MA 331 Intermediate Statistics — Homework 2
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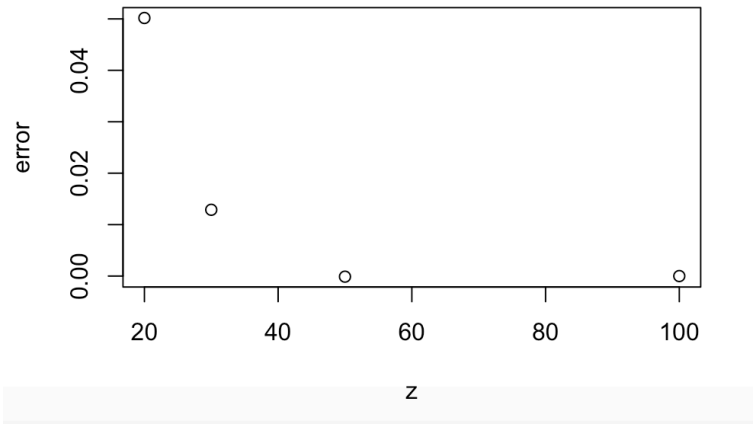
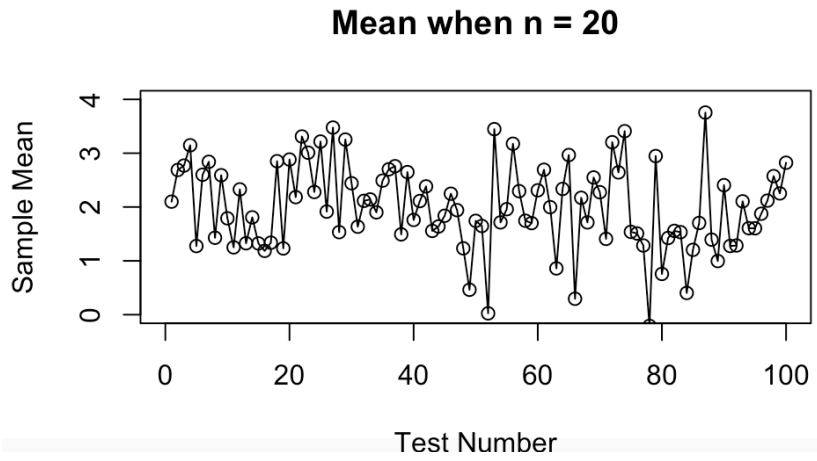
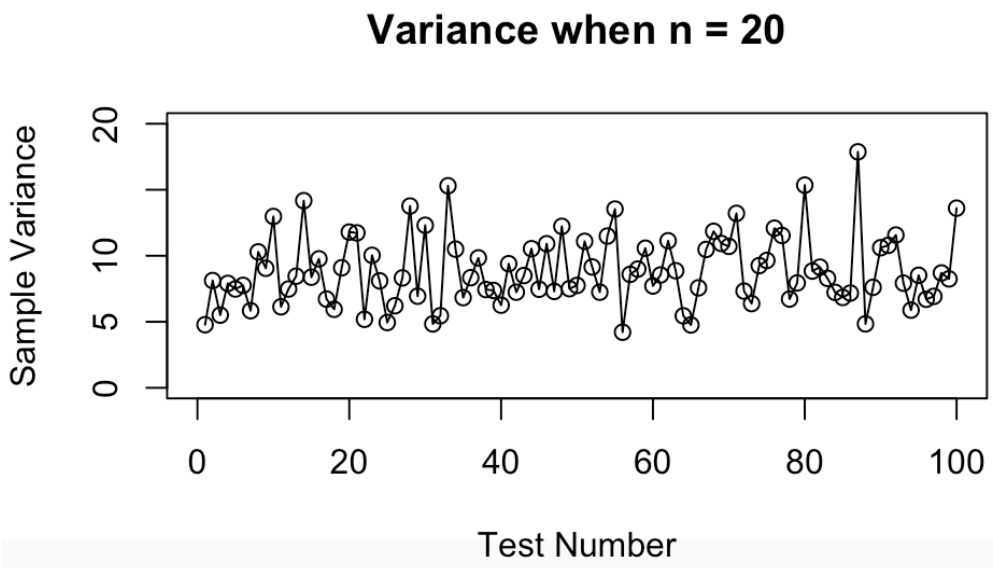
1. Assume that *N* has Binomial distribution with number of trials *n* and probability of success *p=0.4.*
   a. For *n=20, 30, 50* and *100,* accurately compute *P(N<=8.25)* by using R function.
   ```
   > x <- c(20, 30, 50, 100)
   > pbinom(8.25, size = x, prob = 0.4)
   [1] 5.955987e-01 9.401122e-02 2.305229e-04 5.431127e-13
   ```
   b. Compute *P(N<=8.25)* by using normal approximation through Laplace theorem.
   ```
   > n <- c(20, 30, 50, 100)
   > np <- (n*0.4)
   > npp <- (np*0.6)
   > num <- (8.25 - np)
   > denom <- sqrt(npp)
   > pnorm((num/denom), mean = 0, sd = 1)
   [1] 5.454243e-01 8.112525e-02 3.470073e-04 4.557597e-11
   ```
   c. Evaluate and plot errors of all approximation in B

