Probability and Statistics - Unit 7 Estimates and Sample Sizes	Revised August 2023 Revised Nov 2021 20 - 25 Days

Standard – NJSLS: S.ID and S.IC
Estimates and Sample Sizes

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.
1. 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. Why have confidence intervals?	*Students will understand…* ● A point estimate is a single value	***Task 1:*** **Interdisciplinary BU**

3. What are real life examples that involve confidence intervals and margins of error?	used to approximate a population parameter. • The sample proportion is the best estimate of the population proportion. • The best estimate of the population mean is the sample mean. • The best point estimate of the variance of a population is the variance of a sample. • To determine a confidence interval for a population proportion, the requirements that a simple random sample exists, there are at least 5 successes and 5 failures, and the conditions for a binomial	The tobacco industry closely monitors all surveys that involve smoking. One survey showed that among 785 randomly selected subjects who completed four years of college, 18.3% smoke (based on data from the American Medical Association.) • Construct the 98% confidence interval for the true percentage of smokers among all people who completed four years of college. • Based on the result from part (a), does the smoking rate for those with four years of college appear to be substantially different than 27% rate for the general population? ***Answer:*** • We first verify the requirements are satisfied. The sample is a simple random sample and the requirements for a binomial distribution are satisfied. Also there are at least 5 successes (144 = 758*.183) and 5 failures (641). Using a critical value of 2.33, the confidence interval is constructed as follows: $\frac{144}{285} - 2.33\sqrt{\frac{.183 * .817}{785}} < p < \frac{144}{285} + 2.33\sqrt{\frac{.183 * .817}{785}}$. This yields 15.1% < p < 21.6%. We are 95% confident that the interval limits of 15.1% and 21.6% contain the true population proportion. • Yes it appears that the smoking rate for the college graduates is significantly less than the rate for the general population. ***Task 2:*** **Interdisciplinary BU** A NAPA Auto Parts supplier wants information about how long car owners plan to keep their cars. A simple random sample of 25 car owners in results in $\bar{x} = 7.01$ years and s = 3.74 years, respectively (based on data from a Roper poll). Assume that the sample is drawn from a normally distributed population. • Find a 95% confidence interval estimate of the population mean. • Interpret the 95% confidence interval in the context of this problem

	distribution must be satisfied. ● A confidence interval is a range of values used to estimate the true value of a population parameter. ● The confidence level is the proportion of times that the confidence interval actually does contain the population parameter, assuming the estimation process is repeated a large number of times. ● A confidence level of 95% tells us that the process we are using will, in the long run, result in confidence interval limits that contain the	***Answer:*** ● We first verify that the requirements are satisfied. The sample is a simple random sample and the population is normally distributed. Since the population standard deviation is unknown, the margin of error is calculated using $t_{\alpha/2}$. The critical value is 2.064 and the degrees of freedom is 24. The 95% confidence interval is now calculated as follows: $7.01 - 2.064\frac{3.74}{\sqrt{25}} < \mu < 7.01 + 2.064\frac{3.74}{\sqrt{25}}$. Evaluating this results in 5.47 years < μ < 8.55 years. ● Based on this result, we are 95% confident that the limits of 5.47 years and 8.55 years actually do contain the value of the mean time car owners plan to keep their cars. **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, 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. **Spot Light On:** *Seek multiple perspectives and different answers to questions.*

	true population proportion 95% of the time. ● The higher confidence level, the wider the interval of the estimate must be. ● A critical value is the number on the borderline separating sample statistics that are likely to occur from those that are unlikely to occur. ● The margin of error is the maximum likely difference between the observed sample statistic and the true value of the population parameter. ● To use sample data to construct a confidence interval estimate for a population	**Teacher Resources** online achievethecore resource online learnzillion resource online khanacademy resource online desmos resource online ixl resource

	mean, the sample must be random sample and the value of the population standard deviation must be known. Also either the population is normally distributed or the sample size is greater than 30. ● To use sample data to construct a confidence interval for a population mean, if the population standard deviation is unknown then a Student *t* distribution must be used. ● The number of degrees of freedom for a collection of sample data is the number of	

	sample values that can vary after certain restrictions have been imposed on all data values. ● Confidence intervals for variances and standard deviations can be computed by using the chi-square distribution. ● A sample is a simple random sample and the population is normally distributed are two assumptions that must be checked when constructing a confidence interval for a variance or a standard deviation. ● A chi-square variable cannot	

	be negative and the distributions are skewed to the right.	
Content Statements	**Cumulative Progress Indicators**	
Students will know… ● How to find the best point estimate of a population parameter ● How to estimate the value of a population parameter with a confidence interval ● How to correctly interpret a confidence interval ● How to generate confidence intervals from many samples to see how often they successfully capture the true proportion ● How to obtain critical values for the normal, *t,* and chi-square distributions. ● How to determine sample sizes necessary to estimate population proportions, means and variances. ● How to determine when to use the *z* distribution or *t* distribution when	● Tests ● Quizzes ● Practice problems for homework ● Workbook pages ● Worksheets	

obtaining a confidence interval estimate for a population mean.
- How to interpret and use a chi-square distribution with tables.
- How to use a graphing calculator to calculate confidence intervals

Desired Results

- **Population Parameters**
- **Chi-square distribution**
- **Z distributions and t distributions**
- **Calculate confidence intervals**

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.**

Standards for Mathematical Practices

8. Look for and express regularity in repeated reasoning.	

Probability and Statistics - Unit 7 Estimates and Sample Sizes	Revised August 2023 Revised Nov 2021 20 - 25 Days

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

- Alan Turning: English mathematician, computer scientist, logician, cryptanalyst, philosopher, and theoretical biologist. Turning was highly influential in the development of theoretical computer science.

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.

New Jersey Legislative Statutes and Administrative Code (place an "X" before each law/statute if/when present within the curriculum map)								
	Amistad Law: *N.J.S.A. 18A 52:16A-88*		Holocaust Law: *N.J.S.A. 18A:35-28*	x	LGBT and Disabilities Law: *N.J.S.A. 18A:35-4.35*	x	Diversity & Inclusion: *N.J.S.A. 18A:35-4.36a*		Standards in Action: *Climate Change*