Unit 4: Inference: Conclusions with Confidence

Content Area: **Mathematics**
Course(s):
Time Period: **Marking Period 3**
Length: **9-10 weeks**
Status: **Published**

Brief Summary of Unit

In this unit, students will be able to interpret a confidence level in context. Students will be able to determine critical values for calculating a confidence interval using a table or calculator. Students will be able to state correct hypotheses for significance test about a population proportion or mean. Students will be able to interpret p-values, Type I and Type II errors in context.

Standards

Analyzing various sets of data will allow students to explore studies about people from different backgrounds. Statistical studies and analysis provides students an opportunity to read about historical statistics about people's cultures. Embracing the diversity within society incorporates the following:

Amistad Commission

This unit also reflects the goals of the Department of Education and the Amistad Commission including the infusion of the history of Africans and African-Americans into the curriculum in order to provide an accurate, complete, and inclusive history regarding the importance of of African-Americans to the growth and development of American society in a global context.

Asian American and Pacific Islander History Law

This unit includes instructional materials that highlight the history and contributions of Asian Americans and Pacific Islanders in accordance with the New Jersey Student Learning Standards in Social Studies.

New Jersey Diversity and Inclusion Law

In accordance with New Jersey’s Chapter 32 Diversity and Inclusion Law, this unit includes instructional materials that highlight and promote diversity, including:

economic diversity, equity, inclusion, tolerance, and belonging in connection with gender and sexual orientation, race and ethnicity, disabilities, and religious tolerance.

Commission on Holocaust Education

This unit further reflects the goals of the Holocaut Education mandate where students are able to identify and analyze applicable theories concerning human nature and behavior; understand that genocide is a consequence of prejudice and discrimination; understand that issues of moral dilemma and conscience have a profound impact on life; and understand the personal responsibility that each citizen bears to fight racism and hatred whenever and wherever it happens.

CS.K-12.6.a	Systematically test computational artifacts by considering all scenarios and using test cases.
CS.K-12.6.b	Identify and fix errors using a systematic process.
LA.K-12.NJSLSA.L4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.
LA.K-12.NJSLSA.L5	Demonstrate understanding of word relationships and nuances in word meanings.
MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.K-12.8	Look for and express regularity in repeated reasoning.
MA.S-IC.A	Understand and evaluate random processes underlying statistical experiments
MA.S-IC.A.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
MA.S-IC.A.2	Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.
MA.S-IC.B	Make inferences and justify conclusions from sample surveys, experiments, and observational studies
MA.S-IC.B.3	Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
MA.S-IC.B.4	Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
MA.S-IC.B.5	Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
MA.S-IC.B.6	Evaluate reports based on data.
SCI.HS-ESS3-2	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
SCI.HS-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.

TEC.K-12.8.1	All students will use computer applications to gather and organize information and to solve problems.
TEC.K-12.8.2	All students will develop an understanding of the nature and impact of technology, engineering, technological design, and the designed world as they relate to the individual society, and the environment.
WORK.K-12.9.1	All students will develop career awareness and planning, employability skills and foundational knowledge necessary for success in the workplace.
WORK.K-12.9.2	All students will develop career awareness and planning, employability skills and foundational knowledge necessary for success in the workplace.
	Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.
	Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

Transfer

Demonstration of how/why/where/when confidence intervals appear in real life application.

Inference leads to many real life decisions involving medical experiments, quality control, etc.

Bias and how a sample is gathered or an experiment is run is very important when performing a significance test or creating a confidence interval.

Essential Questions

- How important is confidence interval in estimation?
- How are Type I and Type II errors defined?
- How are hypothesis tested?
- How is the precision of a prediction related to its reliability?
- How can a sample size be determined for a study that would place your results within a specified error?
- How can the statistical method of hypothesis testing prove or disprove a given hypothesis statement?
- What is meant by statistically significant?
- How can hypothesis testing be used to find out if a difference between two samples is greater than a given value?
- What are differences between pooled and non-pooled and does it matter which is used to test data?
- When is it appropriate to use a matched pair t-test instead of a two sample t-test?

