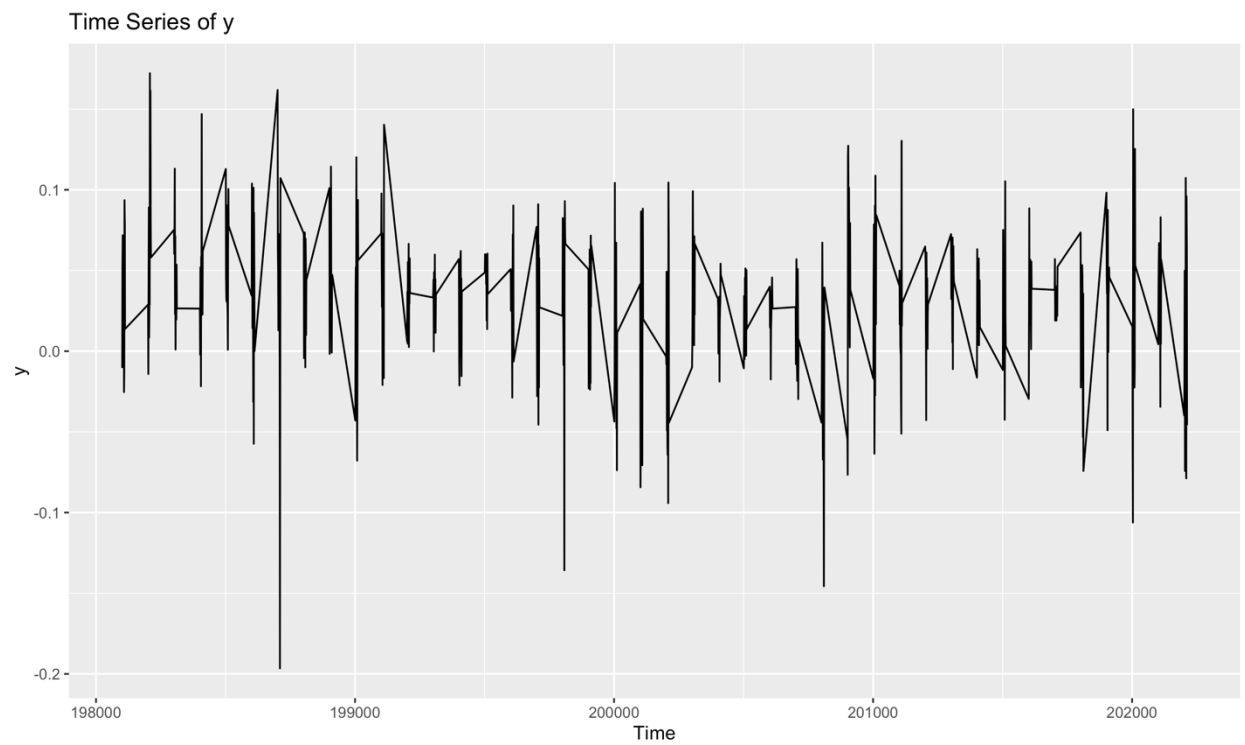
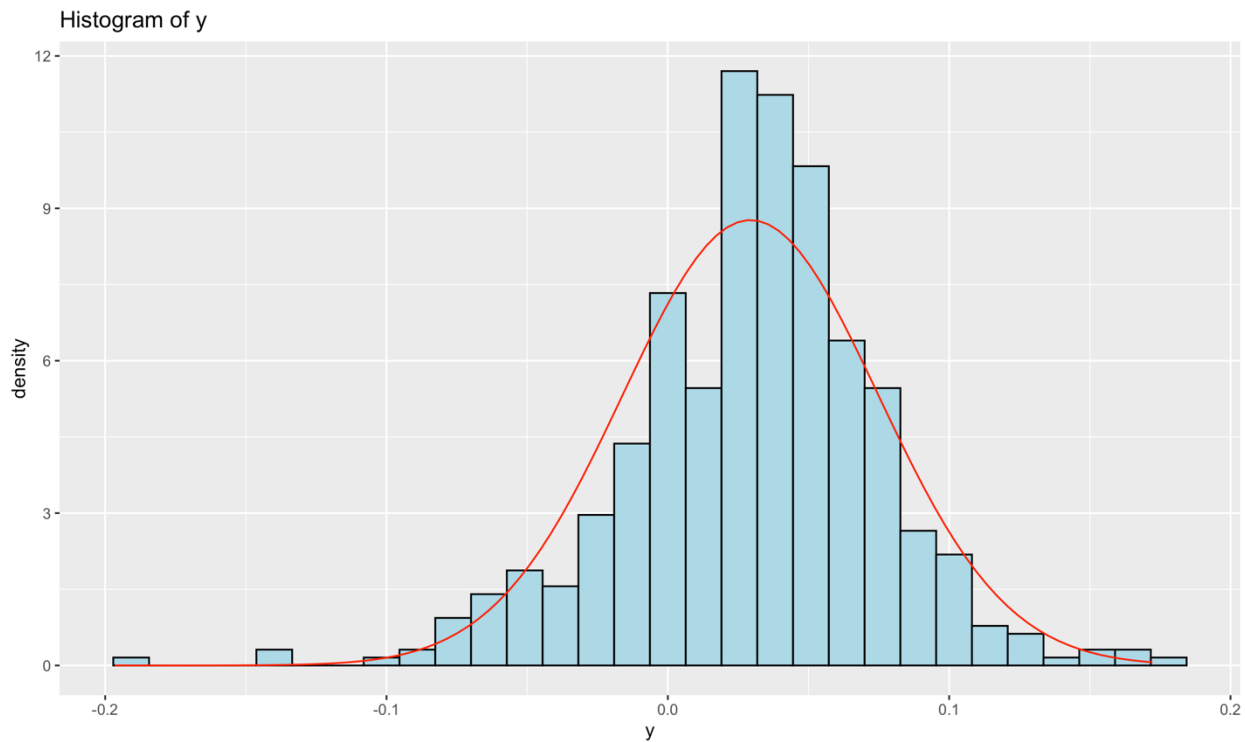
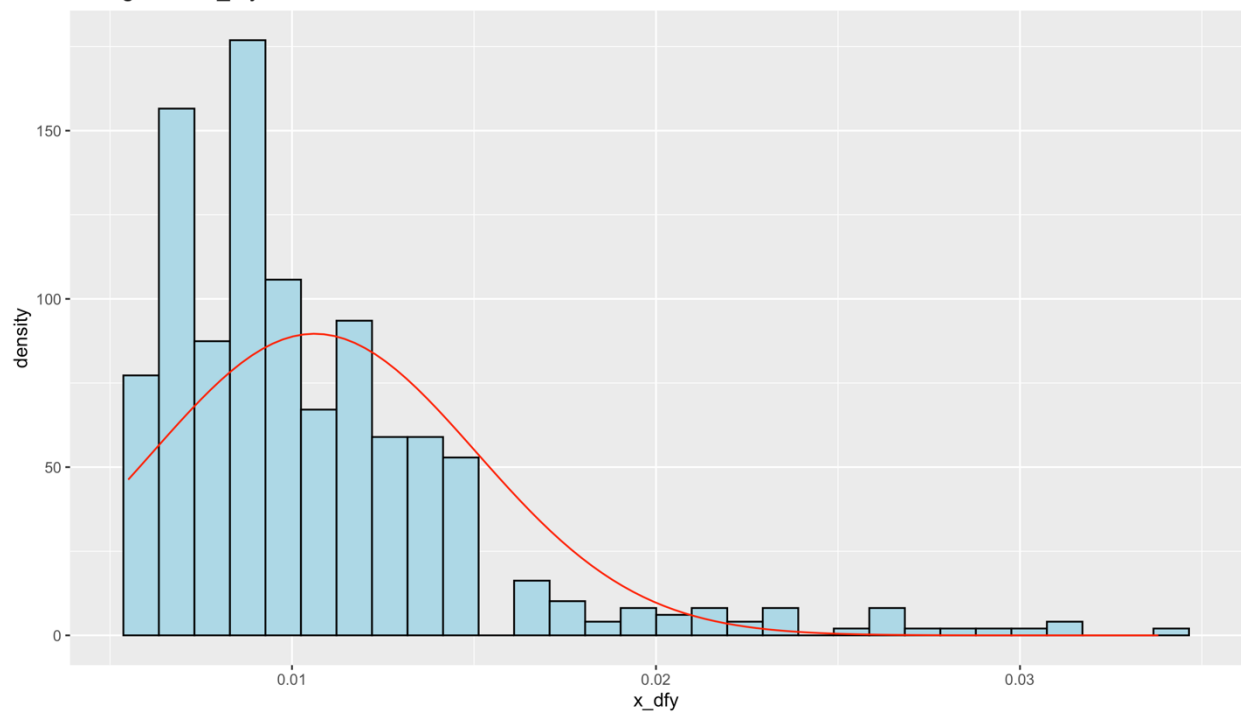


