TAMALPAIS UNION HIGH SCHOOL DISTRICT
Larkspur, California

Course of Study

Statistics 1/2

Overview:	
Course Author(s): Jen Noland and Karen Gladysz	Course taught at Redwood, Drake, Tamalpais, and Tamiscal
Length of Course: one-year	Subject Area and Discipline: Mathematics
Grade Levels: Junior and Senior	Is this course an integrated course? No
Is this course being submitted for possible UC honors designation? No	Are you seeking UC approval? If so, in what area (A-G)? C
Prerequisites (required): Completion of Advanced Algebra 1/2 or Intermediate Algebra 1/2	Co-requisites (required or recommended): None
Check all that apply: X UC A-G course ❑ Graduation Requirement X Elective ❑ Honors/AP ❑ ROP	

Introduction

Course Overview: The purpose of the Statistics 1-2 course is to introduce students to the methods of collecting, organizing, displaying, analyzing, and draw conclusions from data. It is a course set in a broad, relevant, social context, with an emphasis on statistical ideas, expressed in a variety of settings from public policy questions to the behavioral sciences to sociology and psychology. Although mathematical methodology is used, taught and valued, it is a course that emphasizes understanding data and the principles of drawing justifiable inferences from data. Anticipating patterns using probability and simulation are included in this course.

Stage 1 Desired Results

Unit Title: Displaying Data

ESTABLISHED LEARNING GOALS

Interpreting Categorical and Quantitative Data
Summarize, represent, and interpret data on a single count or measurement variable.
Summarize, represent, and interpret data on two categorical and quantitative variables. Interpret linear models.

Transfer

Students will be able to independently use their learning to…

- Select an appropriate display and organize data using a number of different methods, including but not limited to: stem-and-leaf displays, box-and-whisker plots, frequency tables, histograms, standard line and bar graphs, and scatterplots.

Meaning Making

UNDERSTANDINGS	ESSENTIAL QUESTIONS
Students will understand that… Categorical data and quantitative data require specific types of graphical representations.	What graphical representation is best used to display a particular data set?

Acquisition

Students will know…	*Students will be skilled at…*
How to create and analyze the various types of graphs and interpret the results.	Creating these graphs with precision on paper, and using various types of graphical technology.

5-10 sentence summary of key learning in this unit.

1) Students will be able to create data displays for both Categorical and Quantitative data sets.
2) Students will be able to choose the most fitting data display given a particular data set.
3) Students will be able to analyze, describe, and compare various graphical representations.
4) Students will be able to determine the shape, center and spread, clusters and gaps, outliers, and other unusual features for a graphical display of data.
5) Students will be able to interpret the correlation of bivariate data and distinguish between correlation and causation.
6) Students will be able to make predictions using regression lines and be able to interpret the slope and y-intercept.

Stage 2 - Evidence

Learning Goals Measured: Interpreting Categorical and Quantitative Data Summarize, represent, and interpret data on a single count or measurement variable. Summarize, represent, and interpret data on two categorical and quantitative variables. Interpret linear models.

Success Criteria (e.g.. Learning progression, rubric, proficiency scale, etc.)

	Conceptual Understanding	Mathematical Skills	Work Habits
1	Shows complete understanding of all graphs to represent any type of data set	Determines correct graphical representation to accurately represent data. Scales and labels axes correctly	All graphs are drawn with precision and systematically. Work is very neat and well organized.
2	Shows nearly complete understanding of graphs to represent any type of data set	Mostly determines correct graphical representation to accurately represent data. Scales and labels axes correctly	Most graphs are drawn with precision and systematically. Work is neat and organized.
3	Shows some understanding of graphs to represent any type of data set	Sometimes determines correct graphical representation to accurately represent data. Scales and labels axes correctly	Graphs are drawn with less precision. Work is not very neat or organized.
4	Shows little understanding of graphs to represent any type of data set	Does not determine correct graphical representation to accurately represent data. Scales and labels axes correctly	Little to no work towards progress of the problem. Work is sloppy and disorganized.

Sample Assessment

1. Sketch the scatter-plot and describe (form, strength, direction, and outliers)

age	height
8	25
14	27
19	29
22	32
26	34

2. Since the scatterplot shows a linear form, calculate the LSRL and graph
3. State and interpret the correlation coefficient

4. Find the R^2 value and interpret
5. Interpret the slope in the context of the problem (as an average value)
6. Interpret the y-intercept in the context of the problem
7. If a child is 10 months old, how tall should he be, based on the model? In other words, how tall is an average 10 month old?
8. Would you be willing to predict the height of a 10 year old child with this model? Why or why not?

