Basic Statistics and Probability (2018-19)
Science & Engineering Program Boston University-Faculty of Science UAM

Chapter 7: Inferences Based on a Single Sample. Estimation with Confidence Intervals

The following problems are from McClave, J. and Sincich, T. (2017), *Statistics*, 13th. edition, Pearson. The number preceding the exercise is the corresponding one from this textbook. Some of the problems may also appear in previous editions of the book, possibly with different numbering.

7.7 Find $z_{\alpha/2}$ for each of the following:

a. $\alpha = .10$
b. $\alpha = .01$
c. $\alpha = .05$
d. $\alpha = .20$

7.11 A random sample of 100 observations from a normally distributed population possesses a mean equal to 83.2 and a standard deviation equal to 6.4.

a. Find a 90% confidence interval for μ.
b. What do you mean when you say that a confidence coefficient is .95?
c. Find a 99% confidence interval for μ.
d. What happens to the width of a confidence interval as the value of the confidence coefficient is increased while the sample size is held fixed?
e. Would your confidence intervals of parts **a** and **c** be valid if the distribution of the original population were not normal? Explain.

7.33 Let t_0 be a specific value of t. Use technology or Table III in Appendix B to find t_0 values such that following statements are true:

a. $P(t \geq t_0) = .025$, where df $= 10$
b. $P(t \geq t_0) = .01$, where df $= 17$
c. $P(t \leq t_0) = .005$, where df $= 6$
d. $P(t \leq t_0) = .05$, where df $= 13$

7.39 Radon exposure in Egyptian tombs. Many ancient Egyptian tombs were cut from limestone rock that contained uranium. Since most tombs are not well-ventilated, guards, tour guides, and visitors may be exposed to deadly radon gas. In *Radiation Protection Dosimetry* (Dec. 2010), a study of radon exposure in tombs in the Valley of Kings, Luxor, Egypt (recently opened for public tours), was conducted. The radon levels – measured in becquerels per cubic meter (Bq/m^3) – in the inner chambers of a sample of 12 tombs were determined. For this data, assume that $\bar{x} = 3,643$ Bq/m^3 and $s = 1,187$ Bq/m^3. Use this information to estimate, with 95% confidence, the true mean level of radon exposure in tombs in the Valley of Kings. Interpret the resulting interval.

7.55 A random sample of size $n = 196$ yielded $\hat{p} = .64$.

a. Is the sample size large enough to use the large sample approximation to construct a confidence interval for p? Explain.
b. Construct a 95% confidence interval for p.
c. Interpret the 95% confidence interval.

7.65 What we do when we are sick at home. *USA Today* (Feb. 15, 2007) reported on the results of an opinion poll in which adults were asked what one thing they are most likely to do when they are home sick with a cold or the flu. In the survey, 63% said that they are most likely to sleep and 18% said that they would watch television. Although the sample size was not reported, typically opinion polls include approximately 1,000 randomly selected respondents.

a. Assuming a sample size of 1,000 for this poll, construct a 95% confidence interval for the true percentage of all adults who would choose to sleep when they are at home sick.
b. If the true percentage of adults who would choose to sleep when they are at home sick is 70%, would you be surprised? Explain.

7.82 It costs you \$10 to draw a sample of size $n = 1$ and measure the attribute of interest. You have a budget of \$1,500.

a. Do you have sufficient funds to estimate the population mean for the attribute of interest with a 95% confidence interval 4 units in width? Assume that $\sigma = 12$.
b. If you used a 90% confidence level, would your answer to part **a** change? Explain.

7.88 Aluminum cans contaminated by fire. A gigantic warehouse located in Tampa, Florida, stores approximately 60 million empty aluminum beer and soda cans. Recently, a fire occurred at the warehouse. The smoke from the fire contaminated many of the cans with black-spot, rendering them unusable. A University of South Florida statistician was hired by the insurance company to estimate p, the true proportion of cans in the warehouse that were contaminated by the fire. How many aluminum cans should be randomly sampled to estimate the true proportion to within .02 with 90% confidence?

7.98 Preventing production of defective items. It costs more to produce defective items–since they must be scrapped or reworked–than it does to produce non-defective items. This simple fact suggests that manufacturers should ensure the quality of their products by perfecting their production processes instead of depending on inspection of finished products (Deming, 1986). In order to better understand a particular metal stamping process, a manufacturer wishes to estimate the mean length of items produced by the pro- cess during the past 24 hours.

a. How many parts should be sampled in order to estimate the population mean to within .2 millimeter (mm) with 95% confidence? Previous studies of this machine have indicated that the standard deviation of lengths produced by the stamping operation is about 2 mm.
b. Time permits the use of a sample size no larger than 100. If a 90% confidence interval for μ is constructed with $n = 100$, will it be wider or narrower than would have been obtained using the sample size determined in part **a**? Explain.