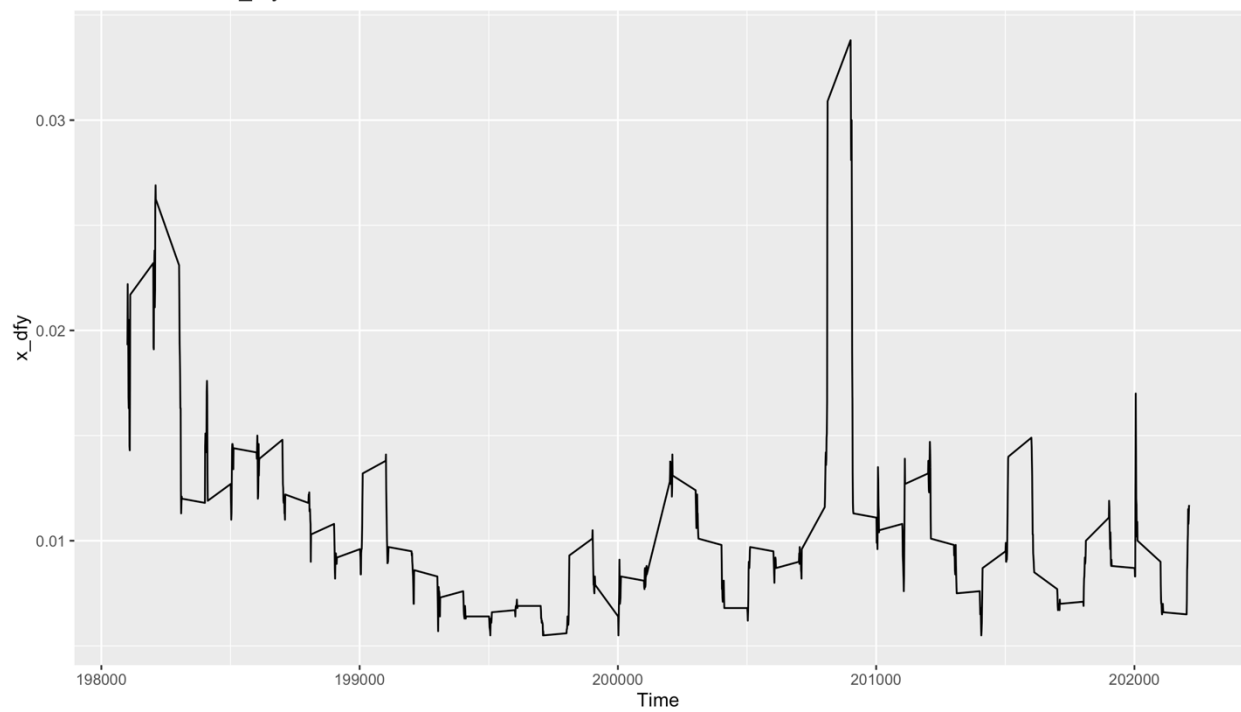
Q1. Data Visualization



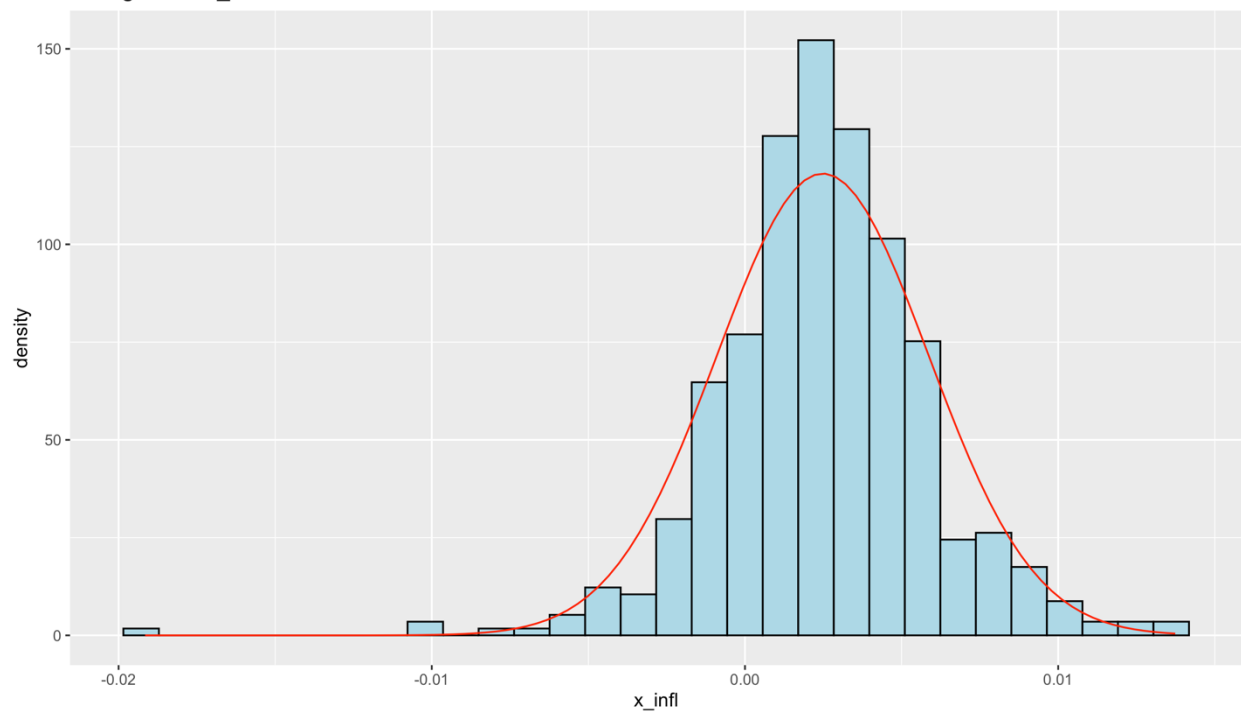
Histogram of x_{dfy}



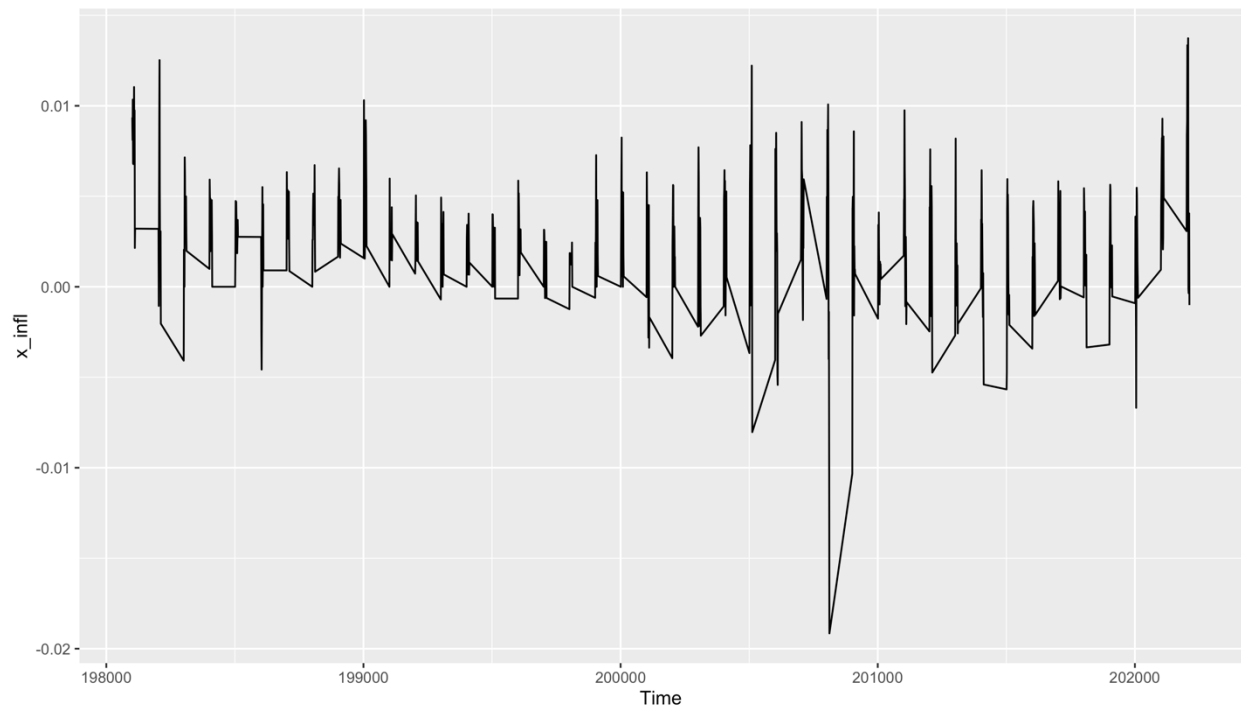
Time Series of x_{dfy}



