

# FE 515 Introduction to R

## Assignment 1

Please answer following questions in R markdown. After you finishing the homework, please generate a pdf report from the `rmd` file. The pdf report includes questions description, your answer codes and non-trivial output.

### Question 1: (50 points)

- 1.1 Generate a vector  $x$  from 5 to 35 with increment 2, and calculate its length.
- 1.2 Use the vector  $x$  in 1.1 to generate a 4-by-4 matrix  $A$  which filled by rows.
- 1.3 Calculate the eigenvalues of the matrix  $A$  in 1.2.
- 1.4 Change the 4 elements in first two rows and first two columns of the matrix  $A$  to 7. i.e. Let  $a_{11}, a_{12}, a_{21}, a_{22}$  equal to 7.

$$A = \begin{pmatrix} a_{1,1} & a_{1,2} & a_{1,3} & a_{1,4} \\ a_{2,1} & a_{2,2} & a_{2,3} & a_{2,4} \\ a_{3,1} & a_{3,2} & a_{3,3} & a_{3,4} \\ a_{4,1} & a_{4,2} & a_{4,3} & a_{4,4} \end{pmatrix}$$

- 1.5 Calculate the determinant of  $A$  in 1.4.
- 1.6 Calculate the inverse of  $A$  in 1.4.
- 1.7 Create a vector  $b$  by assigning the first row of  $A$  in 1.4 to  $b$ .
- 1.8 Find  $y$  by solving linear equation  $Ay = b$  with the  $A$  in 1.4 and  $b$  in 1.7.  
(Hint.  $y$  can be found by  $y = A^{-1}b$  where  $A^{-1}$  is the inverse of  $A$ .)
- 1.9 For each element of  $y$  in 1.8 find the minimum between its value and  $\frac{\pi}{2}$ .  
Store all results into a single vector. Print the value of resulting vector.  
i.e.  $v_{min} = (\min\{y_1, \pi/2\}, \min\{y_2, \pi/2\}, \dots, \min\{y_n, \pi/2\})$

$$y = \begin{pmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{pmatrix}$$

1.10 Read the documentation for function `diag` and use the function to generate the following 10-by-10 square matrix

$$\begin{pmatrix} 1 & 0 & \cdots & 0 \\ 0 & 2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 10 \end{pmatrix}$$

### Question 2: (10 points)

Consider a Fibonacci sequence  $S_n = S_{n-1} + S_{n-2}$  with the initial value  $S_0 = 0$  and the value at stage 1 as  $S_1 = 1$ . Please determine the values of  $S_3$  and  $S_{50}$ . (Hint.  $S_3 = S_1 + S_2 = 1 + 1 = 2$ , use this fact to check your result.)

### Question 3: (10 points)

Find all the integers between 1 and 100 which are divisible by both 3 and 5. Store the results into a vector. Print each element of the resulting vector.

### Question 4: (10 points)

Create a function with input parameter  $n$  and returns a vector. The output vector contains all integers between 1 and  $n$  which are divisible by 3 and 5. Please test the function with two cases  $n = 100$  and  $n = 200$ .

### Question 5: (10 points)

Create a function with parameters  $a$  and  $b$ . In the function body, it tries to find the smallest positive number that is divisible by both  $a$  and  $b$ . Please test your function with following two cases ( $a = 3, b = 5$ ) and ( $a = 6, b = 10$ ).

### Question 6: (10 points)

Please find the attached JPM.csv and load this data into R. Make a subset of the loaded data frame. The subset contains open prices, closing prices and adjusted closing prices (They are indicated by Open, Close and Adjusted). Please calculate the mean value of each column of the subset. (Hint. `apply` functions are better choice for this problem.)