Stage 3 – Learning Plan

Learning Goals Addressed: Interpreting Categorical and Quantitative Data Summarize, represent, and interpret data on a single count or measurement variable. Summarize, represent, and interpret data on two categorical and quantitative variables. Interpret linear models

Sample Assignment: A brief summary of one assignment that explains what a student produces, how the student completes the assignment, and what the student learns. Make connections to unit learning goals (2-4 sentences).

Students will produce and describe the frequency distribution of phone call durations in the form of a histogram. Students will start by filling out a frequency table. Students will learn the difference between frequency and relative frequency. When they construct the graph they will learn the proper scaling and intervals that would best describe the data. Lastly, students will learn how to read the graphs and describe the shape and any interesting outliers or gaps in the data. Example problem below.

Duration (minutes)	Frequency	Percent
0 – 6		
6 – 12		
12 – 18		
18 – 24		
24 – 30		
30 – 36		
36 – 42		
42 – 48		
48 – 54		

Table 3.5. Frequency distribution table for duration of phone calls.

b. What percentage of phone calls lasted less than 12 minutes?

c. What percentage of calls lasted a half hour or more?

d. Represent the frequency distribution with a histogram. Use a percent scale on the vertical axis.

e. Describe the shape of the distribution. Are there any gaps in the data? Outliers?

	Differentiated Approaches: Include descriptions of how to meet the needs of diverse learners in the context of the sample assignment above (2-3 examples recommended). Sentence frame such as: "the histogram I constructed has these characteristics on the board." Vocabulary key for terms associated with graphing visible to all students. - Provide a pre-made x- and y-axis with the range preset on each axis - Provide technology to create graphs digitally

Stage 1 Desired Results		
Unit Title: Collecting Data		
ESTABLISHED LEARNING GOALS Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each	***Transfer***	
	Students will be able to independently use their learning to use appropriate techniques to collect data for observational studies and experiments.	
	Meaning Making	
	UNDERSTANDINGS Students will understand that data from a sample can be used to represent a population given that the data collected using appropriate methodologies.	ESSENTIAL QUESTIONS How can we collect data so that the result is a true representation of the population being studied?
	Acquisition	
	Students will know how to determine the characteristics and differences of a well designed: census, sample survey, experiment, and observational study.	Students will be skilled at determining which method of data collection would be appropriate and use that method to plan and conduct their data collection.

5-10 sentence summary of key learning in this unit.

1) Students will be able to conduct and distinguish between different types of sampling methods; such as, SRS, stratified, convenience, voluntary response, blah, blah, blah….
2) Students will know how to design an observational study to avoid bias.
3) Students will know the sampling errors that cause bias and specific methods to prevent bias.
4) Students will be able to design a randomized experiment that prevents confounding.
5) Students will know how to utilize placebos and blinding in the design of an experiment.

Stage 2 - Evidence

Learning Goals Measured: Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each

Success Criteria (e.g.. Learning progression, rubric, proficiency scale, etc.)

	Conceptual Understanding	Mathematical Skills	Work Habits
1	Shows complete understanding of sampling techniques and biases and correct experimental design	Designs observational studies with little or no bias to fit criteria of the population. Experiments designed with correct controls and randomizations.	Work is very well organized.
2	Shows nearly complete understanding of sampling techniques and biases and correct experimental design	Designs observational studies with some inherent bias that somewhat fits the population. Experiments designed with mostly correct controls and randomizations.	Work is organized.
3	Shows some understanding of sampling techniques and biases and correct experimental design	Designs observational studies with bias to fit criteria of the population. Experiments designed with some correct controls and randomizations.	Work is not very organized.
4	Shows little understanding of sampling techniques and biases and correct experimental design	Designs observational studies with bias that does not fit criteria of the population. Experiments designed without correct controls and ramdomizations.	Work is disorganized.

Sample Assessment

A statistics teacher wants to know how her students feel about an introductory statistics course. She decides to administer a survey to a random sample of students taking the course. She has several sampling plans to choose from. Match the sampling strategy in each.

There are four ranks of students taking the class: freshmen, sophomores, juniors, and seniors. Randomly select 15 students from each class rank.

Randomly select a class rank (freshmen, sophomores, juniors, and seniors) and survey every student in that class rank.

1. SRS (simple random sample)
2. stratified sample
3. systematic sample
4. cluster sample

Each student has a nine-digit student number. Randomly choose 60 numbers.

Using a class roster, randomly select the first student, and then select every fifth student from the list.

Explain why the plan in problem b might be biased. Be sure to name the kind(s) of bias you describe.

