36-402 Homework 8

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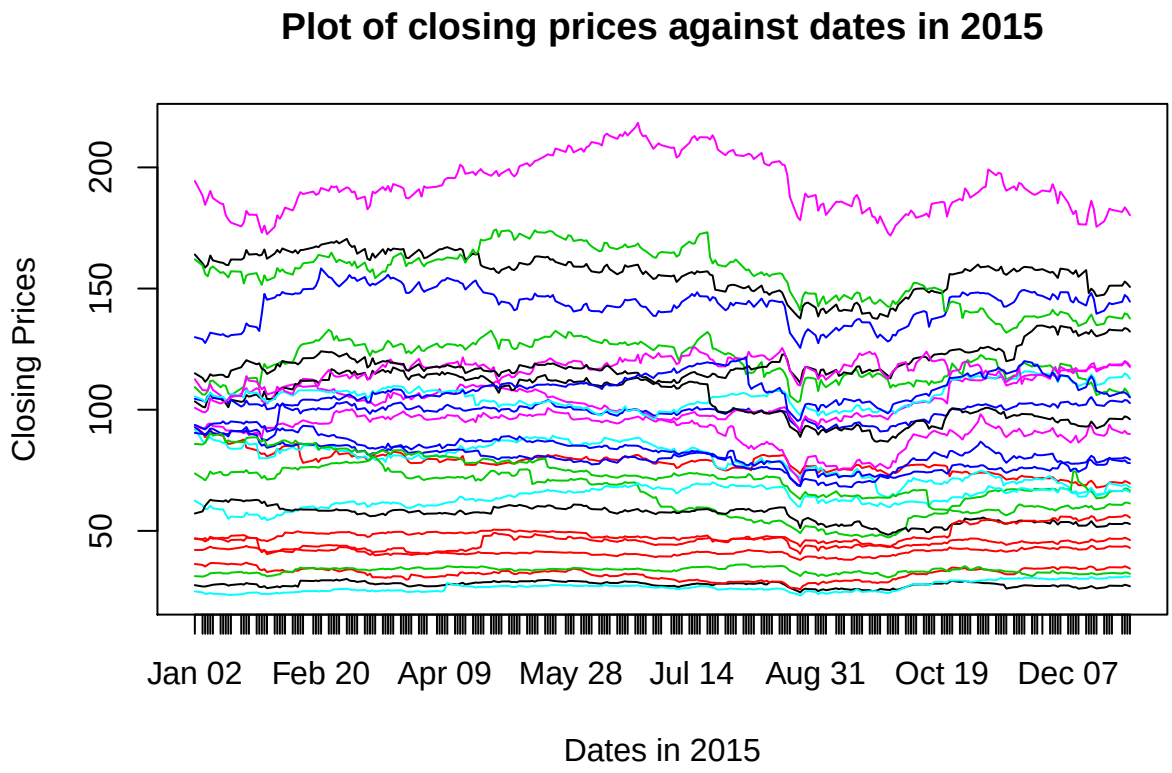
Question 1

