FA and ICA

WEEK 6

Instructions

The output to be handed in should be in html.

Assignment

The Macroeconomic variables, both real and financial, do have considerable influence, positive as well as negative, on the performance of the corporate sector of the economy. Consequently, the stock markets of the economy got affected by such performance. The movement of stock prices, apart from the firms' fundamentals, also depends upon the level of development achieved in the economy and its integration towards the world economy. Since macroeconomic variables are highly interdependent, using all of them as explanatory variables in affecting the stock market may pose a severe multicolinearity problem and it becomes difficult to delineate the separate affects of different variables on the stock market movement. Deriving basic factors from such macroeconomic variables and employing these factors in pricing models can provide valuable information about the contents of priced factors in different stock markets. Generating orthogonal factor realizations eliminates the multicolinearity problem in estimating factor regression coefficients and serves to find the factors that are rewarded by the market. In this assignment, such factors will be extracted from twelve macroeconomic variables in India. The variables are:

- ***Money Supply (MS)***
- ***Consumer Price Index (CPI)***
- ***Gold Prices (GP)***
- ***Crude Oil Prices (COP)***
- ***Foreign Exchange Reserves (FER)***
- ***Foreign Direct Investment (FDI)***
- ***Foreign Institutional Investment (FII)***
- ***Call Money Rate (CMR)***
- ***Balance of Trade (BOT)***
- ***Foreign Exchange Rate (ER)***

- ***Repo Rate (Repo)***
- ***Industrial Growth Rate (IGR)***

The standardized observations in the data file *IndianSM.txt* are based on monthly averages, for 149 months.

```
IndianSM <- read.table("IndianSM.txt", header = T)
```

Question A

Factor analyze the data and determine how many common factors are at least needed to explain at least 80% of the total variance.

```
results <- factanal(IndianSM, 5, scores="regression")

results$scores |> head(10)
```

```
##           Factor1    Factor2    Factor3    Factor4    Factor5
##  [1,] -0.21574977  1.0426498  1.2886433 -0.1504372 -0.2787296
##  [2,]  0.71758987  0.9099490 -1.0976347 -0.3474526 -0.7759150
##  [3,]  0.06335160  0.7920057 -0.0748036 -0.4245977 -0.5391634
##  [4,] -1.17219259 -0.2613084 -0.8466282 -1.1234047  2.3025161
##  [5,]  1.41566099 -0.7757470  0.8642184 -0.5004315 -1.0307391
##  [6,] -0.27476087 -0.7639171 -1.0227758  0.1338186 -0.1772319
##  [7,] -1.74984883 -1.5180455  0.8154210  0.5611552  0.8515630
##  [8,] -0.09918391 -1.0417398 -1.8396970  0.4755918  0.2633024
##  [9,]  0.56686120  0.9839900  0.1588811 -0.1676382  0.9308356
## [10,]  0.77876861  0.5362683 -1.7473648  0.7823024 -0.5800120
```

```
results$loadings
```

```
##
## Loadings:
##      Factor1 Factor2 Factor3 Factor4 Factor5
## MS    0.937   0.283           0.146   0.127
## CPI   0.931   0.314                   0.118
## GP    0.901   0.357                   0.158
## COP   0.889  -0.159   0.148   0.283
## FER   0.903                   0.384
## FDI   0.540  -0.185           0.548
## FII   0.679  -0.112  -0.174  -0.144  -0.161
## CMR   0.273   0.152   0.882   0.131   0.198
## BOT  -0.889  -0.270  -0.184           0.115
## ER    0.231   0.939   0.161  -0.150  -0.109
## Repo -0.172           0.897          -0.144
## IGR          -0.773
##
##                Factor1 Factor2 Factor3 Factor4 Factor5
## SS loadings      5.864   1.962   1.719   0.636   0.175
## Proportion Var   0.489   0.164   0.143   0.053   0.015
## Cumulative Var   0.489   0.652   0.795   0.848   0.863
```

```
# No common factors that can be explained by at least 80% of the total variance.
```

Question B

Does the factor model with the in (a) selected number of common factors fit to the data? Why?

```
results$uniquenesses
```

```
##         MS        CPI         GP        COP        FER        FDI        FII
## 0.00500000 0.01326399 0.01741139 0.08117704 0.02453226 0.36858569 0.44944080
##        CMR        BOT         ER       Repo        IGR
## 0.06902553 0.08571310 0.00500000 0.13664932 0.38769774
```

```
# Model with 5 factors fits well to the data

# The uniqueness values should ideally be low. High uniqueness values suggest
# that a variable is not well explained by the factors and may not fit the
# model well.
```

Question C

Give the correlations between the 'regression' factor scores, given the in (a) selected number of common factors.

```
cor(results$scores)
```

```
##             Factor1     Factor2      Factor3     Factor4     Factor5
## Factor1  1.000000000  0.02783952 -0.007726156  0.08220534  0.06531316
## Factor2  0.027839519  1.00000000  0.016582192 -0.08169138 -0.06329903
## Factor3 -0.007726156  0.01658219  1.000000000  0.01543023  0.02550634
```

```
## Factor4  0.082205341 -0.08169138  0.015430233  1.00000000 -0.06522386
## Factor5  0.065313160 -0.06329903  0.025506340 -0.06522386  1.00000000
```

Question D

Carry out an independent component analysis and determine the number of independent components. How many independent components do you select? Why?

```
library(fastICA)
set.seed(100)

result_ICA <- fastICA(IndianSM, 3)

x <- c(result_ICA$X)
e <- c(result_ICA$S%*%result_ICA$A)
evar <- (2*t(x)%*%e-t(e)%*%e)/t(x)%*%x
evar
```

```
##           [,1]
## [1,] 0.8559661
```

```
# It is advisable to use components that explain at least 80% to 90% of the
# total variance.

# Our variance is 85.6% thus 3 components are ok
```

Question E

Give the correlations between the features (macro-economic variables) and the independent components. Use these correlations to interpret the independent components.

```
cor(IndianSM, result_ICA$S)
```

```
##             [,1]         [,2]         [,3]
## MS   -0.9495089  0.019422760  0.270101500
## CPI  -0.9552322  0.028696792  0.230232382
## GP   -0.9602285  0.097491476  0.176799565
## COP  -0.6923667  0.183967222  0.627147827
## FER  -0.8270694 -0.040383839  0.498399293
## FDI  -0.3852214  0.189124692  0.698906482
## FII  -0.5359454 -0.280649849  0.388223419
## CMR  -0.3446872  0.884725736 -0.002790757
## BOT   0.9020972 -0.175553349 -0.226434256
## ER   -0.6686630  0.121906826 -0.661488902
## Repo  0.1139906  0.914483146 -0.225228220
## IGR   0.5221316 -0.003816265  0.708086252
```

```
# Foreign Institutional Investment (FII) has negative correlation with component
# 1 and 2. Foreign Exchange Rate (ER) has the negative correlation
# with component 1 and 3. Balance of Trade (BOT) has the highest positive
# correlation with component 1. Repo Rate (Repo) has the highest positive
# correlation with component 2. Industrial Growth Rate (IGR) has the highest
# negative correlation with component 2.
```