AP® Statistics Syllabus

Last Updated: May 2023

Curricular Requirements

- *CR1* The students and teacher have access to a college-level statistics textbook, in print or electronic format.
    - *The syllabus must list the title, author, and publication date of a college-level introductory statistics textbook*.
- *CR2* The course provides opportunities for students to interpret standard computer output and use graphing calculators with statistical capabilities to describe data, determine probabilities, and perform tests.
    - *The syllabus must include a description of one or more classroom activities, projects, or problem sets in which students interpret standard computer output to describe data, determine probabilities, or perform tests.*
    - *The syllabus must include a description of one or more classroom activities, projects, or problem sets in which students use graphing calculators to describe data, determine probabilities, or perform tests.*
- *CR3* The course is structured to incorporate the big ideas and required content outlined in each of the units described in the AP Course and Exam Description (CED).
    - *The syllabus must include an outline of course content by unit title or topic using any organizational approach with the associated big idea(s) to demonstrate the inclusion of required course content. All three big ideas must be included: Variation and Distribution (VAR), Patterns and Uncertainty (UNC), and Data-Based Predictions, Decisions, and Conclusions (DAT).*
- *CR4* The course provides opportunities for students to develop the course skills related to Skill Category 1: Selecting Statistical Methods.
    - *The syllabus must include a brief description of one or more classroom activities, projects, or problem sets in which students describe an appropriate method for gathering and representing data (Skill 1.C). The activities, projects, or problem sets must be labeled so that the corresponding skill and big idea(s) are evident.*
- *CR5* The course provides opportunities for students to develop the course skills related to Skill Category 2: Data Analysis.
    - *The syllabus must include a brief description of one or more classroom activities, projects, or problem sets in which students do one or more of the following skills:*
        - *describe data presented numerically (Skill 2.A)*
        - *construct numerical or graphical representations of distributions (Skill 2.B)*
        - *calculate summary statistics, relative positions of points within a distribution, correlation, and predicted response (Skill 2.C)*
        - *compare distributions or relative positions of points within a distribution (Skill 2.D)*
    - *The activities, projects, or problem sets must be labeled so that the corresponding skill(s) and big idea(s) are evident.*
- *CR6* The course provides opportunities for students to develop the course skills related to Skill Category 3: Using Probability and Simulation.
    - *The syllabus must include a brief description of one or more classroom activities,*

projects, or problem sets in which students do one or more of the following:
    - *Determine relative frequencies, proportions, or probabilities using simulation or calculation (Skill 3.A)*
    - *Determine parameters for probability distributions (Skill 3.B)*
    - *Describe probability distributions (Skill 3.C) The activities, projects, or problem sets must be labeled so that the corresponding skill(s) and big idea(s) are evident.*
- *CR7* The course provides opportunities for students to develop the course skills related to Inference and Skill Category 4: Statistical Argumentation.
    - *The syllabus must include a brief description of one or more classroom activities, projects, or problem sets in which students perform and interpret statistical inference to justify conclusions using one of the following procedures and all corresponding skills:*
        - *confidence intervals (Skills 1.D, 3.D, 4.A, 4.B, 4.C, and 4.D)*
        - *significance tests (Skills 1.E, 1.F, 3.E, 4.A, 4.B, 4.C, and 4.E)*
    - *The activities, projects, or problem sets must be labeled so that the corresponding skills and big idea(s) are evident.*

Texts and Supplemental Materials (*CR1*)

This syllabus corresponds to a digital curriculum: The New Jersey Center for Teaching and Learning (NJCTL) Progressive Math Initiative® (PMI®): AP Statistics. Course resources including Presentations, Problem Sets, Quizzes, Tests, Labs and Unit Plans can be accessed at:
https://njctl.org/materials/courses/ap-statistics/

NOTE: The course materials located on the NJCTL website are accepted as equivalent to a college textbook for this and other AP courses.

