Assignment4

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Problem Set 1:

1. In this problem, we'll verify using R that SVD and Eigenvalues are related as worked out in the weekly module. Given a $3x2$ matrix A

```
# First create matrix A
A <- matrix(c(1,2,3,-1,0,4), nrow = 2)

# Then transpose matrix A using t()
AT <- t(A)
AT
```

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

```
# Multiply the transposed matrix A by matrix A
Y<- AT %*% A
Y
```

```
##      [,1] [,2] [,3]
## [1,]    5    1    8
## [2,]    1   10   -4
## [3,]    8   -4   16
```

```
# Multiply A by transposed matrix A (AA^T)
X<- A %*% AT
X
```

```
##      [,1] [,2]
## [1,]   10   -1
## [2,]   -1   21
```

```
# compute eigenvalues and eigenvectors
EX = eigen(X)

EY = eigen(Y)

SA <- svd(A)

#As you can see the first two columns are the Evectors of X and the right are the lef
t singular for A
cbind(EX$vectors, SA$u)
```

```
##            [,1]       [,2]       [,3]      [,4]
## [1,] -0.0898056 -0.9959593 -0.0898056 0.9959593
## [2,]  0.9959593 -0.0898056  0.9959593 0.0898056
```

```
#As you can see the first two columns are the Evectors of X and the right are the rig
ht singular for A except the Evectors for Y has the third column that is not present
in svd for the right singular.
cbind(EY$vectors, SA$v)
```

```
##            [,1]       [,2]       [,3]       [,4]      [,5]
## [1,] -0.4141868 -0.3734355  0.8300574  0.4141868 0.3734355
## [2,]  0.2755368 -0.9206109 -0.2766858 -0.2755368 0.9206109
## [3,] -0.8674842 -0.1141117 -0.4842001  0.8674842 0.1141117
```

```
#to compute the non zero values, you need to take the sqrt of the eigenvalues for X a
nd compare it to the singulard values of svd for A.

cbind(sqrt(EX$values), SA$d)
```

```
##          [,1]     [,2]
## [1,] 4.592404 4.592404
## [2,] 3.147988 3.147988
```

2. Using the procedure outlined in section 1 of the weekly handout, write a function tocompute the inverse of a well-conditioned full-rank square matrix using co-factors. Your function should be myinverse(A).

```
A <- matrix(c(2,3,6,6,3,5,5,8,9),nrow=3)
myinverse <- function(A){
  #generate empty I matrix first
  I <- diag(1,nrow(A),ncol(A))
  #iterate over the rows
   for (i in 1:nrow(A)) {
        #iterate over the columns
        for (j in 1:ncol(A)){
          #Calucate the value for each cell in the matrix
          Mmini <- A[-i,-j]
          #-1 raised to a power provides the appropriate signs as the mini det is cal
culated for the 2x2s
          I[i,j] <- ((-1)^(i+j))*det(Mmini)
        }
   }
  #finish the calculation by dividing by the det of A
  return(t(I)/det(A))
}

#Original Matrix cbind to Inverse matrix B
B=myinverse(A)
A%*%B
```

```
##              [,1] [,2]         [,3]
## [1,] 1.000000e+00    0 1.110223e-16
## [2,] 2.220446e-16    1 2.220446e-16
## [3,] 5.551115e-16    0 1.000000e+00
```

```
#althought the values are in scinotation you can see the 1's along the diagonal and z
ero/near zero in the other cells.
```