Stage 3 – Learning Plan

Learning Goals Addressed: Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each	**Sample Assignment:** A brief summary of one assignment that explains what a student produces, how the student completes the assignment, and what the student learns. Make connections to unit learning goals. (2-4 sentences). **Scope of Inference Assignment** Students are given 4 cases that represent a similar situation of local dentists determining whether a daily dose of Vitamin C will result in fewer canker sores. For each case, student groups must determine whether each case is an observational study or an experiment, whether the information would result in a cause and effect conclusion or a trend, and what population the conclusion can be made about. Groups need to be able to explain why they made each choice**.**
	Differentiated Approaches: Include descriptions of how to meet the needs of diverse learners in the context of the sample assignment above (2-3 examples recommended). Students are supported by working in groups Vocabulary key/Sentence frame

Stage 1 Desired Results		
Unit Title: Probability		
ESTABLISHED LEARNING GOALS Using Probability to Make Decisions Calculate expected values and use them to solve problems. Use probability to evaluate outcomes of decisions	***Transfer***	
	Students will be able to independently use their learning to… Calculate Probabilities from Randomized Data sets	
	Meaning Making	
	UNDERSTANDINGS *Students will understand that…* it is important to determine if data is independent or dependent, mutually exclusive or inclusive, or conditional, to know the correct methodology necessary to find a probability.	ESSENTIAL QUESTIONS How do we use probability to determine the likelihood of an event and make decisions utilizing the results?
	Acquisition	
	Students will know… how to utilize a frequency table to calculate conditional probabilities.	Students will be skilled at… Using normal models to calculate percentile rankings within a data set.

1) Students will be able to find the probability that an event or another event happens.
2) Students will be able to find the probability that an event and another independent event both happens.
3) Students will be able to use the Laws of Probability to justify their conclusions.
4) Students will be able to calculate conditional probabilities
5) Students will be able to use a normal model to determine z-scores and percentile rankings
6) Students will be able to calculate expected value
7) Students will use simulations to model real world situations

Stage 2 - Evidence

Learning Goals Measured:
Using Probability to Make Decisions
Calculate expected values and use them to solve problems.
Use probability to evaluate outcomes of decisions

Success Criteria (e.g.. Learning progression, rubric, proficiency scale, etc.)

	Conceptual Understanding	Mathematical Skills	Work Habits
1	Shows complete understanding of types of probability and their outcomes	Use the techniques necessary to correctly solve probabilities given data and will be able to justify their conclusions.	All probabilities are written with precision and systematically. Work is very neat and well organized.
2	Shows nearly complete understanding of types of probability and their outcomes	Use most of the techniques necessary to solve probabilities given data and will usually be able to justify their conclusions.	Most probabilities are written with precision and systematically. Work is neat and organized.
3	Shows some understanding of types of probability and their outcomes	Use some of the techniques necessary to solve probabilities given data and may not be able to justify their conclusions.	Probabilities are written or with less precision. Work is not very neat or organized.
4	Shows little understanding of types of probability and their outcomes	Do not know the techniques necessary to solve probabilities.	Little to no work towards progress of the problem. Work is sloppy and disorganized.

Sample Assessment

It is estimated that 4% of people who spend time in the woods will get Lyme disease. Of people with Lyme disease, the test to determine if you have it will give a positive reading 97% of the time. Of people who do not have Lyme disease, the same test will give a negative rating 92% of the time. Make a tree diagram for this problem and then answer the following questions.

Find the probability that:

a) the person gets a positive reading
b) the person gets a negative reading
c) given the person gets a positive reading,

	d) given the person gets a positive reading they have Lyme disease e) given the person gets a negative reading, they do not have Lyme disease. g) a person does not have Lyme disease, given they test positive.

Stage 3 – Learning Plan	
2.5Learning Goals Addressed: Using Probability to Make Decisions Calculate expected values and use them to solve problems. Use probability to evaluate outcomes of decisions	**Sample Assignment:** A brief summary of one assignment that explains what a student produces, how the student completes the assignment, and what the student learns. Make connections to unit learning goals (2-4 sentences). Students learn the probabilities associated with the California Lotto game Keno. Each group in the class uses data to determine the expected value "their" casino offers for the game Keno. The groups compare their results to find the best expected results for the game. The class discusses casino games in general, the probabilities associated, and the facts regarding how the "house" always wins in the long run. Students learn how to calculate expected values from tables and learn about the probabilities associated with gambling.
	Differentiated Approaches: Include descriptions of how to meet the needs of diverse learners in the context of the sample assignment above (2-3 examples recommended). Vocabulary key for terms associated with probability visible to all students. Examples for students to follow. Students work in differentiated groups

Stage 1 Desired Results	
Unit Title: Inference	
ESTABLISHED LEARNING GOALS Making Inferences and Justifying	***Transfer***
	Students will be able to independently use their learning to… Analyze and draw conclusions from data.

