Solving Equations with Maple

Introduction

The purpose of this lab is to introduce you to the basic commands needed in any Maple lab. There are

- 2 ways to enter a mathematical expression in Maple.
- 3 ways to plug in an x-value to get the y-value.
- 2 ways to find an x-value in an equation algebraically.

Pay close attention in this lab to all the variations in the syntax.

Entering a a mathematical expression

Expressions such as x^3+3x^2-x+1 can be entered in a similar way to variable assignment. Choose a variable name to represent the expression and assign the expression to the variable as follows.

```
>qq:=x^3+3*x^2-x+1;
```

Entering a function

Suppose you want to enter an expression as a function of x. In Maple you would type the following.

```
>f:=x->x^2+x^2-6;
```

Entering an expression and a function differ as do how they are **called up** in a Maple command. The function must have the (x) and the expression **does not**.

```
>plot([qq,f(x)],x=-6..4);
```

Evaluating functions and expressions

In order to evaluate an expression at a given x-value, you can use the `subs` or `eval` command.

```
>subs(x=2,qq);
>eval(qq,x=Pi);
```

In Maple, functions are much easier to evaluate than expressions.

```
>f(2);
```

Solving a function or an expression algebraically

You can set an expression or function equal to another expression, function, or number inside a `solve` command.As an example, you may want to find where the following two parabolas intersect.

```
> g := 9*x^2-14;
> h:=-x^2;
> plot([g,h],x=-2..2);
> solve(g=h,x);
```

The plot shows that there are two intersection points and the `solve` command finds both x values.It is good to get into the habit of naming your output so you can use it in a later command. Giving the x values a name makes it easy to plug them into the function to find the y values.

```
> ip:=solve(g=h,x);
```

Since there are two x values called *ip*, use [ ] to call up the one you want.

```
> eval(g,x=ip[1]);
> subs(x=ip[2],g);
```

Therefore the two intersection points are $(\frac{\sqrt{35}}{5}, \frac{-7}{5})$ and $(\frac{-\sqrt{35}}{5}, \frac{-7}{5})$. This seems like the answer shown on the graph.

Solving a function or an expression numerically

If you want to find where the following function crosses the x-axis, just set it equal to zero.

```
> f:=theta->-1/2*theta+sin(theta);
> plot(f(theta),theta=-3*Pi..3*Pi);
> solve(f(theta)=0,theta);
```

Wow, what is that?!?! We know from the graph that there should be three answers and `solve` wasn't a great option so try `fsolve`.

```
> fsolve(f(theta)=0,theta);
```

Where are the other two answers!? This is actually how `fsolve` usually works. It shoots for one answer and only gives that one. But you can tell `fsolve` where to look by getting an idea from the graph and typing that domain into the `fsolve` command.

```
> a:=fsolve(f(theta)=0,theta=-Pi..-1);
> b:=fsolve(f(theta)=0,theta=-1..1);
> c:=fsolve(f(theta)=0,theta=1..Pi);
```

To find the y values just plug in the names of the x values.

```
> f(a);
> f(b);
> f(c);
```

(Of course the y-values are zero!)

Exercises

1. Given the expressions $x^3 - 6x + 4$ and $-x + 4$ find the intersection points. (Do not change the answers to decimals)

2. Given the functions $f(x) = \sqrt{\frac{x}{2}}\sin(x)$ and $h(x) = e^{\frac{x}{12}} - \frac{11}{20}$ find the intersection points.