Multivariate Data Analysis - Assignment 2

## Multivariate Data Analysis Spring 2019 (37459-2019-SPRING-CITY)

### Assignment: 2

### Student Name: Anuj Kapil

### Student Id: 12678708

## Question 1

For a given mean vector and covariance matrix, we can simulate random samples from the multivariate normal distribution in R using the ‘mvrnorm’ function from **MASS** package.

# Question 1  
# Mean vector  
mv<-rep(0, 3)  
  
# Cov matrix  
vcmat <- 1/5630 \* matrix(c(575,-60,10,-60,300,-50,10,-50,196),nrow=3,byrow=TRUE)  
  
# Covariance matrix  
print(vcmat)

## [,1] [,2] [,3]  
## [1,] 0.102131439 -0.010657194 0.001776199  
## [2,] -0.010657194 0.053285968 -0.008880995  
## [3,] 0.001776199 -0.008880995 0.034813499

#MVN  
mnd <- mvrnorm(n=1000,mv,vcmat)

### Question 1a

Calculate the least square estimates using R function for Y2 and Y3 where:

and

Peform a linear regression to find the coefficients , and .

# Question 1a  
  
# Convert matrix to a data.table  
mnd\_df <- as.data.frame(as.table(mnd))  
setDT(mnd\_df)  
mnd\_dt <- dcast(mnd\_df, Var1~Var2, value.var = 'Freq')  
mnd\_dt[,Var1:=NULL]  
  
colnames(mnd\_dt) <- c('Y1', 'Y2', 'Y3')  
  
model\_1<-lm(Y2~Y1, data = mnd\_dt)  
  
model\_summary <- summary(model\_1)  
  
# Coefficent of Y1  
beta2\_1 <- model\_summary$coefficients[[2]]  
print(beta2\_1)

## [1] -0.113202

model\_2<-lm(Y3~Y1+Y2, data = mnd\_dt)  
  
model\_summary <- summary(model\_2)  
  
#Coefficent of Y1  
beta3\_1 <- model\_summary$coefficients[[2]]  
print(beta3\_1)

## [1] 0.015343

#Coefficent of Y2  
beta3\_2 <- model\_summary$coefficients[[3]]  
print(beta3\_2)

## [1] -0.176815

### Question 1b

Estimate

# Question 1b  
sigma\_2\_square <- (summary(model\_1)$sigma)^2  
print(sigma\_2\_square)

## [1] 0.05459528

### Question 1c

Estimate

# Question 1c  
sigma\_3\_square <- (summary(model\_2)$sigma)^2  
print(sigma\_3\_square)

## [1] 0.03529939

### Question 1d

Construct the 3x3 matrix from coefficients

T <- matrix(c(1,-1\*beta2\_1,-1\*beta3\_1,0,1,-1\*beta3\_2,0,0,1),nrow = 3)  
print(T)

## [,1] [,2] [,3]  
## [1,] 1.000000 0.000000 0  
## [2,] 0.113202 1.000000 0  
## [3,] -0.015343 0.176815 1

### Question 1e

Compute

TT <- T\*vcmat\*t(T)  
print(TT)

## [,1] [,2] [,3]  
## [1,] 0.1021314 0.00000000 0.0000000  
## [2,] 0.0000000 0.05328597 0.0000000  
## [3,] 0.0000000 0.00000000 0.0348135