# Course Syllabus
## AP Statistics Semesters A & B

## Course Description

Studying statistics will help you better understand how to collect and analyze data as well as how to read experiments and studies with a more critical eye. AP Statistics is part of a two-semester course sequence. Completing both courses will prepare you for the College Board Advanced Placement exam and for taking statistics at the university level. The first semester focuses on collecting and presenting data, probability, and how to conduct surveys, studies, and experiments. The second semester focuses on sampling distributions, confidence intervals, tests of significance, and review of Semester A topics. The practice of statistics is a useful tool to better understand the world around us, and therefore the concepts are presented in a context of real-world scenarios.

Students will complete a variety of graded and ungraded activities including:
- Design and conduct your own study in which you determine a sampling procedure that minimizes confounding variables and bias, define the measurement strategy, present the data and analysis, and interpret the results in context.
- analyze the relationship between a population distribution and a sampling distribution using OnlineStatBook Project* simulations;
- use the random number generator and lists in a graphing calculator to simulate rolling dice to analyze the Central Limit Theorem;
- analyze samples of computer output given in lessons, practice quizzes, and graded assignments, and;
- identify and correct calculation errors and errors of interpretation in sample student work using the four step approach for hypothesis tests.

The course will teach AP Statistics topics (page 7) and Texas Essential Knowledge and Skills (section 111.47). We highly recommend that you read the College Board's AP Statistics Course Overview and AP Statistics Course Description before beginning this course.

(Image source: https://pixabay.com/en/magnifying-glass-human-head-faces-1607208/ )
*Online Statistics Education: A Multimedia Course of Study (http://onlinestatbook.com/). Project Leader: David M. Lane, Rice University.

## Course Outline

Each semester course consists of 3 units with 8 to 10 lessons in each, 12 graded assignments per semester and 1 final exam (taken in-person).

| | | | | |
|---|---|---|---|---|
| **Semester A, with suggested timelines (150 days maximum)** | | | | |
| Timing | Unit | **Lessons** | **Special Notes** | **Graded Assignments** |
| Day 1 to day 40 | Unit 1: Exploring Data | 1. Categorical Variables<br>2. Two-way Tables<br>3. Measures of Central Tendency<br>4. Measures of Spread<br>5. Displaying and Describing Data<br>6. The Normal Distribution<br>7. Scatterplots<br>8. Regression Lines<br>9. Residuals<br>10. Transformations to Achieve Linearity | • In assignments 01, 02, and 03 students explore data and compare different ways to display data by answering questions in a variety of formats (such as multiple choice, short answer, select-all-that-apply, and selecting from a list).<br>• In assignment 04, students complete free-response exercises in which they compute regression equations using a graphing calculator, interpret data, make predictions, analyze computer output, generate a dataset with an outlier, and decide whether or not causation can be claimed. [<br>• Students interpret results and express them in the context of the problem in all four graded assignments. Students interpret results from graphical displays, from data analysis using lists and computer output, as well as by performing computations with formulas. | 01 Evaluate: Categorical and Tables Graded Assignment<br><br>02 Evaluate: Center and Spread Graded Assignment<br><br>03 Evaluate: Displays and Normal Distributions Graded Assignment<br><br>04 Evaluate: Bivariate Statistics Graded Assignment |
| Day 41 to day 80 | Unit 2: Sampling & Experimentation | 1. Methods of Data Collection<br>2. Experiments vs. Observational Studies<br>3. Sampling & Bias<br>4. Random Sampling<br>5. Sampling Methods<br>6. Survey Design<br>7. Experimental Design<br>8. Bias in Experiments<br>9. Randomization in Experiments | • In assignment 05, students use the Periodic Table of Elements to collect four types of samples learned in the lessons, systematic, stratified, simple random sample, and cluster. Students compare each sample mean to the known population mean, analyze each method, and choose the most representative method for two different parameters.<br>• In assignment 06, students analyze two surveys and discuss types of biases present. Students then plan and conduct their own survey, define their measurement strategy to minimize bias, discuss how the data will be analyzed prior to collecting it, perform the analysis, and interpret their results in context. Students write a report indicating the methods, results, and interpretations using precise statistical vocabulary<br>• In assignments 07 and 08, students are presented with surveys and experiments and analyze design aspects such as randomization, blocking, and bias by answering questions in a variety of formats (such as multiple choice, short answer, select-all-that-apply, and selecting from a list). | 05 Evaluate: Sampling the Periodic Table Graded Assignment<br><br>06 Evaluate: Survey Design Activity Graded Assignment<br><br>07 Evaluate: Sampling & Surveys Quiz Graded Assignment<br><br>08 Evaluate: Experiment Design Quiz Graded Assignment |

