AP Statistics Unit 4 - AP Review and Project

Content Area: **Math**
Course(s):
Time Period: **MP4**
Length: **35**
Status: **Published**

Unit Overview

Unit Summary	Unit Rationale
Unit 4 marks the culminating phase of the AP Statistics course and is divided into two key components: intensive AP Exam preparation and a post-exam project experience.	The purpose of this unit is twofold: to ensure students are well-prepared to succeed on the AP Statistics Exam and to offer them an opportunity to apply their statistical knowledge in meaningful, real-world contexts after the exam.
The first portion of the unit is dedicated to comprehensive AP test prep, where students revisit all major units of the course—exploring concepts such as data analysis, probability, statistical inference, and experimental design. Through collaborative review sessions, timed practice exams, targeted mini-lessons, and reflections, students build confidence, deepen conceptual understanding, and refine their test-taking strategies.	The AP Exam review component is essential in reinforcing mastery of key concepts and skills across all units of the course. Focused practice with multiple-choice and free-response questions, as well as timed testing conditions, helps students become more confident and strategic test takers. The review also provides opportunities for reteaching and clarification of persistent misconceptions, strengthening students' ability to apply statistical reasoning flexibly and accurately.
Following the AP Exam, students transition into a student-driven statistical project. This capstone-like experience offers a choice of real-world investigations or creative statistical storytelling, allowing students to apply their knowledge beyond the standardized test setting. Projects may involve designing and conducting surveys, analyzing datasets, modeling probability scenarios, or even critiquing misleading statistics in media. This phase reinforces statistical thinking and communication skills, emphasizing data literacy as a tool for lifelong learning and responsible citizenship.	The post-exam project phase serves a critical role in transitioning students from test preparation to authentic application. By engaging in choice-based projects, students explore the power of statistics to interpret real-world phenomena. This open-ended exploration fosters creativity, collaboration, and independence while reinforcing the statistical practices.
Unit 4 not only supports high performance on the AP Exam but also empowers students to see the relevance and versatility of statistics in real life, academics, and future careers.	Together, these components honor the hard work students have invested throughout the year, provide closure to the academic journey, and demonstrate that statistical literacy extends far beyond the classroom and testing environment.

NJSLS

1	Exploring One-Variable Data and Collecting Data
2	Probability, Random Variables, and Probability Distributions
3	Inference for Categorical Data: Proportions
4	Inference for Quantitative Data: Means
5	Regression Analysis

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

Unit Focus

Enduring Understandings	Essential Questions
• Students understand that variability, data collection, probability, and inference are deeply interrelated. Mastery involves integrating concepts across topics to reason statistically and draw meaningful conclusions. • Through structured review, students identify conceptual gaps, refine problem-solving strategies, and internalize patterns in question types. This metacognitive process supports lifelong learning and assessment readiness. • Students recognize how statistical tools can be applied to investigate real-world issues, evaluate public claims, and support evidence-based decision-making across disciplines. • Clear written and verbal communication of statistical reasoning—including context, justification, and interpretation—is key to engaging others in evidence-based dialogue and decision-making. • The post-exam project fosters autonomy and creativity. Students explore statistical questions of interest, making decisions about	• How do the major concepts of statistics—data collection, variability, probability, and inference—connect to help us make informed decisions? • What strategies can help me prepare effectively for the AP Statistics Exam and demonstrate my understanding under timed conditions? • How can I use data and statistical reasoning to investigate real-world problems or tell a meaningful story? • What makes an explanation or argument in statistics convincing and clear to others? • How does designing and carrying out a statistical investigation help deepen my understanding of the course content? • Why is it important to recognize and address bias, variability, and uncertainty when interpreting data?

data collection, analysis, and presentation—mirroring authentic statistical practice.	