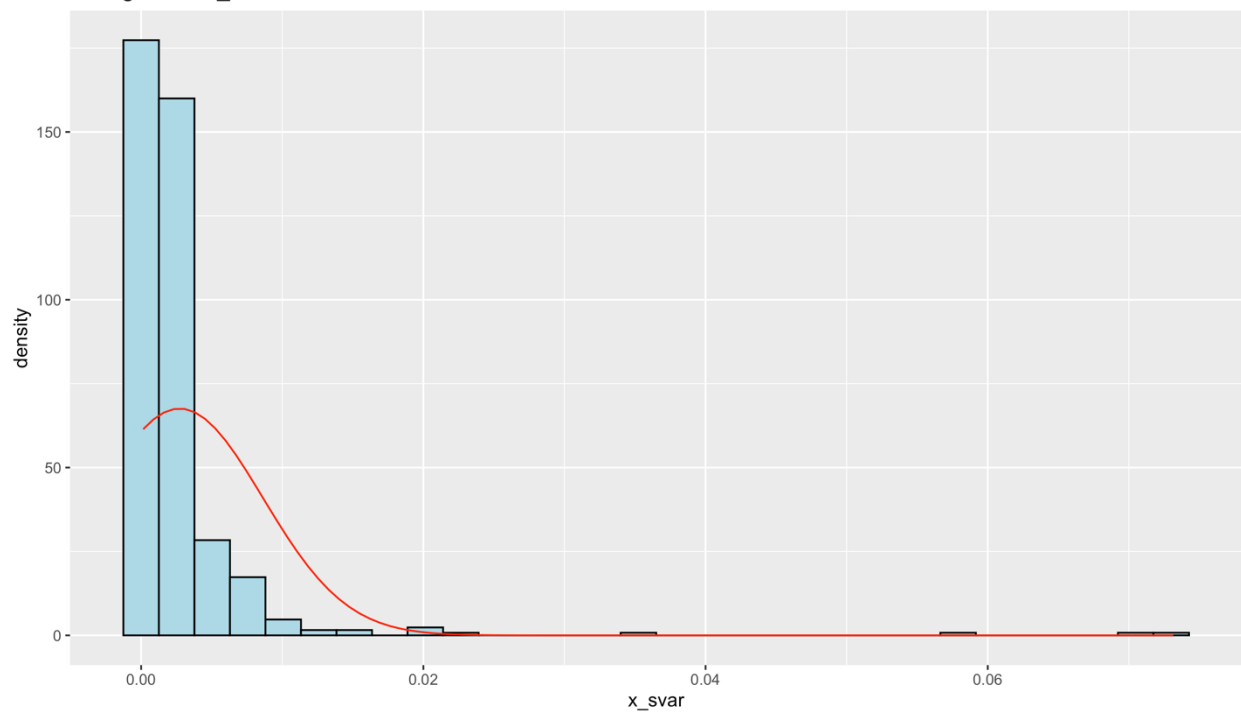
Histogram of x_{infl}



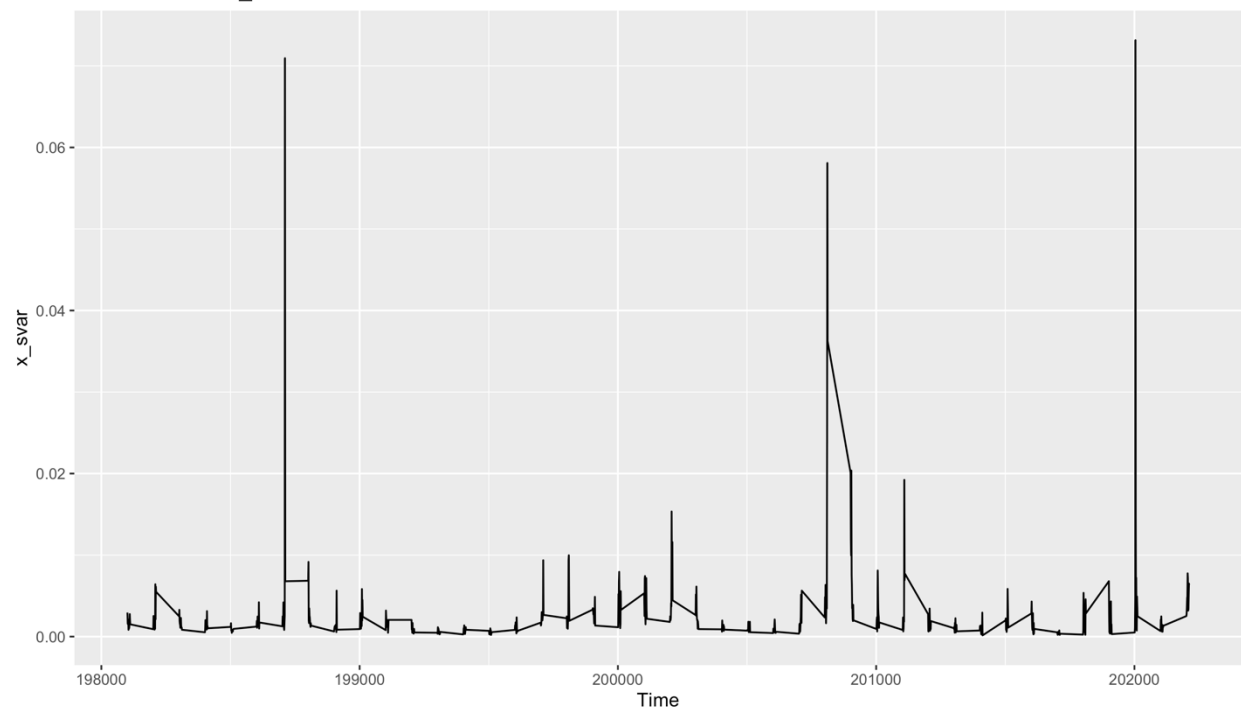
Time Series of x_{infl}

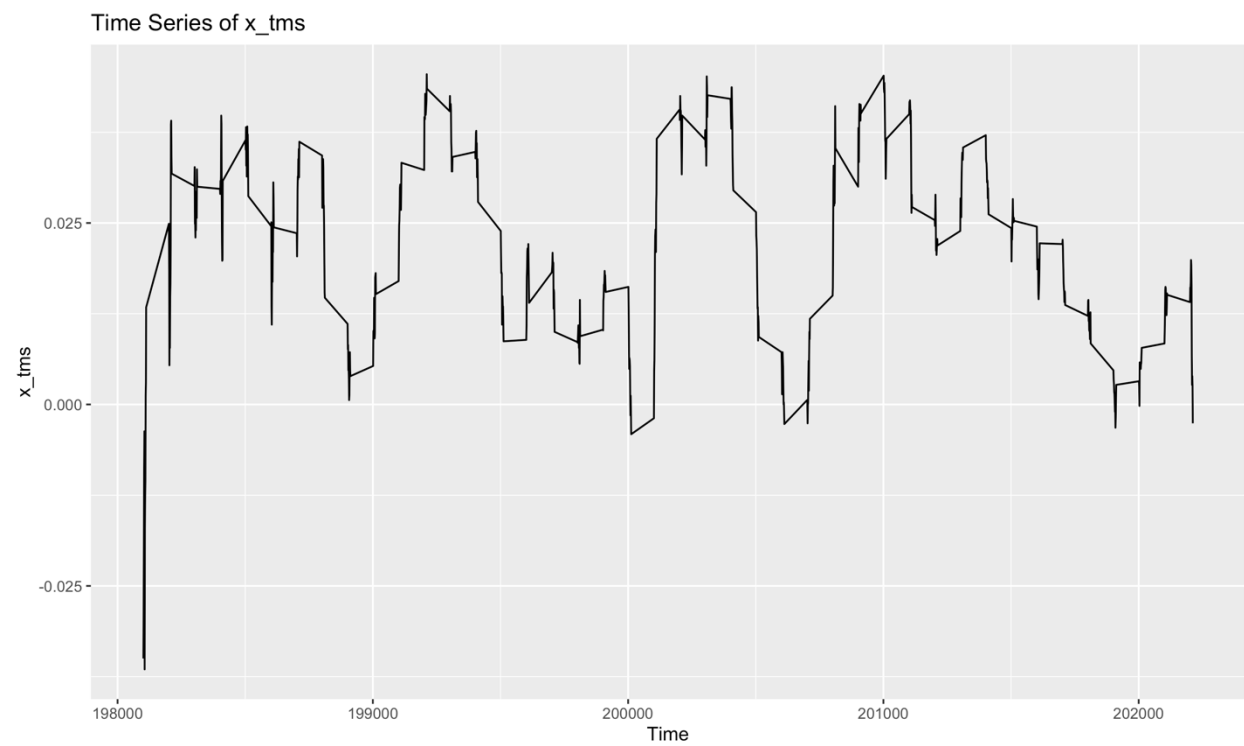
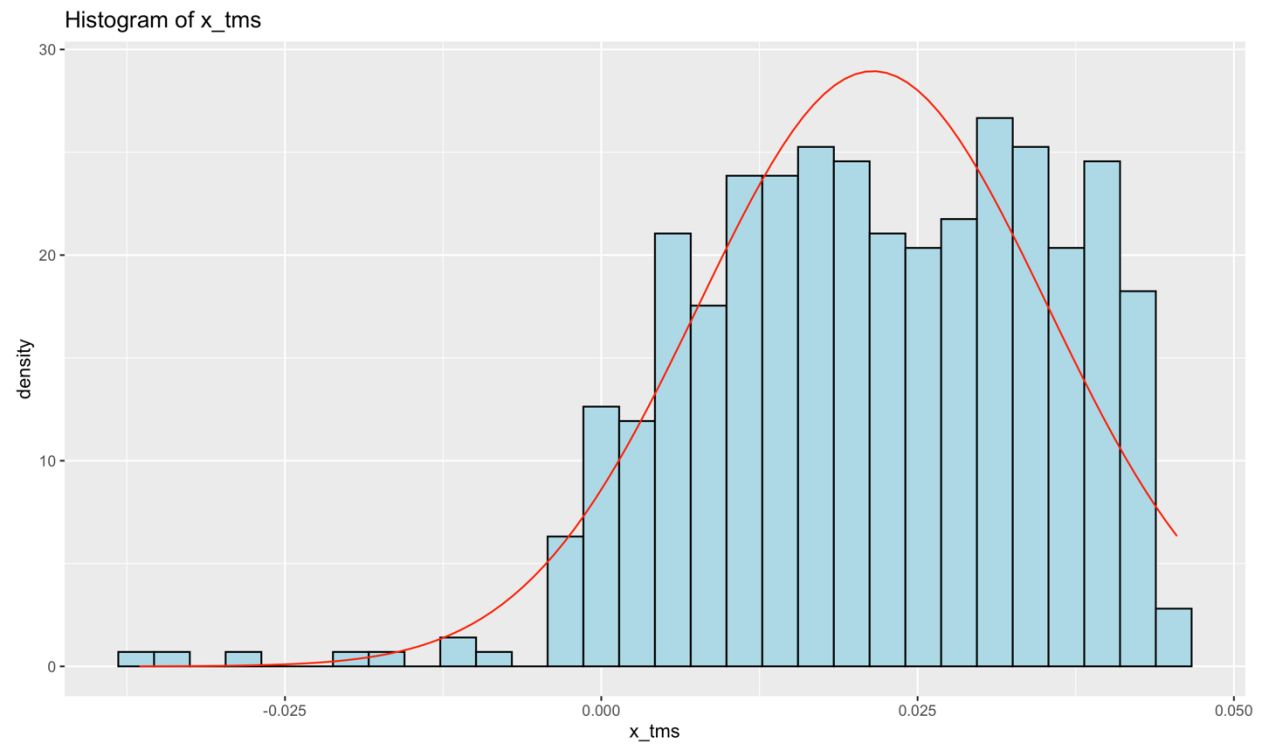


