tools (REQUIRED):

Please list different methods of assessments that will be used.

- Daily homework
- Daily classwork
- Tests (one per chapter—15 total)
- Individual and Group Investigations (one per chapter—15 total)
- Comprehensive final exam (one per semester)

COURSE PACING GUIDE AND OBJECTIVES (REQUIRED)				
Day(s)	**Objective**	**Standard(s)**	**Chapter(s)**	**Reference**
18	**Exploring Categorical Data** *Did LeBron James Choke in the Playoffs?* · Distinction between categorical and quantitative variables · Displays of categorical data, including bar charts, pie charts, and segmented bar charts · Distinction between parameters and statistics in a sports context · The law of large numbers · The use of simulations, by hand and with technology, to investigate variability in athletic performance · The concept of sampling variability in the context of sports and its role in the decision making process · How to make conclusions based on the results of simulations, including common errors made in conclusions	S-ID 9 S-IC 2 S-IC 6 S-MD 2	1	

	Misleading graphs			
14	**Comparing Two Proportions** *Is There a Home Field Advantage in the NFL?* · How to state hypotheses, including a null and alternative hypothesis, about the difference between two proportions · How to simulate the distribution of the difference in two proportions · How to estimate and interpret p-values · Using p-values to make conclusions about the difference in two proportions · The vocabulary and principles of experimental design, including explanatory and response variables, treatments, control, and randomization · The concept of confounding and the types of conclusions that can be drawn from various types of studies, including cause-and-effect conclusions	S-MD 2 S-CP 4-5 S-IC 2,3,5,6 S- ID 5, 9	2	
12	**Investigating Independence** *Does the Hot Hand Exist in Sports?* · The concept of independence in sports · Stating hypotheses about independence · Using different test statistics to measure the hot hand, including simulating the distribution of the test statistics, by hand and with technology · Statistical significance and significance levels · Type I and Type II errors, and how to avoid them	S-MD S-CP 4, 5, 6 S-IC 2 and 6 S- ID 5 and 9	3	
10	**Exploring Numerical Data** *Does the Designated Hitter Increase Offense in Major League Baseball?* · Displays of numerical variables, including dot plots, histograms, and boxplots · Describing the shape of a distribution · Measuring the center of a distributions using the mean and the median	S-IC 2 and 6 S- ID 1-3,9	4	

	· Measuring the spread of a distribution using the range and the interquartile range Outliers, how they can be identified, and how they affect measures of center and measures of spread			
8	**Comparing Two Means or Two Medians** *Does the Designated Hitter Increase Offense in Major League Baseball?* · Stating hypotheses about the difference between two means or two medians · Simulating the distribution of the difference in two means or two medians, by hand and using technology Additional concepts in experimental design, including blindness and replication	S-MD 6 S-IC 2, 3, 5, 6 S- ID 1-3, 9	5	
12	**Exploring Paired Data** *Can Polyurethane Suits Make You Swim Faster?* · Using paired data to control a source of variability in experiments and observational studies · The distinction between paired data and unpaired data · Analyzing paired data using the difference in each pair and the mean difference · Stating hypotheses about the mean difference Simulating the distribution of the mean difference, by hand and using technology	S-ID 1, 9 S-IC 2, 3, 5 and 6 S-MD 6	6	
12	**Exploring Measures of Variability** *Which 7-Iron is More Consistent?* · Using the mean absolute deviation as a measure of consistency/variability · Using the standard deviation as a measure of consistency/variability · The influence of outliers on the mean absolute deviation and standard deviation · Stating hypotheses about the difference of two standard deviations, including the	S-MD 6 S-IC 2, 3, 5, 6 S-MD 1-3, 9	7	