Instructional Focus

Learning Targets
Part 1: AP Exam Preparation • Identify which statistical concepts and topics I need to review most in preparation for the AP Exam. • Solve multiple-choice and free-response questions from previous AP Statistics exams accurately and under timed conditions. • Interpret and explain statistical results in context using correct vocabulary and notation. • Justify my reasoning and critique incorrect or incomplete statistical arguments. • Describe strategies for managing time and minimizing errors during the AP exam. • Reflect on my mistakes and revise my thinking to avoid repeating misconceptions. *Part 2: Post-Exam Project/Real World Application* • Develop a clear, testable statistical question or claim based on a topic of interest. • Design or select an appropriate method for collecting data or identifying an existing dataset. • Choose and carry out the correct graphical and numerical methods to analyze my data. • Apply appropriate inference procedures (e.g., confidence intervals or hypothesis tests) when relevant. • Evaluate the limitations, sources of bias, or uncertainty in my data and methods. • Communicate the results of my project clearly and accurately in both written and visual formats. • Explain how the statistical tools I used in my project connect to what I learned throughout the AP Statistics course.
Prerequisite Skills
• Identify and classify variables as categorical or quantitative. • Create and interpret frequency tables, bar graphs, histograms, boxplots, and scatterplots. • Describe distributions using shape, center, spread, and unusual features.

- Compare distributions using appropriate statistical measures.
- Distinguish between observational studies and experiments.
- Identify and evaluate sampling methods and potential sources of bias.
- Explain the principles of experimental design (randomization, control, replication, blocking).
- Interpret probability as a long-run relative frequency.
- Use simulation to estimate probabilities.
- Apply basic probability rules, including conditional probability and independence.
- Use probability distributions (binomial, geometric, normal) to solve problems.
- Construct and interpret confidence intervals for proportions and means.
- Conduct significance tests for proportions, means, and differences.
- Check conditions for inference procedures.
- Interpret p-values, confidence levels, and test results in context.
- Use correct notation and vocabulary (e.g., population vs. sample, parameter vs. statistic).
- Interpret results in context using full sentences.
- Justify conclusions with statistical reasoning and appropriate evidence.
- Critique flawed or incomplete statistical arguments.

Common Misconceptions

- "I need to memorize everything."
    - Students often overemphasize memorization rather than understanding concepts and how they connect. The AP Exam rewards reasoning and communication over rote memorization.
- "If I got the correct answer, my work must be correct."
    - Students may ignore flawed reasoning or incorrect notation as long as they reach the right answer. The exam often requires full justification and context-based interpretation, not just answers.
- "I can skip checking conditions for inference."
    - Students frequently forget or rush through conditions, not realizing that omitting them can result in point deductions on free-response questions.
- Confusing population vs. sample and parameter vs. statistic
    - Students may use these terms interchangeably or apply them incorrectly in context, especially when explaining inference procedures.
- Misinterpreting confidence intervals
    - Many students incorrectly believe a 95% confidence interval means there is a 95% chance that the parameter is in the interval, rather than understanding the long-run interpretation.
- Misunderstanding p-values
    - A common error is thinking the p-value is the probability the null hypothesis is true, rather than the probability of observing the sample result (or more extreme) assuming the null is true.

- Assuming association implies causation
    - Students often struggle to distinguish between correlation and causation, especially when interpreting observational studies or when no random assignment is present.
- Believing any dataset is valid for inference
    - Students may not consider whether data collection was random or representative before applying inference procedures.
- Choosing the wrong type of analysis
    - Some students select inappropriate graphical or numerical tools (e.g., using a mean for skewed data or a two-sample t-test instead of a matched-pairs test).
- Overgeneralizing results from small or biased samples
    - Students may fail to recognize that non-random samples or small sample sizes limit the generalizability of their findings.
- Undervaluing the communication piece
    - Some students focus heavily on computations and ignore how to clearly communicate their findings or interpret results in context.