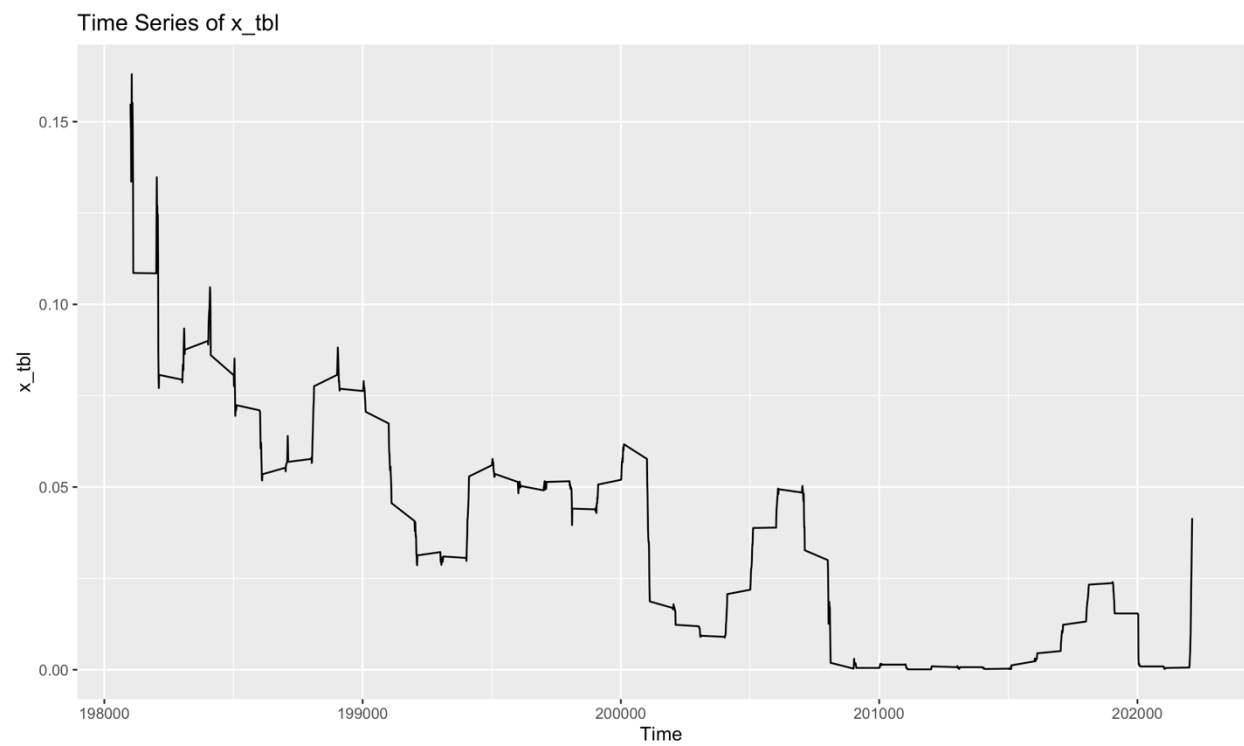
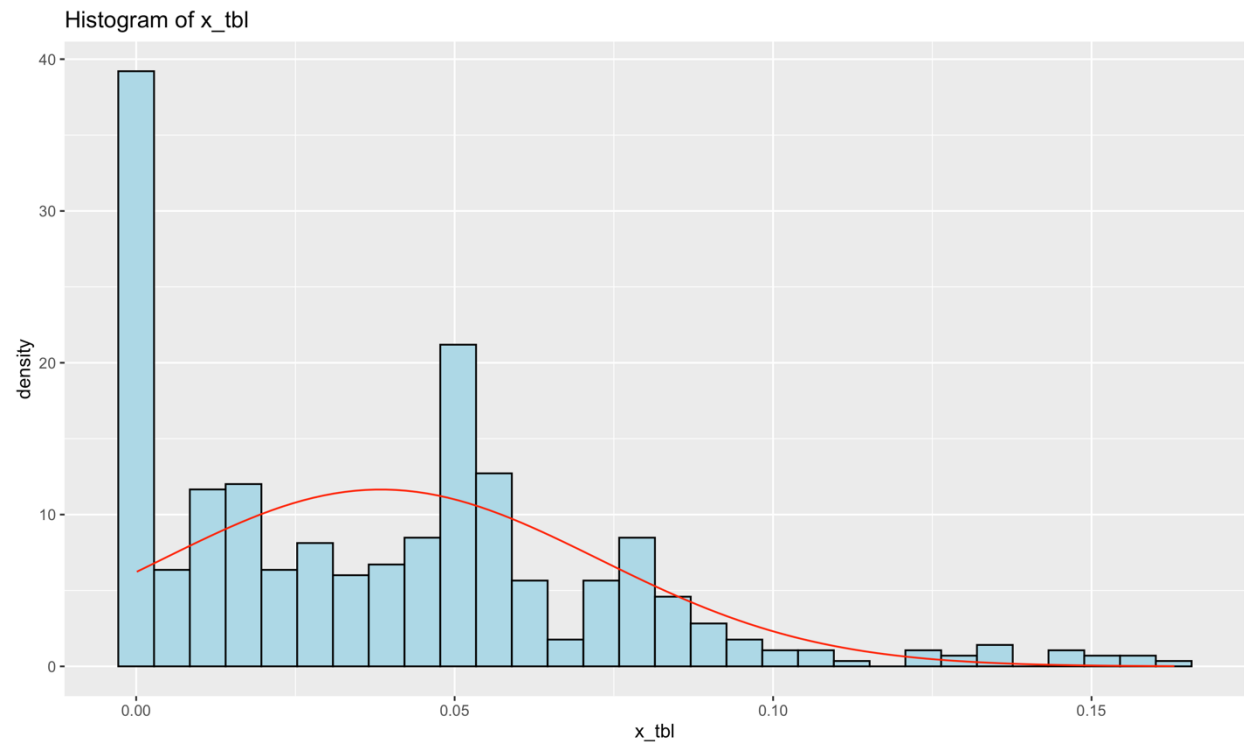
Histogram of x_{svar}

