SANTA ROSA CITY SCHOOLS
Excellence is our Common Ground

Santa Rosa City Schools Course Proposal:

Statistics for Social Justice

Proposal Submitted By:

Needs Statement: Discuss how this course fits into your Site and/or the District's goals. Attach minutes of meetings where this course was approved at site or district leadership meetings.

This course serves as an option for students to meet the graduation requirement of three years of math. This course also meets the Theory of Action and Mission and Vision in that the course content address issues of equity, social justice and cultural relevancy.

Graduation Requirements: Specify which requirement is met.(High School only)

Math

UC a-g Requirements: Specify which requirement is met. (High School only)

C: math

Explain the rationale for course addition or modification. How does this fit in with district/site goals. Is this course is replacing a current course, which course is it replacing and why? Will this course require new sections? Be explicit.

This is an additional course option for the third year of math.

Explain the measurable learning outcomes

The purpose of the course Statistics for Social Justice is to expose students to social issues through a mathematical lens. Students will be empowered to actively engage in the exploration of real data, use it to plan and conduct studies, and to anticipate patterns in the social context. Students will describe and interpret authentic data patterns, and deviation from those patterns using graphical and numerical representations of their social context. They will collect data according to well-developed plans if valid information on a conjecture is to be obtained. These plans will include clarifying the question and deciding upon a method of data collection and analysis. Students will be exposed to probability and simulation techniques to explore random phenomena and anticipate data distribution under a given model. Students will also learn how to

estimate population parameters and testing hypotheses using appropriate tools. They will use all the statistical analysis learned in the course to analyze society and become critical about the injustices that certain individuals or groups face in their everyday. Mathematics will be a powerful tool, which allows them to visualize and examine these injustices, but they will also explore the complexities of histories that are erased when data is simplified into numbers. The goal of the course is to encourage students to reimagine their future and take actions that move towards social change.

Course Description (To be used in the course catalog)

The purpose of the course Statistics for Social Justice is to expose students to social issues through a mathematical lens. Students will be empowered to actively engage in the exploration of real data, use it to plan and conduct studies, and to anticipate patterns in the social context. Students will use all the statistical analysis learned in the course to analyze society and become critical about the injustices that certain individuals or groups face in their everyday.

Detailed Course Design

(Course design should include the objectives, activities, assessments, and standards to be addressed in this course.)

Daily and Key Assignments:

Unit 1: Data Representation and the Census

Overview:

Students will begin exploring and understanding data through the study of descriptive statistics. Students will learn to collect, properly display, analyze, and describe data. Visualizing information in the form of graphical representations such as: dot plots, scatterplots, stem-and-leaf plots, histograms, bar graphs, circle graphs, and two-way tables. They will discover the different types of data and variables. They will examine the mean and median of each data and connect it to the IQR and standard deviation to decide which is most appropriate considering the shape and outliers of the distribution. They will calculate z-score, use percentiles and find linear correlations between data.

Students will connect all the statistical analysis that they learned to social issues about Race, Ethnicity, and Gender that arise from the census. They will also learn to complete and use the census as a form to gather information about the population in our classroom to analyze and visualize the data. In addition, they will examine and discuss the implications for society to categorize individuals in these ways. They will look at the development of the census to show the complexity of their history. They will then develop an understanding of how the census is a form of data representation, but simplifies our societal context. The fluidity of the census over the years shows that the categories of race and ethnicity are social constructs, which drives many aspects of our lives.

Essential Question:

How can data representation be used to describe and analyze patterns?

Objectives:

Students will:

1. represent data in different forms.
2. display data using the central tendency and 5 point summary.
3. find the IQR and standard deviation.
4. learn to calculate z-score, use percentiles and find linear correlations between data.

Unit Assignment(s)

Census Data Comparisons

Students will analyze the most current census to gather data about the class. You will focus on three related set to compare the data in the form of box plots or histograms, central tendency, 5 point summary, IQR, standard deviation, z-score, and linear correlations. Make a full analysis in terms of tendency, variation, shape and extremes. Finally, discuss how your project's conclusion can be useful in analyzing the evolution of different census questionnaire and how it relates to the construction of race and ethnicity in the U.S.

Unit 2: Two Variable Quantitative Data and Women

Overview:

Students will explore relationships between variables through the use of scatterplots, association, and correlation. They will learn to describe associations between two quantitative variables from a scatterplots. They will find the line of best fit and interpret the slope and *y*-intercept of the model in each context. Students will also explore the limitations of their models and use residuals to create the least squares regression line. They will apply the regression line to predict y for a given x and recognize the implications of extrapolation. Students will learn to describe the association between two quantitative variables—the form, direction, strength, and outliers. They will calculate and graph residuals, find the correlation coefficient, coefficient of determination, and interpret these quantities in the context of the situation. Students will understand why association is not the same as causation.

