Maple Command list
Fall 2012

Helpful commands for Math 2250. Suggest more and I will add them to this list!

If you see a command "foo" that you like, try it! If you want more information or extra options for foo, type ?foo in a math field and hit enter...the "foo" help window should open. (You can also find out about "foo" from the help directory, at the upper right of your Maple window.)

Probably at least once you should go through all of the commands in this document, to see what they do. Math commands should end with a semi-colon, or with a colon if you wish the output to be supressed. No command is actually executed by Maple until the cursor is in the command field and the user presses the <ret> (or <ent>) key.

Help:
if you know the command or have an idea of what it should be, you can open a help window by doing ? command:
> *? integrate;   #execute this command....you'll find out that the correct command is "int", and you'll*
       #be able to learn the syntax and see examples.....
If you don't know the command you can use the "Help" icon at the top of the Maple window to search for the topic. Using google in your browser for specific Maple help can also be fruitful. There is also an official website at www.maplesoft.com.

Constants
> $c := 3;$ *# the symbol at the left creates a comment field within a math execution group.*
       # the command c:=3; defines c to be 3. Use shift−enter
        # to enter multi-line commands.

> $d := 4;$
> $c; d;$
  $c + d;$
> $unassign('c','d');$ *# turn c, d back into letters*
              # (these are forward quotes!)

> $c; d; c + d;$ *#should be symbols c,d, c+d, and not the earlier numerical values*
              # Maple usually ignores spaces

> $e;$ *# the keyboard e is just a symbol, not the mathematical constant*
> $\exp(1.0);$ *# the numerical value of the mathematical constant e*
> $e^{1.0};$ *# this e^a came* **from** *the expressions* **in** *the Maple*
       # window at the left, NOT from the keyboard.
> $evalf(\text{Pi});$ *#Pi with a capital P is the mathematical Pi*
  $evalf(pi);$ *#this is the greek letter pi*
  $evalf(\pi);$ *# from the windows at the left.*
>

Text fields

You can create a text field by using the T icon in the menu bar. (Whether you can erase the [on the left will depend if you're in "Worksheet" or "Document" mode.) Alternately, if you're in a text field you can insert enter the math prompt [> from the menu bar to create a math field. In documents math can get executed even in text fields, but it's a good idea to not do this as it can create confusion.

>

Functions

```
> restart :          #clears ALL memory.  You can then reload
                     #any commands you want by putting your
                     #cursor anywhere into the command field and
                     #hitting enter.

> f := t → t^2 * exp(t);   #define the function f(t)=t^2*exp(t)
                          #depending on how your Maple is configured (and you can change this
                          #under "tools", Maple will display powers as powers, and fractions as
                          #fractions....e.g. t^2.
>
> f(z);              #should return f(z)

> f(2);              #should return f(2)

> evalf(f(2));       #should be decimal value (i.e. floating point)

> g := (z, w) → z^2 + w^2;   # define a function of two variables
> ggg := (a, b, c) → a^2 + b * exp(c);   #or of three variables

> g(2, 1);           #should be 5
> ggg(1, 2, 0);      #should be 3

> ggg(1, 2, c);      #should be 1+2*exp(c)
> z := 3;            #set z equal to 3
> z;                 #should be 3
> g(z, w);           #should be g(3,w), i.e. 9+w^2

> unassign('z');     #undefine z, and set it back to a letter
> z;                 #should be z again

> unassign('f');     #turn f back into a variable!
> f(t);              #maple echos f(t) because f no longer
                     #has meaning as a function
```