Spiraling For Mastery

Current Unit Content/Skills	Spiral Focus	Activity

Review Week 1:
• Describing One Variable Data
  ○ Shape/center/spread, boxplots vs. histograms, z-scores
• Investigative Questions
  ○ Identifying the investigative question in a study
• Collecting Data
  ○ Sampling methods, bias, experimental design, confounding variables
• Mixed MCQ Practice
• FRQ Day
 	
Review Week 2:
	Unit 1:
	• Revisit skills such as describing distributions (shape, center, spread, outliers) and comparing distributions using graphical and numerical summaries.
	• Reinforced through interpretation of data displays and justifying conclusions during exam review and project work.
	• Reinforce interpretation of scatterplots, correlation, least-squares regression, and
		• **AP Stats Skills Scavenger Hunt**
		  ○ Reinforce concepts from all units through active recall.
		  ▪ Post multiple-choice or FRQ-style questions around the room, each labeled with a unit/topic (e.g., sampling, regression, inference). Students rotate

- Probability and Two-Way Tables
    - Probability rules, two-way tables, conditional probability
- Random Variables
    - Discrete random variables, binomial distribution
- Normal Distribution and Intro to Sampling Distributions
    - Normal distribution → intro to sampling distributions/CLT
- Mixed MCQ Practice
- FRQ Day

Review Week 3

- Inference for Proportions
    - 4-step procedure
- Chi-Square
    - (independence & homogeneity only)
- Inference for Means
    - one- and two-sample t-procedures, matched pairs
- Mixed MCP Practice
- FRQ Day

Review Week 4/5

- Two-Variable Quantitative Data
    - correlation, LSRL, residuals
- Summative FRQ Marathon
    - one FRQ per task model (all 4)
- Full Practice Exam - MCQ
    - Two Days
- Full Practice Exam - FRQ
    - Two Days
- Review and Debrief

After AP Exam Project

- Skew the Script
    - Sports Statistics
    - Machine Learning
    - Economic Freedom and Development
    - Simpson's Paradox
    - Exit Polling
    - Flint Water Crisis
    - Election Fraud
    - Hurricane Maria
- Math Medic

residual analysis.

- Integrated in project analysis and when interpreting relationships between quantitative variables.
- Spiral in concepts like observational studies vs. experiments, sampling methods, bias, and the importance of randomization.
- Crucial in student-designed projects and free-response questions involving study design or data collection methods.

Unit 2:

- Reengage with key probability rules, independence, simulations, and distributions (binomial, geometric, normal).
- Applied in project modeling and multiple-choice review practice.
- Review the logic of sampling distributions and the relationship between sample size and variability.
- Reinforced through inference questions and conditions for using normal approximations.

Unit 3:

- Spiral in interpretation of confidence levels and margin of error.
- Used heavily in projects involving estimation and in interpreting free-response questions with intervals.
- Revisit structure of significance tests, conditions, test statistics, and interpretation of p-values.
- Critical during both AP prep and student-designed

in pairs, solving problems and recording justifications.

- **"Error Analysis Gallery Walk"**
    - Promote conceptual understanding and peer teaching.
        - Display common AP-style errors (e.g., misinterpreting p-values, skipping conditions). Students rotate, identify what's wrong, and rewrite the correct reasoning.
- **Mock AP Exam / Practice FRQ Rotation**
    - Build stamina and refine written statistical communication.
        - Give students a set of released AP Free Response questions and have them rotate through answering, peer scoring (with rubrics), and revision.
- **Statistical Debate: Misleading or Meaningful?**
    - Apply critique and communication skills.
        - Present students with claims from news articles or social media involving

○ Posing a Statistical Question ○ The Data Science Challenge	investigations. • Reapply procedures for comparing proportions, means, and categorical data (e.g., chi-square tests). • Skills spiral into both exam review and student analysis in post-exam projects.	statistics. Students analyze the study methods and argue whether the conclusions are valid. • **Project Proposal Workshop** ○ Connect prior knowledge to real-world questions. ▪ Students draft and workshop their post-AP project ideas in small groups, with peers offering feedback on feasibility, statistical techniques, and clarity of question. • **Inference Procedure Sorting Task** ○ Reinforce correct selection of statistical tests. ▪ Provide students with brief research scenarios. They sort and match each one with the correct inference test, checking assumptions and identifying variables. • **"Create the Question" Challenge** ○ Synthesize understanding of how AP questions are constructed. ▪ Students

		design their own multiple-choice or short FRQ questions, aligned to AP skills, and trade with peers to solve and critique.
		