Conclusions Understand and evaluate random processes underlying statistical experiments. Make inferences and justify conclusions from sample surveys, experiments, and observational studies.	***Meaning Making***	
	UNDERSTANDINGS *Students will understand that…* Statisticians need to determine the strength and validity of data before drawing conclusions.	ESSENTIAL QUESTIONS How do we determine if a hypothesis is statistically significant?
	Acquisition	
	Students will know… What types of tests are necessary in consideration of the various types of data presented.	Students will be skilled at… The process of completing confidence intervals and hypothesis tests and drawing reasonable conclusions from their results.

5-10 sentence summary of key learning in this unit.

1) Students will be able to calculate confidence intervals for proportions and means.
2) Students will be able to design and calculate hypothesis tests for proportions, means, and categorical data.
3) Students will be able to determine whether the correct conditions exist to conduct a hypothesis test.
4) Students will be able to draw conclusions from confidence intervals and hypothesis tests

Stage 2 - Evidence

Learning Goals Measured: Making Inferences and Justifying Conclusions Understand and evaluate random processes underlying statistical experiments. Make inferences and justify

Success Criteria (e.g.. Learning progression, rubric, proficiency scale, etc.)

	Conceptual Understanding	Mathematical Skills	Work Habits
1	Shows complete understanding of confidence intervals and hypothesis tests and are able to draw conclusions from their results.	Will correctly calculate confidence intervals for proportions and means and hypothesis tests for proportions, means, and categorical data and correctly analyze their meanings.	All graphs are written or drawn with precision and systematically. Work is very neat and well organized.

conclusions from sample surveys, experiments, and observational studies.

2	Shows nearly complete understanding of confidence intervals and hypothesis tests and may be able to draw conclusions from their results.	Will mostly calculate confidence intervals for proportions and means and hypothesis tests for proportions, means, and categorical data and analyze their meanings.	Most equations and graphs are written or drawn with precision and systematically. Work is neat and organized.
3	Shows some understanding of confidence intervals and hypothesis tests and are unable to draw conclusions from their results.	Will sometimes calculate confidence intervals for proportions and means and hypothesis tests for proportions, means, and categorical data and partially analyze their meanings.	Equations and graphs are written or drawn with less precision. Work is not very neat or organized.
4	Shows little understanding of confidence intervals and hypothesis tests	Will not correctly calculate confidence intervals for proportions and means and hypothesis tests for proportions, means, and categorical data and cannot analyze their meanings.	Little to no work towards progress of the problem. Work is sloppy and disorganized.

Sample Assessment

Write the null and alternative hypotheses you would use to test each of the following situations.

1. A governor is concerned about his "negatives" – the percentage of state residents who express disapproval of his job performance. His political committee pays for a series of TV ads, hoping that they can keep the negatives below 30%. They will use follow-up polling to assess the ads effectiveness.

2. In the 1950's only about 40% of high school graduates went to college. Has the percentage changed?

3. Only about 20% of people who try to quit smoking succeed. Sellers of a motivational tape claim that listening to the recorded messages can help people quit.

	4. In the 1980's it was generally believed that congenital abnormalities affected about 5% of the nation's children. Some people believe that the increase in the number of chemicals in the environment has led to an increase in the incidence of abnormalities. A recent study examined 384 children and found that 46 of them showed signs of abnormality. Is this strong evidence that the risk has increased? a. Write appropriate hypotheses. b. Perform the test and find the p-value. c. State your conclusion. d. Do environmental chemicals cause congenital abnormalities?
Stage 3 – Learning Plan	
Learning Goals Addressed: Making Inferences and Justifying Conclusions Understand and evaluate random processes underlying statistical experiments. Make inferences and justify conclusions from sample surveys, experiments, and observational studies.	**Sample Assignment:** A brief summary of one assignment that explains what a student produces, how the student completes the assignment, and what the student learns. Make connections to unit learning goals (2-4 sentences). Each group of students reads a different article about assumptions made regarding a statistical analysis in society. The group designs an observational study or experiment testing a similar premise to their article. The students then complete the observational study, analyze the data using techniques learned in class and present their findings in a Google slide presentation. Students learn how to design a study and analyze the results. The most learning occurs when they need to discuss how they could have improved their methodology to get more statistically significant results.
	Differentiated Approaches: Include descriptions of how to meet the needs of diverse learners in the context of the sample assignment above (2-3 examples recommended). Vocabulary key for terms associated with graphing visible to all students. Differentiated groups

Instructional Materials:

Textbook:
Statistics and Probability with Applications,
Author: Starnes and Tabor
Publisher: Bedford, Freeman, & Worth
3rd edition

UC (c) Approved
BOT Revision Approved 10/9/18