**MT. DIABLO UNIFIED SCHOOL DISTRICT**
**COURSE OF STUDY**

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| **COURSE TITLE COURSE:** | **Statistics** |
| **COURSE NUMBER:** | **1520** |
| **CALPADS NUMBER:** | **2410** |
| **DEPARTMENT:** | **Mathematics** |
| ~~**NCLB CREDENTIAL**~~ | |
| **REQUIREMENT:** | **Math Credential with Subject Matter Proficiency** |
| **LENGTH OF COURSE:** | **One Year** |
| **CREDITS PER SEMESTER:** | **5** |
| **GRADE LEVEL(S):** | **10-12** |
| **REQUIRED OR ELECTIVE:** | **This course fulfills one year of the high school mathematics requirement and UC/CSU "c" requirement.** |
| **PREREQUISITES:** | **C or better in Algebra II or Algebra II / Trig** |

**BOARD OF EDUCATION ADOPTION:** ~~**June 3, 2013**~~

~~COURSE DESCRIPTION:~~

~~The purpose of the Statistics course is to encourage student awareness of the importance of mathematics in the real world. This course is an introduction to fundamental statistical problem solving and interpretation of data. Students will gather, analyze and interpret data. Students will apply appropriate statistical models to draw conclusions and learn to use technology in solving statistical problems. The course will cover basic statistical concepts that will prepare the student to take a College-level statistics course in the future.~~

## COURSE OVERVIEW

Statistics is an activity and project-based class that will familiarize students with the collection and analysis of current real-world data. Students will learn reliable methods for obtaining sample data from a population, as well as various methods of visual and numerical description of the findings. Measuring the probability of an event, interpreting probability, and using probability in decision making are central themes of the course. Emphasis will be placed on forming original hypotheses, testing them, and then constructing formal written presentations of their methods, results, and conclusions. Students will discover throughout the year how careful critical analysis is essential to gaining statistical proficiency.

Through project-based assignments, students will learn how to apply statistical concepts to better understand their world. Students will make informed mathematical predictions, test hypotheses and use findings to justify conclusions. Mathematical modeling is essential to this course as students apply the

rules of statistics to real-world situations. Students will not only develop a fluency in statistical concepts, they will learn how to use tools such as graphing calculators to manipulate and present statistical data and conclusions.

In addition to the California Common Core State Standards for Mathematics, students will experience and gain fluency with the 8 Standards for Mathematical Practice:

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning

Overall, the quality of a learning environment depends on the extent to which it provides opportunities for students along the following five dimensions:

1. The richness of disciplinary concepts and practices ("the content") available for learning;
2. Student sense-making and "productive struggle";
3. Meaningful and equitable access to concepts and practices for all students;
4. Means for constructing positive disciplinary identities through presenting, discussion and refining ideas; and
5. The responsiveness of the environment to student thinking.

~~COURSE OUTLINE:~~

~~1. MAJOR GOALS~~

~~1.1 Students will be able to organize data effectively and use statistical measures to interpret and draw conclusions from the data set.~~
~~1.2 Students will be able to organize probability data sets and calculate probabilities using appropriate probability rules and methods.~~
~~1.3 Students will be able to use one or two samples to make valid inferences about the population of interest (small and large samples).~~
~~1.4 Students will be able to display and interpret bivariate data, make inferences, and draw reasonable conclusions from various statistical calculations.~~

~~2. PERFORMANCE OBJECTIVES:~~

~~2.1 Identify different data types and think critically about the data source~~
~~2.2 Create a survey and identify bias~~
~~2.3 Represent data using appropriate models including bar charts, pie charts, bar graphs, etc.~~
~~2.4 Calculate statistical measures including measures of center, variability, a n d relative Standing using appropriate t o o l s~~
~~2.5 Determine the shape, center, spread, outliers and characteristics~~
~~2.6 Compare two data sets using various representations~~
~~2.7 Use probability r u l e s including Addition and Multiplication Rules 2.8 Identify sample spaces, independent e v e n t s, mutually exclusive e v e n t s, and complements~~
~~2.9 Use Fundamental Counting Principle to calculate probabilities~~
~~2.10 Represent information with tree diagram, Venn diagram, and table~~