Student Practice

Throughout each unit, Topic Questions will be provided to help students check their understanding. The Topic Questions are especially useful for confirming understanding of difficult or foundational topics before moving on to new content or skills that build upon prior topics. Topic Questions can be assigned before, during, or after a lesson, and as inclass work or homework. Students will get rationales for each Topic Question that will help them understand why an answer is correct or incorrect, and their results will reveal misunderstandings to help them target the content and skills needed for additional practice.

At the end of each unit, Personal Progress Checks will be provided in class or as homework assignments in AP Classroom. Students will get a personal report with feedback on every topic, skill, and question that they can use to chart their progress, and their results will come with rationales that explain every question's answer. One to two class periods are set aside to re-teach skills based on the results of the Personal Progress Checks.

Additional Resources

- All students have access to a graphing calculator. Students use the calculator regularly throughout the year to construct plots, to calculate probabilities, to find the least squares regression line, to construct confidence intervals, and to perform tests of significance.
- Desmos software—freeware.
- Fathom for teacher demonstrations.
- AP Classrom
- Released AP questions are used extensively throughout the course.

- Applets such as the whfreeman applets. Many of these applets lead students through a process to help them understand a concept.
- CollegeBoard Resources at https://apcentral.collegeboard.org/courses/ap-statistics

The course follows the nine units outlined in the Course and Exam Description (CED). Throughout each unit, the three big ideas are emphasized: Variation and Distribution (VAR); Patterns and Uncertainty (UNC); Data-Based Predictions, Decisions, and Conclusions (DAT).

Unit 1: Introduction to Probability & Statistics (*CR3*)
Aligns to CED TOPICS 3.1-3.4, 4.1-4.3

Topics	**Personal Progress Check**

• Introduction to Probability
• Experimental & Theoretical Probability
• Word Problems
• Probability of Compound Events
• Sampling
• Analyzing Data
• Measures of Center
• Measures of Variation
• Mean Absolute Deviation
	• **Big Ideas - UNC, VAR, DAT**
	• Formative Assessment Questions
	  ○ NJCTL created within presentations
	  ○ AP Classroom Topic Questions to target learning goals
	• AP Classroom
	  ○ Personal Progress Check MCQ
	  ○ Personal Progress Check FRQ
	• Unit Test

Activities/Labs *(CR2 & CR5)*	

• Introduction to Probability Lab: **Skills 1.A, 3.A, 4.B**
  ○ In this activity, students use a spinner to find the probability of odds for various numbers of sections and colors.
  ■ Students will analyze theoretical and experimental probabilities for various types of spinners.
  ■ Students will examine various types of spinners by adjusting the sector boundaries and performing the experiment.
  ■ Conclusion questions ask students to provide reasoning to extend their understanding of theoretical and experimental probabilities.
  ■ Students use calculators in this lab to explore and interpret theoretical and experimental probabilities.
  ■ Students will use appropriate mathematical language when answering questions to communicate their understanding of probability & statistics based on observations and discoveries made during the lab activity.
• Problem Solving Activities: **Skills 1.A, 1.C, 2.C, 3.A, 4.B**
  ○ These lessons include various AP-style probability & statistics questions in which students apply appropriate mathematical procedures.
  ○ Students are asked to justify their reasoning for solutions to problem set problems using probability & statistics procedures.	

Unit 2: Geometric Probability
Aligns to CED TOPICS 4.1-4.3

Topics	**Personal Progress Check**
• Probability of Simple Events • Probability and Length	• **Big Ideas - UNC** • Formative Assessment Questions

