DATA SCIENCE FOR ENGINEERS

Linear Algebra-FAQ's

Errors

1. Getting an error while finding values of variables
   the code is
   A=matrix(c(1,2,3,4,5,6,7,8,9),ncol=3,byrow=F)
   b=c(2,3,4)
   x=solve(A)%*%b
   The error is " Lapack routine dgesv: system is exactly singular: U[3,3] = 0"
   Answer:
   Please check the determinant of the matrix. The determinant of the matrix is 0. Hence it cannot be solved. That is why it throws up the error.

2. library(reshape2) shows the below error. How to solve this?
   "package reshape2 doesn't exist"
   Answer:
   A simple fix to this problem will be to run the command
   install. packages("reshape2")

3. Already installed the package 'reshape2''but still, getting the following error.
   > library(reshape2)
   Error: package or namespace load failed for 'reshape2' in loadNamespace
   (i,c(lib.loc, .libPaths()), versionCheck = vI[[i]]):
   there is no package called 'stringi'
   Answer:
   While installing the packages we have to install the dependencies as well.

Inverse

1. How to perform A inverse in R?.
   Answer:
   To calculate the inverse of A, use the command solve(A).

2. The R Code doesn't show the multiplication of inverse of A with B. How to represent the inverse of A in R also?

Answer:

To calculate the inverse of a matrix , please use the command inv(A) or solve (A) Please find attached snapshots to calculate the inverse of a matrix

```
> A=matrix(c(1,4,8,5,6,2,3,2,1),3,3,byrow = F)
>
> #To find A inverse:
> library(matlib)#load the library
> inv(A) #(or)
            [,1]        [,2]       [,3]
[1,] -0.03448276 -0.01724138  0.1379310
[2,] -0.20689655  0.39655172 -0.1724138
[3,]  0.68965517 -0.65517241  0.2413793
> solve(A)
            [,1]        [,2]       [,3]
[1,] -0.03448276 -0.01724138  0.1379310
[2,] -0.20689655  0.39655172 -0.1724138
[3,]  0.68965517 -0.65517241  0.2413793
```

```
A=matrix(c(1,4,8,5,6,2,3,2,1),3,3,byrow = F)
#####  Solve Ax=b1  #####
b1=c(2,3,3)

#to solve x= inv(A)*b1
solve(A,b1)
```

Null space

1. Explain the concept of the size of the null space. It is being said that the Beta has to be a 3 x 1, so does it not mean that the size of Beta in this example is 3

   Answer:

   Size of the null space is the dimension of the null space matrix. In this case, It is a matrix of size 3*1.

2. Is there a way or method available in R through which one can find Null Space vector in R?

   Answer:

   nullspace() is the function in R

3. How is the size of the null space calculated in R?

Answer:

To calculate the nullspace, please use the command nullspace(matrix_name).

To calculate the size of the nullspace , use the command dim(matrix_name).

Please find attached snapshot for your reference.

```
> A=matrix(seq(1:9),3,3,byrow = F)
> library(pracma)
> Rank(A)
[1] 2
> b<-nullspace(A)
> b
             [,1]
[1,]  0.4082483
[2,] -0.8164966
[3,]  0.4082483
> dim(b)
[1] 3 1
```

Pracma library

1. What does library pracma contain?

Answer:

By loading library called **pracma**, it allows you to perform some matrix operations such as finding the **rank** of the matrix.

Please make sure you installed the package pracma before loading it as library

2. How to install and use the pracma library?

Answer:

Use >install.packages("pracma") download it. Then use >library(pracma).

3. The command "library(pracma)" is throwing an error.

Answer:

Before loading the library , kindly install the package pracma using the command
install.packages("pracma") and then load the library(pracma).

Rank

1. Explain the difference between the functions Rank() and rank() in R?

   Answer:

   Rank() returns the sample ranks of the values in a vector. Ties (i.e., equal values)
   where as Rank() gives the no.of linearly independent columns of the matrix.

2. The Rank provides us the number of independent columns in the matrix & Nullity provides the number of columns that are linearly dependent. So for a given matrix, how to identify what are the columns that are linearly dependent?

   Answer:

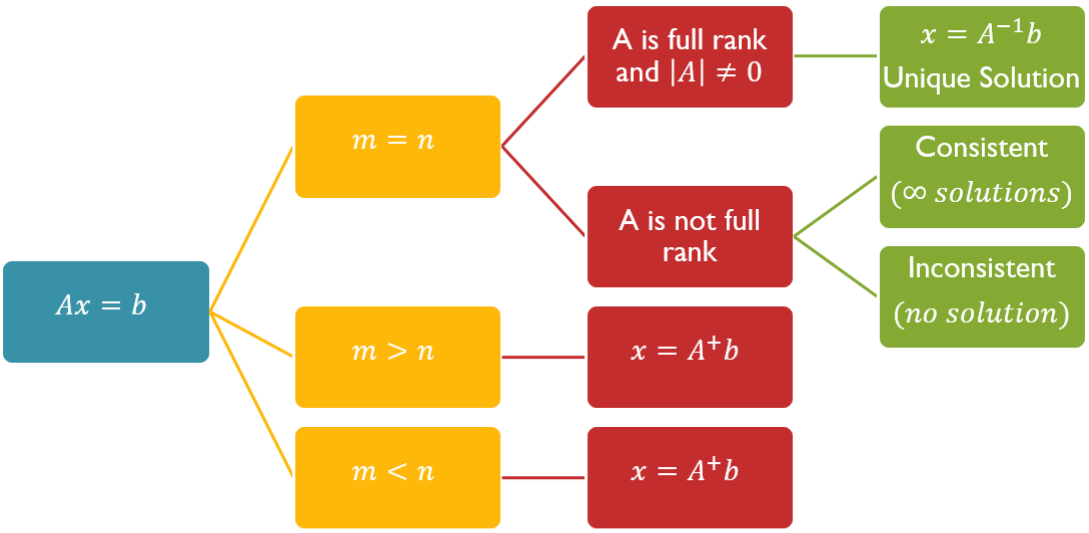
   Nullity provides the number of **linear relationships among columns**. Using the concept of **Rank** of the matrix we can only identify the no. of linearly related columns.

Solving linear equations

1. Matrix A where m = n and A if full rank and |A| = 0. does A have any solution?

Answer:

If you have a matrix A where m= n , both cannot happen at the same time. The conditions for solving linear equations have been attached below.



where we define pseudo inverse A^{+} appropriately

Vectors

1. Why are basis vectors not unique?

Answer:

There are many ways to define a basis vector. However, all share the same properties. Basis is a collection of vectors that are linearly independent and span the whole space.

2. Can we insert row or column in between matrix?

Answer:

Yes! Rbind () and cbind () is used to insert row and column matrix respectively.

Principal component analysis

1. Can you please give a practical application in data science where projection and principal component analysis is used?

Answer:

Projection is a very widely used in concept in data science. While there are many applications, whenever we have dimensionality reduction, we project data onto the basis vectors that we choose. In PCA, the data is projected along the chosen set of directions of maximum variance, in classification data is projected onto directions that enhance separability and so on.