AP Statistics / Mr. Hansen
3/5/2015

Snow Day Mini-Project:
Are 95% Confidence Intervals Really 95% Accurate?

This mini-project should take you approximately two hours to complete. Before you dive in, give careful thought to how you will organize, capture, and present your raw data. Scoring will follow the rubric outlined below. This mini-project will constitute approximately 50% of your grade for the test that was originally scheduled for today. The remaining points will come from a 20-minute in-class quiz on Tuesday, March 10.

Ground Rules

1. Work alone. The skills tested in this mini-project are skills that could have been tested on an in-class test, though they would have been covered in less depth during an in-class test. When you place your name in the upper right corner of the first sheet of paper that you submit, you are certifying that the work represented in your mini-project is your work, and yours alone.

2. Use of tutors, parents, friends, classmates, or any other human being constitutes a violation of the rules. You need to work alone. You may ask Mr. Hansen questions for clarification, but no hints will be given.

3. Use of non-human supplementary resources (textbook, *static* web pages, or other published materials) is permitted. In particular, you will need to use the random digit table on pp. 814-815 of your textbook. Other than that, however, please try to do the mini-project without consulting supplementary resources, since you should already know the skills being tested here.

4. Interactive web pages are **prohibited.** For example, you may not post a question related to this assignment on a web page or a chatroom. You may not use Skype, instant messaging, telephone, texting, or any other communications system for getting hints or collaborating with other people. You may not use Internet-based analytic tools (e.g., lock5stat.com/statkey) to do part or all of the work for you. **All work done in this mini-project must be yours and yours alone.**

5. Use of a TI-83 or TI-84 calculator is assumed. A spreadsheet (e.g., Excel) is permitted, but only your hard-copy submission will be graded. If you use a spreadsheet, only the raw data tabulation and summary statistics may be computed using the spreadsheet; all other questions must be answered in pencil and paper. A spreadsheet is not required.

6. Please use pencil. A small point deduction will be made if you use pen. Cryptic, sloppy, or illegible submissions will be penalized more heavily in the point scoring.

7. Your writeup is due at 3:00 p.m. on Friday, March 6. Submit your writeup *in person* to Mr. Hansen on or before the deadline. In the event that school is canceled for March 6, the due date will be extended to 3:00 p.m. on Monday, March 9.

8. Stapling is not required. However, regardless of whether or not you use staples, your initials must be in the upper right corner of each continuation page. Follow the homework guidelines that we have used all year (http://staweb.sta.cathedral.org/departments/math/mhansen/public_html/goodhw.htm), except that you may use the full width of the page.

Scoring Rubric for the Mini-Project

Points for the mini-project will be allocated as follows:

Question 1: Time log (2%)
Question 2: Methodology and NPP (25%)
Question 3: Execution of simulation (20%)
Question 4: Explanation of why PHASTPC fails (20%)
Question 5: Conclusion (20%)
Neatness and overall quality of presentation (13%)

Mini-Project Questions

Your writeup must address each of the following questions. Number them on your paper.

1. At the top of the first page, near your name, record your start time and end time. The amount of time you took will not affect your score, but the time log must be present for full credit.

2.(a) Produce a population of 50 real numbers in an approximately normal distribution. At least some of your numbers must be negative. List your numbers.

(b) Use a normal probability plot (NPP) to demonstrate that your population closely follows a normal distribution. You must show the NPP in your writeup, of course.

(c) Compute the population mean, using correct notation. *Note:* In the real world, of course, we would almost never know the true population mean. We are computing it here in order to perform a simulation to estimate how likely it is that a 95% C.I. captures the true population mean, and in order to do that, we need to know what the population mean is.

(d) Describe a methodology for using the random digit table on pp. 814-815 of your textbook to select 20 SRS's of size 6 from your population. Describe how your procedure can be used to estimate the parameter p, where p is defined to be the probability that a 95% C.I. generated from an SRS of size 6 captures the true population mean. Specify all your details: what row of the random digit table you are starting on, how you will pick your SRS of size 6, how you will compile the data, and how you will compute the estimate of parameter p. Use standard statistical notation and terminology.

3. Execute the simulation described in question 2(d). Record all of your raw data in a table that is easy to understand. For the first SRS of size 6, show all the work for the computation of the 95% C.I. for the mean. For the other 19 SRS's, simply punch buttons on your calculator to find the 95% C.I. for the mean in each case. In your table, record the lower and upper endpoints of the C.I. for each of the 20 trials, and remember to indicate clearly whether the true mean was or was not captured by the C.I.

4. Look at the subtitle of this mini-project: *Are 95% Confidence Intervals Really 95% Accurate?* We would like to design a significance test to address this research question.

In particular, we want to see whether there is evidence that the true probability of capturing the population mean in a C.I. is less than 95%. Set up the P, H, and A steps only, and in your A step, clearly indicate the type of statistical test that you would want to use. Explain clearly why we cannot proceed by using the data gathered in question 3. *Do not perform the S, T, P, or C steps.*

5. Conclusion: What do you think? Are 95% confidence intervals really accurate 95% of the time? Explain how you would go about addressing this research question, and explain some of the issues involved for real-world data where the true nature of the distribution and population mean are uncertain. (After all, that's the way things are in the real world.) For full credit, connect your answer with the recent BASP ban on *P*-values and confidence intervals. It is not required for you to conduct additional research, although you are certainly welcome to do that if you wish. A good, solid answer to this question should take approximately two paragraphs.