• Probability and Area	○ NJCTL created within presentations ○ AP Classroom Topic Questions to target learning goals • AP Classroom ○ Personal Progress Check MCQ ○ Personal Progress Check FRQ • Unit Test
Activities/Labs (*CR2*)	
• Geometric Probability Lab: **Skills 3.A, 4.B** ○ In this lab activity, students investigate probability using a virtual spinner simulation. ■ Students analyze multiple spinners containing different numbers of sectors. ■ Students answer questions that ask them to relate theoretical probability, experimental probability, and a fair game. ■ Students complete conclusion questions that require them to provide reasons which satisfy the conditions of a fair game ■ Students will use appropriate mathematical language when answering questions to communicate their understanding of probability based on observations and discoveries made during the lab activity. • Problem Solving Activities: **Skills 3.A, 4.B** ○ These lessons include various AP-style probability questions in which students apply appropriate mathematical procedures of probability with technology. ○ Students complete problems that require them to analyze probability situations to draw conclusions. ○ Students will be asked to justify their reasoning for solutions in problem set assignments using probability rules and procedures. ○ Students demonstrate notational fluency by connecting the different notations for probability from one problem to the next within one problem set assignment and use the appropriate mathematical notation in applying procedures. ○ Students will do a review activity where they must first identify which probability rule to use before they find the probability of an event.	

Unit 3: Linear Regression & Correlation

Aligns to CED TOPICS 2.1-2.6

Topics	**Personal Progress Check**
• Two Variable Data • Line of Best Fit • Determining the Prediction Equation • Two-Way Table	• **Big Ideas - VAR** • Formative Assessment Questions ○ NJCTL created within presentations ○ AP Classroom Topic Questions to target learning goals • AP Classroom ○ Personal Progress Check MCQ ○ Personal Progress Check FRQ • Unit Test
Activities/Labs (*CR5*)	
• _ Lab: **Skills 2.A, 2.B, 2.C, 2.D, 4.B**	

    - In this lab, students construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Students will also describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.
        - Students analyze the patterns of association between two quantities.
        - Students answer questions that make statistical, graphical, analytical and verbal connections between two-variable data points.
        - Conclusion questions ask students to use the PhET Least Squares Regression Simulation to explain their real-world meanings of association through graphical and verbal representations.
        - Students use graphing simulation features in this lab to explore and interpret the statistics application concepts of scatter plots and line of best fit.
- Problem Solving Activities: **Skills 2.A, 2.B, 2.C, 2.D, 4.B**
    - These lessons include various AP-style statistics questions in which students apply appropriate mathematical procedures of statistical analysis with technology.
    - Students complete problems that require them to analyze the association between data points.
    - Students will be asked to justify their reasoning for solutions in problem set assignments using data correlation rules and procedures.

Unit 4: Data Collection & Displays

Aligns to CED TOPICS 1.1-1.8

Topics	Personal Progress Check
● Measures of Data ● Central Tendency Application Problems ● Data Displays ● Frequency Tables & Histograms ● Stem & Leaf Plots ● Measures of Dispersion: Box-and-Whisker Plots ● Review: Two-Way Tables ● Choosing a Data Display	● **Big Ideas - UNC, VAR** ● Formative Assessment Questions ○ NJCTL created within presentations ○ AP Classroom Topic Questions to target learning goals ● AP Classroom ○ Personal Progress Check MCQ ○ Personal Progress Check FRQ ● Unit Test

Activities/Labs (*CR4*)

- Mean, Median, Mode & Range Virtual Lab: **Skills 1.A, 2.A, 2.B, 2.C, 4.B**
  - In this lab, students use the simulation to create different boxing scores as a data set to investigate and explore different measures of central tendency and variation.
    - Students will participate in a virtual boxing simulation to create data that resemble the scores achieved in boxing matches.
    - Students will use the boxing scores created to calculate the measures of center and variation of the data.
    - Students will answer questions by applying appropriate mathematical rules to make predictions and drawing conclusions about a data display with the use of technology.
    - Conclusion questions will ask students to make graphical connections using analytical interpretations of the data provided.
- Problem Solving Activities: **Skills 1.A, 2.A, 2.B, 2.C, 2.D, 4.B**
  - These lessons include various AP-style statistical questions in which students apply appropriate mathematical procedures displaying and interpreting data.
  - Students use calculators in problem sets to solve _
  - Students complete free response questions that conclude _
  - Students complete problem set assignments that analyze the behavior of data displays based on the conclusions.