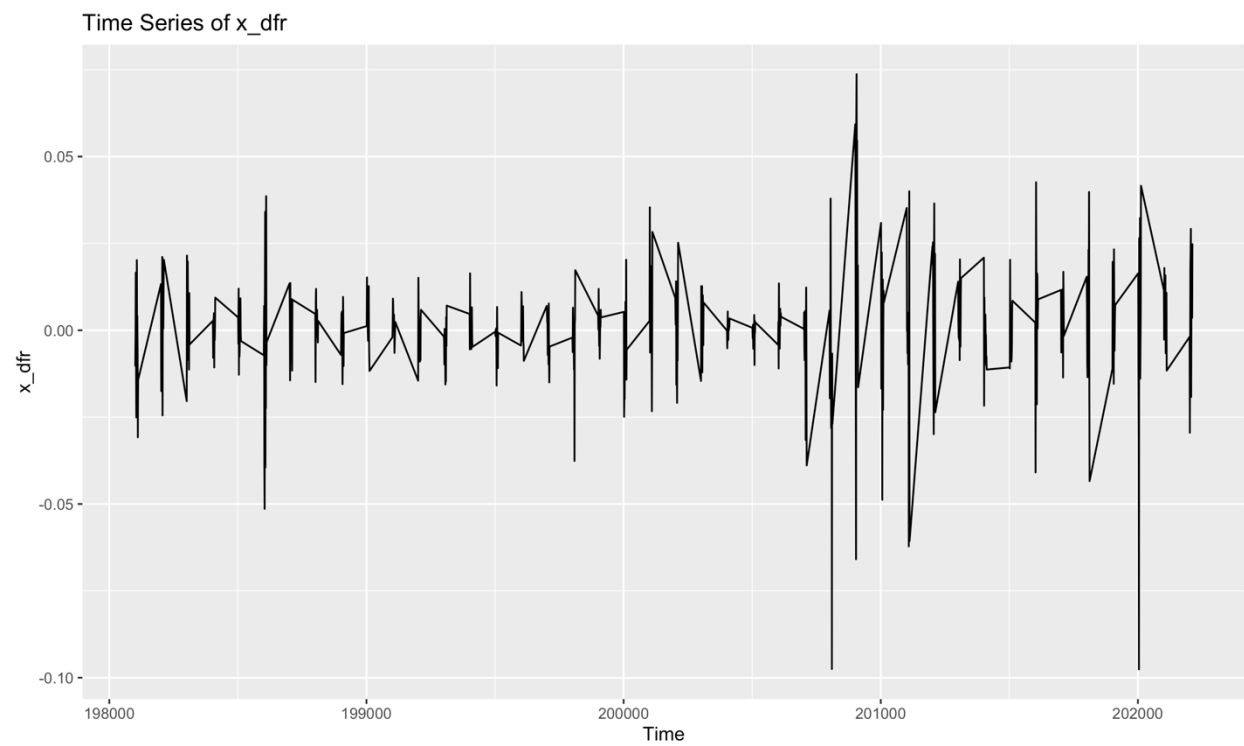
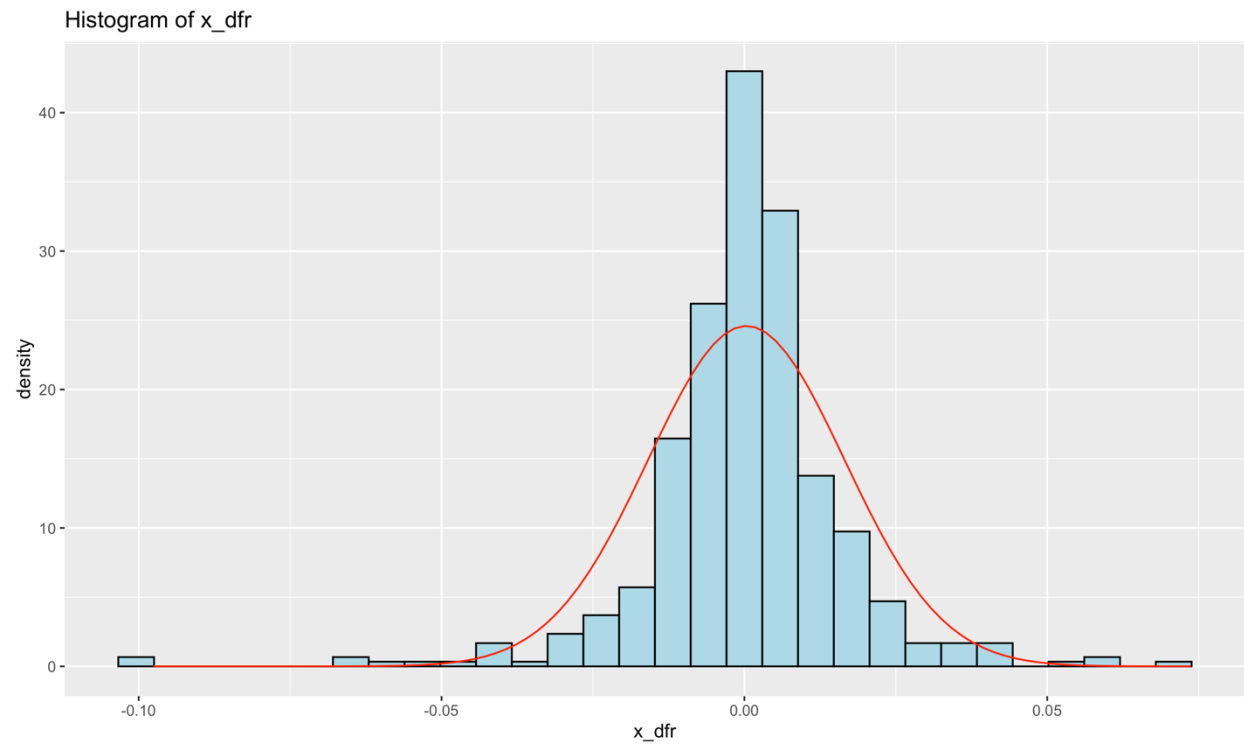


