Homework 4

Answer the following questions using: R.
Submitted homework solutions should be well written and should include all R code and R output. R Markdown is a useful tool for doing this nicely.

1. Thirty recreational basketball players were asked to shoot two free throws. Data on whether the made or missed their shots are shown in the table below. The question of interest is whether the probability of making a shot on the first attempt is difference than the probability of making a shot on the second attempt.

```
mat<-matrix(c(4,5,14,7),ncol=2)
rownames(mat)<-c("Made First","Missed First")
colnames(mat)<-c("Made Second","Missed Second")
mat

##                Made Second Missed Second
## Made First              4            14
## Missed First            5             7
```

   (a) Use McNemar's test to answer this question.

   (b) (GRAD ONLY) Ignore the pairing of the data and analyze this data using a permutation χ^2 test. Compare this p-value with the p-value from the previous part. Comment.

2. The data below are the eosinophil counts taken from blood samples of 40 health rabbits. Obtain bootstrap estimates of the MSE and standard error of the sample mean, the standard deviation and the 95-th percentile.

```
eosinophil<-c(55,140,91,122,111,185,203,101,
              76,145,95,101,196,45,299,226,
              65,70,196,72,121,171,151,113,
              112,67,276,125,100,81,122,71,
              158,78,162,128,96,79,67,119)
```

3. Simulation Study 1:

   - Generate a random sample of size $n = 15$ from a normal distribution witn mean 5 and variance 36.
   - Calculate $\bar{X}$ from your sample.
   - What is the true value of $var(\bar{X})$?

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- Calculate $var(\bar{X})$ using the bootstrap approach based on your random sample of data.
- Compare the theoretical $var(\bar{X})$ to the bootstrap estimate $var(\bar{X})$.

4. (GRAD STUDENTS ONLY) Simulation Study 2:

- Generate a random sample of size $n = 100$ from a random variable X such that $X|B = 1 \sim Normal(20, 5)$, $X|B = 0 \sim Normal(10, 10)$, and $B \sim Binomial(1, p = 0.75)$.
- Calculate $\bar{X}$ from your sample.
- What is the true value of $var(\bar{X})$?
- Calculate $var(\bar{X})$ using the bootstrap approach based on your random sample of data.
- Compare the theoretical $var(\bar{X})$ to the bootstrap estimate $var(\bar{X})$.