Assignment 1

This assignment contributes to 10 % of your final grade.

Due Date: Wednesday 8 August by 11:59 PM

Late submissions will receive a 10 % penalty for each additional 24 hours over the due date.

Instructions

Complete the questions below either by hand, or using SAS code or a combination of the two.

- When completing by hand ensure you show all working and formulas used to receive full marks.
- When completing by SAS code ensure you include the SAS output and your full SAS code file (or copy of code text) with your assignment.

Submissions are to be made through Canvas. All work is to be your own as in accordance with the Assessment declaration.

Question 1

Let $\mathbf{A} = \begin{bmatrix} 2 & 2 \\ -1 & 1 \end{bmatrix}$; $\mathbf{B} = \begin{bmatrix} 5 & 1 \\ 4 & -2 \\ -1 & 2 \end{bmatrix}$, and $\mathbf{C} = \begin{bmatrix} 6 \\ -2 \\ 1 \end{bmatrix}$

Perform the following multiplications where possible or state why they are not possible.

a) **C'B** (1 mark)

b) **A'B'** (1 mark)

c) **BA** (1 mark)

d) **AB** (1 mark)

Question 2

Using the matrix

$$\mathbf{F} = \begin{bmatrix} \mathbf{4} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{9} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{1} \end{bmatrix}$$

a) Calculate **G**=**F**′**F** (1mark)

b) Obtain the eigenvalues and eigenvectors of **G** (4 marks)

Question 3

You are given the random vector $\mathbf{X}' = [\mathbf{X}_1, \quad \mathbf{X}_2, \quad \mathbf{X}_3, \quad \mathbf{X}_4]$ with mean vector $\boldsymbol{\mu}'_X = [4, \quad 3, \quad 2, \quad 1]$ and variance-covariance matrix

$$\boldsymbol{\Sigma}_X = \begin{bmatrix} \mathbf{3} & \mathbf{0} & \mathbf{2} & \mathbf{2} \\ \mathbf{0} & \mathbf{1} & \mathbf{1} & \mathbf{0} \\ \mathbf{2} & \mathbf{1} & \mathbf{9} & \mathbf{-2} \\ \mathbf{2} & \mathbf{0} & \mathbf{-2} & \mathbf{4} \end{bmatrix}$$

Partition **X** as $\mathbf{X} = \begin{bmatrix} \mathbf{X}_1 \\ \mathbf{X}_2 \\ \cdots \\ \mathbf{X}_3 \\ \mathbf{X}_4 \end{bmatrix} = \begin{bmatrix} \mathbf{X}^{(1)} \\ \cdots \\ \mathbf{X}^{(2)} \end{bmatrix}$

Let $\mathbf{A} = [1 \quad -1]$ and $\mathbf{B} = \begin{bmatrix} 2 & -1 \\ 0 & 1 \end{bmatrix}$ and consider the linear combinations $\mathbf{AX}^{(1)}$ and $\mathbf{BX}^{(2)}$ to find:

a) E($\mathbf{X}^{(1)}$) (1 mark)

b) E($\mathbf{AX}^{(1)}$) (1 mark)

c) Cov($\mathbf{X}^{(1)}$) (1 mark)

d) Cov($\mathbf{AX}^{(1)}$) (1 mark)

e) E($\mathbf{X}^{(2)}$) (1 mark)

f) E($\mathbf{BX}^{(2)}$) (1 mark)

g) Cov($\mathbf{X}^{(2)}$) (1 mark)

h) Cov($\mathbf{BX}^{(2)}$) (1 mark)

i) Cov($\mathbf{X}^{(1)}$,$\mathbf{X}^{(2)}$) (1 mark)

j) Cov($\mathbf{AX}^{(1)}$,$\mathbf{BX}^{(2)}$) (1 mark)

Question 4

The dataset on Canvas iceland.csv contains information about ocean characteristics as collected by the International Council for the Exploration of the Sea (ICES)[1] use this datafile to answer the following questions to explore the dataset.

a) Read the dataset into SAS (1 mark)

b) Produce the appropriate univariate descriptive statistics for each variable in the dataset using SAS code. (1 mark)

c) Choose an appropriate method to plot the dataset (2 marks)

d) Produce the covariance matrix for the dataset (1 mark)

e) Produce the correlation matrix for the dataset (1 mark)

f) Using your answers from part b) to part e) above, summarise your exploration of the dataset and identify any potential issues arising from this exploration. (5 marks)

1

ICES Dataset on Ocean Hydrography. The International Council for the Exploration of the Sea, Copenhagen. 2014