Probability and Statistics - Unit 8 Hypothesis Testing	20 - 25 Days Established 14-15 Revised 20-21 Revised Nov 2021

Standard – NJSLS: S.ID and S.IC
Hypothesis Testing

Strand
S-ID: Interpreting Categorical and Quantitative Data
Summarize, represent, and interpret data on a single count or measurement variable
1. *Represent data with plots on the real number line (dot plots, histograms, and box plots).*

S-IC: Making Inferences and Justifying Conclusions
Understand and evaluate random processes underlying statistical experiments.
1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

Make inferences and justify conclusions from sample surveys, experiments, and observational studies.
2. 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.

Curriculum aligned with: 2009 New Jersey Core Curriculum Content Standards for 21st Century Skills (9.1 A-F)

21st Century Theme: *Global Awareness ☐, Financial, economic, business and entrepreneurial literacy , , Civic literacy ☐, Health literacy , Environmental Literacy ☐,*

21st Century Skills: *Critical Thinking & Problem Solving , Creativity and Innovation ☐, Collaboration, Teamwork and Leadership ☐, Cross-Cultural Understanding and Interpersonal Communications ☐, Communication and Media Fluency ☐, Accountability, Productivity and Ethics ☐*

Interdisciplinary Connection: Math=MA, English=ELA, Science=SCI, Social Studies=SS, Physical Education=PE, Art=ART, Music=MU, Technology=TECH, World Language=WL, Business = BU

Essential Questions	Enduring Understandings	Activities, Investigation, and Student Experiences
1. What is the purpose of inferential statistics? 2. What are real life examples where the	*Students will understand…* ● A hypothesis test is a standard	***Task 1:*** Based on the given conditions, identify the alternative hypothesis. Identify the sampling distribution (normal or *t*) of the test statistic.

methods of hypothesis testing can be applied?	procedure for testing a claim about a property of a population. • The rare event rule for inferential statistics is used for testing a claim by analyzing sample data in an attempt to distinguish between results that can easily occur by chance and results that are highly unlikely to occur by chance. • The null hypothesis denoted by H_0 is a statement that the value of a population parameter is equal to some claimed value.	• Claim: The mean annual income of full-time college students is below \$10,000. Sample data: For 750 randomly selected college students, the mean is \$3662 and the standard deviation is \$2996. The sample data suggest that the population has a distribution that is not normal. • Claim: The majority of college students have at least one credit card. Sample data: Of 500 randomly selected college students, 82% have at least one credit card. • Claim: The mean IQ of adults is equal to 100. Sample data: $n = 150$ and $\bar{x} = 98.8$. it is reasonable to assume that $\sigma = 15$. ***Answer:*** • $H_1 : \mu < \$10{,}000$; t distribution • $H_1 : p > 0.5$; normal distribution • $H_1 : \mu \neq 100$; normal distribution ***Task 2:*** **Interdisciplinary BU** *Glamour* magazine sponsored a survey of 25000 prospective brides and found that 60% of them spent less than \$750 on their wedding gown. • Use a 0.01 significance level to test the claim that less than 62% of brides spend less than \$750 on their wedding gown. • How are the results affected if it is learned that the responses were obtained from magazine readers who decided to respond to the survey through an Internet Web site? ***Answer:***

	• The alternative hypothesis denoted by H_1 is the statement that the population parameter has a value that somehow differs from the null hypothesis. • If you are conducting a study and want to use a hypothesis test to support your claim, the claim must be worded so that it becomes the alternative hypothesis. • The test statistics is a value used in making a decision about the null hypothesis.	• $H_0 : p = 0.62$. $H_1 : p < 0.62$. Test statistic: z = -2.06. Critical value: z = -2.33. P-value: 0.0197. Fail to reject the H_0 . There is not sufficient evidence to support the claim that less than 62% of brides spend less than $750 on their wedding gown. • The results would not be valid if they were obtained from a voluntary response sample. ***Task 3*:** **Interdisciplinary BU** The Carolina Tobacco Company advertised that its best-selling nonfiltered cigarettes contain at most 40 mg of nicotine, but *Consumer Advocate* magazine ran tests of 10 randomly selected cigarettes and found the amounts (in mg) shown in the accompanying list. It's a serious matter to charge that the company advertising is wrong, so the magazine editor chooses a significance level of $\alpha = 0.01$ in testing her belief that the mean nicotine content is greater than 40 mg. 47.3 39.3 40.3 38.3 46.3 43.3 42.3 49.3 40.3 46.3 Using a 0.01 significance level, test that editor's belief that the mean is greater than 40 mg ***Task 3 Answer*:** • $H_0 : \mu = 40$ mg. $H_1 : \mu > 40$ mg. Test statistic: t = 2.746. Critical value: t = 2.821. P-value: greater than 0.0113. Fail to reject H_0 . There is not sufficient evidence to support the claim that the mean body nicotine content is greater than 40 mg. **Modifications and/or Accommodations:** • **Special Education:** Utilize a multi-sensory (VAKT) approach during instruction, provide alternate presentations of skills by varying the method (repetition, simple explanations, additional examples, modeling, etc.), modify test content and/or format, allow students to retake test for additional credit,