Students will connect what they learned about examining two variable relationships to issues that affect women in our society. To this day there continues to be a double standard in regards to women in many aspects of their lives. Although there have been advances towards gender equality, society has different expectations for men and women. Students will develop an understanding about the struggles women are faced with by analyzing data about women in education, workforce, economy, and their role at home. It is important to analyze the history about women and the influence society has on the actions they take.

Essential Question:

How can you describe the relationship between two variables and use it to make predictions?

Objectives:

Students will:

1. Make scatterplots to display the relationship between two quantitative variables.
2. Recognize positive or negative associations in linear patterns.
3. Explain the slope and y-intercept of a regression line.
4. Recognize outliers and unusual patterns.

Unit Assignment(s):

Hiring Practices Project

Students will gather data of certain hiring practices that represent qualified male and female workers to be hired. Then use their understanding about associations and correlations to determine if there were prejudicial hiring practices between men and women.

Unit 3: Multivariable Categorical Data and Health

Overview:

Students will explore probability in the context of multivariable categorical data. They will extend what they learned about statistical association and use it to represent two-way frequency tables – Association and conditional. Students will learn to calculate the probability of different situations, using the correct notation, to analyze specific outcomes. Although systems can be highly accurate in detecting rare events, students need to be able to analyze false positives. They will decide whether social cost of false positives is greater than the benefits of true positive results. Students will use probability tree diagrams as a tool for solving and conceptualizing situations involving more than two categorical variables and make comparisons between them. Students will then learn how to problem solve with categorical data and use simulation probabilities**.**

Students will connect what they learned about probability to issues about Health. They will look at systems about HIV testing and other drug tests to analyze false positives. Students will measure the risks of developing diabetes, high blood pressure, high levels of cholesterol, and depression. They will use this information to make different choices about finding other forms of maintaining a healthier lifestyle.

Essential Question:

How are the advantages and disadvantages of categorizing multivariable data?

Objectives:

Students will:

1. Represent two-way frequency tables.
2. Calculate the probability of different outcomes.
3. Analyze false positives.
4. Utilize probability tree diagrams to make comparisons.

Unit Assignment(s):

Frequency Tables for False Narratives

The April 10th issue of the Journal of the American Medical Association reports a study on the effects of anti-depressants. The study involved 340 subjects who were being treated for major depression. The subjects were randomly assigned to receive one of three treatments: St. John's Wort (an herb), Zoloft (Pfizer's) or placebo for an 8-week period. The following are the mean scores (approximately) for the three groups of subjects over eight - week experiment. The first column is the baseline. Lower the scores means less depression.

Placebo	22.5	19.1	17.9	17.1	16.2	15.1	12.1	12.3
Wort	23.0	20.2	18.2	19.0	16.5	16.1	14.2	13.0
Zoloft	22.4	19.2	16.6	15.5	14.2	13.1	11.8	10.5

1. Create a graph to display these means.
2. Calculate the probability of receiving the placebo?
3. Analyze the false positives that can arise from taking any of the anti-depressants?

Unit 4: Studies and Experiments and Racial Profiling
Overview:

Students will explore different survey designs and consider the bias of how the data was gathered. Students will discover the importance of random selection in sampling to produce a sample that is representative of the population. They will apply different methods of sampling and consider the strengths and weakness of each. They will compare and contrast observational studies and experiments to analyze the conclusions for various studies. Students will determine what makes a well-designed experiment. They will discover what is necessary to produce treatment groups that have similar attributes and explore other features of experimental designs.

Students will apply the idea about studies and experiments to issues about racial profiling. They will analyze different data and break it down according to race. Students will be exposed to studies about the "stop and frisk" policy, the likelihood of someone going to prison, and different court sentencing for similar crimes. Based on this analysis students will examine our criminal justice system and its implications to our society.

Essential Question:

How do we analyze surveys, studies, and experiments to judge the validity of the conclusion?

Objectives:

Students will:

1. Recognize bias from inferior sampling methods.
2. Select a simple random sample (SRS) from a population.
3. Determine whether a study is observational study or experiment.
4. Recognize bias due to confounding of explanatory variables and with lurking variables with either an observational study or experiment.

Unit Assignment(s):
Random Experimentation

1. Students will conduct an experiment to find the probability of randomly choosing 100 different colored marbles.
2. They will then look up the demographics of the New York City that is represented by the data they gather by race.
3. Then they will analyze a case study about an analysis of the "Stop and Frisk" policy in the claims of racial bias.
4. Finally, they will determine the validity of the case study and make a conclusion about their hypothesis.

