

Homework 1

Due Thursday, 1/28/20 on Canvas.

This homework contains one problem and is designed to get you to start thinking critically about data. You learned all of the techniques necessary to do this problem last semester. Homework 2 will be the first homework to contain material from this semester.

1. The National Bureau of Standards performed eight series of experiments between 1924 and 1935 to determine g , the acceleration due to gravity. The National Bureau of Standards (now called the National Institute of Standards and Technology) is the government agency that measures things. The following statement is taken from the NIST website: “Founded in 1901, NIST is a non-regulatory federal agency within the U.S. Department of Commerce. NIST’s mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.” Thus, it is safe to assume that the NBS scientists were trying hard to measure the same quantity g (e.g., all experiments were done in the same location) throughout all eight series of experiments. The data are given in “Gravity.txt”. The column “Series” represents the experiment group number (ordered by time), where series 1 represents the earliest set of experiments and series 8 the last. The column “Value” is the measurement taken in each experiment in deviations from 9.8 m/s^2 times 10^5 . For example, the value for the first measurement is 9.80076 m/s^2 .
 - (a) Consider testing the null hypothesis that the means for all 8 series are equal versus the alternative that they are not. What scientific conclusion would you draw if the data did not support the null hypothesis?
 - (b) Calculate the standard F statistic for this null hypothesis and obtain the p-value for this statistic. State explicitly the assumptions underlying this test procedure.
 - (c) Compute the likelihood ratio statistic for the null hypothesis that the means are all equal allowing for a different variance for each series (but still assuming the observations are independent and Gaussian) and assess its statistical significance. (You may be able to find a routine in R or SAS that will do this for you, or you may try to do this from first principles.)
 - (d) Assuming the observations in each series are given in time order taken, plot the observations in a way that preserves both the time order of the series and the time order of the observations within each series. What does your plot suggest about the validity of the various assumptions you made in parts (b) and (c)?
 - (e) Doing whatever analyses you deem appropriate, provide your best estimate of g at the location of these experiments and a standard error of your estimate using only the data in “Gravity.txt”.