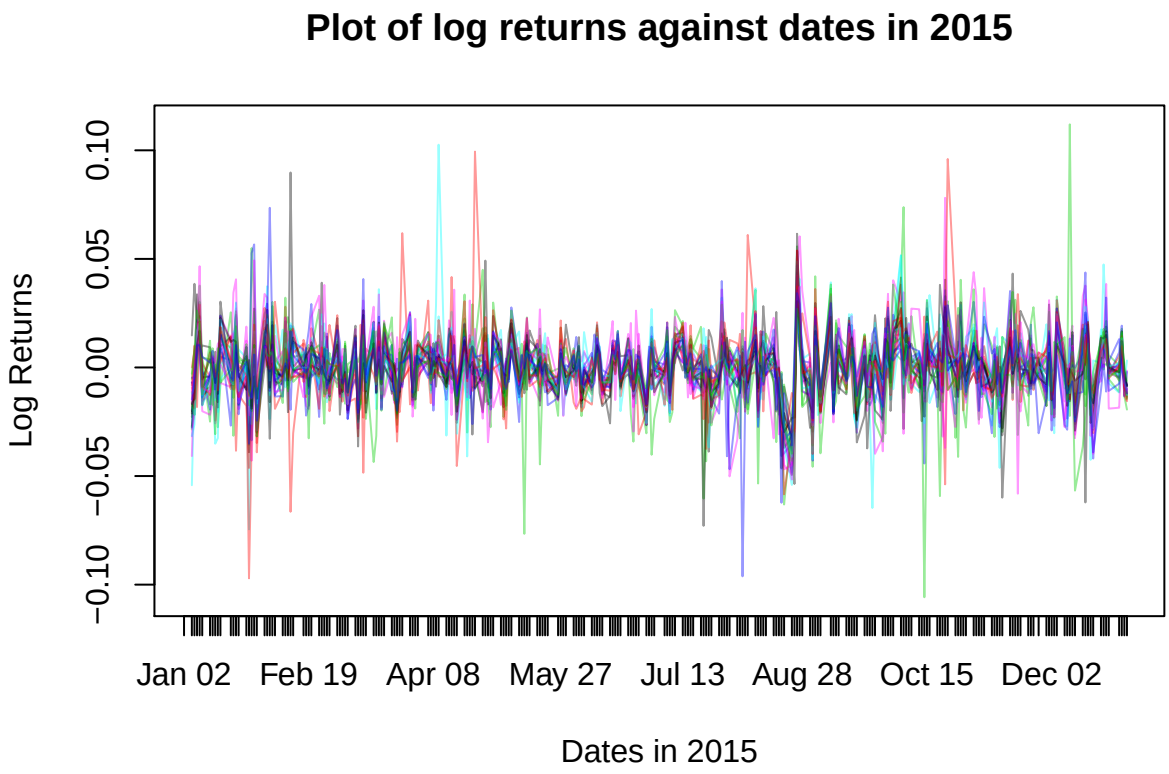
a)



b)

```
n <- nrow(close_price)
l.returns <- log(close_price[2:n, ] / close_price[1:(n-1), ])
```

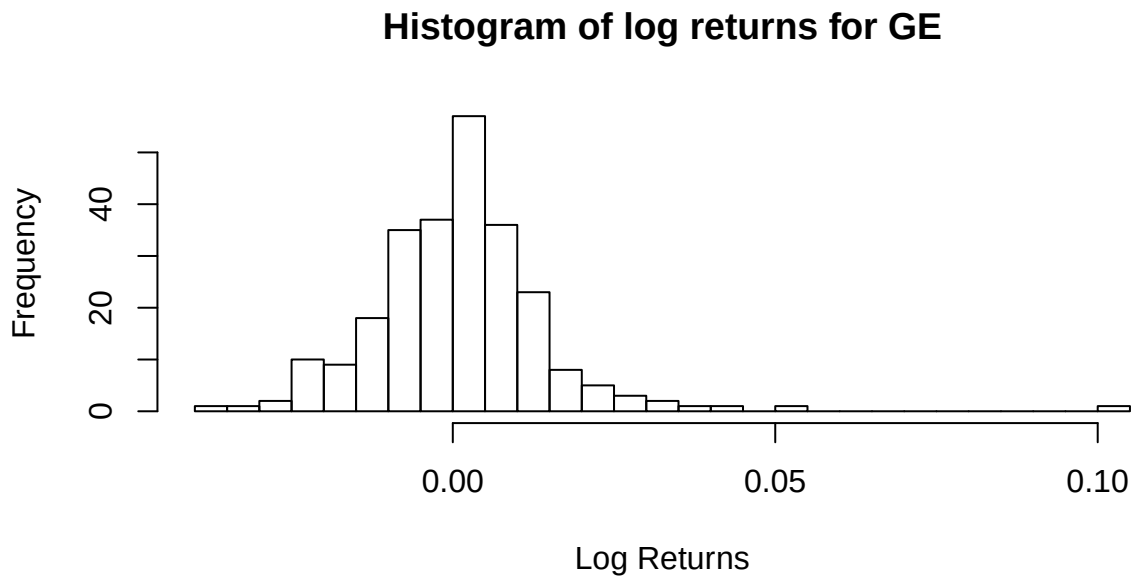
c)



