# Confidence Intervals Homework

## Part 1 – Filtration System Analysis

A new filtration system (Method B) has been developed to filter out smaller particles (they want large particles, not small ones). In order to test the performance of the new filtration system, 10 samples were taken using the old method (Method A), and 10 samples were also taken using the new method (Method B). The samples were taken downstream of the filter system. See data file for HW2

1. Calculate the mean and 95% Confidence Interval of Method A as a function of how many samples were taken – i.e. do the calculation nine times as if you took 2,3… or 10 samples. Graph the results with the mean and confidence interval on the y-axis and number of samples on the x-axis.
2. Repeat question 1) for Method B
3. Answer the following questions about your graphs from question 1 & 2 (it may be necessary to plot additional graphs)
   1. How many samples do you need to take with method A before you reach a point of diminishing return on the confidence interval? For method B?
   2. Can we determine if there is a statistical difference between the methods? If so, which method was better at filtering out large particles?
4. Calculate the difference of means as function of the number of runs. Graph your results with the mean and confidence interval on the y-axis and the number of samples on the x-axis. You may assume the variances remain the same
5. Answer the following questions about your graph from question 4 (it may be necessary to plot additional graphs)
   1. Can we determine if there is a statistical difference between the methods? If so, how many samples do we need to take?
   2. What would we be able to tell if we would have taken only 4 samples of each method
6. If your boss wants to know which filtration system is better, what would your answer be? Don’t forget to explain it quantitatively.

## Part 2 – Voltage Measurement

1. After doing such a good job on the filtration project your boss comes to you and asks you do determine the mean output voltage of a particular device.
   1. The equipment you have in the lab will measure the voltage to ±0.1 volts at 95% confidence. Assuming the output voltage is supposed to be 12.0 ±0.03 volts, how many runs would you need to take to assure your boss to a 95% confidence that this was the true output voltage? Use a random number generator to determine your results.
   2. If you could measure the voltage to ±0.05 volts at 95% confidence, how many runs would you need?
   3. What do your findings from 7a & 7b tell you.
   4. Can you think of a way to perform the calculations without generating fake data? (hint: Suppose you were to estimate s from a limited amount of data. Could you predict what would happen if more data were taken?). Explain your answer