Matlab/Freemat/Octave/Scilab: Inverse Matrices

The inverse[1] of a 2×2 matrix can be computed very quickly by hand[2]. The inverse of a 3×3 matrix can be achieved in a few steps[3]. In Matlab/Freemat/Octave/Scilab the inverse of a matrix can be found easily by using the command inv. In this document the use of the command inv is illustrated. However, note that finding an inverse is rarely required in computation and it is often more computationally intensive than alternative methods.

Inverse of a 2×2 matrix

In the following example the matrix

$$A=\begin{pmatrix} 2 & 1 \\ 3 & 2 \end{pmatrix}$$

is declared[4] and its inverse is found in Matlab/Freemat. It is also verified that

$$A\,A^{-1}=A^{-1}A=I.$$

```
--> A=[2 1; 3 2]
A =
2 1
3 2
--> Ainv=inv(A)
Ainv =
2.0000   -1.0000
-3.0000    2.0000
--> A*Ainv
ans =
1 0
0 1
--> Ainv*A
ans =
1 0
0 1
```

[1] Identity and Inverse Matrices
[2] Inverse of a 2x2 Matrix
[3] Inverse of a 3x3 Matrix
[4] Matlab/Freemat/Octave: Arrays – Matrices and Vectors

Determinant and Singular Matrices

A singular matrix has no inverse and its determinant is zero. The determinant of a matrix can be found using the det command. In the next example det is demonstrated and the result of trying to invert a singular matrix is shown.

```
A=[2 1; 3 2]
A =
2 1
3 2
--> det(A)
ans =
1.0000
--> A=[2 1; 4 2]
A =
2 1
4 2
--> det(A)
ans =
0
--> inv(A)
Warning: Matrix is singular to
working precision.  RCOND =
0.000000e+000
ans =
0 0
0 0
```

Inverse of a 3×3 matrix

In the following example the inverse of the 3×3 matrix[5]

$$A = \begin{pmatrix} 1 & 2 & 2 \\ 1 & 0 & 1 \\ 1 & 2 & 1 \end{pmatrix}$$

is shown in Matlab/Freemat/Octave/Scilab. It is also verified that $A\,A^{-1}=A^{-1}A=I$.

[5] Inverse of a 3x3 Matrix

```
--> A=[1 2 2; 1 0 1; 1 2 1]
A =
1 2 2
1 0 1
1 2 1
--> Ainv=inv(A)
Ainv =
-1.0000    1.0000    1.0000
0   -0.5000    0.5000
1.0000        0   -1.0000
--> A*Ainv
ans =
1 0 0
0 1 0
0 0 1
--> Ainv*A
ans =
1 0 0
0 1 0
 0 0 1
```

Inverse of Larger Matrices

Matlab/Freemat can find the inverse of matrices of any size. For example the inverse of the matrix

$$A = \begin{pmatrix} 1 & -2 & 0 & 4 & 2 \\ 3 & 0 & -2 & -1 & 1 \\ 2 & 5 & -1 & 0 & 1 \\ 0 & 2 & -1 & 5 & 3 \\ 3 & -2 & 2 & 1 & 0 \end{pmatrix}$$

is found using Matlab/Freemat and verified in the usual way.

```
--> A=[1 -2 0 4 2; 3 0 -2 -1 1; 2 5 -1 0 1; 0 2 -1 5 3; 3 -2 2 1 0]
A =
1 -2  0  4  2
3  0 -2 -1  1
2  5 -1  0  1
0  2 -1  5  3
3 -2  2  1  0
--> Ainv=inv(A)
Ainv =
2.3600   -0.5600    1.3600   -1.8400   -0.8000
0.4400   -0.2400    0.4400   -0.3600   -0.2000
-6.3600    1.5600   -3.3600    4.8400    2.8000
6.5200   -1.9200    3.5200   -4.8800   -2.6000
-13.2800    3.8800   -7.2800   10.3200    5.4000
--> A*Ainv
ans =
1.0000    0.0000    0.0000         0   -0.0000
0    1.0000         0    0.0000   -0.0000
0    0.0000    1.0000         0   -0.0000
0         0   -0.0000    1.0000         0
0   -0.0000   -0.0000         0    1.0000
--> Ainv*A
ans =
1.0000    0.0000   -0.0000    0.0000    0.0000
0.0000    1.0000   -0.0000         0    0.0000
-0.0000   -0.0000    1.0000   -0.0000   -0.0000
0.0000    0.0000   -0.0000    1.0000    0.0000
-0.0000   -0.0000    0.0000   -0.0000    1.0000
```