STAT 540: Test 1

1. (20 pts) You will receive full credit if you minimize the number of lines of code for each sequence and you minimize the use of `c()`.

   (a) Generate the following sequence: 2,4,6,8,2,4,6,8

   (b) Modify your code to generate the following sequence: 2,2,4,4,6,6,8,8,2,2,4,4,6,6,8,8

   (c) What sequence would the following command generate? `seq(.1, 1.2, by=.3)`

   (d) Graduate Students. Generate the following sequence: 1.5, 1.2, 0.9, 0.6, 0.3

2. (30 pts) Write the outcome after each step of the following commands.

   (a)
   ```
   m1=matrix(rep(2:4,1:3),nrow=2)
   m2=matrix(rep(2:4,each=2),ncol=2,byrow=T)
   apply(m1,1,sum)
   rbind(t(m1),m2)
   ```

   (b) Graduate Students should show how they would add the column from the `apply` statement to m1.

3. (20 pts) The following code from class simulates n=1000 draws from a beta random sample with beta shape parameters $\alpha = 5$ and $\beta = 1$, which are then used to estimate $E(-ln(X))$.

   ```
   n <- 1000
   rand.beta <- rbeta(n,5,1)
   Expect.val <- (1/n)*sum(-log(rand.beta))
   ```

   (a) Write a `for` loop so that the above script is run `nloop=50` times. `Expect.val` should be a numeric vector in the `for` loop that stores the result from each of the `nloop=50` runs.

   (b) Write commands to plot a histogram of the values stored in Expect.val and to draw a blue vertical reference line at 0.2 (the actual value of the function).

   (c) Graduate students should create a function named Beta.sim based on the work from (a). The function should allow the user to specify nloop, n, a and b, and return the value of Expect.val.

4. (30 pts) 30 bridge decks were inspected for damage using two different remote-sensing methods–GPR (Ground Penetrating Radar) and IR (Infrared). Suppose we have numeric vector `GPR` (Percent damage detected by GPR), numeric vector `IR` (Percent damage detected by IR) and factor Type (Highway type with 1=secondary road, 2=primary road, 3=state road, 4=US road, 5=interstate). List commands for each of the following tasks.

   (a) Create a dataframe named Bridge from these 3 variables. Use Bridge as the dataframe for the remaining tasks.

(b) Extract records where GPR is greater than 30%. In addition, graduate students should provide code to recover the indices of these records.

(c) Extract rows where percent damage detected by GPR on interstates is less than 50%.

(d) Change the name of `Type` in the dataframe to `RoadType`.

(e) Order the data frame so that IR damage is ranked from lowest to highest.

(f) Compute the mean percent damage detected by GPR for each highway type. Efficient coding is important here.