Math 20
Lab 2
Due: July 20 2015

The goal of this lab is to use permutation statistics to analyze certain stocks using R. Start by downloading the files `ge_data.txt` and `apple_data.txt` from the course website. Each file contains the closing stock prices (adjusted for dividends and splits) for General Electric and Apple respectively from January 2, 2001 to July 11, 2015.

We can use R to analyze this data. After downloading the text files, open RStudio and navigate to the directory where the text files are saved. Then click the `more` icon under the Files tab and select `Set As Working Directory`. To get R to "read" the data (so that we can manipulate it) use the command: `data <- read.table("apple_data.txt")`. This creates a table called `data` that contains the stock prices from the Apple file. To select a specific data element, we use the usual indexing syntax. For instance, the ith row and jth column element is `data[i,j]`. Note that the way the data is stored there is only 1 column. To treat the entire table as a vector use `data[ ,1]`.

As described in class, we want to decide whether the sequence of stock prices behaves "randomly." I proposed one way of doing this by generating permutations from the data and computing certain permutation statistics and comparing the observed statistics to statistics for random permutations. One way of generating permutations from our data is by looking at consecutive days of trading and giving prices a relative ordering. For instance, if we look at four consecutive days of trading and observe prices: $\{1.21, 2.01, 1.05, 2.59\}$ this would yield the permutation (in one-line notation) $\{2, 3, 1, 4\}$. One permutation statistic that we studied in class was the probability of a permutation containing at least one fixed point. We will use this statistic throughout the lab.

1. Open an R script and name it `rand_yourlastname.R`. In this script we will verify that a random vector of prices yields a random permutation statistic. Generate a vector of size 10000 that contains random real numbers between zero and 1 (use the `runif()` command). This vector will represent random prices in 10000 days of trading. Every 10 consecutive days of trading yields a permutation. Loop over all consecutive 10-day trading sequences and record whether the permutation generated contains a fixed point. The `sort()` command might be useful. Use this data to derive an experimental value for the probability that a random permutation has at least one fixed point. Your script, once executed, should print the experimental value for the probability that a random permutation has at least one fixed point. Does your experimental value agree with the theoretical value? [Hint: it should.]

2. Open an R script and name it `stocks_yourlastname.R`. This script will compute the experimental probability that a 10-day consecutive trading sequence of Apple or GE stock generates a permutation with at least 1 fixed point. Your script should print out the experimental probability.

Along with the scripts for tasks 1 and 2, in your email please compare the experimental probabilities for the stock data and probability for the random data. Be sure to address the

following questions: 1) Do you think either of the stocks prices fluctuate randomly? 2) Does one stock seem to have more structure (i.e. behave less randomly) than another? Feel free to plot the stocks (you don't have to include the plots in your email) to provide evidence for your claims in answering 2).