2.11 Use Conditional P r o b a b i l i t i e s and Bayes' Theorem
2.12 Introduce Bernoulli's trial and find binomial and geometric probability distributions and calculate statistical measures using appropriate tools
2.13 Define both discrete and continuous random variables and use transformations 2.14 Be able to calculate expected va l u e and standard deviation f r o m probability t a b l e s 2.15 Be able to create and interpret Normal probability d i s t r i b u t i o n graphs 2.16 Use the central measures o f tendency on Normal distributions
2.17 Understand ho w sampling distributions a r e used for inferences a n d apply the Central Limit Theorem
2.18 Be able to use the normal mo d e l as an approximation to a binomial distribution
2.19 Calculate a point estimate and a margin of error
2.20 Construct and interpret confidence i n t e r v a l s for the population p r o p o r t i o n and mean 2.21 Understand w hat hypothesis t e s t i n g is within the context of statistics and state the null and alternative hypotheses
2.22 Perform hypothesis test for the population proportion and population m e a n
2.23 Identify and understand t h e consequences of type I or type II error 2.24 Determine when to use the z-distribution a n d the t-distribution
2.25 Determine if two sample sets are dependent or independent a n d compare using the appropriate hypothesis t e s t
2.26 Represent bivariate data using appropriate models with scatterplots
2.27 Determine the direction, f o r m , and strength of the scatterplot
2.28 Determine the correlation c o e f f i c i e n t and the equation of the regression l i n e 2.29 Determine and interpret the slope and the y-intercept i n context
2.30 Calculate and interpret r e s i d u a l s for data points
2.31 Make predictions using regression linc 01' multiple regression lines and estimate accuracy
2.32 Find and interpret the coefficient of determination) 1'2
2.33 Make inference based on the sample of the slope of the regression line
2.34 Use technology to perform and interpret regression analysis
2.35 Calculate expected frequencies using contingency tables
2.36 Perform inferences of counts using chi-square distribution

3. CONTENT OUTLINE:
3.1 Data Analysis - Univariate
3.1.1 Statistical a n d Critical Thinking
3.1.2 Types of Data
3.1.3 Collecting Sample Data
3.1.4 Frequency Distributions
3.1.5 Histograms
3.1.6 Graphs: Scatterplots, T i m e -Series G r a p h s, Dotplots, St e mpl ots, Bar Graphs, Pareto Charts, Pie Charts, Frequency Polygons, Ogives, Pictographs
3.1.7 Measures o f Center, Variation and Relative Standing and Boxplots
3.2 Probability
3.2.1 Basic Concepts - Events, sample space, 'Law of Large Numbers' concept
3.2.2 Addition r ul e , multiplication r u l e , conditional p r o b a b i l i t y
3.2.3 Simulations a n d probability d i s t r i b u t i o n s
3.2.4 Discrete probability d i s t r i b u t i o n s
3.2.5 Binomial d i s t r i b u t i o n s
3.2.6 Normal probability d i s t r i b u t i o n s - applications a n d sampling

~~3.2.7 Assessing n o r ma l i t y a n d approximation t o binomial~~

~~3.3 Statistical Inferences~~
~~3.3.1 Estimating population proportion and mean~~
~~3.3.2 Estimating population standard deviation or variance~~
~~3.3.3 Basics of hypothesis testing~~
~~3.3.4 Testing a claim about a proportion and a mean~~
~~3.3.5 Testing a claim about a standard deviation 0 1 ' variance~~
~~3.3.6 Independent and dependent samples~~
~~3.3.7 Two variances o r standard deviations~~

~~3.4 Data Analysis - Bivariate~~
~~3.4.1 Correlations~~
~~3.4.2 Regressions, multiple regressions, nonlinear regressions~~
~~3.4.3 Prediction intervals and variation~~
~~3.4.4 'Goodness of Fit' concept~~
~~3.4.5 Contingency tables~~

**COURSE CONTENT:**

**Unit 1: Introduction to Statistics**
This unit includes some definitions and concepts that are very basic in the subject of statistics. Fundamental definitions and the differing types of data are discussed along with dealing with the use of critical thinking in analyzing and evaluating statistical results. Finally, the important elements in the design of experiments are introduced emphasizing the importance of a carefully planned experimental design. Students will learn about the different types of data and levels of measure. They will learn how to think critically when analyzing data and they will learn about the misuses of statistics. Students will also learn about the design of experiments, from the different types of, to the different sampling techniques. Students will also learn to determine types of biases in sampling and the different types of sampling procedures. They will learn how to design experiments using controls and randomization, define the aspects of blind and double blind studies.

