Homework Week 2: PCA / Interest Rates

Step 1.

Read the data session_2_homework_data.csv and visualize and get familiar with the variables.

Date	USGG3M	USGG6M	USGG2YR	USGG3YR	USGG5YR	USGG10YR	USGG30YR	Output1
1/5/1981	13.52	13.09	12.289	12.28	12.294	12.152	11.672	18.01553
1/6/1981	13.58	13.16	12.429	12.31	12.214	12.112	11.672	18.0914
1/7/1981	14.5	13.9	12.929	12.78	12.614	12.382	11.892	19.44731
1/8/1981	14.76	14	13.099	12.95	12.684	12.352	11.912	19.74851
1/9/1981	15.2	14.3	13.539	13.28	12.884	12.572	12.132	20.57204
1/12/1981	15.22	14.23	13.179	12.94	12.714	12.452	12.082	20.14218
1/13/1981	15.24	14.1	13.309	12.97	12.684	12.532	12.082	20.18154
1/14/1981	15.08	13.9	12.959	12.75	12.614	12.532	12.072	19.77729
1/15/1981	15.25	14.09	13.259	13.02	12.774	12.622	12.252	20.29888

The first 7 variables (input variables) are the daily records of the US Treasury yields to maturity. The meaning of the variable Output will become clear later.

Plot the input variables.
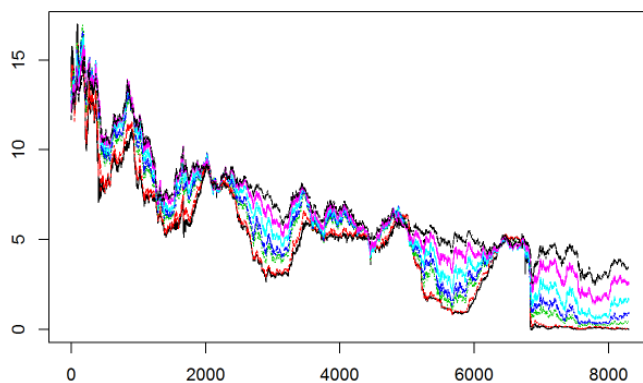
Step 2. Linear Regression

Task 1: Estimate simple regression model with each of the input variables and the output variable given in `AssignmentData`.

Collect all slopes and intercepts in one table and print this table.

Task 2: Fit linear regression models using single output (column 8 `Output1`) as input and each of the original inputs as outputs.

Step 3. Logistic Regression

Estimate logistic regression using all inputs and the data on FED tightening and easing cycles.

Prepare the easing-tightening data.
Make the easing column equal to 0 during the easing periods and NA otherwise.
Make the tightening column equal to 1 during the tightening periods and NA otherwise.

Plot the data and the binary output variable representing easing (0) and tightening (1) periods.

Task 1: Estimate logistic regression with 3M yields as predictors for easing/tightening output.
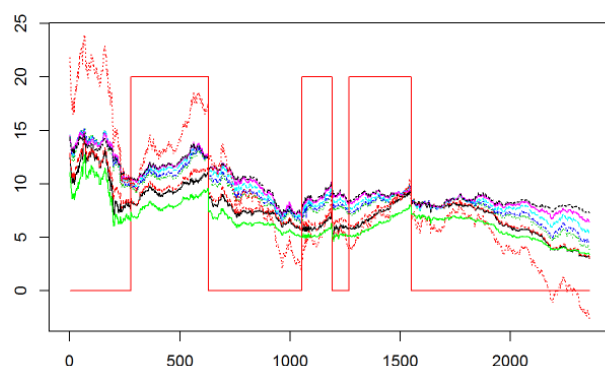
Task 2: Use all inputs as predictors for logistic regression.

Step 4. PCA

Perform PCA with the inputs (columns 1-7).

Task 1: Explore the dimensionality/correlation of the set of 3M, 2Y and 5Y yields.

Task 2: Analyze the covariance matrix of the data

Task 3: Perform the PCA by manually calculating factors, loadings and analyzing the importance of factors. Find eigenvalues and eigenvectors. Calculate vector of means (zero loading), first 3 loadings and 3 factors.

Display the importance of the factors
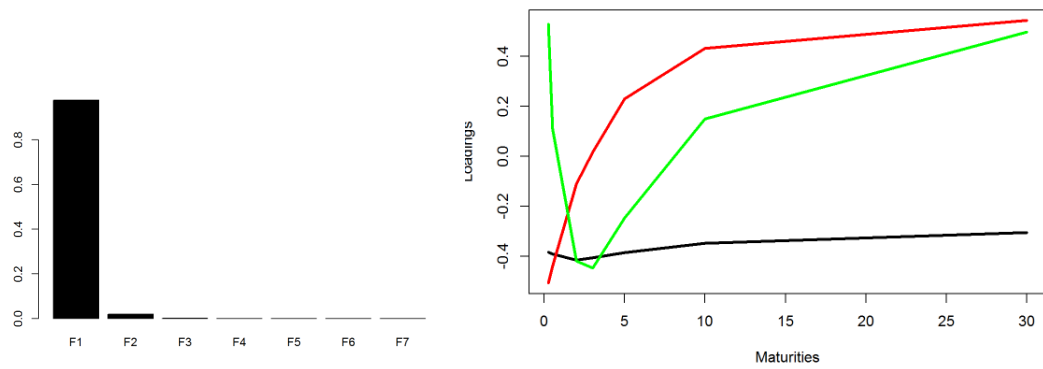
Task 4: Interpret the factors by looking at the shapes of the loadings

Task 5: Perform the PCA by using the library sklearn.