

MATLAB Quick Summary, Part I

General Commands

exit	Exit Matlab
whos	List all variables and info
ls	List the directory
dir	List the directory
help <i>command</i>	Type the help for command
helpdesk	Invoke the browser help
lookfor <i>keyword</i>	Search help for keyword
diary <i>filename</i>	Save all commands in filename
edit	Invoke the editor
clc	Clear command window

File Input/Output

save <i>filename</i>	Save all as filename.mat
save <i>filename</i> <i>var1</i>	Save var1 as filename.mat
load <i>filename</i>	Load filename.mat
open <i>filename.fig</i>	Load a figure
X=load('file.dat');	Loads text data into X

Arithmetic and Functions

+, -, *, / Add, Subtract
 Multiply, Divide

Usual Trig Functions

atan2(y,x)	4-quadrant inverse tangent
exp(A)	e^A , elementwise
log(A)	$\ln(A)$, elementwise
mod(x,y)	See help
randperm(n)	Random permutation of integers 1-n

Array Commands

size,length	
A'	A^T for A real
A.*B	Element multiply
A.^n	Element exponentiate
A./B	Element divide
A*B	Matrix multiply
A+c	Add scalar c to all A .
A*c	Multiply scalar c to all A
A=rand(m,n)	Random matrix
A=randn(m,n)	Random matrix
A=zeros(m,n)	Zero matrix
A=ones(m,n)	Matrix of 1's
A=eye(n)	$n \times n$ identity
a:c	[a a+1 a+2 ... a+m] with $a + m \leq c$
a:b:c	[a a+b a+2b ... a+mb] with $a + mb \leq c$
linspace(a,b,N)	N points between a and b (inclusive)
A(i,j)	The (i,j) th element of A
A(i,:)	The entire i th row
A(:,j)	The entire j th column
A(:,2:5)	The 2d to fifth columns, all rows
A(1:4,2:3)	A 4×2 submatrix
A(1,:)=[];	Delete the first row.
A([1,3],:)=[];	Delete rows 1 and 3.
A(:,3)=[];	Delete column 3.
A(:,1:2:5)=[];	Delete the odd columns.

Plot Example:

```
x=linspace(-2,2);
y1=sin(x);
y2=x.^2;
plot(x,y1,'g*-',x,y2,'k-.');
```

```
title('Example One');
legend('The Sine Function','A Quadratic');
xlabel('Dollars');
ylabel('Sense');
```

Code	Color	Symbol	Creates
y	yellow	.	point
m	magenta	o	("oh", not zero) circle
c	cyan	x	x-mark
r	red	+	plus
g	green	—	solid
b	blue	*	star
w	white	:	dotted
k	black	-.	dashdot
		--	dashed

Also see: `plotyy semilogx semilogy`

Calculus and Equations

*Require symbolic algebra toolbox

*Equation Solver example:

```
[x,y]=solve('x^2+x*y+y=3','x^2-4*x+3=0')
```

Approx Derivative: `diff`

Also: `x(n,:)-x(n-1,:)=diff(x);`

Symbolic Derivative examp:

```
x = sym('x');      t = sym('t');
```

```
diff(sin(x^2)) is 2*cos(x^2)*x
```

```
diff(t^6,6) is 720
```

Approx Integral: `quad`

Symbolic Integral: `int`

```
x=sym('x'); int(1/(1+x^2))=tan^-1(x)
```

Diff. Eqns: `dsolve`

Diff. Eqns: `ode23` or `ode45`

Matrix Exponential: `expm(A)`

Taylor Series: `taylor`

Linear Algebra Basics

X=A\B	Solution to $AX=B$ (Exact or Least-squares)
norm(x)	$\ x\ $
[U,S,V]=svd(A)	The Singular Value Decomposition of A
R=rref(A)	Produce the RREF of A
Q=orth(A)	Basis for $\text{Col}(A)$ (columnwise, orthonormal)
N=null(A)	Basis for $\text{Null}(A)$ (columnwise, orthonormal)
[Q,R]=qr(A)	QR factorization $A = QR$, with Q orthog and R upper triangular

Basic Statistics

mean(x)	mean of vector x
mean(X)	mean taken columnwise
std(x)	standard deviation of x
std(X)	stand dev columnwise
hist(a,n)	Histogram of values in vector x using n bins.
hist(A,n)	Histogram (columnwise) of matrix A using n bins
errorbar(m,s)	Error bar plot, m = means s = standard deviations

Bits of useful code

Choose action k with prob $p(k)$

```
P=cumsum([0,p]); %if p is a row
x=rand;
n=histc(x,P);
k=find(n==1);
```

Sort and applications

```
[vals,idx]=sort(b) Sorted (lo-hi) values
                    in vals Indices in idx
b(idx(1))           Smallest value of b
b(idx(end))         Biggest value of b
b(idx)              Same as vals
idx1=idx(end:-1:1) Reverse the index
```

Maxs/Mins

```
a=max(b)           Max of b
a=max(B)           Max of each column
a=max(max(B))      Max of B
                    Same for min
```

Use of repmat

`A=repmat(x,a,b)` replicates x a times down and b times across.

1. Example: Mean subtract a matrix X (vectors are columns)

```
[m,n]=size(X);
x=mean(X');
X=X-repmat(x',1,n);
```

2. Example: Normalize a matrix X :

```
[m,n]=size(X);
d=sqrt(sum(X.*X));
Xnorm=X./repmat(d,m,1);
```

(Note the second line- it computes a vector whose values are the norms of each column of X).

3. Example: Find the column in X closest to a vector a (assume X is $m \times n$ and a is a column)

```
A=X-repmat(a,1,n);
d=sqrt(sum(A.*A));
[vals,idx]=sort(d);
```

Then `X(:,idx(1))` is the column closest to a .

```
image(X)           Display matrix  $X$  as an image
imagesc(X)         Same, but scale the colors
Also see colormap and colorbar
```

Movie Example:

```
for k=1:10
    plot(x,y);
    M(:,k)=getframe;
end
movie(M,3)          Play movie M 3 times
```

Also see `slideshow`

Sounds: See help file for info

```
wavread
sound
soundsc
```

Debugging

Either use the tools with the editor, or use `dbstop if error`

To turn this off: `dbclear if error`

Sight and Sound