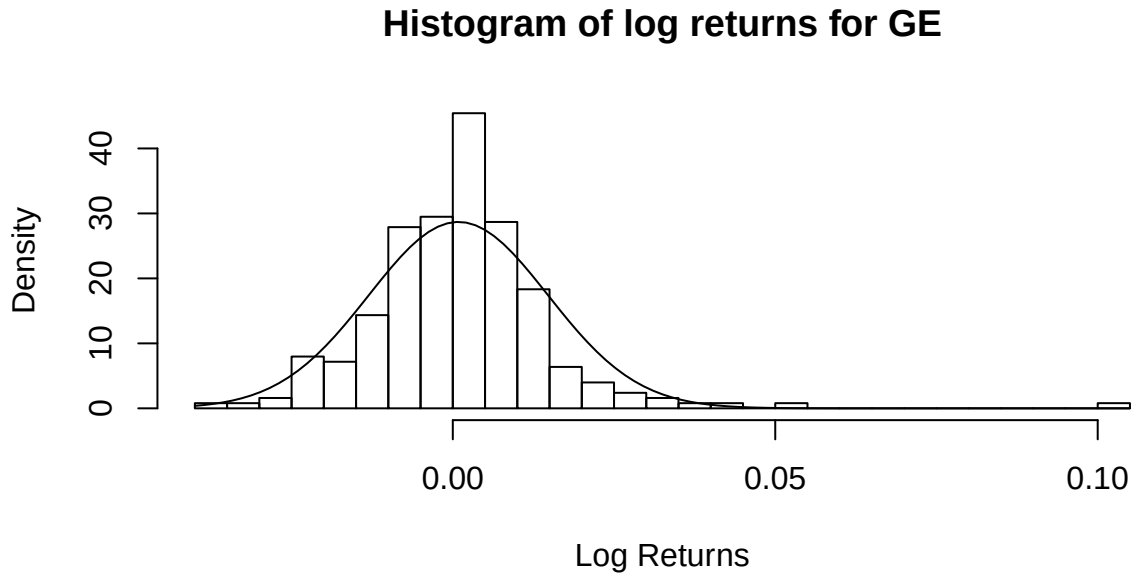
The log returns look more comparable as they all have the same scale now and the dependence over time is more visible.

