Week_3 605 assignment

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1/21/2020

Problem set_1

(1) What is the rank of the matrix A?

$$\begin{bmatrix} 1 & 2 & 3 & 4 \\ -1 & 0 & 1 & 3 \\ 0 & 1 & -2 & 1 \\ 5 & 4 & -2 & -3 \end{bmatrix}$$

```r
a_mEn <- matrix(c(1,2,3,4,
                  -1,0,1,3,
                  0,1,-2,1,
                  5,4,-2,-3), 4, byrow=T)
# a <- matrix(c(0,1,2,1,2,7,2,1,8), ncol = 3)
a_mEn
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    1    2    3    4
## [2,]   -1    0    1    3
## [3,]    0    1   -2    1
## [4,]    5    4   -2   -3
```

```r
a_mbn <- matrix(c(1,2,3,4,
                  -1,0,1,3), 4, byrow=T)
a_mbn
```

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

```r
a_mln <- matrix(c(1,2,3,4,
                  -1,0,1,3), 2, byrow=T)
a_mln
```

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

```r
get_echoln <- function(a) {
  U = a
  n = ncol(a)
  m = nrow(a)
```

```r
  if(m == n) {
    for (i in 1:n) {
      for (j in 2:m) {
        if(U[j,i] != 0 & j > i) {
          # Add multiples of the pivot row to each of the lower rows,
          # so every element in the pivot column of the lower rows equals 0.
          mplier = U[[j,i]]/U[[i,i]]
          # reduce by reduction and subtitute in the U matrix
          U[j,] = U[j,] - mplier * U[i,]
        } else if (j == i) {
          U[j,] = U[j,] / U[[j,i]]
        }# end if
      } # end if
    } # end for
  } else if(m < n) {
    for (i in 1:n) {
      for (j in 2:m) {
        if(U[j,i] != 0 & j > i) {
          U[i,] = U[i,] / U[[i,i]]
          # Add multiples of the pivot row to each of the lower rows,
          # so every element in the pivot column of the lower rows equals 0.
          mplier = U[[j,i]]/U[[i,i]]
          # reduce by reduction and subtitute in the U matrix
          U[j,] = U[j,] - mplier * U[i,]

        } else if(U[j,i] != 0 & j == i) {
          U[i,] = U[i,] / U[[i,i]]
        } # end if
      } # end for
    } # end for
  } else if (m > n) {
    for (i in 1:n) {
      for (j in 2:m) {
        if(U[j,i] != 0 & j > i) {
          U[i,] = U[i,] / U[[i,i]]
          # Add multiples of the pivot row to each of the lower rows,
          # so every element in the pivot column of the lower rows equals 0.
          mplier = U[[j,i]]/U[[i,i]]
          # reduce by reduction and subtitute in the U matrix
          U[j,] = U[j,] - mplier * U[i,]

        } else if(U[j,i] != 0 & j == i) {
          U[i,] = U[i,] / U[[i,i]]
        } # end if
      } # end for
    } # end for
  } # end if
  return(round(U, digits = 1))
}

equal = get_echoln(a_mEn)
equal
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    1    2    3  4.0
## [2,]    0    1    2  3.5
## [3,]    0    0    1  0.6
## [4,]    0    0    0  1.0
```

```
greater = get_echoln(a_mbn)
greater
```

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

```
lesser = get_echoln(a_mln)
lesser
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    1    2    3  4.0
## [2,]    0    1    2  3.5
```

```r
# rank needs to be modified
ranking = function(cd) {
  rank = 0
  sol = as.array(colSums(cd))
  # [1]  1  3  6 10
  for (i in 1:length(sol)) {
    if(sol[i] != 0 & ncol(cd) <= nrow(cd)) {
      rank = rank + 1
    } else if (sol[i] != 0 & ncol(cd) > nrow(cd)) {
      rank = nrow(cd)
    }
  }
  return(rank)
}

r1 = ranking(equal)
r1
```

```
## [1] 4
```

```
r2 = ranking(greater)
r2
```

```
## [1] 2
```

```
r3 = ranking(lesser)
r3
```

```
## [1] 2
```

(2) Given an $m \times$ matrix where m > n, what can be the maximum rank? The mini- mum rank, assuming that the matrix is non-zero?