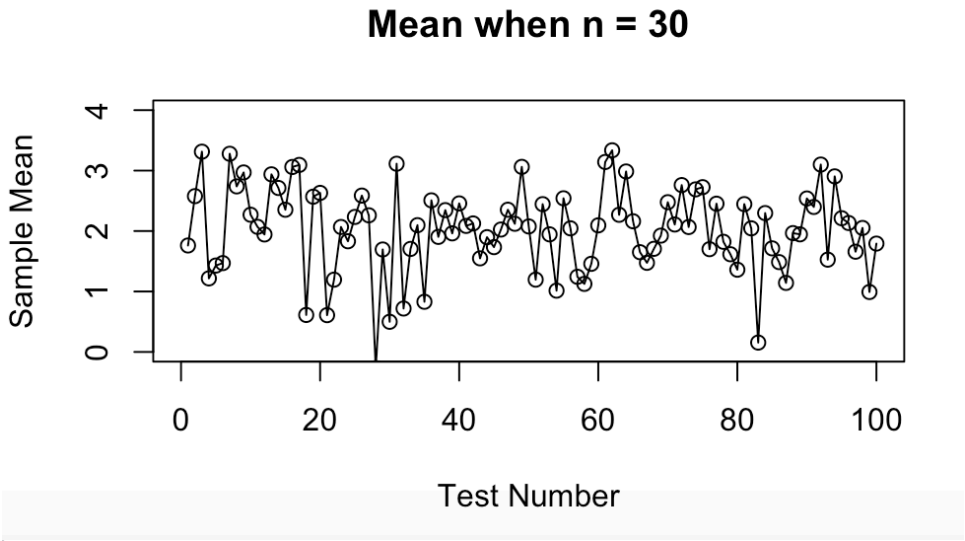


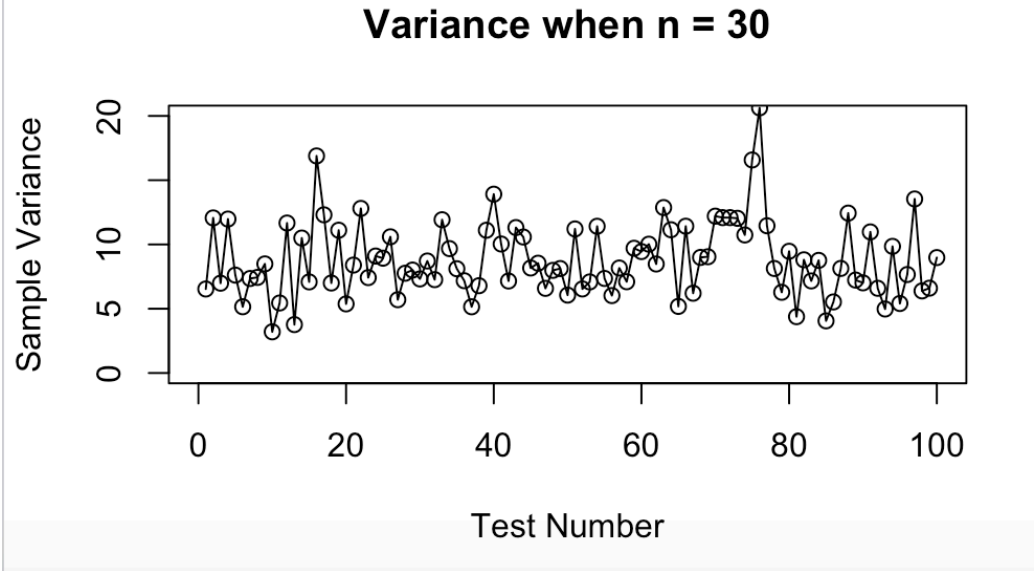

   ```
   [1]  5.017440e-02  1.288597e-02 -1.164844e-04 -4.503286e-11
   ```
   d. What do you perceive based on the plot?
   Based on the plot, I noticed that the larger the size value (n in this case), the smaller the error, which means to approximate the closest to the correct probability, you need to have a large n.
2. By using R function generate a simple and random sample of size *n* for the population *X* having normal distribution with mean *2* and variance 3^2.
   a. Let *n=20,* compute sample mean $\frac{(\bar{X}-2)}{\sqrt{3^2/n}}$ and sample variance $\frac{(n-1)S^2}{3^2}$. Then, repeat (a) for 100 times and plot $\frac{(\bar{X}-2)}{\sqrt{3^2/n}}$ and sample variance $\frac{(n-1)S^2}{3^2}$ *respectively.*