Unit 5: Discrete and Normal Probability Distribution (*CR3*)

Aligns to CED TOPICS 1.9-1.10, 4.4-4.6

Topics	**Personal Progress Check**

• Sets
• Independence & Conditional Probability
• Permutations & Combinations
• Law of Large Numbers
• Law of Small Numbers
• Standard Deviation
• Normal Distribution
• Two-Way Frequency Tables
• Sampling & Experiments
	• **Big Ideas - UNC, VAR, DAT**
	• Formative Assessment Questions
	  ○ NJCTL created within presentations
	  ○ AP Classroom Topic Questions to target learning goals
	• AP Classroom
	  ○ Personal Progress Check MCQ
	  ○ Personal Progress Check FRQ
	• Unit Test

Activities/Labs (*CR6*)

- Discrete and Normal Probability Distributions Lab: **Skills 1.A, 2.A, 2.B, 2.C, 2.D, 3.A, 4.B**
  - In this lab, students investigate the outcomes achieved through discrete probability simulations.
    - Students answer questions comparing and contrasting the outcomes achieved during the experiment between the different simulations.
    - Conclusion questions ask students to justify their reasoning used to support the conclusions made during the activity.
    - Students use discrete probability simulations in this lab to explore and interpret the statistical concepts of discrete probability distribution.
    - Students will use appropriate mathematical language when answering questions to communicate their understanding of probability & statistics based on observations and discoveries made during the lab activity.
- Problem Solving Activities: **Skills 1.A, 1.B, 1.C, 2.A, 2.B, 2.C, 2.D, 3.A, 3.B, 4.A, 4.B**
  - These lessons include various AP-style questions in which students apply appropriate mathematical procedures of probability & statistics with technology.
  - Students use calculators in problem sets to solve problems with varying levels of difficulty.
  - Students complete free response questions that draw conclusions based on discrete and normal probability distributions.
  - Students complete problem set assignments that analyze the behavior of data displays based on the conclusions.

Unit 6: Advanced Probability & Statistics (*CR3*)

Aligns to CED TOPICS 2.7-2.9, 4.7-4.12, 5.1-5.8

Topics	**Personal Progress Check**
● Creating Linear Regression Models ● Least-Squares Regression Models ● Random Variable Probability ● Expected Value ● Linear Combinations of Random Variables ● Binomial Distribution ● Geometric Distribution ● Sampling Distributions ● Central Limit Theorem ● Extension of Central Angles & Arcs: Circle Graphs	● **Big Ideas - UNC, VAR, DAT** ● Formative Assessment Questions ○ NJCTL created within presentations ○ AP Classroom Topic Questions to target learning goals ● AP Classroom ○ Personal Progress Check MCQ ○ Personal Progress Check FRQ ● Unit Test

Activities/Labs (*CR6*)

- Boys vs Girls Geometric Distribution Lab: **Skills 1.A, 3.A, 3.B, 3.C, 3.E, 4.B, 4.E**
  - In this activity, students investigate and analyze the geometric distribution of childbirths from a data set.
  - Students calculate the expected values of boy vs girl childbirths and weights.
  - Students make graphical, analytical and verbal connections between geometric distribution, binomial distributions, and expected values.
  - Students use calculators in this lab to explore and interpret the statistics application concepts of distribution.
- Problem Solving Activities: **Skills 1.A, 1.E, 1.F, 3.A, 3.D, 3.E, 4.B, 4.E**
  - These lessons include various AP-style questions in which students apply appropriate mathematical procedures to solve probability and statistical application problems with technology.
  - Students use calculators to solve problem set assignments, display various types of data, and evaluate statistical formulas.
  - Students will use appropriate techniques and procedures to solve problems involving probability and statistics.
  - Students justify their reasoning for solutions using statistical formulas and procedures.
  - Students apply their knowledge of probability & statistics to solve real-world problems.