Time Series of x_{svar}

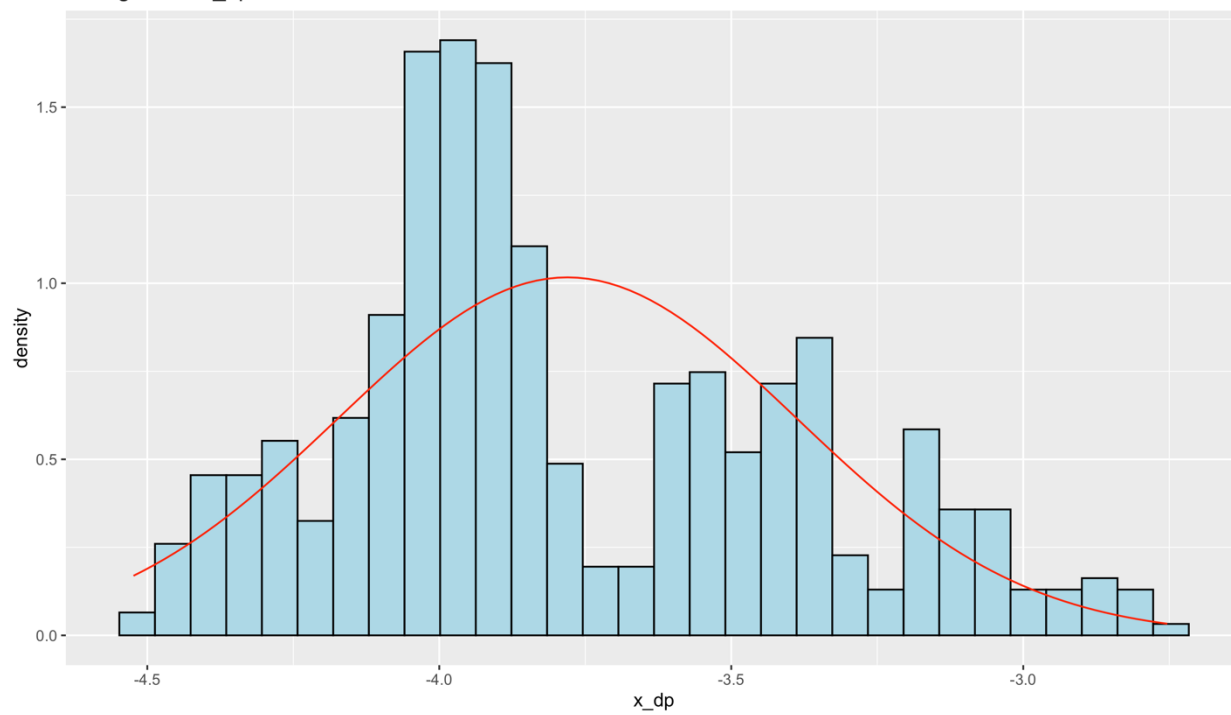




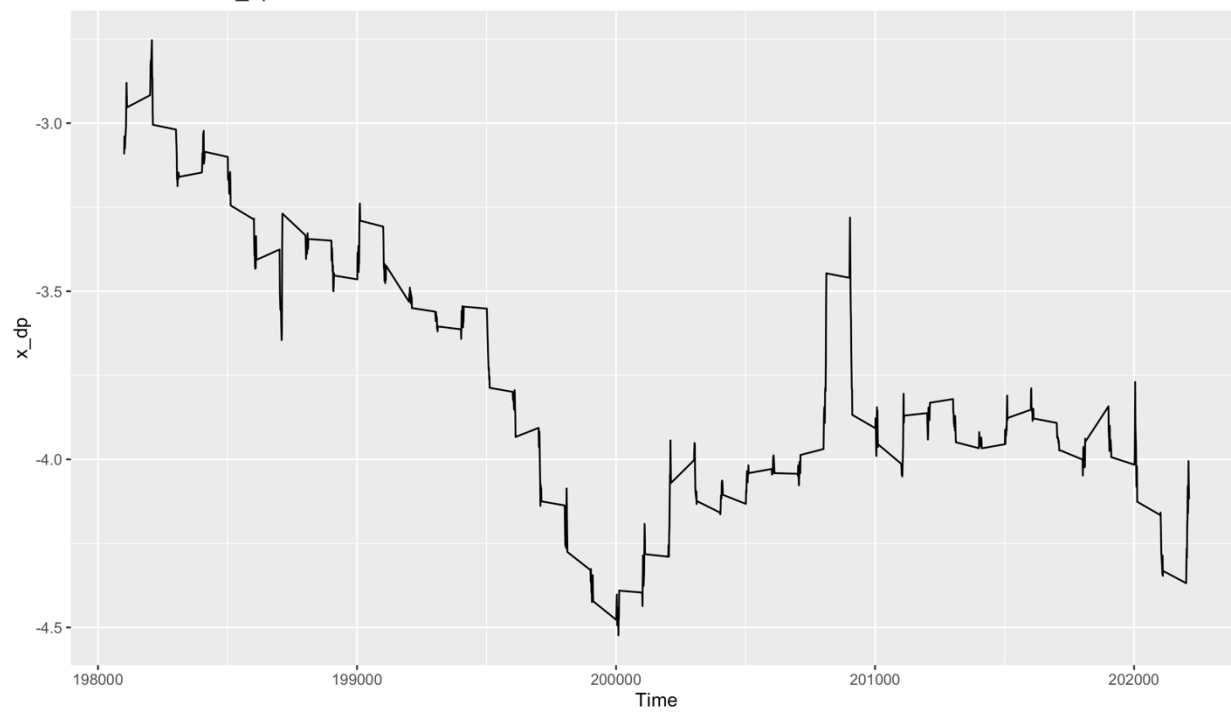




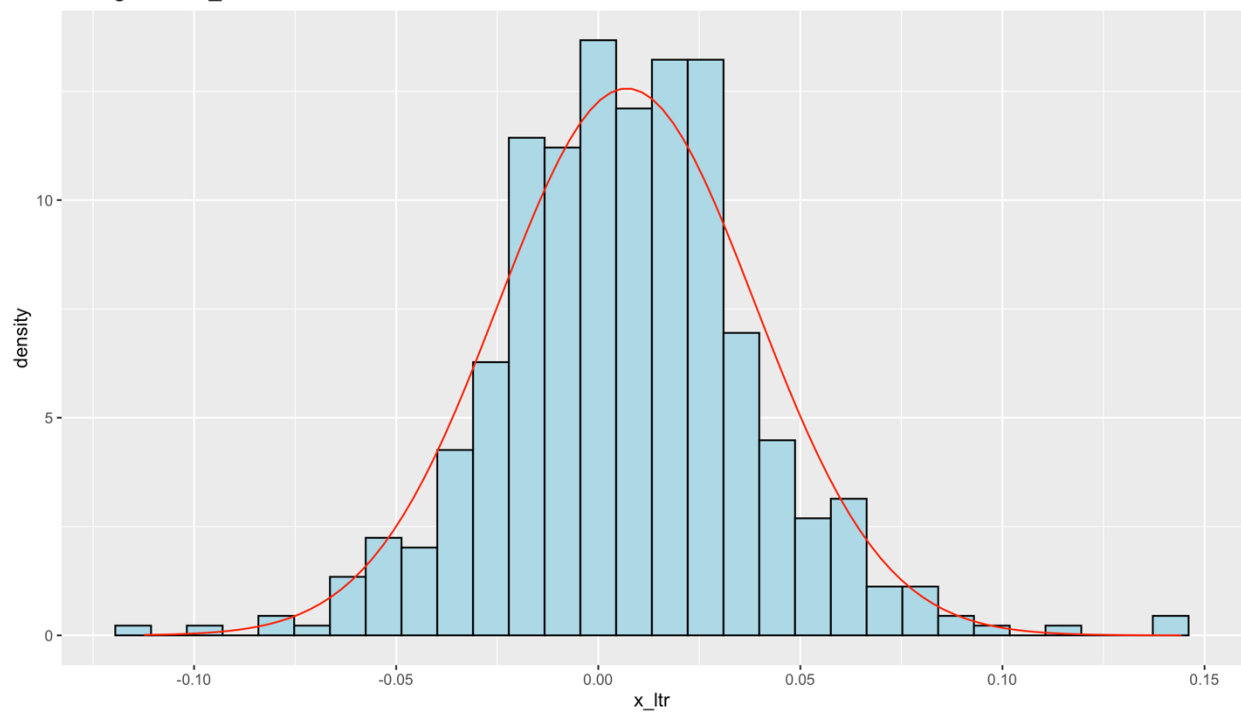
Histogram of x_{dp}



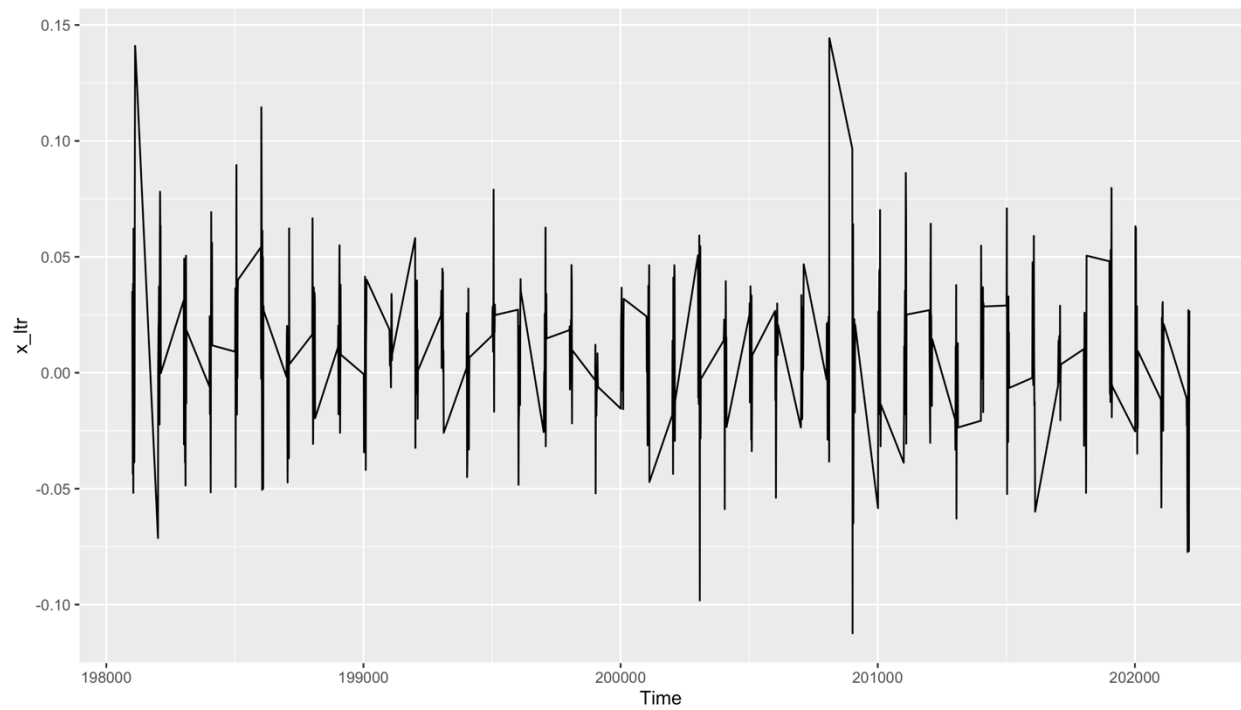
Time Series of x_{dp}