Question 2

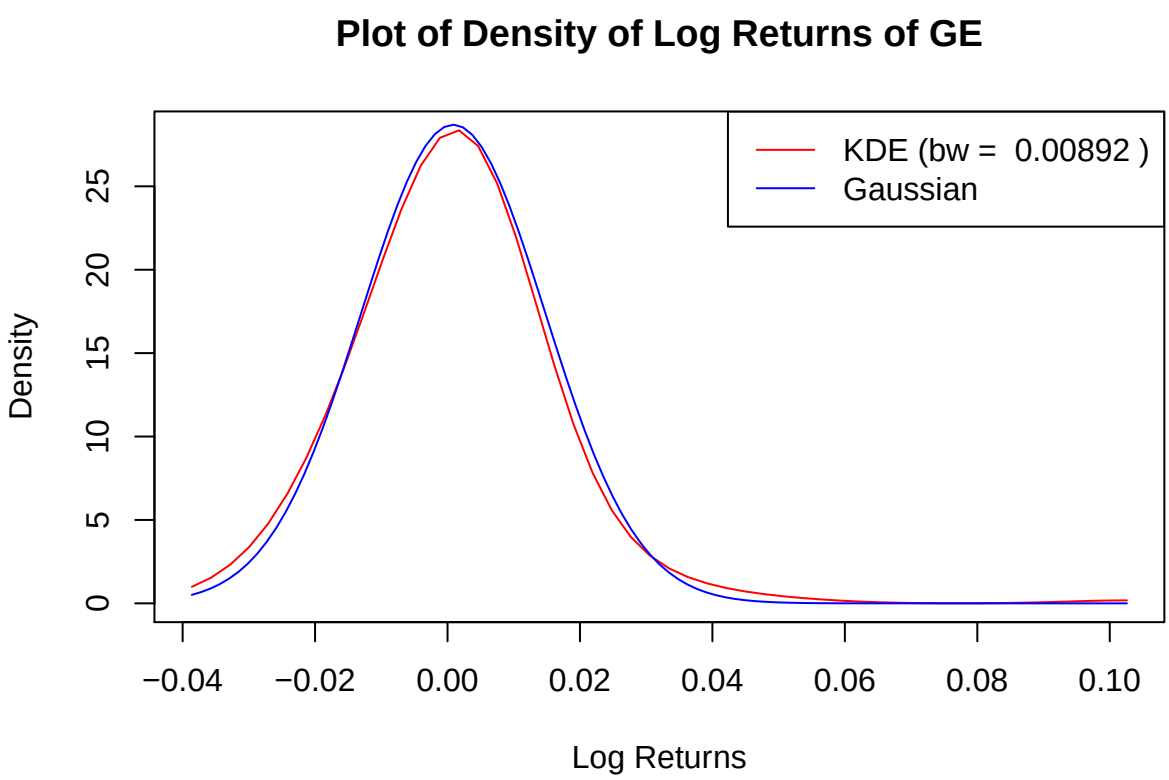
a)



b)

