

2026 AP Statistics Unit 3 - Statistical Inference

Content Area: **Math**
Course(s):
Time Period: **MP3**
Length: **45**
Status: **Published**

Unit Overview

Unit Summary	Unit Rationale
Unit 3 of AP Statistics focuses on formal statistical inference, helping students move from simply describing data to making well-informed decisions based on analysis. Over 45 days, students learn two main approaches: interval estimation using the PANIC template and hypothesis testing with the PHANTOMS method. They start by building and interpreting confidence intervals and running significance tests for a single population proportion. Along the way, they learn about Type I and Type II errors and the concept of statistical power. The unit then moves into comparing two independent proportions and introduces Chi-Square tests, such as Goodness-of-Fit, Independence, and Homogeneity, to help students analyze two-way tables and discover patterns in categorical data.	This complete Statistical Inference unit is designed as the main instructional focus of the AP Statistics curriculum. Descriptive analysis helps students summarize past events, while probability explores what could happen in ideal situations. Inference connects these areas to answer a key question: Is what we see in our sample data a real, general pattern, or just random chance? By grouping all the main inference topics—one proportion, two proportions, one mean, two means, categorical tables, and regression slopes—into a single continuous unit, the curriculum avoids the confusion that can arise when these topics are taught separately. This procedure helps students understand inference as a single, logical system with consistent rules, whether they are looking at medical treatment success rates or the average lifespan of a machine part.
In the second half of the unit, students shift from working with categorical data to focusing on quantitative measurements. They learn how to use inference methods for population means and bivariate slopes. Students are introduced to the Student's t-distribution and see how it accounts for extra uncertainty when estimating a population parameter from sample data. They practice t-procedures for single-sample means, learn how to analyze paired data with paired t-tests, and compare two independent groups. The unit concludes with regression inference, in which students check the LINER conditions and use computer outputs to test the significance of the population slope. Throughout the unit, students practice explicit communication, learn to check normality visually, and avoid making overly certain conclusions, all to help them succeed on the AP Exam's multiple-choice and free-response questions.	Breaking this large unit into 47-minute lessons using Math Medic's EFFL model helps students remember key ideas by focusing on patterns rather than memorizing formulas. High school students often struggle when they have to learn many different formulas, but through active inquiry, they see that every confidence interval follows the identical structure: a point estimate plus or minus a margin of error. Every test statistic simply measures how far a sample result is from a null claim in standard errors. This method helps students become more flexible thinkers, moving from z-procedures to t-distributions and Chi-Square curves without confusion. In the end, this super-unit gives students the time and practice they need to master the language, safety checks, and careful interpretations that turn basic calculations into strong statistical arguments.

Standards for Mathematical Practice

MATH.K-12.1	Make sense of problems and persevere in solving them
MATH.K-12.2	Reason abstractly and quantitatively
MATH.K-12.3	Construct viable arguments and critique the reasoning of others
MATH.K-12.4	Model with mathematics
MATH.K-12.5	Use appropriate tools strategically
MATH.K-12.6	Attend to precision
MATH.K-12.7	Look for and make use of structure
MATH.K-12.8	Look for and express regularity in repeated reasoning

Unit Focus

Enduring Understandings	Essential Questions
1. We can leverage sample statistics to construct a confidence interval that estimates an unknown population parameter with a quantified margin of error and a specified level of long-run reliability. 2. Hypothesis testing utilizes the laws of probability to determine if an observed sample result is due to mere random sampling variability or if it represents a statistically significant, generalizable phenomenon. 3. The type of variable being evaluated (categorical vs. quantitative) and the structure of the study design dictate the unique inferential framework (z, t, or χ^2) and safety conditions required to draw mathematically sound conclusions.	1. How can we use data from a single sample to estimate an entire population's hidden characteristics with absolute precision and confidence? 2. How do we decide whether a strange or extreme sample result is a statistical fluke or a real breakthrough? 3. How do the type of data we have and the way we grouped our subjects change the mathematical rules we must use to make an inference?

Instructional Focus

Learning Targets

Part 1: Inference for One Proportion

- I can interpret the meaning of a confidence level and a confidence interval in context.
- I can construct and interpret a one-proportion z -interval, verifying the required conditions (Random, 10%, Large Counts).
- I can explain the relationship between sample size, confidence level, and width of an interval, and compute the minimum sample size required to achieve a target margin of error.
- I can construct a valid set of hypotheses (H_0 and H_a) and interpret a P-value as a conditional probability.
- I can define, detect, and interpret Type I and Type II errors in context, and explain the consequences of each.
- I can perform a full significance test for a population proportion and evaluate the test's power.

Part 2: Inference for Two Proportions and Two-Way Tables

- I can check conditions and construct a confidence interval to estimate the difference between two population proportions.
- I can perform a significance test to compare two population proportions using a pooled sample proportion ($\hat{p}_c$) for the standard error.
- I can use a Chi-Square Goodness-of-Fit Test to evaluate whether an observed categorical distribution matches a hypothesized historical distribution.
- I can construct a two-way contingency table, calculate expected counts, and use a Chi-Square Test for Homogeneity or Independence to determine if an association exists between two categorical variables.

Part 3: Inference for One Mean

- I can describe the properties of a t-distribution, explain how it changes as degrees of freedom ($df = n - 1$) increase, and find critical t^* values.
- I can construct and interpret a confidence interval for a population mean (μ), checking for normality using the sample size rules ($n \geq 30$, or examining a graph of the sample data for outliers/skewness).
- I can perform a one-sample significance test for a population mean and state a statistically valid conclusion.
- I can distinguish between independent samples and paired data, and perform paired t-procedures to test for a population mean difference (μ_d).

