**Comparing Student Performance in Different Countries**

The Program for International Student Assessment[[1]](#footnote-1) (PISA) is an international exam that is administered to 15-year-old students in many different countries every three years.

This activity will look at data from the PISA that was conducted in 2009. This particular exam was worth 219 points. 515,958 students from around the world took the 2009 PISA. A random sample from those students was taken from the United States, Finland and Spain, each with a sample size of 100. Your instructor will provide the data file for this activity.

**Research Question:** How large are the differences in student performance on the PISA exam for the United States and Finland?

**Discuss the Following Questions**

1. If you are comparing the mean total scores for the United States and Finland, what statistic would be of interest? Would you be looking at a one-sample mean, two-sample means, mean of paired data, or two-sample means? Explain.
2. How is a bootstrap interval for two-sample means different from a bootstrap interval for one-sample or paired data?

* Open a web browser and go to <http://lock5stat.com/statkey>.
* Click on the appropriate link to simulate the difference in total scores for the United States and Finland.
* Open the file *PISA.csv*.
* In *StatKey*, click on the button that says *Edit Data*.
* Highlight all of the data in the window and press Delete.
* Copy the data for Finland and US. Paste it into the *Edit Data* window. Uncheck the *Data has a header row* box. Then click Ok.
* Simulate at least 10,000 bootstrap samples to compare the mean total scores for the United States and Finland.

1. What are the sample mean total scores for each country?

1. Look at the distribution of the bootstrap samples. Will it matter which approach you use (the standard error approach or percentile approach) to create a bootstrap interval?
2. Create a 95% bootstrap interval to compare the mean total scores for the United States and Finland.
3. Where is the interval centered? Why does that make sense?
4. In order to answer the research question, provide an interpretation of the interval you created.
5. Does the interval include 0 between the limits? Explain what that means.

**Research Question:** How large are the differences in student performance on the PISA exam for the United States and Spain?

* In the applet, edit the data so it only includes the data for the United States and Spain.

1. What are the sample mean total scores for each country?
2. Is the sample mean for the United States more different than the sample mean for Finland or the sample mean for Spain?
3. Based on your answer to the previous question, do you think the bootstrap interval for the difference between the United States and Spain is more or less likely to include 0 between the limits than the bootstrap interval for the difference between the United States and Finland? Explain.
4. Create a 95% bootstrap interval to compare the mean total scores for the United States and Spain.
5. In order to answer the research question, provide an interpretation of the interval you created.
6. Does the bootstrap interval include 0 between the limits? Explain what that means.

**EXTENSIONS**

1. Create a 90% bootstrap interval to compare the mean total scores for the United States and Spain. To do this you will need to change the value in the middle box on the plot.
2. Why would you want to create an interval with a lower confidence level? What benefits are there to creating an interval with a lower confidence level?
3. Is the value of 0 included between the limits of the 90% bootstrap interval? Explain what that means.
4. Is it possible that a bootstrap interval with a lower confidence level would not include 0 when the bootstrap interval with the higher confidence level did?

1. National Center for Education Statistics (2011b). Program for international student assessment (PISA). Washington, D.C.: U.S. Department of Education, Retrieved from <http://nces.ed.gov/surveys/pisa/>. [↑](#footnote-ref-1)