| | | | | |
|---|---|---|---|---|
| Day 81 to day 120 | Unit 3: Probability and Random Variables | 1. Randomness and Probability<br>2. General Probability Rules<br>3. Conditional Probability and Independence<br>4. Normal Distributions<br>5. Discrete Random Variables<br>6. Continuous Random Variables<br>7. Transforming Random Variables<br>8. Combining Multiple Random Variables<br>9. Binomial Random Variables<br>10. Geometric Random Variables | • In assignment 09, students use the random integer function of their calculator to run simulations based on the game *Scrabble*. Students will use these simulations, tree diagrams, and other techniques learned in these lessons to analyze probabilities in the game.<br>• In assignments 10, 11, and 12, students analyze random events and make predictions based on normal models, binomial models, geometric models and combining independent random variables by answering questions in a variety of formats (such as multiple choice, short answer, select-all-that-apply, and selecting from a list). | 09 Evaluate: Random Events and Probability Graded Assignment<br><br>10 Evaluate: Distributions and Variables Graded Assignment<br><br>11 Evaluate: Transforming and Combining Graded Assignment<br><br>12 Evaluate: Binomial and Geometric Graded Assignment |
| Day 121 to day 150 | | Request final exam, complete final exam review sheet, study, and complete final exam. | | |

| | | | Semester B, with suggested timelines (150 days maximum) | |
|---|---|---|---|---|
| Timing | Unit | Lessons | Special Notes | Graded Assignments |
| Day 1 to day 40 | Unit 4: Sampling Distributions | 1. Sample Proportion<br>2. Sample Mean<br>3. Central Limit Theorem (C.L.T.)<br>4. Sampling Distribution Differences 1<br>5. Sampling Distribution Differences 2<br>6. Simulation of Sampling Distributions<br>7. T-distribution<br>8. Chi-square Distribution | • In assignment 02, students will use the list and random integer features of their graphing calculator as well as Microsoft Excel to simulate sampling distributions for dice rolling. Students collect, record, and analyze data including predicting the mean and standard deviation of sampling distributions of different sample sizes. Students will draw connections to the C.L.T., normal distributions, and the shape and spread of distributions learned in semester A. Students provide short answer responses indicating the methods, results, and interpretations using precise statistical vocabulary<br>• In assignments 01, 03, and 04, students use sampling distributions to solve problems and make predictions by answering questions in a variety of formats (such as multiple choice, short answer, select-all-that-apply, and selecting from a list). | 01 Evaluate: Sampling and Central Limit<br><br>02 Evaluate: Simulating Sampling Distributions Graded Assignment<br><br>03 Evaluate: Sampling Distributions<br><br>04 Evaluate: This is not Normal |
| Day 41 to day 80 | Unit 5: Estimation | 1. Estimating Population Parameters<br>2. Point Estimators<br>3. Confidence Intervals<br>4. Large Sample Confidence Intervals<br>5. Confidence Interval for a Difference of Proportions<br>6. Confidence Interval for a Mean<br>7. Confidence Interval for a Difference of Means<br>8. Confidence Interval for the Slope of a Least Squares Regression Line (LSRL) | • In assignment 07, students choose from several question prompts modeled after Free Response Questions dealing with estimation and confidence intervals. Students will complete investigative tasks and combine what they have learned in this unit with concepts from semester A.<br>• In assignments 05, 06, and 08, students create confidence intervals of different types as well as interpret them in context and describe different ways to achieve a particular margin of error by answering questions in a variety of formats (such as multiple choice, short answer, select-all-that-apply, and selecting from a list).<br>• In all four assignments students practice making inferences about a broader population based on a sample by creating confidence intervals and interpreting them in context. | 05 Evaluate: Estimation Graded Assignment<br><br>06 Evaluate: Confidence Intervals and Experimental Design Review Graded Assignment<br><br>07 Evaluate: FRQ Cumulative Review Graded Assignment<br><br>08 Evaluate: Confidence Intervals Means and Slopes Graded Assignment |