Unit 5: "Normal" Distribution and the Wealth in the US
Overview:

Students will explore different types of density functions and create a bell-shaped mathematical model of data called normal probability density function. Students will examine similarities and differences between a relative frequency histogram as a way to represent a sample, and the normal distribution model for the population represented. Students will learn that every normal density function has an inverse. They will use the inverse normal functions to convert probabilities

and percentiles into values of a random variable, and then discuss the standard normal distribution and z-scores.

Students will connect what they learned about density functions and normal distributions to different issues in society. The wealth disparity in the U.S. is unimaginable and only keeps getting worse because of capitalism, laws and regulations that benefit the rich, and the lack of realistic opportunities for social mobility. Students will be exposed to different forms of oppression that they are faced with which maintain this structural inequality. They will experience the power of visualizing data of these disparities and use it to analyze the reality of everyday life in our society.

Essential Question:

How do I use density functions and normal distributions to analyze data?

Objectives:

Students will:

1. Classify different types of density functions.
2. Create bell-shaped mathematical models.
3. Apply inverse normal functions to convert probabilities and percentiles into values of a random variable.
4. Learn the standard normal distribution and z-scores

Unit Assignment(s):
Normal Distribution Analysis:

Question: A test correctly identifies a disease in 95% of people who have it. It correctly identifies no disease in 94% of people who do not have it. In the population, 3% of the people have the disease. What is the probability that you have the disease if you tested positive? Students will analyze the question and provide a statistical analysis to prove their answer correct.

Unit 6: Discrete Probability Distribution and Education

Overview:

Students will explore binomial and geometric distributions. They will learn to calculate the mean and variance of a discrete random variable, and linear combinations of independent random variables. Students will learn the variability of $X - X$ and what is represents. They will develop notions of shape, center, and spread of binomial distributions and use a normal approximation to the binomial distribution to compute probabilities. Students will do the following for both binomial and geometric distributions: use technology or formulas to determine probabilities and construct probability distribution tables and histograms, calculate cumulative distribution functions, and formulate expected values and standard deviation.

Students will connect the ideas about probability distribution to issues around our education system. They will evaluate data about the issues surrounding educational attainment in relation to mathematics. It has become increasingly critical to provide students with accessibility to higher levels of mathematics because it has become an issue of their civil rights. In addition, students will examine data about policies that reinforce the school to prison pipeline. Students will assess educational policies and beliefs to reimagine a system that will be more egalitarian.

Essential Question:

How can you compare probability distributions for discrete and random variables?

Objectives:

Students will:

1. calculate the mean, variance, and variability of $X -$
2. use technology or formulas to determine probabilities and construct probability distribution

tables and histograms.
3. calculate cumulative distribution functions.
4. formulate expected values and standard deviation.
5. use a normal approximation to the binomial distribution to compute probabilities.

Unit Assignment(s):
Distributions Functions

A company produces cases for a phone that is 5.8 inches tall. The case is designed to have a snug fit. The engineers designed the height of the case to be normally distributed with a mean of 5.85 inches and a standard deviation of 0.017 inches. Let X be a random variable representing the height of a randomly chosen case.

1. Is X continuous or discrete? Explain.
2. Find $P(X < 5.8)$.
3. In a shipment of 1000 phones, let Y represent the number of cases that are smaller than 5.8 inches in height. Is Y continuous or discrete? Explain.
4. In the shipment of 1000 phones, find the probability that $Y = 2$. Assume that the heights are all independent.

Unit 7: Data Sampling and Stereotypes
Overview:

Students will explore a statistical analysis technique used to select, manipulate, and analyze a representative subset of points to identify patterns. They will develop an idea of sampling distributions, confidence intervals, and compare proportions within the samples. Students will use simulation to estimate a sampling distribution of a sample proportion, and recognize that this creates a reasonable estimate of the variability of the true sampling distribution. The binomial distribution is revisited to derive the formulas and conditions for the normal approximation for the sampling distribution for a sample proportion; this is the root of proportion confidence intervals and tests.

Students will apply the idea about data sampling to common stereotypical ideologies about certain ethnic groups. Students will use data to compare different groups to each other, while looking at the complexities between certain samples. Students will be critical about stereotypes that exist which seem to be good. For example, the “Model Minority” is an idea that can be used against other ethnic groups. This issue around immigration and the comparison of Asians to Latinos is unreasonable because it ignores circumstances that contribute to educational attainment. Statistics can create false comparisons of data to compare groups, because it oversimplifies and erases the history of other contributing factors. Data can be manipulated to show strong correlations that develop certain stereotypes about certain groups and students need to be conscious and critical about this.

Essential Question:

What is important to consider about selecting a sample so that it isn’t biased?