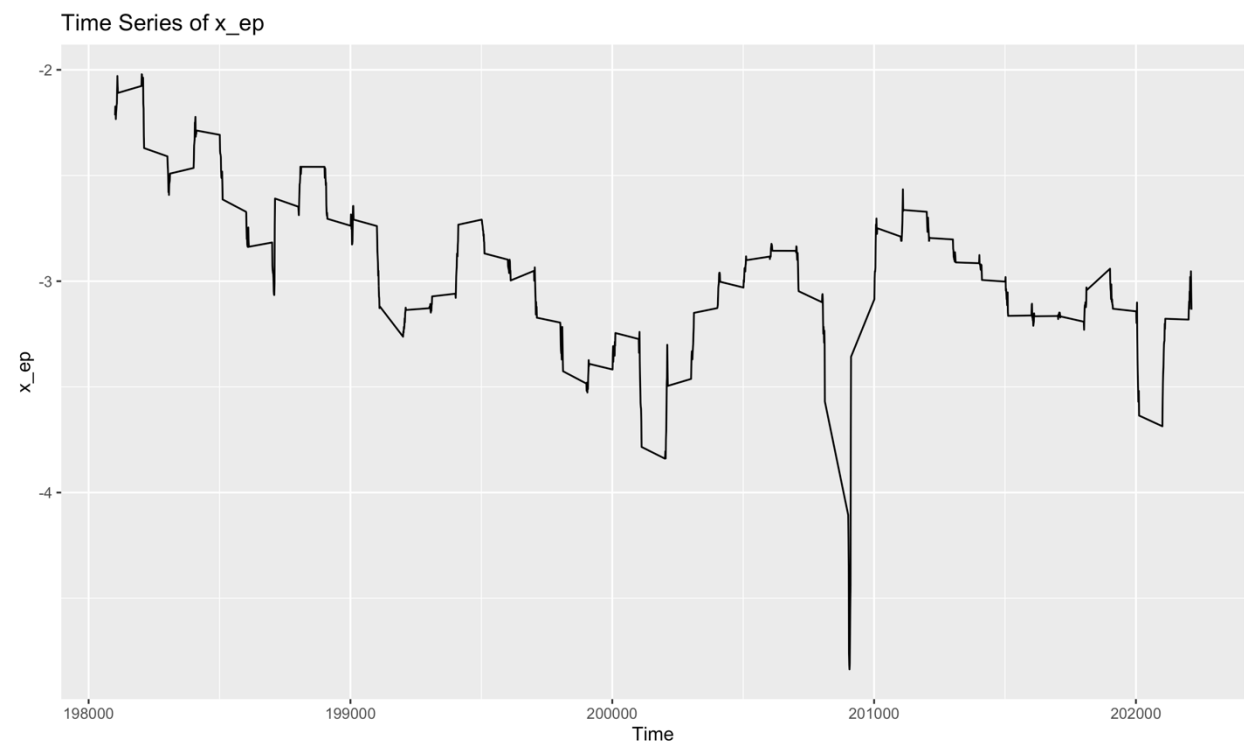
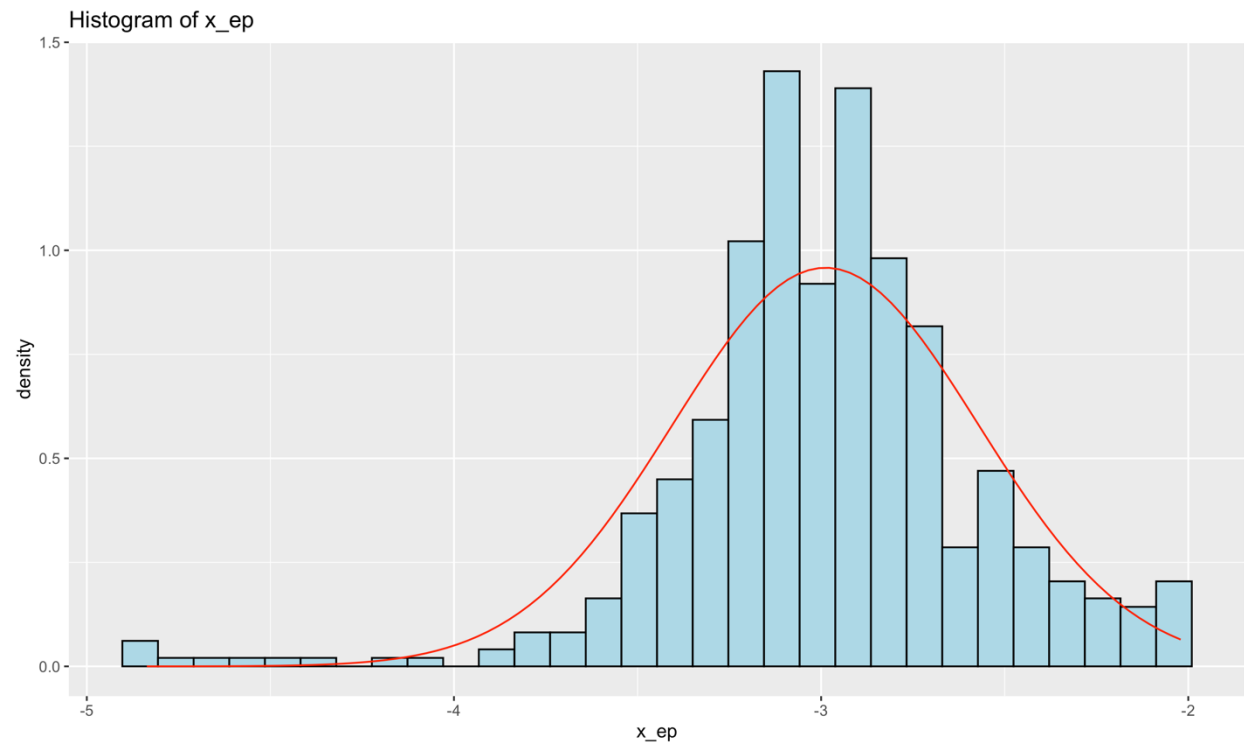


Histogram of x_{ltr}

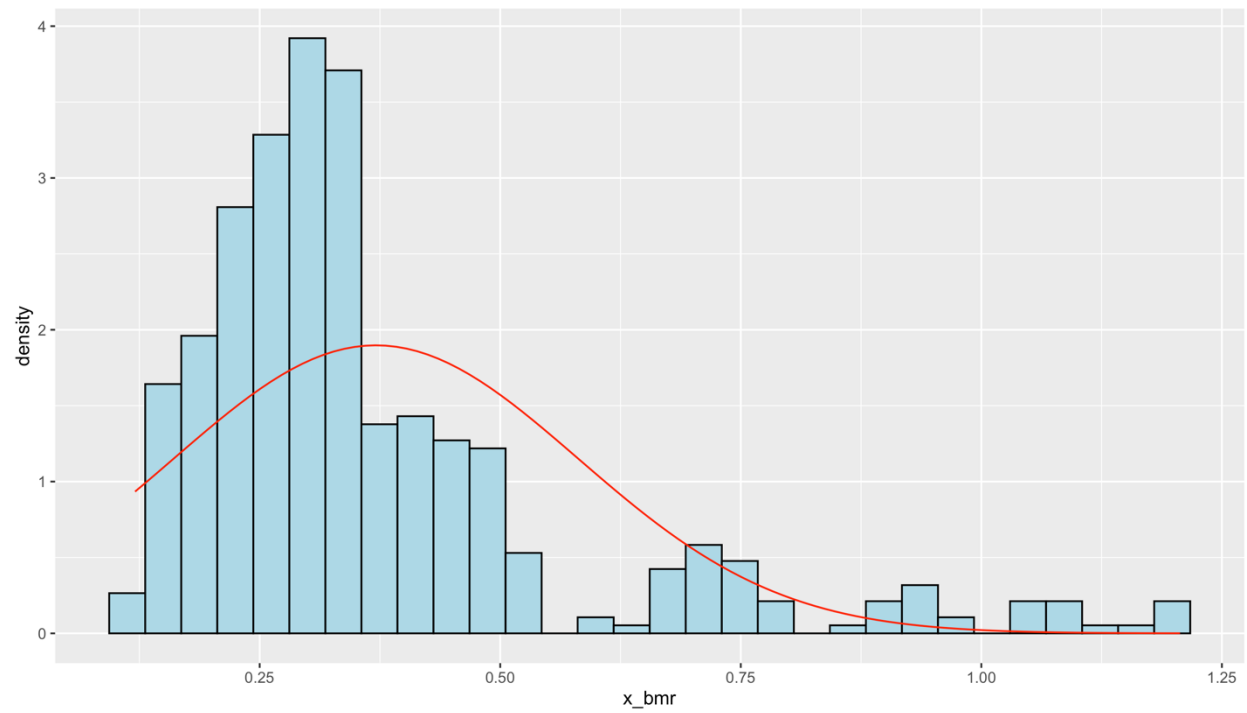


Time Series of x_{ltr}

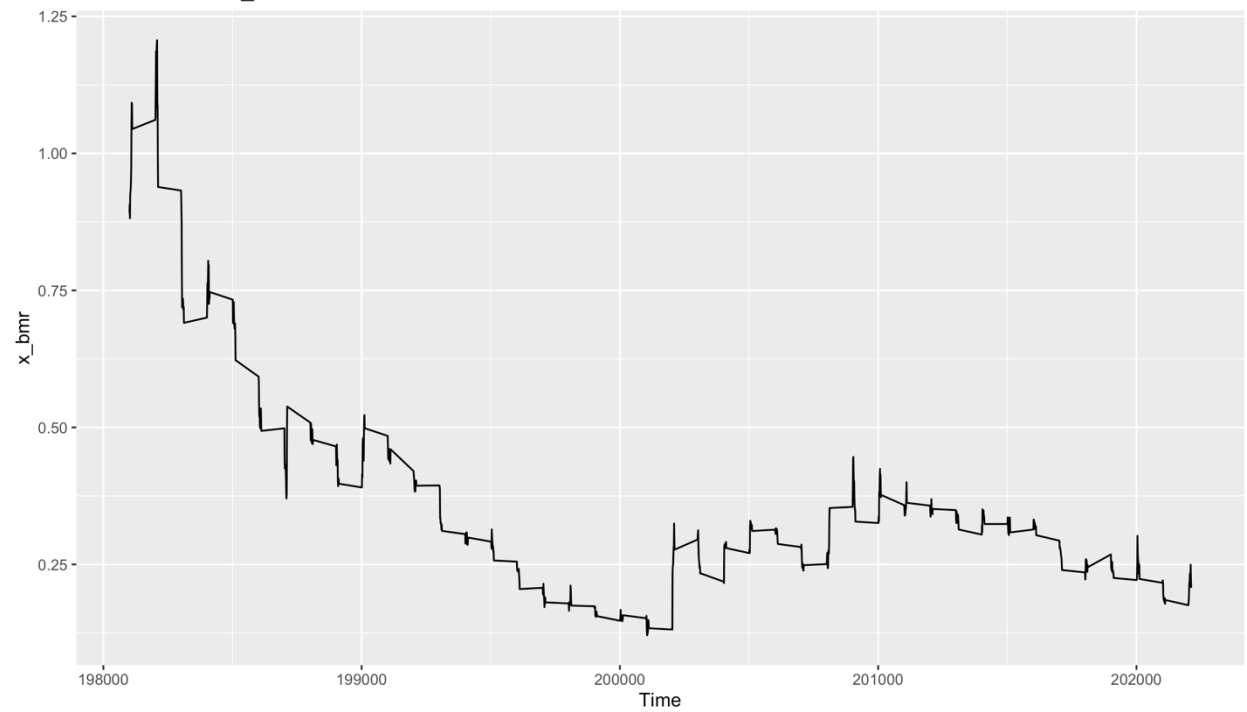




Histogram of x_bmr



Time Series of x_bmr



Q2.