At the end of the unit, students will be given a group project to gather data, analyze results, and represent in graphical information all the concepts they have learned. Then they will be asked to compare their data and analyze each group's results, looking for highlights and corrections.

**Unit 2: Summarizing and Graphing Data**
Students will consider methods for summarizing and graphing data. They will investigate a data set using the characteristics of center, variation, distribution, outliers, and the changing pattern over time. Students will learn how to create and display data using frequency distributions, relative frequency distributions, and cumulative frequency distributions. They will also create and interpret stem plots, dot plots, box plots, histograms, frequency polygons, and other statistical graphs.

At the end of the unit, students may be given an activity, American Time Use Survey from Desmos.com. This activity invites students to think about how they use their time and how that time use changes for Americans over their lives. They'll predict by sketching graphs. Then they'll see the actual data from the U.S. Bureau of Labor Statistics.

**Unit 3: Measures of Center and Relative Standing**
Students will find the measures of center, measures of variation, measures of relative standing while understanding the general methods of describing, exploring, and comparing data sets. Students will

describe distributions with numbers including mean, median, mode, standard deviation, and quartiles. Students will learn how to standardize values of data using z-scores and percentiles.

At the end of the unit, students may work on Measures of Relative Standing assignment. In this assignment, students will outline how percentiles and quartiles measure relative standing within a data set. Students will identify the median in a data set and distinguish its properties from other measures of central tendency. Students will define the mode and explain its limitations.

**Unit 4: Probability, Probability Distributions, and Normal Probability Distributions**
This unit will begin with the basic concept of probability, which is so important for methods of inferential statistics introduced later in the course. The rare event rule will garner attention as it is an important concept in inferential statistics. Students will be presented with basic definitions and notations, including the representation of events by letters such as A. Students will know that a probability value, which is expressed as a number between 0 and 1, reflects the likelihood of some event. Students will learn to calculate probabilities through the theoretical probability formula, relative frequency formula, and subjective probability. These will include the multiplication and addition rules as well as independence, mutually exclusive events, and conditional probability. They will also incorporate the fundamental counting rule along with permutations and combinations.

At the end of the unit, students will be assigned experiments involving random events for which a theoretical probability may be determined (ex. rolling number cubes, selecting playing cards, flipping coins, etc.). Students will calculate the theoretical probabilities for various random events and perform simulations to estimate those same probabilities. Written and oral reports will include a discussion of differences between theoretical and experimental probabilities encountered in their work.

**Unit 5: Probability Distributions**
Students will be introduced to probability distribution. This unit combines the methods of the previous three units; summarizing and graphing data, measures of center and relative standing, and probability. They will focus on discrete probability distribution before moving onto more complex distribution in later units. Students will learn the difference between discrete and continuous random variables, means and variances of random variables. They will also learn to construct probability distribution and derive expected value. Students will learn the components of the binomial setting and learn the formulas associated with binomial distributions.

At the end of the unit, students may gather real world data such as statistics about commercial airline flights, including those that involve accidents. The distribution of these accidents are given in a table and a histogram. Students will calculate the probability that a randomly selected flight involved a fatal accident.

**Unit 6: Normal Probability Distributions**
In this unit, students will learn the properties of continuous probability distributions and the focus of this unit will be on normal probability distributions. They will also learn to find proportions of area beneath a normal curve using the normal distribution table and their calculators and calculate probabilities using it. They will learn the Central Limit Theorem and the appropriate situations of its use. Students will also learn when it is appropriate to use a Normal probability curve approximation about the binomial distribution.

At the end of the unit, students will apply the central theorem and continuity correction in binomial distributions. They will be presented with data to determine whether they can use a normal distribution

to approximate the binomial distribution, and indicate whether they can or cannot approximate the indicated probabilities and create a graph.

**Unit 7: Confidence Intervals**
In this unit, students will be introduced to the basic methods for finding estimates of population proportions, means, and variances and be able to construct and interpret confidence intervals. Students will be able to state conditions, perform calculations, and interpret results in context. They will also calculate the minimum sample size needed to accurately predict the population parameter within a certain margin of error. This unit also introduces the concept of critical values. It is important to learn how to obtain critical values for the normal and student t distributions because they will be used in following units.