		• **Regression Detective**
		  ○ Revisit linear regression and interpretation.
		  ▪ Provide messy real-world scatterplot data (e.g., from Gapminder or StatCrunch). Students clean the data, perform regression, interpret r, residuals, and outliers.
		
		• **Inference Mad Libs**
		  ○ Practice correct statistical language.
		  ▪ Give students structured inference statement templates with blanks (e.g., "Since the p-value of ___ is ___ than α = ___, we ___ the null hypothesis."). They fill in the blanks with context-specific values and justify.
		
		• **Stat Olympics (Team Review Games)**
		  ○ Increase engagement in

		review. ▪ Host a class-wide competition with stations representing each unit. Teams earn points for accuracy and the quality of their explanations.

Assessment

Formative Assessment	Summative Assessment
• Homework • Lesson Checks • Quizzes • Exit Tickets • Lesson Reflections • Performance Tasks • AP Classroom Progress Checks • AP Practice Exams	• AP Statistics Project

Resources

Key Resources	Supplemental Resources
AP Classroom AP Statistics CED Pacing Guide	iXL Delta Math Desmos Khan Academy Math Medic Skew the Script Teacher Made worksheets Textbook - Starnes, D., & Tabor, J. (2024). *The*

	Practice of Statistics for the AP Classroom (7th ed.). Beford, Freeman & Worth.

Career Readiness, Life Literacies, and Key Skills

9.3.ST.1	Apply engineering skills in a project that requires project management, process control and quality assurance.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
9.3.IT.5	Explain the implications of IT on business development.
9.2.12.CAP.4	Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
9.2.12.CAP.6	Identify transferable skills in career choices and design alternative career plans based on those skills.
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
9.4.12.IML.5	Evaluate, synthesize, and apply information on climate change from various sources appropriately (e.g., 2.1.12.CHSS.6, S.IC.B.4, S.IC.B.6, 8.1.12.DA.1, 6.1.12.GeoHE.14.a, 7.1.AL.PRSNT.2).
9.4.12.IML.7	Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change (e.g., NJSLSA.W1, 7.1.AL.PRSNT.4).
9.4.12.TL.3	Analyze the effectiveness of the process and quality of collaborative environments.

Interdisciplinary Connections

S.ID.A.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).
S.ID.A.2	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
S.ID.A.3	Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
N.Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
N.Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
S.ID.B.6.a	Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.
N.Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
S.ID.B.6.b	Informally assess the fit of a function by plotting and analyzing residuals, including with the use of technology.

S.ID.B.6.c	Fit a linear function for a scatter plot that suggests a linear association.
S.ID.C.7	Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
S.ID.C.8	Compute (using technology) and interpret the correlation coefficient of a linear fit.
S.ID.C.9	Distinguish between correlation and causation.
S.IC.A.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
S.IC.A.2	Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.
RL.CR.11–12.1	Accurately cite strong and thorough textual evidence and make relevant connections to strongly support a comprehensive analysis of multiple aspects of what a literary text says explicitly and inferentially, as well as interpretations of the text; this may include determining where the text leaves matters uncertain.
SL.II.11–12.2	Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.
SL.PI.11–12.4	Present information, findings and supporting evidence clearly, concisely, and logically. The content, organization, development, and style are appropriate to task, purpose, and audience.
6.1.12.EconET.14.b	Analyze economic trends, income distribution, labor participation (i.e., employment, the composition of the work force), and government and consumer debt and their impact on society.
HS-LS2-6	Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.