Essential Understandings

- A point estimate is used to establish a value for a population parameter.
- A confidence interval is a range of plausible values for a characteristic of a population.
- Confidence intervals are always two tailed and the confidence level relates to the area under the curve between the interval.
- Standard error is the estimated standard deviation of the statistic.
- Confidence level and confidence intervals are related.
- Hypothesis testing uses sample data to decide between two competing claims about a population characteristic.
- There is a possibility of making a Type I or Type II error when conducting a hypothesis test.
- Tests can be performed using the critical value approach or the p-value approach.
- The level of significance is the total area in the rejection region.
- Hypothesis testing for two samples involves the difference between the means or proportions.
- Identifying and labeling each population allows for more accurate and less confusing conclusions.
- Procedures vary for samples that are dependent as opposed to independent.
- Matched pair tests are an important analysis tool when analyzing results of an experiment.

Students Will Know

- Key concepts/vocabulary- point estimation, confidence interval, confidence level, biased statistic, unbiased statistic, true value of a parameter, standard error, bound (margin of error), sample size, sampling distribution, z-score (critical value), t-distribution (t-scores).
- The basic characteristics of center, shape, and spread both qualitative and quantitative data take on given a particular sample size.
- The nature of sampling variability and how sampling distributions help to filter out some of its effects.
- The basic principles behind inferential statistics.

Students Will Be Skilled At

- Determine critical values for calculating a confidence interval using a table or calculator.
- Construct confidence intervals for one sample and two sample statistics.
- Understand the relationship between the interval and a normal curve.
- Summarize calculations and interpret a confidence level in context.
- Identity probabilities associated with standardized values (z and t-scores) of normal distributions.
- Work backwards to find sample size needed for a given study.

Evidence/Performance Tasks

- Assessments

- Formative: Daily assessments using examples from class notes, NJSLA test bank problems, and/or Albert/AP Classroom assessments
- Summative: Teacher-created assessments, NJSLA test bank problems, Big Ideas Math online platform problems, Albert/AP Classroom and/or Big Ideas Math unit assessments
- Benchmark: IXL or teacher created diagnostic assessments in addition to unit assessments from Big Ideas Math
- Alternative Assessments: Student-centered activities such as scavenger hunts, various projects involving real world applications, and differentiated learning tasks in Khan Academy, DeltaMath, and IXL

- Answer essential questions
- Class discussion of daily topic
- Teacher Observation
- Tests and quizzes that assess the essential questions
- Classwork and homework that assess the essential questions
- Written assignments that assess the essential questions that involves providing explanations
- Provide alternative means of assessments for certain students
- Conduct hypothesis tests.
- Determine the null and alternate hypotheses for a given scenario.
- Understand difference between one tailed and two tailed test and draw curve.
- Identify and interpret Type I and Type II errors in context of problem.
- Follow procedure and conduct hypothesis test on one sample mean.
- Understand and use p-value approach as well as critical value approach.
- Analyze results of test in context of the problem.
- Perform hypothesis tests on one sample proportion.
- Establish and interpret the power of the test.
- Conduct two sample t-test for pooled or non-pooled data.
- Distinguish between independent and dependent samples.
- Perform matched pair t-test and interpret results.

Learning Plan

- Demonstration of how/why/where/when hypothesis testing appears in real life application.
- Class discussion/notes on key concepts/vocabulary/calculations.
- Class activities/games/projects using the characteristics of confidence intervals and hypothesis testing.

Topics:

- Large sample confidence intervals for a proportion and for a difference of two proportions.
- Large sample confidence intervals for a mean and for a difference of two means (unpaired and paired).
- Tests of significance: null and alternative hypotheses, p-values, one- and two-sided tests
- Large sample test for proportion and for a difference of two proportions.

- Large sample test for a mean and for a difference of two means (unpaired and paired)
- Chi-square test for goodness of fit, homogeneity of proportions and independence.
- Type I Error, Type II Error and Power of a Significance Test
- Normally distributed data
- t-distribution
- Single sample t procedures.
- Two sample (independent and matched pairs) t procedures
- Inference for slope of least squares line.

Materials

Core Book List including Practice of Statistics

Supplemental materials: AP Classroom, Khan Academy, Edia, and DeltaMath

- District approved textbook
- Khan Academy
- Supplemental Materials – worksheets, guided notes
- Teacher created activiites
- Teacher created notes
- TI-84 Graphing Calculator

Suggested Strategies for Modifications

Possible accommodations/modification for AP Statistics