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` *command*	Type the help for command
`helpdesk`	Invoke the browser help
`lookfor` *keyword*	Search help for keyword
`diary filename`	Save all commands in filename
`edit`	Invoke the editor
`clc`	Clear command window

File Input/Output

`save filename`	Save all as filename.mat
`save filename var1`	Save var1 as filename.mat
`load filename`	Load filename.mat
`open filename.fig`	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 ith row
`A(:,j)`	The entire jth 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
y	yellow
m	magenta
c	cyan
r	red
g	green
b	blue
w	white
k	black

Symbol	Creates
.	point
o	("oh", not zero) circle
x	x-mark
+	plus
−	solid
*	star
:	dotted
−.	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 Col(A) (columnwise, orthonormal)
`N=null(A)`	Basis for 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.

Sight and Sound

`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`