`Math 585    HW 1 Spring 2024       Due Friday, Jan. 26.`

R and *Arc* are described in more detail in Section 15.2. **Place plots and relevant output** in *Word*. **Two pages, problems A)-E).**

A) 1.2abcd (so do not do part e)) **1.2.** The Cushny and Peebles data set (see Staudte and Sheather 1990, p. 97) is listed below.

```
1.2  2.4  1.3  1.3  0.0  1.0  1.8  0.8  4.6  1.4
```

a) Find the sample mean $\overline{Y}$.

b) Find the sample standard deviation S.

c) Find the sample median MED(n).

d) Find the sample median absolute deviation MAD(n).

B), 3.12 Let $\boldsymbol{x}$ be a $p \times 1$ random vector with covariance matrix Cov($\boldsymbol{x}$). Let $\boldsymbol{A}$ be an $r \times p$ constant matrix and let $\boldsymbol{B}$ be a $q \times p$ constant matrix. Find Cov($\boldsymbol{Ax}, \boldsymbol{Bx}$) in terms of $\boldsymbol{A}, \boldsymbol{B}$ and Cov($\boldsymbol{x}$).

C), 2.4 i) Let $\boldsymbol{\Sigma}$ be a $p \times p$ matrix with eigenvalue eigenvector pair $(\lambda, \boldsymbol{x})$. Show that $c\boldsymbol{x}$ is also an eigenvector of $\boldsymbol{\Sigma}$ where $c \neq 0$ is a real number.

ii) Let $\boldsymbol{\Sigma}$ be a $p \times p$ matrix with eigenvalue eigenvector pairs $(\lambda_1, \boldsymbol{e}_1), ..., (\lambda_p, \boldsymbol{e}_p)$. Find the eigenvalue eigenvector pairs of $\boldsymbol{A} = c\boldsymbol{\Sigma}$ where $c \neq 0$ is a real number.

Information for problem D). The computer lab Neckers 258 is open MTuWThF 8–4:30. I can let you in M-F during my office hours. Computers 21-30 in the back of the computer lab Neckers 258 have *R*, *SAS* and *Arc* and may be easier to use. If the computer is not on, turn it on and double click on the *R* icon. The *R* window should appear.

Type *q()* or click on the *X* in the upper right corner of the screen and then click on *No* (when asked whether to save the workspace image) to get out of *R.*

To get into *Word*, single click on the round *start icon* in the lower left corner of the screen. Click on *All programs*, click on *Microsoft office* and click on *Microsoft office Word 2007.* The *Word* window should appear.

You can also copy and paste the *R* commands for HW1 D) from (http://parker.ad.siu.edu/Olive/mrsashw.txt) into *R.*

D), 2.10 Use the following *R* commands to make 100 multivariate normal (MVN) $N_3(\boldsymbol{0}, \boldsymbol{I}_3)$ cases and 100 trivariate non-EC lognormal cases.

```
n3x <- matrix(rnorm(300),nrow=100,ncol=3)
ln3x <- exp(n3x)
```

In *R*, type the command *library(MASS).*

Using the commands *pairs(n3x)* and *pairs(ln3x)* and include both scatterplot matrices in *Word.* (Click on the plot and hit *Ctrl* and *c* at the same time. Then go to *file* in the *Word* menu and select *paste.*) Are strong nonlinearities present among the MVN predictors? How about the non-EC predictors? (Hint: a box or ball shaped plot is linear.)

E) The data in the above plot corresponds to pollution variables used to predict mortality rates. Use the above plot to give transformations, if any, that you would use to remove strong nonlinearities from the variables.