Part 4: Inference for Two Means

- I can verify conditions, compute standard errors, and construct a confidence interval for the difference between two independent population means ($\mu_1 - \mu_2$).
- I can execute a two-sample t-test to compare the centers of two independent quantitative distributions.
- I can verify the structural conditions (LINER) required for inference in a linear regression model.
- I can construct a confidence interval and perform a significance test for the true population slope (β) using standard linear regression computer output.

Prerequisite Skills

Parts 1 and 2: Inference for Proportions

- Calculating relative frequencies out of subset pools rather than the grand total.
- Instant fluency with the Large Counts condition ($np \geq 10$ and $n(1 - p) \geq 10$) from Unit 2.
- Solving for an unknown variable embedded beneath a radical sign or within a fraction denominator.

Parts 3 and 4: Inference for Means

- Recalling that sample means approach normality when $n \geq 30$, regardless of population shape.
- Quick identification of extreme skew or outliers from dotplots, boxplots, or normal probability plots.
- Locating the intercept, slope coefficient, and standard error lines within a standard software regression readout table.

Common Misconceptions

Proportions:

- Students write: "There is a 95% probability that the true proportion of voters is between 0.42 and 0.48."
 - Once an interval is calculated, its endpoints are fixed. There is no probability involved. The correct interpretation is: "We are 95% confident that the interval from 0.42 to 0.48 captures the true population proportion."
- Students define a P-value as the probability that the null hypothesis is true.
 - A P-value assumes the null hypothesis is true and measures the probability of obtaining our observed sample data (or something more extreme) purely by chance.
- When writing out Chi-Square tests, students plug raw percentages or observed counts into the expected-values rows. They must use the formula $(\text{row total} \times \text{column total}) \div (\text{table total})$ and leave expected entries as decimals.

Means:

- If a dataset has two columns of numbers, students automatically default to a 2-sample t-test.
 - Train them to ask: Are these groups independent, or are these two measurements taken on the same individual (or matched pairs)? If paired, they must subtract the columns first and run a 1-sample test on the single list of differences.
- Students use normal distribution critical values (z^*) instead of Student's t distribution values (t^*) when analyzing quantitative averages.
 - Remind them of the mantra: When you don't know the population standard deviation (σ) and must estimate it using the sample standard deviation (s), you must use t .

Spiraling For Mastery

Current Unit Content/Skills	Spiral Focus	Activity
<i>Part 1: Inference for One</i>	<i>Part 1: Inference for One</i>	<i>Part 1: Inference for One</i>

<i>Proportion</i> • Constructing Intervals • Performing Significance Tests • Evaluating Type I/II errors <i>Part 2: Two Proportions and Two-Way Tables</i> • Running 2-proportion z-tests. • Calculating Chi-Square statistics • Assessing independence <i>Part 3: Inference for One Mean</i> • Building t-intervals • Executing 1-sample t-tests • Evaluating paired data <i>Part 4: Inference for Two Means</i> • Performing 2-sample t-tests • Modeling independent groups • Evaluating regression slopes.	<i>Proportion</i> • Unit 2 - Binomial conditions and sampling distributions • Verifying safety via standard deviations and expected successes. <i>Part 2: Two Proportions and Two-Way Tables</i> • Unit 1 - Contingency tables and relative frequencies • Evaluating conditional percentages visually vs. mathematically. <i>Part 3: Inference for One Mean</i> • Unit 1 - Outliers and Graph Audits (CUSS & BS) • Checking normality using visual data sets. <i>Part 4: Inference for Two Means</i> • Unit 1 - Two-Variable Relationships • Interpreting computer output parameters	<i>Proportion</i> • The Standard Error Connection ○ When calculating the standard error for a 1-proportion z-interval, give students 3 minutes to justify how this formula stems directly from the standard deviation of a sample proportion distribution. <i>Part 2: Two Proportions and Two-Way Tables</i> • From Graph to Test Pivot ○ Present students with a segmented bar chart showing two categorical variables from Unit 1. Have them write a 4-minute hypothesis set (H_0 / H_a) and use the visual breakdown to predict whether a Chi-Square test will reject or fail to reject the null. <i>Part 3: Inference for One Mean</i> • The Normality Audit Drill ○ When teaching the Normal condition for a 1-sample t-test with a small sample size ($n < 30$), display a boxplot or stemplot of the sample data. Have students spend 3 minutes evaluating
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		the distribution's shape, specifically testing for strong skewness or outliers that could invalidate t-procedures. <i>Part 4: Inference for Two Means</i> • The Slope Diagnostic ○ When introducing inference for regression slope, project a standard computer output block from Super-Unit 1. Have students identify the slope estimate (b) and the standard deviation of the residuals (s), and connect them to the calculation of the standard error of the slope coefficient.
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Assessment

Formative Assessment	Summative Assessment
• Homework • Lesson Checks • Quizzes • Exit Tickets • Lesson Reflections • Performance Tasks • AP Classroom Progress Checks	• Topic Tests • Unit 3 Benchmark (Link-It)

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). <i>The Practice of Statistics for the AP Classroom</i> (7th ed.). Bedford, Freeman & Worth.

Career Readiness, Life Literacies, and Key Skills

WRK.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.
WRK.9.2.12.CAP.21	Explain low-cost and low-risk ways to start a business.
TECH.9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
TECH.9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12prof.CR3.a).
TECH.9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
TECH.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).
TECH.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).

Interdisciplinary Connections

ELA.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
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explicitly and inferentially, as well as interpretations of the text; this may include determining where the text leaves matters uncertain.

ELA.W.IW.11–12.2

Write informative/explanatory texts (including the narration of historical events, scientific procedures/experiments, or technical processes) to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

ELA.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.

SOC.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.

SCI.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.

SCI.HS-ETS1-3

Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.