Math 505 Lab 2

Import the data set Lab2Data.txt into R. This data consists of four columns, Y, X_1, X_2, and X_3 (in this order), which were generated from the model

$$Y_i = 50 + 5X_{i1} + 20X_{i2} - 0.6X_{i3} + \epsilon_i, \text{ for } i = 1, \ldots, 100,$$

where the ϵ_i's are IID normal random variables with a mean of zero and standard deviation $\sigma = 10$.

Let's place the data into four R vectors called Y, X1, X2, and X3. Now, let's pretend that we don't know what the model coefficients are. We can estimate them using R's linear model function as follows

```
mymodel=lm(Y~X1+X2+X3)
summary(mymodel)
```

Notice that the estimated coefficients are close to the true coefficients from the model above. The goal of this lab is to write functions to perform the tasks given below, and to test these functions using the given data. On each problem, the corresponding R command will be given as well, so that you can learn these commands and check your work. For this lab, please turn in a script containing all of your functions, and a document that has your results for this particular data set.

Write a function that accepts a vector Y and a design matrix X and returns each of the following. When writing each function, you can use other functions that you have already written.

1. The corresponding OLS estimate $\hat{\beta}$. Test your function on the given data, and compare to the commands

   ```
   coef(mymodel)    #or
   mymodel$coefficients
   ```

2. The vector of residuals e. Compare to

   ```
   residuals(mymodel)   #or
   mymodel$residuals
   ```

3. The estimate $\hat{\sigma}$. Compare to

   ```
   summary(mymodel)$sigma
   ```

   Also note that this appears as "Residual standard error" in the model summary.

4. The estimated covariance matrix $\widehat{\text{cov}}(\hat{\beta})$. Compare to

   ```
   vcov(mymodel)
   ```