Unit 7: Confidence Intervals

Aligns to CED TOPICS 3.5-3.7, 6.1-6.3, 7.1-7.3

Topics	Personal Progress Check
● Confidence Intervals: The Basics ● Interpreting Confidence Intervals ● Constructing Confidence Intervals ● Conditions for Estimating a Population Proportion ● Constructing Confidence Intervals for a p ● The 4-Step Process for Confidence Intervals ● T-distributions ● Estimating μ ● Confidence Intervals for μ	● **Big Ideas - UNC, VAR, DAT** ● Formative Assessment Questions ○ NJCTL created within presentations ○ AP Classroom Topic Questions to target learning goals ● AP Classroom ○ Personal Progress Check MCQ ○ Personal Progress Check FRQ ● Unit Test

Activities/Labs *(CR7)*

- Confidence Interval Intro Lab: **Skills 1.A, 1.B, 2.A, 2.B, 2.C, 2.D, 3.D**
  - In this activity, students conduct an experiment with a "Hershey Kiss Flip" simulation.
  - Students analyze their individual and class results obtained in the experiment to calculate the mean and standard deviation of the data, create confidence intervals, and draw conclusions.
  - Students make graphical, analytical and verbal connections between confidence intervals and normal distribution curves.
  - Students use calculators in this lab to explore and interpret the statistics application concepts of confidence intervals.
- Problem Solving Activities: **Skills 1.A, 1.B, 1.D, 1.E, 1.F, 3.A, 3.D, 3.E, 4.A, 4.B, 4.C, 4.D, 4.E**
  - These lessons include various AP-style questions in which students apply appropriate mathematical procedures to solve probability and statistical application problems with technology.
  - Students use calculators to solve problem set assignments, display various types of data, and evaluate statistical formulas.
  - Students will use appropriate techniques and procedures to solve problems involving probability and statistics.
  - Students justify their reasoning for solutions using statistical formulas and procedures.
  - Students apply their knowledge of probability & statistics to solve real-world problems.

Unit 8: Significance Testing

Aligns to CED TOPICS 6.4-6.11, 7.4-7.10

Topics	Personal Progress Check
● Significance Test & *p*-values ● Errors and Significance Levels ● Population Proportions & the *z* Test ● Two-Sided Tests & Errors ● Tests About a Population Mean ● *t* Test & Procedures ● Sampling and Null Hypothesis ● Working with $p_1 - p_2$ ● Inference for Experiments ● Comparing Two Means ● Two-Sample *t* Statistics ● $\mu_1 - \mu_2$ ● Two-Sample *t* Procedures	● **Big Ideas - UNC, VAR, DAT** ● Formative Assessment Questions ○ NJCTL created within presentations ○ AP Classroom Topic Questions to target learning goals ● AP Classroom ○ Personal Progress Check MCQ ○ Personal Progress Check FRQ ● Unit Test

Activities/Labs (*CR7*)

- Water v Mouthwash Lab: **Skill 1.B, 1.C, 1.E, 1.F, 2.C, 2.D, 3.E, 4.B, 4.E**
  - In this activity, students are introduced to a T-Sample Mean T-Test, and a contextual example (the effectiveness of fluoride on preventing tooth decay) is provided.
  - Students investigate how hypothesis testing can be used within this experiment.
  - Students make graphical, analytical and verbal connections between data analysis and significance tests.
  - Students use calculators in this lab to explore and interpret the statistics application concepts of hypothesis testing and a mean t-test.
- Problem Solving Activities: **Skill 1.B, 1.C, 1.E, 1.F, 2.C, 2.D, 3.D, 3.E, 4.B, 4.C, 4.D, 4.E**
  - These lessons include various AP-style questions in which students apply appropriate mathematical procedures to solve probability and statistical application problems with technology.
  - Students use calculators to solve problem set assignments, display various types of data, and evaluate statistical formulas.
  - Students will use appropriate techniques and procedures to solve problems involving probability and statistics.
  - Students justify their reasoning for solutions using statistical formulas and procedures.
  - Students apply their knowledge of probability & statistics to solve real-world problems.