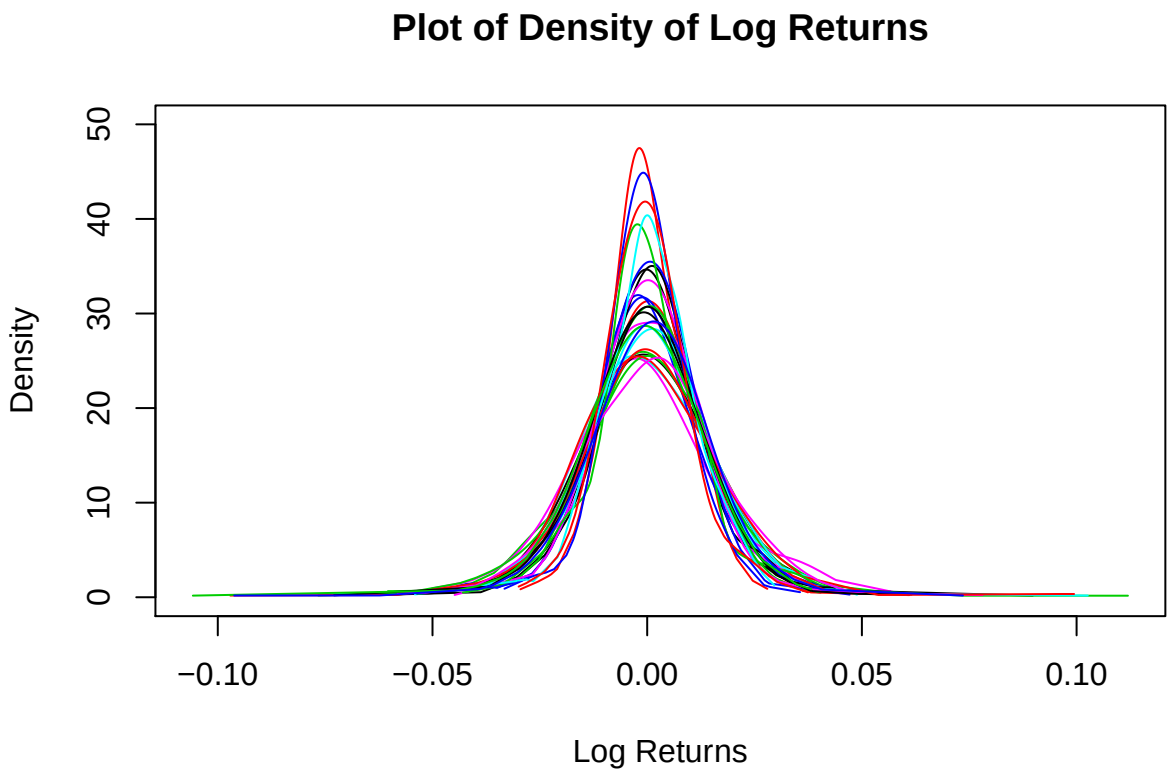


The normal distribution appears to fit the distribution of the log returns well, with the exception of possible outliers with exceptionally high log returns. **c)**



The kernel density estimate (KDE) has slightly heavier tails than the best-fitting gaussian and is also slightly skewed to the left. The KDE also has relatively lower density around the mean. However, it still appears approximately gaussian on the whole.

d)



The curves seem similar to that of the GE curve, and supports the previous statements as the curve all look approximately gaussian, with mean near 0.

Question 3

a)

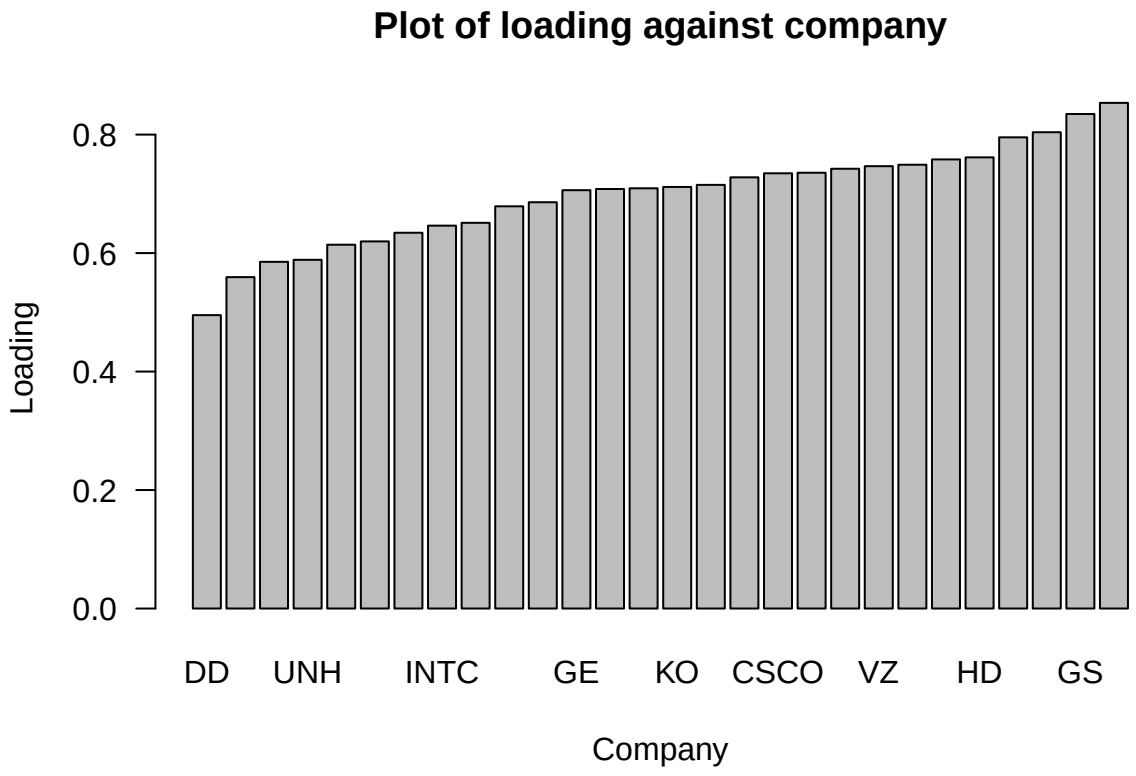
Table 1: Table of loadings for one-factor model