>

Integrals and Derivatives

```
> f := t → t^2;          #define f(t) to be t^2
```

```
> int( f(z), z);         #should be z^3/3  (Maple doesn't include the + C)
  int( f(x), x = 0 ..2);   #definite integral, should be 8/3
```

```
>
```

```
> ∫ f(t) dt;  # or use the point and click "Expressions" in left margin menu
```

```
> diff( f(y), y);         #should be 2·y
```

```
> f'(t);      # or use the ' "Common Symbol" in left margin menu
```

```
> diff( f(t)^4, t);       #should equal 4*(f(t)^3)*2*t, by the
                              #chain rule
```

```
> int(t^3 * exp(5 * t) * sin(3 * t), t);  #maple is good...
> int(exp(sin(t)), t);  #but not every integral has an
                  #answer in terms
                  #of elelmentary functions -
                  #if maple can't do a computation,
                  #it just echos what you typed.
```

```
> int(exp(sin(t)), t = 0 ..1);  #no symbolic answer
> evalf(int(exp(sin(t)), t = 0 ..1));  #decimal (approximate) answer
>
```

Plots

```
> restart :
```

```
> with(plots) :        #loads the plotting library (to see all the
                  #commands in this library replace colon with
                  #semicolon
```

```
> f := theta → sin(theta);  #f(x)=sin(x)
> plot( f(t), t = 0 ..2 * Pi, color = green, title = `sinusoidal!`);
                  #plain vanilla plot of a graph in the plane
                  #click on the plot, then on a point in
                  #the plot, and a window at upper left says
                  #where you are!
                  #resize plots as if you were in MSWord -
                  #grab a corner with your mouse, and move it.
```

```
> plot1 := plot( f(t), t = -2 * Pi ..2 * Pi, color = green) :  #use colon or maple
                  #will list all the points in the plot!
  plot2 := plot(.2 * t^2, t = -5 ..5, color = black) :
  plot3 := plot( [cos(s), s, s = 0 ..2 * Pi], color = blue) : #parametric curve
  display( {plot1, plot2, plot3}, title = `three curves at once!`);
```

```
> f := (x, y) → x^2 - y^2;   #function of two variables
  plot1 := plot3d(f(x, y), x = -1 ..1, y = -1 ..1, color = blue) :
                #graph of z=x^2-y^2
  plot2 := plot3d([.5 * cos(theta), .5 * sin(theta), z],
          theta = 0 ..2 * Pi, z = 0 ..1, color = pink) : #vertical cylinder,
                #defined parametrically!
  plot3 := plot3d(.5, x = -1 ..1, y = -1 ..1, color = brown) :
                #horizontal plane z=0.5
  display({plot1, plot2, plot3}, axes = boxed); #if you click
      #on the plot you can move it around in space!
      #and a box in upper left of window will give you
      #the spherical coordinates you're looking from!

> implicitplot(f(x, y) = .5, x = -1 ..1, y = -1 ..1, color = black); #this is the
          #level curve where x^2-y^2=.5

> g := (x, y) → 3 * x^2 - 2 * x * y + 5 * y^2 :
          #a quadratic function of two variables

> implicitplot(g(x, y) = 1, x = -2 ..2, y = -2 ..2);
          #rotated ellipse,kind of badly drawn!

> implicitplot(g(x, y) = 1, x = -2 ..2, y = -2 ..2, color = blue, grid = [80, 80]);
          #better resolution

>
```

Differential equations

```
> with(DEtools) :   #differential equation package
> deqtn := y'(x) = y(x);
      #the DE dy/dx = y ....note you                                    #must
      write y(x), and not just y
> dsolve(deqtn, y(x));      #general solution...notice the funny way Maple writes constants

> dsolve(y'(x) = y(x), y(x))   # same answer
> dsolve({deqtn, y(0) = 2}, y(x)); #IVP for exponential growth
> dsolve({y'(x) = y(x), y(0) = 2}, y(x));  #same answer
> dsolve({x'(t) = 3·x(t) + y(t), y'(t) = -4·y(t)}, {x(t), y(t)});
      #solving a system of DEs
> dsolve({x'(t) = 3·x(t) + y(t), y'(t) = -4·y(t), x(0) = 1, y(0) = 2}); # and IVP
> DEplot(deqtn, y(x), x = -1 ..1, y = -2 ..2, [[y(0) = 0], [y(0) = 1],
      [y(.3) = -2]], arrows = line, color = blue, linecolor = green);
                #slope field with solution graphs

> deqtn2 := y''(x) + 2·y'(x) + y(x) = 0; #higher order DE
  ics2 := y(0) = y0, y'(0) = v0; #initial conditions
```

```
    dsolve({deqtn2, ics2});
>
```