Q2.1(calculate by R)

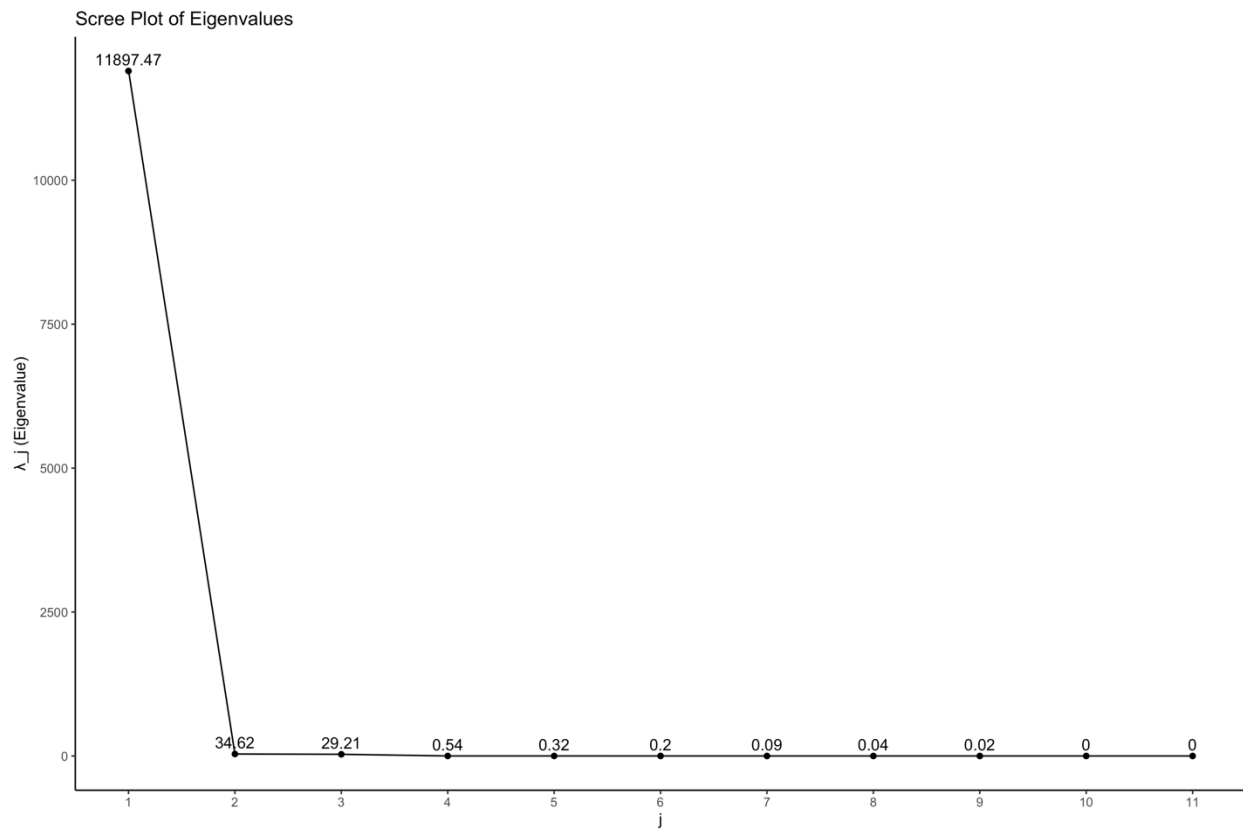
$$\text{trace}(X(X'X)^{-1}X') = 11$$

Q2.2(calculate by R)

$$\text{trace}(I_n - X(X'X)^{-1}X') = 493$$

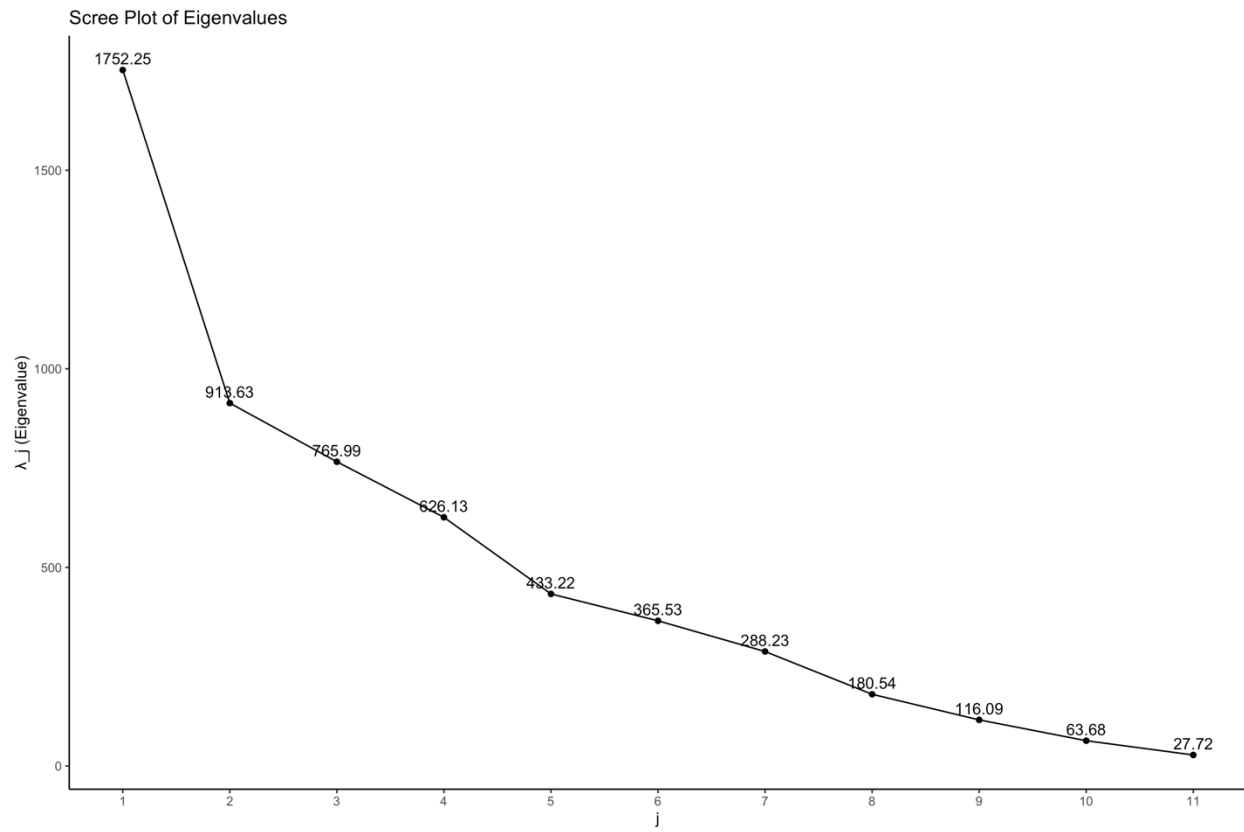
```
Q2-1: The result of trace(X(X'X)^-1X') is: 11
Q2-2: The result of trace(I_n - X(X'X)^-1X') is: 493
```

Q3.



Note: Eigenvalues are sorted in advance.

Q4.



Note: Eigenvalues are sorted in advance.

Q5. (calculate by R)

Apply spectral decomposition:

$$H = \tilde{X}' \cdot \tilde{X}$$

$$A = H\Lambda^{-1}H'$$

Then we can verify the equation in the problem statement by R. The result is:

```
Q5. Verify that  $AA^{-1}$  equals to  $I_k$  by calculating the maximum element-wise difference:  
Maximum element-wise difference: 7.771561e-15.  
=> The result is effectively the identity matrix within the specified tolerance  $10^{-12}$ .
```

Q6. (calculate by R)

The best fitted b is the projection part of y in the row space of \tilde{X} , which is calculated as follow equation:

$$b = (\tilde{X}' \cdot \tilde{X})^{-1} \cdot \tilde{X}' \cdot y$$

Then we got the result of vector b by R:

```
[1] "Q6: Result of b is:"  
      [,1]  
[1,] -0.0051961288  
[2,] -0.0012814334  
[3,] -0.0005996872  
[4,] -0.0045372084  
[5,] -0.0108741731  
[6,]  0.0044648300  
[7,]  0.0177837102  
[8,]  0.0040115413  
[9,] -0.0008651173  
[10,] 0.0060527912  
[11,] 0.0013990910
```