

Statistics 624: Statistical Computing
Homework # 8

Due Tuesday, 9 Oct., 8am

In this assignment, please complete, organize, and turn in **electronically** to `stat624@stat.byu.edu`.

This assignment creates two different programs for creating the $\mathbf{X}'\mathbf{X}$ matrix in preparation for computing the least squares estimator.

1. In most applications, the data file contains the rows and columns for the \mathbf{X} matrix and we expect the software to add the ‘column of ones’ for the Y -intercept.

Write a C program with the following features:

- read in a matrix from a file
 - supplement the matrix with a column of ones
 - write a `double` function that returns the inner product of two vectors. (arguments are `double` vectors and `int` length of the vectors)
 - write a function to compute $\mathbf{X}'\mathbf{X}$ that uses the inner product function.
 - write the result to a file
2. Consider ‘standardizing’ the columns of the \mathbf{X} matrix by subtracting the mean and dividing by the standard deviation.

(a) Write a C program with the following features:

- read in a matrix from a file
 - create a ‘standardized’ \mathbf{X}_s matrix
 - write a `double` function that returns the inner product of two vectors. (arguments are `double` vectors and `int` length of the vectors)
 - write a function to compute $\mathbf{X}'\mathbf{X}$ that uses the inner product function.
 - write the result of $\mathbf{X}'_s\mathbf{X}_s$ to a file
- (b) Why doesn’t the \mathbf{X}_s matrix require a supplemental column of ones? What is the equation for $\hat{\beta}_0$ given $\hat{\beta}_s = [\mathbf{X}'_s\mathbf{X}_s]^{-1}\mathbf{X}'_s\mathbf{y}_s$?
- (c) What are the diagonal elements of $\mathbf{X}'_s\mathbf{X}_s$? What are the off-diagonal elements of $\mathbf{X}'_s\mathbf{X}_s$?

3. Test your code on the data in `txttest.txt`. How does the results compare to the same computation in R?

If you are interested, the columns in this file represent features of homes in Iron County, UT. In order, sales price, lot size, number of floors, construction quality (1=poor, 4=excellent), roof condition (1=poor, 4=excellent), home condition (1=poor, 4=excellent), square feet, year built, age, number of baths, garage (0=no, 1=yes), basement (0=no, 1=yes).