Algebra and equations - including simplifying and factoring

```
> g := t → exp(-k*t) * (cos(omega*t) * exp(2*k*t));
> simplify(g(z));  #simplify will try to simplify
                #you can ask it to try special tricks,
                #see help windows.

> h := x → sin(x)^2 + cos(x)^2;

> simplify(h(x));

> f := t→exp(-k·t)·(int(exp(k·r)·(a + b·cos(ω·r) + c·sin(ω·r)), r = 0..t));
> f(t);
> expand(f(t));  #multiplied out
> collect(expand(f(t)), {cos(ω·t), sin(ω·t), exp(k·t)});  #collect terms with
      #the factors in the list at the right
> Digits := 5 :  #example above continued...
   k := .6 : ω := 3. : a := 1 : b := 2 : c := -2 :
   f(t);
> unassign('f','k','ω','a','b','c');
   a; b; c; k; f(t);
> F := x → ((3*x^2 + 5*x + 7) / (x^4-x));
   convert(F(x), parfrac, x); #partial fractions!

> g := t → exp(t);
> solve(g(t) = 2);      #solve an equation, maple tries
                   #symbolic solution

> solve(g(t) = 2.);      #unless you enter a decimal

> Digits := 5;        #use a different number of significant
                    #digits, rather than the default of 10.
   solve(g(t) = 2.);     #cleaner looking, but less accurate answer.
```

Linear algebra commands

```
> with(LinearAlgebra);  # the newer of two linear algebra libraries in Maple.
                # the older one is called "linalg" and tends to use
                #lower case commands rather than capitalized ones.
> with(Student[LinearAlgebra]);
         #a subpackage of commands helpful in a first linear algebra course
```

>

Read more about student linear algebra commands in a help window:

> *? Student[LinearAlgebra];*
> *A := Matrix(3, 3, [1, 2, 3, 4, 5, 6, 7, 8, 9]); # a 3 by 3 matrix, with entries*
        #listed across each row, from the first to the last.
  A1 := Matrix([[1, 2, 3], [4, 5, 6], [7, 8, 9]]); # same matrix
  ReducedRowEchelonForm(A); #self explanatory

to find out more about the Matrix command, ask help:

> *? Matrix;*
> *b := Vector([0, -3, -6]); # a vector*
  C := ⟨A|b⟩;   #augmented matrix
  ReducedRowEchelonForm(C); #reduced row echelon form, from which
        #you can read off solutions to Ax=b, if there are any.
  LinearSolve(A, b); #equivalent way of writing the solutions,
        #notice the funny parameter notation
  d := Vector([0, -3, -5]);
  ReducedRowEchelonForm(⟨A|d⟩); #does Ax=d have solutions?
  LinearSolve(A, d); #Maple informs you the system is inconsistent
  MatrixInverse(A); #does not exist
  Determinant(A);   #so also the determinant is zero
  A^{-1};   #another way to compute matrix inverse, when it exists.
> *B := Matrix(3, 3, [1, 2, 3, 4, 5, 6, 7, 8, 10]);*
  Iden := Matrix(3, shape = identity); #3 by 3 identity matrix
  < B|Iden >;   #augmented with identity
  ReducedRowEchelonForm(< B|Iden >); # to read off B^{-1};
  B^{-1};   #check
  $B.B^{-1}$;   #use periods to multiply matrices - should get identity
  $B^{-1}.b$;   #solution to Bx=b
  LinearSolve(B, b); #same solution

> *3·Iden + 2·B; #scalar multiplication and addition of matrices*
  B.A;
  A.B; # matrix multiplication need not commute
  (2·A + 3·Iden).Iden; #what should you get?
>