# Assignment 3

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**PS1.**

**1.** The matrix in this case will looks like the following in row echelon form. In this case there are 4 non-zero rows, so the rank is 4. We can check in R with `rankMatrix()`.

```
library(Matrix)
matrix <- matrix(c(1,-1,0,5,2,0,1,4,3,1,-2,-2,4,3,1,-3), nrow = 4)
matrix(c(1,0,0,0,2,2,0,0,3,4,-4,0,4,7,-5/2,9/8), nrow = 4)
```

```
##      [,1] [,2] [,3]   [,4]
## [1,]    1    2    3  4.000
## [2,]    0    2    4  7.000
## [3,]    0    0   -4 -2.500
## [4,]    0    0    0  1.125
```

```
rankMatrix(matrix, method = "qr")[1] #using build in
```

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

**2.** `n` would be the maximum rank. Assuming the matrix is non-zero the minimum rank would be 1.

**3.** Rows 2 and 3 are eliminated, leaving 2 zero rows. The rank is 1.

```
matrix <- matrix(c(1,0,0,2,0,0,1,0,0), nrow = 3);matrix
```

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

```
rankMatrix(matrix, method = "qr")[1]
```

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

**PS2**

**1.** Solve for the determinant first.

$$det(\begin{bmatrix}1 & 2 & 3\\0 & 4 & 5\\0 & 0 & 6\end{bmatrix} - \begin{bmatrix}\lambda & 0 & 0\\0 & \lambda & 0\\0 & 0 & \lambda\end{bmatrix}) = 0$$

$$det(\begin{bmatrix}1-\lambda & 2 & 3\\0 & 4-\lambda & 5\\0 & 0 & 6-\lambda\end{bmatrix}) = 0$$

$$(1-\lambda)(4-\lambda)(6-\lambda) = 0$$

Which gives the characteristic polynomial as the following, and three eigenvalues of 1, 4, and 6.

$$-\lambda^3 + 11\lambda^2 - 34\lambda + 24$$

The eigenvalues plug in to give the following three equations:

$$\begin{bmatrix}1-1 & 2 & 3\\0 & 4-1 & 5\\0 & 0 & 6-1\end{bmatrix} * \begin{bmatrix}v_1\\v_2\\v_3\end{bmatrix} = 0$$

$$\begin{bmatrix}1-4 & 2 & 3\\0 & 4-4 & 5\\0 & 0 & 6-4\end{bmatrix} * \begin{bmatrix}v_1\\v_2\\v_3\end{bmatrix} = 0$$

$$\begin{bmatrix}1-6 & 2 & 3\\0 & 4-6 & 5\\0 & 0 & 6-6\end{bmatrix} * \begin{bmatrix}v_1\\v_2\\v_3\end{bmatrix} = 0$$

Which then give eigenvectors of:

$$\begin{bmatrix}1\\0\\0\end{bmatrix}, \begin{bmatrix}1\\3/2\\0\end{bmatrix}, \begin{bmatrix}1\\25/16\\5/8\end{bmatrix}$$