DATA 605 - Homework 4

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```
library(ggplot2)
library(psych)
library(dplyr)
library(knitr)
library(tidyr)
```

Problem Set 1

1) We start with matrix A

```
A = matrix(c(1,2,3,-1,0,4),nrow=2,ncol=3,byrow = T)

A
```

```
##      [,1] [,2] [,3]
## [1,]    1    2    3
## [2,]   -1    0    4
```

We create X = A(AT) and Y = (AT)A:

```
X = A %*% t(A)
Y = t(A) %*% A

X
```

```
##      [,1] [,2]
## [1,]   14   11
## [2,]   11   17
```

```
Y
```

```
##      [,1] [,2] [,3]
## [1,]    2    2   -1
## [2,]    2    4    6
## [3,]   -1    6   25
```

EigenValue and EigenVector of X and Y:

```
eigen(X)
```

```
## eigen() decomposition
## $values
## [1] 26.601802  4.398198
##
## $vectors
##           [,1]       [,2]
## [1,] 0.6576043 -0.7533635
## [2,] 0.7533635  0.6576043
```

```
eigen(Y)
```

```
## eigen() decomposition
## $values
## [1]  2.660180e+01  4.398198e+00 -6.098625e-16
##
## $vectors
##             [,1]       [,2]       [,3]
## [1,] -0.01856629  0.6727903  0.7396003
## [2,]  0.25499937  0.7184510 -0.6471502
## [3,]  0.96676296 -0.1765824  0.1849001
```

left-singular, singular values, and right-singular vectors of A:

```
svd(A)
```

```
## $d
## [1] 5.157693 2.097188
##
## $u
##            [,1]       [,2]
## [1,] -0.6576043 -0.7533635
## [2,] -0.7533635  0.6576043
##
## $v
##             [,1]       [,2]
## [1,]  0.01856629 -0.6727903
## [2,] -0.25499937 -0.7184510
## [3,] -0.96676296  0.1765824
```

The third eigenvalue of Y is actually zero (shows as e-16).

We can see that our manual calculation and the built in svd has the same results.

```
svd(A)$d**2
```

```
## [1] 26.601802  4.398198
```

we can see that the square is equal to the eigenvalue

Problem Set 2

```
myinverse <- function(A) {


cofactor <- matrix(0,nrow(A),ncol(A))
  for(i in 1:nrow(A)) {
    for(j in 1:ncol(A)) {

      temp = A
      temp = temp[-i,] #remove row i
      temp = temp[,-j] #remove col j
      cofactor[i,j] <- (-1)^(i+j) * det(temp)
    }
  }

#from the weekly material we know that A-1 = cT / det(A)

return(t(cofactor)/ det(A))
}
```

1) We will use the below matrix to test the function:

```
A = matrix(c(1,2,3,4,5,6,7,8,10),nrow=3,ncol=3,byrow = T)

A
```

```
##      [,1] [,2] [,3]
## [1,]    1    2    3
## [2,]    4    5    6
## [3,]    7    8   10
```

```
my_inv_A = myinverse(A)

my_inv_A
```

```
##            [,1]      [,2] [,3]
## [1,] -0.6666667 -1.333333    1
## [2,] -0.6666667  3.666667   -2
## [3,]  1.0000000 -2.000000    1
```

```
inv_A = solve(A)

inv_A
```

```
##            [,1]      [,2] [,3]
## [1,] -0.6666667 -1.333333    1
## [2,] -0.6666667  3.666667   -2
## [3,]  1.0000000 -2.000000    1
```

We can see that both inverses are the same

Github (both PDF and RMarkdown):

https://github.com/chilleundso/Data605_CompMath/tree/master/Homework4