Unit 9: Chi Squares & Slopes

Aligns to CED TOPICS 8.1-8.7, 9.1-9.6

Topics	Personal Progress Check

• Chi-Square Statistic
• Chi-Square Distributions and *P*-Values
• Inference for Two-Way Tables
• Expected Counts
• Chi-Square Test for Homogeneity
• Chi-Square Test for Independence
• Regression Inference
• Confidence Interval for Slope
• Significance Test for Slope
• Transforming with Powers and Roots
• Transforming with Logarithms
	• **Big Ideas - UNC, VAR, DAT**
	• Formative Assessment Questions
	  ○ NJCTL created within presentations
	  ○ AP Classroom Topic Questions to target learning goals
	• AP Classroom
	  ○ Personal Progress Check MCQ
	  ○ Personal Progress Check FRQ
	• Unit Test

Activities/Labs (*CR7*)

- Observed v Expected Frequencies of Meal Distributions Lab: **Skills 1.A, 1.E, 3.A, 3.C, 4.A, 4.B, 4.C, 4.E**
  - In this activity, students investigate and compare the observed frequencies of the distribution of children's meals with the expected frequency based on an "ideal" situation.
  - Students analyze the table of data to derive the chi-square statistic and its meaning.
  - Students make analytical and verbal connections between frequencies and the value of the chi-square statistic in order to draw conclusions about the likelihood of occurrence.
  - Students use calculators in this lab to explore and interpret the concepts of the chi-square statistic.
- Problem Solving Activities: **Skills 1.A, 1.E, 1.F, 3.A, 3.C, 3.E, 4.B, 4.C, 4.E**
  - These lessons include various AP-style questions in which students apply appropriate mathematical procedures to solve statistical application problems involving Chi-Square with technology.
  - Students use calculators to solve problem set assignments, display various types of data, and evaluate statistical formulas.
  - Students will use appropriate techniques and procedures to solve problems involving Chi-square.
  - Students justify their reasoning for solutions using statistical formulas and procedures.
  - Students apply their knowledge of Chi-square to solve real-world problems.

Project Description *(CR7)*

Students will complete a project in which they are required to design an experiment or sample survey, collect data, and analyze their results using an appropriate method of inference (Skills 1.A, 1.B, 1.C, and 1.E). The project emphasizes that the big idea of variation and distribution has been the underlying theme throughout all nine units. Students develop hypotheses (Skills 1.F and 4.A) and then collect their own data and examine it graphically, exploring measures of center, shape, and variation (Skills 2.A, 2.B, and 2.C). They justify the approximate shape of the sampling distribution for the statistic and check conditions for inference (Skill 4.C) and then obtain the test statistic and p-value (Skill 3.E). They justify their claim based on the test statistic in the context of the study (Skills 4.B and 4.E). All three big ideas are reviewed in this project.

Guidelines for Statistics Projects

The process of developing a statistical project should demonstrate the scientific method of solving a problem:

1. Pose a focused question or questions
2. Collect appropriate data
3. Analyze the data intelligently
4. Draw correct conclusions

In proposing a question to be answered, you should consider what you find interesting. What are your hobbies or passions in life? You will be spending much time on this project, so think about a question that you are interested in discovering the answer to. Make sure that it is a question that can be answered and not one that is completely open-ended. You must collect your own data. You cannot use data from another source, such as the internet, that you can look up. You must implement a sample survey or conduct an experiment.

Before you begin collecting data, you must consider how you will analyze the data. Will your analysis answer your question? Test this by making up some data in response to your survey or experiment. Try to analyze it. Do you meet the conditions of the procedure? Do your results provide an answer to your question? If so, you may begin collecting your data. A self-critique is required in your written report. Consider the strengths and weaknesses of the project. What went right? What went wrong? What would you change if you were to do it again?

The Written Report

You should plan how you will communicate your work effectively. The longest report does not necessarily represent the best project. However, the report MUST do the following:

1. Demonstrate how and why the particular topic was chosen
2. Show how the research was conducted
3. Delineate what conclusions were obtained
4. Include the collected data and analysis of the data
5. Discuss the strengths and weaknesses of the selected statistical methods

The Oral Presentation

In addition to all the elements of the written report, you should consider what visual aids you will incorporate into your oral presentation.