

II. Instructor Notes

Disciplines/courses suitable for this project: This project is an appropriate supplement to any introductory course in history or political science.

Degree of difficulty: Depending on the type of simulation and post-project discussion on interpretation of the results, this project is classified as M (moderately difficult), A (advanced.)

Resources/background needed:

In addition (or in place) of simple simulation using marbles, one could create random samples using a software(Minitab) or through a simple Java code (see [3]) or other codes [2]. The results can be saved in a text document and exported to Minitab for graphing the histogram. It is important to give students(specifically the non-science majors, step by step instructions for the digital randomization. The population size(max number) is fixed at 100. The user will start with a small sample size of 3 and gradually increase the sample size. As expected , as we increase the sample size and/or the number of trials, we expect to get smaller standard deviation and our result will be closer to the actual value of 100.

Software

For the data collecting, just about any program that can collect numbers in a set range will work, or one can write a java [3] or [3]. For the graphing the histograms and descriptive statistics ,Minitab works well, and Excel would likely work as well. In Minitab, to generate a histogram, you click on the “Graph” tab at the top panel, then on the “Histogram...” button in the second partition. After choosing the simple fit and entering the data you should have a histogram. Minitab chooses its own class/interval size, but you can customize the interval it fairly easily.

Expanding the study

- Reference [4] of the student version has a formula for estimating the standard deviation based on the sample size and number of trials. It is a good exercise to let students compare their own with the value predicted by that formula.
- There are various applications of German tank formula (ex; number of a certain brand of car produced in a given year by taking a small sample of a component which is numbered sequentially, etc.). it is important to emphasize to students that German tank formula only estimates the size of a population where the elements are numbered sequentially.

About running individual or group project: Groups of 2-3 should work together in this project. Instructor might also assign different sample sizes to different groups. Students should be notified that during the presentation of their results, the instructor and the

audience will be asking questions and all members of the group should be prepared to answer those questions.

Discussion on duration of the project: The **M** (medium difficulty) version of this project should take two period of a typical course. A more advanced version, where we add digital simulation, may take three class sessions.

Open ended questions:

- Why do you think larger samples give us more accurate results?
- Can you think of a way to improve the original formula?
- Can you think of a way to improve the estimate using the original formula?

Special instructions and assumptions: Students should be reminded about underlying assumption about the German tank formula. Specifically, the elements of the population should be sequential, and samples should be random.

Other information for faculty not covered above:

Most, if not all, of the students in a non-STEM elementary course do not have a background in statistics. It is essential to set aside one class to discuss the basics topics such as mean, standard deviation and histogram (without the statistical jargon). Also step by step instructions for the use of software, should be part of the pre-project discussions.