	distinction between an athlete's true standard deviation and the athlete's observed standard deviation Simulating the distribution of the difference in two standard deviations, by hand and with technology			
10	**Standardized Scores and Normal Distributions** *Which Players Should I Draft for My Fantasy League Team?* · Calculating, interpreting and using standardized scores to compare athletic performances from different eras or measured with different units · Using the 68-95-99.7 rule for approximately Normal distributions · Using the Normal distribution to model athletic performance Using the Normal distribution to estimate probabilities and percentiles	S-ID 4, 9 S-IC 2, 6	8	
12	**Estimating Ability with Confidence Intervals** *What is LeBron's True Ability?* · The logic of confidence intervals, including interpretations of confidence intervals and confidence levels · Using confidence intervals to make decisions · Calculating a confidence interval for a single proportion · Calculating a confidence interval for a single mean or mean difference · Calculating a confidence interval for the difference between two proportions Calculating a confidence interval for the difference between two means	S-ID 1, 6 and 9 S-IC 2 - 6 S-MD 9	9	
14	**Exploring Relationships Between Numerical Variables** *Teeing Off: Hit it Long or Hit is Straight?* · Using scatterplots to display the relationship between two quantitative	S-MD 6 S-IC 2 and 6 S-ID 6, 8 and 9	10	

	variables · Describing associations in scatterplots using the characteristics of direction, form, and strength · Using the correlation coefficient to measure the strength of a linear relationship · Properties of the correlation coefficient, including how outliers influence the correlation coefficient · Stating hypotheses about the correlation coefficient, including the distinction between the true correlation and the observed correlation · Simulating the distribution of the correlation coefficient Using time plots and moving averages to display athletic performances over time			
20	**Using Relationships to Make Predictions** *How Can We Build a Better Baseball Team?* · Using equations to make predictions · Calculating and interpreting residuals · The concept of least squares · Calculating and using least-squares regression lines · Interpreting the slope of a least-squares regression line · Calculating and interpreting the standard deviation of the residuals · How outliers influence the equation of a least squares regression line and the standard deviation of the residuals · Stating hypotheses about the slope of a least-squares regression line, including the distinction between the true slope and the observed slope · Simulating the distribution of the slope of a least-squares regression line Regression to the mean	S-MD 6 S-IC 2 and 6 S-ID 6, 7 and 9	11	
10	**Multiple Regression** *Hit it Long or Hit it Straight? Why Not Both?* · The concept of multiple regression	S-ID 6, 7 and 9 S-IC 6	12	

	· Using multiple regression models to make predictions · Using indicator variables in multiple regression models · Calculating and interpreting the standard deviation of the residuals Variable selection			
14	**Nonlinear Relationships** *Will She Make the Shot?* · Using residual plots to assess the appropriateness of a model and to choose between models · Using quadratic models · Calculating and interpreting the vertex of the graph of a quadratic model · Using exponential models · Interpreting the base and coefficient in an exponential model Using logistic models to predict the outcome of a categorical variable	S-IC 6 S-ID 6, 7 and 9	13	
10	**Exploring Counting Rules and Probability** *How Crazy Was Billy Martin?* · Basic counting rules, including the fundamental counting principle, permutations, and combinations · Random sampling and the distinction between samples and populations · The idea of probability, including sample spaces and events · Basic probability rules and when they are appropriate to use, including the addition, multiplication, and complement rules The binomial distribution, including the mean (expected value) of a binomial random variable	S-MD 2, 3, 6 S-CP 1, 2, 9 S-IC 1, 3, 6	14	
12	**Conditional Probability, Expected Value, and Strategy in Sports** *Should You Go For It on Fourth Down?*	S-MD 1-7 S-CP 3 - 8 S-IC 6	15	

	· Two-way tables and the general addition rule · Conditional probability and independence · Tree diagrams and the general multiplication rule · Random variables and probability distributions · Expected values and their interpretations Using conditional probabilities and expected values to evaluate strategies in sports	S- ID 5		

C. HONORS COURSES ONLY
Indicate how much this honors course is different from the standard course.

D. BACKGROUND INFORMATION
Context for course (optional)
History of Course Development (optional)