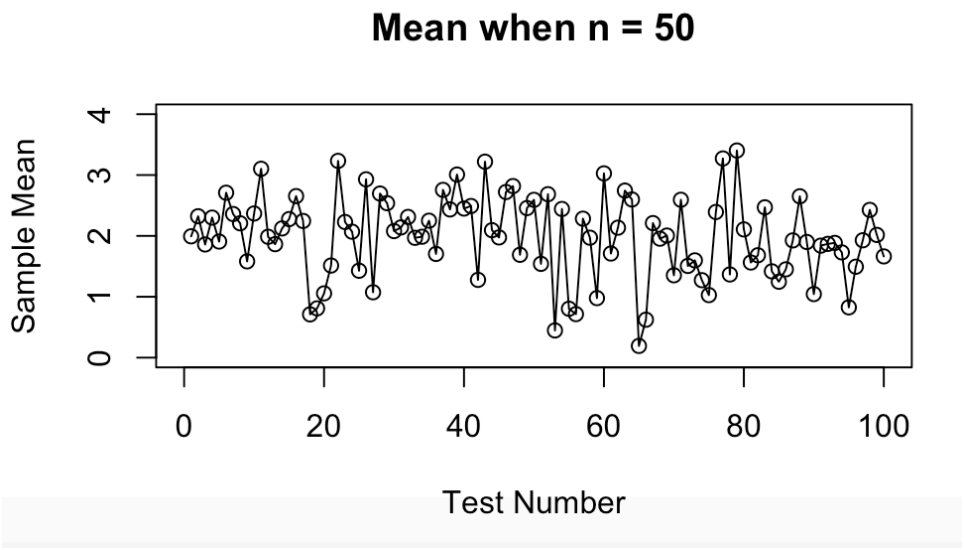


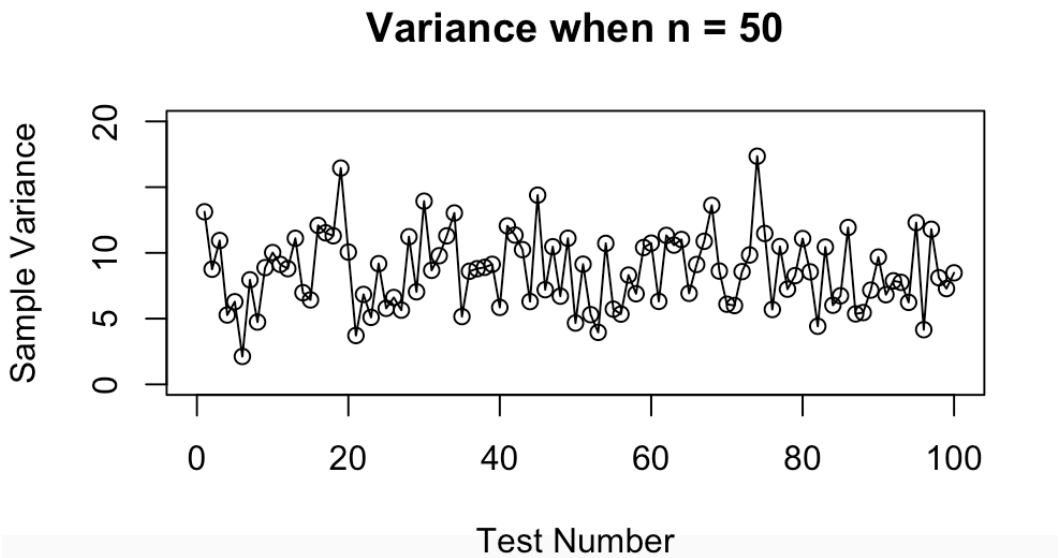
b. For n=30, repeat (a) for 100 times and plot $\frac{(\bar{X}-2)}{\sqrt{3^2/n}}$ and sample variance $\frac{(n-1)S^2}{3^2}$.





c. For n=50, repeat (a) for 100 times and plot $\frac{(\bar{X}-2)}{\sqrt{3^2/n}}$ and sample variance $\frac{(n-1)S^2}{3^2}$ ^{2}.





d. Describe your findings based on plots in (a), (b) and (c).
Based on the plots, it seems that the larger your sample size, the closer the results are together. It seems like the set that the sample variances and the sample means lie in get a little smaller when the size of the sample gets larger.