	w
MMM	0.758
AXP	0.585
AAPL	0.634
BA	0.728
CAT	0.620
CVX	0.651
CSCO	0.735
KO	0.712
DD	0.495
XOM	0.715
GE	0.706
GS	0.835
HD	0.762
INTC	0.646

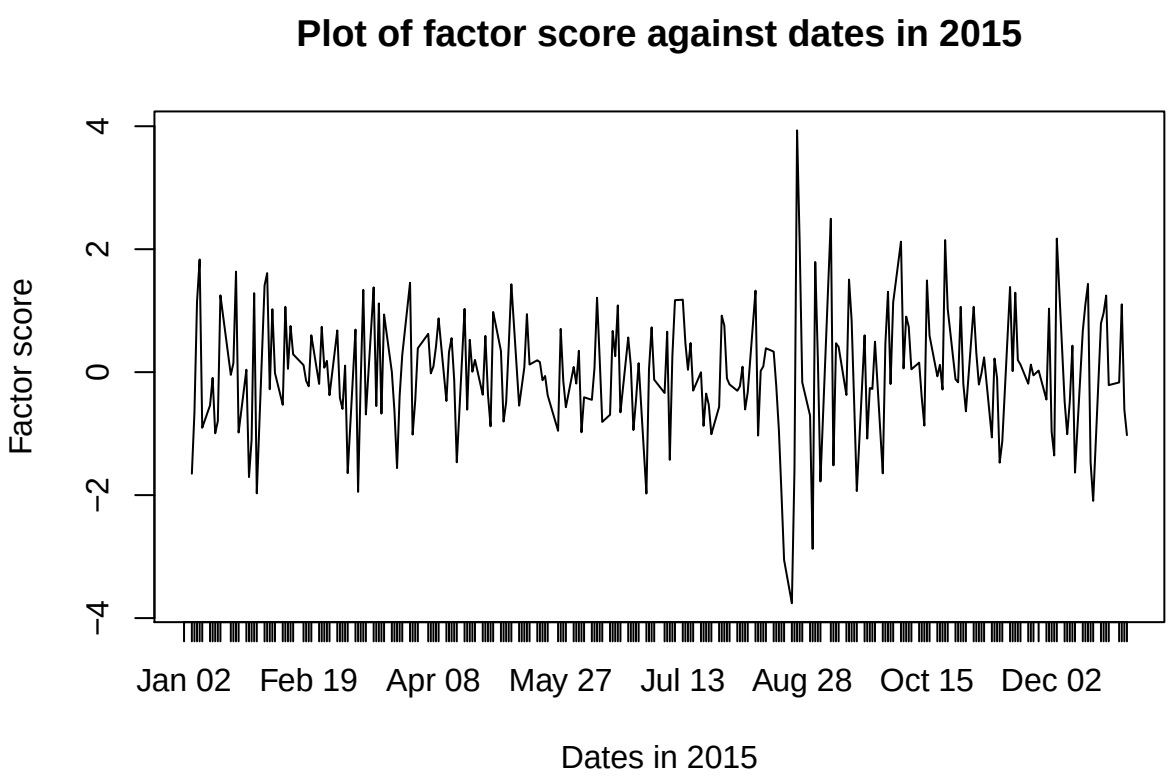
	w
IBM	0.736
JNJ	0.795
JPM	0.854
MCD	0.708
MRK	0.709
MSFT	0.686
PFE	0.679
PG	0.749
TRV	0.804
UNH	0.589
UTX	0.742
VZ	0.747
WMT	0.559
DIS	0.614

It makes sense that there are 28 entries as we only have 1 row of loadings by setting the factors to 1, where there are 28 columns for the matrix of loadings.

b)



The minimum loading is around 0.50, while the maximum loading is around 0.85. Most of the loadings are also around a small range from 0.6 to 0.7.