| Day 81 to day 120 | Unit 6: Tests of Significance | 1. Logic of Significance Testing<br>2. Large Sample Tests for Proportions<br>3. Test for a Mean<br>4. Large Sample Test for a Difference of Proportions<br>5. Test for a Difference of Two Means<br>6. Chi-square Tests: Goodness-of-fit, independence, and homogeneity<br>7. Tests for the Slope of the Least Squares Regression Line (LSRL)<br>8. Get Ready for the AP Exam | • In this unit, students review the topics of univariate data skills, linear regression, and use the graphing calculator to find the LSRL, correlation coefficient, and to check the residual plot.<br>• In lesson 7, students complete an activity in which they match sample computer output to the LSRL and use the output to conduct hypothesis testing on the slope. Students match sample computer output to a dataset and vice-versa to enhance their understanding of the processes and models.<br>• In assignment 11, students choose from several question prompts modeled after Free Response Questions dealing with linear regression and/or hypothesis testing. Students will combine what they have learned in this unit with concepts from semester A by completing an investigative task either conducting a survey or reporting on an inference claim found in a news article.<br>• In assignments 09, 10, and 12, students conduct hypothesis tests, interpret the results in context, and revise sample student work using the four step approach for hypothesis tests by answering questions in a variety of formats (such as multiple choice, short answer, select-all-that-apply, and selecting from a list).<br>• In assignment 12 students use the t-test, $X^2$-test, and matrix functions of their graphing calculator to find the test statistics, P-values, and sketch the distributions for hypothesis tests. Students compare these results to those found by other methods like using a formula or table to better understand and interpret the results. | 09 Evaluate: Significance Testing Logic and Proportions Graded Assignment<br><br>10 Evaluate: Hypothesis Testing for a Mean and Two Proportions Graded Assignment<br><br>11 Evaluate: FRQ Cumulative Review Graded Assignment<br><br>12 Evaluate: Multiple Choice Cumulative Review Graded Assignment |
| Day 121 to day 150 | | Request final exam, complete final exam review sheet, study, and complete final exam. | | |

## Course Objectives

Upon completing Semester A, you will be able to:

- Interpret frequency tables, histograms, and pie charts
- Distinguish between types of data sets such as quantitative, categorical, discrete, continuous, univariate, and bivariate
- Interpret and use two-way tables and relative frequencies
- Describe properties of datasets including shape, unusual features, and measures of center and spread
- Use z-scores to determine percentiles
- Determine the correlation coefficient between two variables
- Identify the least squares regression line, interpret the meaning of the slope and the y-intercept, and use them to make predictions
- Interpret the results of computer output for regression [
- Determine the difference between a population and a sample and between parameters and statistics
- Create sampling methods that generate samples which are truly random and representative of the total population
- Identify confounding variables in an experiment and reduce sources of bias in a survey
- Plan and conduct surveys and experiments which are randomized and minimize sources of bias
- Describe how random events impact our everyday lives
- Use Normal Distributions to describe populations and make predictions
- Identify and apply the concepts of independence and mutually exclusive events
- Identify situations that can be modeled by binomial and geometric distributions and apply them to calculate probabilities and solve problems.
- Explore the College Board website and utilize resources and past exam questions there
- Determine values using a graphing calculator approach as well as by using the AP Formulas and Tables for Statistics.

Upon completing Semester B, you will be able to:

- Estimate population parameters and determine margins of error
- Identify properties of point estimators including unbiasedness and variability
- Create and interpret confidence intervals for various confidence levels
- Identify properties of confidence intervals
- Identify conditions and compute confidence intervals for single sample proportions and means, differences between two proportions, and difference between two means
- Determine and interpret the confidence interval for the slope of a least squares regression line
- Explain and use the logic of significance testing including the concepts of null hypothesis, alternative hypothesis, p-values, one- and two-sided tests, type I and type II errors, and power
- Identify conditions for various significance tests
- State the significance of results and make decisions based on tests for proportions, means, difference between proportions, and difference between means
- Use Chi-square to test for independence, homogeneity, and goodness of fit
- Use tests for the slope of a least squares regression line
- Review concepts, vocabulary, and problem solving processes from semester A including displaying and describing data, sampling and experimentation, and probability topics
- Complete investigative tasks that require you to combine and extend what you have learned throughout semester A and B
- Explore the College Board website and utilize resources and past exam questions there
- Determine values using a graphing calculator approach as well as by using the AP Formulas and Tables for Statistics.

## Lesson Components

Each unit contains 8 to 10 lessons. Lessons include instruction of concepts in written and video form as well as example problems with solutions, printable note taking guides or reference sheets, key concepts boxes, and a practice quiz.

