

## Matlab/Freemat: Inverse Matrices

The inverse<sup>1</sup> of a  $2 \times 2$  matrix can be computed very quickly by hand<sup>2</sup>. The inverse of a  $3 \times 3$  matrix can be achieved in a few steps<sup>3</sup>. In Matlab/Freemat 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 $2 \times 2$ matrix

In the following example the matrix

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

is declared<sup>4</sup> 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
```

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<sup>1</sup> [Identity and Inverse Matrices](#)

<sup>2</sup> [Inverse of a 2x2 Matrix](#)

<sup>3</sup> [Inverse of a 3x3 Matrix](#)

<sup>4</sup> [Matlab/Freemat: 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 $3 \times 3$ matrix

In the following example the inverse of the  $3 \times 3$  matrix<sup>5</sup>

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

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

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<sup>5</sup> [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
```