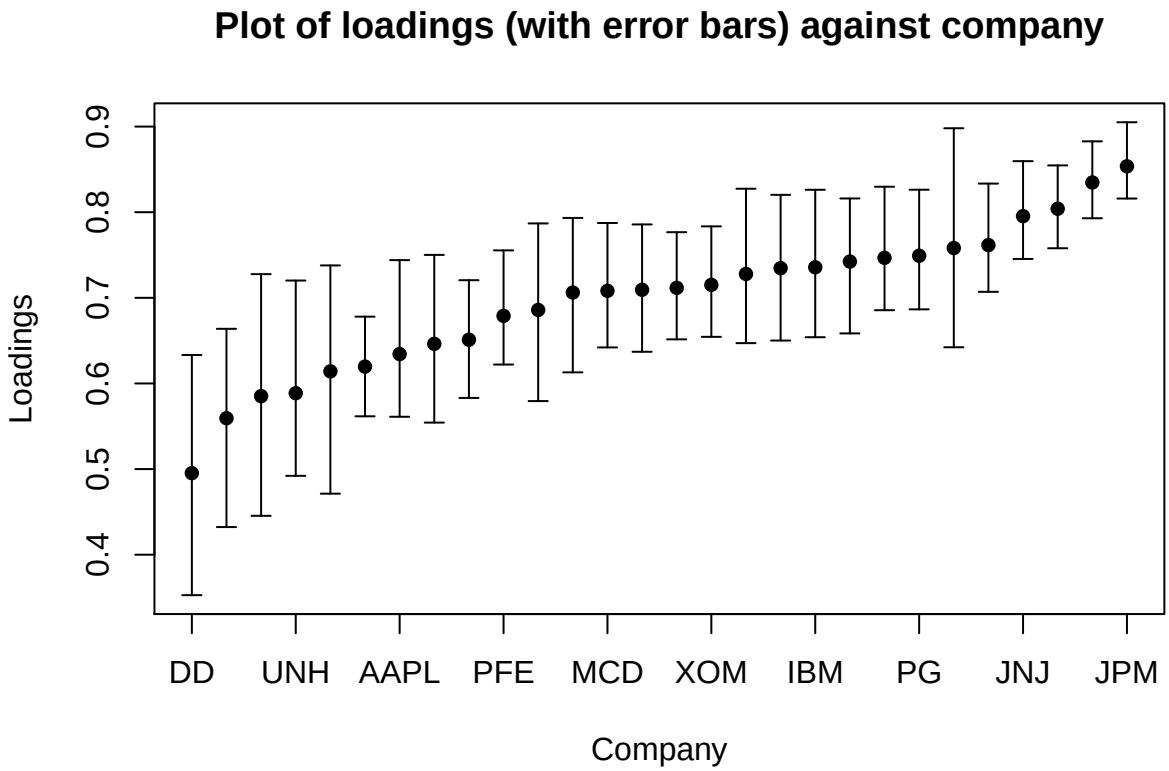


Most of the factor scores seem to be randomly distributed over time within -2 and 2. However, we can observe a large dip and spike in late August, going from roughly -4 to 4.

d)

The time-series plot of factor scores summarizes the time-seies plot of log-returns for each company well, smoothing out the variations between each company. Both plots show similar trends, with scores and log returns looking roughly stationary around 0 across time. The general large dip and spike across all companies' log returns around late August is also clearly reflected in the factor score plot.

Question 4


Plot of loadings (with error bars) against company
Loadings
0.4
0.5
0.6
0.7
0.8
0.9
DD
UNH
AAPL
PFE
MCD
XOM
IBM
PG
JNJ
JPM
Company