Objectives:

Students will:

1. Identify parameters and statistics in a sample or experiment.
2. Develop an understanding about sampling distributions and confidence intervals.
3. Compare proportions within samples.
4. Recognize when a problems involves a sample proportion

Unit Assignment(s):
Sampling Analysis

You have been hired by the National Election Commission to examine how the American people

feel about the fairness of the voting procedures in the U.S. Who will you ask?

Barack Obama received 51% of all votes in the U.S. Presidential election of 2012. One county in Indiana likes to brag that it voted “exactly like the country”—which implies a claim that their proportion of votes for Obama should also have been 51%. Kiran is interested in testing this claim.

1. Write the county’s claim in symbols and define them.
2. Explain why the appropriate hypotheses for this test are H0: $p = 0.51$ and HA: $p \neq 51$.
3. Kiran performed a random sample of voters from the county and found that 308 of the 652 sampled voted for President Obama. The county has around 12,000 residents. Check that all the conditions for the normal approximation to the sampling distribution are met, assuming the null hypothesis is true.
4. What evidence does Kiran have for the alternative hypothesis (use symbols)?
5. Calculate the standard deviation of the sampling distribution assuming the null hypothesis is true. Then calculate the test statistic (z-score of the sample). Sketch the standard normal curve and shade the entire region that represents statistics as or more extreme than the one calculated, based on the new alternative hypothesis. (Hint: remember this is called a two-tailed test.)
6. Use a calculator to calculate the area of the shaded region (the *p*-value). You can use the symmetry of the situation to help.
7. Conclude: at $\alpha = 0.05$, does Kiran have sufficient evidence to reject the county’s claim?

Unit 8: Chi-Squared and Social Justice
Overview:

Students explore the chi-squared inference procedures because it is a method that compares two or more groups. Students realize that it is better to have a single procedure that summarizes the difference across multiple samples to compare them. They learn the chi-squared goodness of fit test and have an opportunity to practice applying the procedure in multiple contexts. Students extend their use of chi-squared procedures to tests of independence and see if there is an association between the variables. The same procedure will be applied to a setting where multiple samples have been gathered, and the question of homogeneity of proportions is considered.

Students will connect the chi-squared inference procedures to any issue in relation to social justice. They will be able to analyze different aspects about society through the lens of race, class, and gender to their life. They will apply the mathematical skills that they have acquired throughout the course to an issue that they are passionate about. More specifically they will gather data, apply different statistical analysis to contemplate and envision how mathematics can serve as a tool to be used for social justice.

Essential Question:

How do we use the chi-squared distribution to construct a confidence interval and how are they used in statistics?

Objectives:

Students will:

1. Calculate goodness of fit test.
2. Distinguish between tests of homogeneity and populations and tests of association.
3. Perform chi-squared test.
4. Interpret chi-squared test.

Unit Assignment(s):
Chi-Squared Test

Zach is doing an experiment on whether or not playing different modes of a video game can raise your blood pressure. He randomly assigns 120 students from his school to two treatments. 60 students will play Call of Battle: Limit to Infinite in the online mode, while the other 60 will play

offline. He then measures their blood pressure after 20 minutes of playing. Zach found that 42 of the online players raised their systolic figure to over 131, while 34 of the offline players had a systolic figure over 131.

A test of significance ($\alpha = 0.05$) was conducted on the following hypotheses: the percent of high blood pressure players is the same for both treatments (H0), and a larger percentage of people playing the game online will have high blood pressure (HA).

This test resulted in a *p*-value of 0.0648.

1. Interpret the results of the test. Specifically, interpret the *p*-value and what conclusions can be drawn from this experiment.
2. Based on your explanation from part (a), what type of error (Type I or Type II) could have been made? Clearly explain this error in the context of the problem

Budget- budget figures must be included even if they are an estimate.

Projected Costs	Start-up	Ongoing
Personnel (Not to include classroom instructor unless a new section is needed)		
Instructional Material Supplies per student (textbooks, software, etc.)	50,000	
Services (training, equipment maintenance, contracts, etc.)	6,000	
Capital Outlay (remodeling, technology, etc.)		
Total Projected Costs	56,000	

Instructional Materials- must include estimate for new materials even if none have been selected. Place in chart above.

Type	Publisher	Title	ISBN	Author	Copyright	# Have/Need
textbook	CPM	Statistics		various	2015	500 needed

Funding Source(s) for Costs and Instructional Materials

Grants (indicate specific grant and grant timeline)	

Categorical Funds (include related programs)	
Career Technical Education (must be for an approved CTE course)	
Department Funds	
Other (be specific)	

Appendix of Additional Documents

**** Required additional documents include meeting minutes where the course was discussed and approved***

District Principal Review and Approvals:

Principal's Signatures	**Site**	**Approved / Not Approved**

District Department Chair Review and Approvals:

Department Chair Signatures	**Site**	**Approved / Not Approved**
