is605 Assignment 3 (PS1 & PS2)

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PS1

PS1 Part 1.

The rank of the matrix below is 4. Since the reduced row echelon form of matrix A is a full rank (4 pivots) square matrix the rank is equal to the number of pivots in the reduced row echelon form of A and in this case the rank is 4. This means that there are 4 linearly independend rows in A and this is validated by the fact that det(A) != 0.

```
require(Matrix)
```

```
## Loading required package: Matrix
```

```
## Warning: package 'Matrix' was built under R version 3.1.2
```

```
require(pracma)
```

```
## Loading required package: pracma
```

```
## Warning: package 'pracma' was built under R version 3.1.2
```

```
##
## Attaching package: 'pracma'
##
## The following objects are masked from 'package:Matrix':
##
##      expm, lu, tril, triu
```

```
A <- matrix(c(1,2,3,4,-1,0,1,3,0,1,-2,1,5,4,-2,-3), nrow = 4, ncol = 4, byrow = TRUE)
A
```

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

```
det(A)
```

```
## [1] -9
```

```
# Verify the Solution
reducedA <- rref(A)
reducedA
```

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

```r
rankMatrix(reducedA)
```

```
## [1] 4
## attr(,"method")
## [1] "tolNorm2"
## attr(,"useGrad")
## [1] FALSE
## attr(,"tol")
## [1] 8.882e-16
```

PS1 Part 2.

Given an mxn matrix where m>n, the maximum rank of the given matrix is $<= \min(m,n)$. Since m>n, then the maximum rank of the given mxn matrix is $<= n$.

Since the given matrix is assumed to be a non-zero matrix the minimum rank of the given matrix is 1.

PS1 Part 3.

The matrix B below only has 1 linearly independent row. R3 is 2xR1 and therefore is eliminated when reduced to row echelon form. R2 is 3xR1 and is also eliminated when reduced to row echelon form. Accordingly the rank of matrix B is 1 since the reduced row echelon form of B yields only 1 linearly independent row.

```r
B <- matrix(c(1,2,1,3,6,3,2,4,2), nrow = 3, ncol = 3, byrow = TRUE)
# Check the Solution
reducedB <- rref(B)
reducedB
```

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

```r
rankMatrix(reducedB)
```

```
## [1] 1
## attr(,"method")
## [1] "tolNorm2"
## attr(,"useGrad")
## [1] FALSE
## attr(,"tol")
## [1] 6.661e-16
```

PS2 Part 1 and Part 2 - See Attached PDF For Handwritten Solution.