

## Section 5 supplement: Functions vs. Expressions.

### ▼ Functions

Remember that *functions* are defined using the arrow notation:

```
> restart;
```

```
> x->x^2;
```

and we use the "colon-equals" assignment symbol to assign this function a name; in this case we'll just call it "fcn":

```
> fcn:=x->x^2;
```

To *evaluate* our function at a point  $p$  we just type "fcn( $p$ )":

```
> fcn(2);
```

```
> fcn(p);
```

```
> fcn(x^2+1);
```

```
>
```

### ▼ Expressions

*Expressions*, on the other hand just require the "colon-equals" assignment symbol:

```
> expr:=x^2;
```

To *evaluate* "expr" we need to use the "eval" command

```
> eval(expr, x=2);
```

```
> eval(expr, x=p);
```

```
> eval(expr, x=x^2+1);
```

### ▼ Conversions

To convert an *expression* to a *function* we need to use the "unapply" command. For example to convert the expression "expr:=x^2" defined above, into a function "newfcn", you do this:

```
> newfcn:=unapply(expr, x);
```

To check that we really have a function here:

```
> newfcn(2);
```

```
> newfcn(x^2+1);
```

```
>
```

### ▼ Plotting functions and expressions

Recall that to plot an expression like "expr" defined above we use

```
> plot(expr, x=-2..2);
```

but to plot a the function  $f:=x \rightarrow x^2$  the syntax is:

```
> plot(fcn(x), x=-2..2);
```

At this point you should remind yourself that "plot(fcn, x=-2..2)" won't work, i.e. you can't treat a function as if it were an expression.

```
>
```

### ▼ Section 5 HW Problems

*Exercise 1.* Convert the expression  $f:=x \sin(x)$  into a function  $g$ . Plot this function on the same

interval you used to plot the expression  $f$  in the HW problem for Section 3, Exercise 1.

*Exercise 2.* For the function  $f(x) = x^7 + 5x^5 + 3x^3 - x$ , use Maple to compute the difference quotient  $\frac{f(x+h) - f(x)}{h}$  and use your result to compute (with pencil and paper) the derivative

$f'(x)$ . Then check your answer using Maple's "diff" command.

(Be sure to use "unassign" to clear the original definition of  $f$ , or restart to clear everything.)

*Exercise 3.* Suppose  $f$  is as in Exercise 2 and  $g(x) = x^5 - 4x^4 + 3x^3 - 2x^2 + x - 1$ .

(a) Without using Maple, tell me the degree of the polynomial  $h(x) = f(g(x))$ .

(b) Now use Maple to find this polynomial. Then tell me the coefficient of  $x^{20}$  in  $h$ .

You may find it useful to use the "simplify" and "sort" commands. Also, the "coeff" command will produce particular coefficients of polynomials.

*Exercise 4.* For the polynomials  $f$  and  $g$  of Exercise 3, use Maple to show that the polynomials  $f(g(x))$  and  $g(f(x))$  are not the same.