At the end of the unit, students may work on this assignment: Connection between Confidence Intervals and Sampling Distributions. The purpose of this activity is to help give students a better understanding of the underlying reasoning behind the interpretation of confidence intervals.

**Unit 8: Hypothesis Testing**
The fundamental concepts of a hypothesis test will be presented and students will, given a claim, identify the components of hypothesis testing and express them in symbolic form. They will calculate the value of the test statistic, identify the critical value(s), p-value, and state the conclusion of a hypothesis test in simple, nontechnical terms. Students will be able to test a claim and interpret hypothesis tests for both population means and proportions.

At the end of the unit, Scientific Experiments: Hypothesis Testing, from Desmos.com may be used to introduce students who are already familiar with hypothesis testing to a 2-Sample Mean T-Test, and gives a contextual example (the effectiveness of fluoride on preventing tooth decay) of how hypothesis testing can be used. Also, there's a competition that the students can do for the second part of the activity.

**Unit 9: Correlation and Regression**
This unit presents basic methods for investigating relationships or correlations between two variables. Students will learn to construct scatterplots, describe the association of the variables, calculate the correlation coefficient, r, and decide whether there is a linear correlation between the two variables. They will also be able to identify the explanatory and response variables. In addition, they will learn to calculate the equation of the least -squares regression line and determine its appropriateness when making predictions. They will be able to calculate residuals and construct residual plots and define the coefficient of determination (r2).

At the end of the unit, Correlation and Regression activity from Desmos.com may be used. In this activity students see that knowing the value of the correlation coefficient is only useful if you also know the graph is linear. The last graph in the activity demonstrates the extreme influence outliers have. This measure of correlation is not very robust, and can be anything with an extreme enough value.

~~4.~~ TIME ESTIMATES: Instructional sequences vary in length from a few days to several weeks.

~~5. INSTRUCTIONAL MATERIALS:~~

- ~~5.1 District adopted textbooks~~
- ~~5.2 Supplementary and teacher-created materials that include a career focus 5.3 Technology m a t e r i a l s and on-line resources~~

## COURSE MATERIALS

| Authors | Copyright | Publisher | Title | Website |
|---|---|---|---|---|
| Triola, Mario F | 2014 | Pearson | Elementary Statistics (12th edition) | |

Teacher support resources can also be found in the Educational Services Website and supplemental online curriculum (for ex. Apex).

## ~~6.~~ EVALUATION OF STUDENT PROGRESS

~~7.1 Formative assessments such as warm-ups, check for understanding strategies, exit tickets, Quizzes and oral participation.~~
~~7.2 Summative assessments such as quizzes, chapter tests, unit tests, labs and final exams~~
~~7.3 Written assignments~~
~~7.4 Teacher observations~~
~~7.5 Unit projects~~
~~7.6 Presentations~~

Assessment Methods:

- Summative assessment
- Formative Assessment

Formative:

- Mathematical Discourse
- Reflection questions
- Teacher observations/evidence
- Student discussions
- Quiz
- Exit ticket

Summative:

- Performance task
- Unit Assessment

Committee Members~~:~~

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|---|---|---|
| ~~Concord HS~~ | ~~Oegie Briones~~ | ~~Teacher~~ |
| ~~Mt. Diablo HS~~ | ~~Shellee Harris~~ | ~~Teacher~~ |
| ~~Northgate HS~~ | ~~Peter Ceresa~~ | ~~Teacher~~ |
| ~~Student Achievement & School Support~~ | ~~Cherisse~~ | ~~Secondary Math Coach~~ |
| ~~Student Achievement & School Support~~ | ~~Payne Hellena~~ | ~~School Support Administrator~~ |

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|---|---|
| College Park | Joan Dahl, Teacher |
| Concord | Maxwell Cazanov, Teacher |
| Concord | Norma Meyerkorth, Teacher |
| Mt. Diablo | Kyle Kondo, Teacher |
| Mt. Diablo | Lisa Scranton, Teacher |
| Northgate | Gregory Lyons, Teacher |
| Ygnacio Valley | David Swenson, Teacher |
| Ygnacio Valley | Erica Huie, Teacher |
| Dent Center | Susan Hartwig, Curriculum Specialist |
| Willow Creek Center | Jodi Masongsong, TOSA |

Jeanne Johnson, TOSA
Angela Victor, TOSA