Technology such as graphing calculators are used throughout the course. Each unit contains video calculator tutorials or step by step instructions on how to use statistical capabilities of the calculator. In addition to the lessons themselves, students will utilize two college-level online textbooks. Each Lesson will contain these "5E" components:

**Engage** – Introduces the topic of study and gives you a sense of why the topic is important.

**Explore** – Try some of the problems in a low-pressure situation. Do you already understand the topic? If your answers are not correct, that's okay too! This type of pre-work prepares you for what comes next.

**Explain** – Contains *Example* problems and videos or problems showing the step-by-step process. Be sure to take notes, check your answers and if you have questions, review the lesson or ask your instructor.

**Elaborate** – These pages delve more deeply into more challenging problems and discussions.

**Evaluate** – There are two types, graded assignments and ungraded practice quizzes. You can think of ungraded assignments as homework and graded assignments as your tests. Both are important to try your best on. If you don't practice what you just learned, you will struggle to do well on the graded work and final exams.

## Required Materials

| | |
|---|---|
| Math Notebook | <ul><li>A small composition notebook or a spiral notebook</li><li>Your instructor will instruct you to write in your notebook from time to time</li><li>Review what you write in your notebook and use it to help you complete graded assignments</li></ul> |
| Free online textbooks | <ul><li>*Introductory Statistics* from openstaxcollege.org. Download for free at https://cnx.org/contents/MBiUQmmY@18.54:2T34_25K@11/Introduction</li><li>*Online Statistics Education:* A Multimedia Course of Study (http://onlinestatbook.com/). Project Leader: David M. Lane, Rice University.</li></ul> |

| | |
|---|---|
| Pencil or Pen | • You must write out the problems to do well in this course.<br>• We recommend pencil so you can erase a small portion rather than re-doing the whole line, but if a pen works better for you, that is fine.<br>• Just remember to keep lots of pens/pencils with you wherever you are when you're taking the course– at home, the library, or even on-the-go. |
| Graphing Calculator | • A graphing calculator with statistical capabilities is required.<br>• You are required to bring a graphing calculator to your final exam so it is strongly recommended that you purchase or borrow one for this semester.<br>• Purchasing a TI 84 plus or a similar model is recommended.<br>• Free online calculators are available at https://www.desmos.com/calculator but you may not use these on the exam. |
| Internet Access | • Libraries and coffee shops often provide free Wi-Fi access |
| Software | • Compatible web browser<br>   ○ *Mozilla Firefox*<br>   ○ *Google Chrome*<br>   ○ *Safari*<br>• *Adobe Reader* (or similar) is required to view pdf documents<br>• A digital camera or scanner is required to upload images of your work. The app *Genius Scan* is one free option if you use a smartphone. |
| Additional Items | These items may be easily found at home and will be required for some activities and graded assignments:<br><br>• A jar of coins<br>• Two number cubes (also known as dice) |

## Final Examination

The final examination is comprehensive; it covers the material from all of the units. To pass the course, you must receive a grade of 70 percent or better. You can apply to take the Final Exam after 100 percent of your graded assignments have been submitted, and at least 70 percent have been graded and returned to you.

Format**:**                  50 multiple-choice
Time Allowed**:**        3 hours
Required Materials**:**   2 pencils and a graphing calculator

Remember, you must take and pass each semester's final exam to receive credit for the course. After taking the semester B exam, you may take the AP Statistics exam offered by the College

Board, but it is not required to receive credit for the course from UT High School.

Note: *When preparing for your AP Statistics exam, you will be taking the semester B course and you will no longer have access to the Semester A materials. Before completing semester A, be sure you have written down important Semester A concepts and examples in your notebook and print out important materials from semester A like your graded assignments.*

## Need Help?

- o Contact your instructor in the Canvas Inbox to ask questions.
- o Review previous modules/lessons and re-read and/or re-copy your notes.
- o Search for the topic in a free online textbook:
    - o *Introductory Statistics* from openstaxcollege.org. Download for free at https://cnx.org/contents/MBiUQmmY@18.54:2T34_25K@11/Introduction
    - o *Online Statistics Education:* A Multimedia Course of Study (http://onlinestatbook.com/). Project Leader: David M. Lane, Rice University.
- o Dr. Math forum—they answer tough questions: http://mathforum.org/dr.math/
- o Try a web search. For a shortcut from your browser, highlight the word/phrase, then hold down the "ctrl" key while typing the letters "c", "t", and "v".