	• The test statistic is found by converting the sample statistic to a score with the assumption that the null hypothesis is true. • The critical region is the set of all values of the test statistic that cause use to reject to the null hypothesis. • The significance level is the probability that the test statistic will fall in the critical region when the null hypothesis is actually true. • A critical value is any value that separates the critical region from the values	provide additional times and preferential seating as needed, review, restate and repeat directions, provide study guides, and/or break assignments into segments of shorter tasks. • **English Language Learners:** Extend time requirements, preferred seating, positive reinforcement, check often for understanding/review, oral/visual directions/prompts when necessary, supplemental materials including use of online bilingual dictionary, and modified assessment and/or rubric. • **Students at Risk of School Failure:** Deliver instruction utilizing varied learning styles including audio, visual, and tactile/kinesthetic, provide individual instruction as needed, modify assessments and/or rubrics, repeat instructions as needed. • **Gifted Students:** Create an enhanced set of introductory activities, integrate active teaching/learning opportunities, incorporate authentic components, propose interest-based extension activities, and connect student to related talent development opportunities. **Teacher Resources** online achievethecore resource online learnzillion resource online khanacademy resource online desmos resource online ixl resource

	of the test statistic that do not lead to rejection of the null hypothesis. ● With hypothesis testing, your conclusion is either to reject the null hypothesis or fail to reject it. ● Type I error is the mistake of rejecting the null hypothesis when it is actually true. The alpha symbol (α) is used to represent the probability of a type I error. ● Type II error is the mistake of failing to reject the null hypothesis when it is actually false. The beta	

	symbol (β) is used to represent the probability of a type II error. ● The power of a hypothesis test is the probability (1 - β) of supporting an alternative hypothesis that is true. ● Claims about a population proportion are tested by using a normal distribution as an approximation to the binomial distribution. ● To test claims about a population proportion, you must be sure the requirements are satisfied.	

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Content Statements	**Cumulative Progress Indicators**
Students will know… ● How the fundamentals of hypothesis testing ● How to identify the null hypothesis and the alternative hypothesis if given a claim and express both in symbolic form. ● How calculate the value of the test statistic if given a claim and sample data ● How identify the critical values with a given significance level ● How to identify the *P*-value given a value of the test statistic ● How to state the conclusion of a hypothesis test in simple, nontechnical terms ● How to use a calculator to do hypothesis testing	● Tests ● Quizzes ● Practice problems for homework ● Workbook pages ● Worksheets
Desired Results	
● **Hypothesis Testing**	

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- **Critical Values**
- **P-value**
- **Using a calculator for Hypothesis testing**

Standards for Mathematical Practices

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.**

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LGBT and Disabilities Law: *N.J.S.A. 18A:35-4.35*

Sally Ride - American astronaut and physicist.

The mission is to ensure that every student is able to see themselves in our rich and diverse history.

Social and Emotional Learning: ***Competencies***	**Social and Emotional Learning:** ***Sub-Competencies***
Self-Awareness Social Awareness Self-Management Relationship Skills Responsible Decision-Making	• Recognizing the importance of self-confidence in handling daily tasks and challenges. • Demonstrate an awareness of the expectations

	for social interactions in a variety of ways. ● Demonstrate an understanding of the need for mutual respect when viewpoints differ. ● Recognize the skills needed to establish and achieve personal and educational goals. ● Utilize positive communication and social skills to interact effectively with others. ● Develop, implement, and model

	effective problem solving and critical thinking skills.