

## MATH 101 Lab 1

For two curves  $y = f(x)$  and  $y = g(x)$  with  $g(x) \leq f(x)$  on an interval  $[a, b]$ , the area between the curves is given by

$$\int_b^a f(x) - g(x) dx.$$

In this lab we will look at Maple's commands for integration and what happens for general  $f(x)$  and  $g(x)$ .

Maple has two basic integration commands that can both be used in two ways. The Maple help file says:

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FUNCTION: int or Int - Definite and Indefinite Integration

CALLING SEQUENCES:

int(f, x)

Int(f, x)

int(f, x=a..b, ...)

Int(f, x=a..b, ...)

PARAMETERS:

f - an algebraic expression or a procedure, the integrand

x - a name

a, b - interval on which integral is taken

... - options

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Use

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

```
> g:=x-> x^3;
```

to define the functions  $f(x) = x^2$  and  $g(x) = x^3$ . Plot  $f$  and  $g$  on the interval  $-10 < x < 10$  using

```
> plot({f(x),g(x)},x=-10..10);
```

to approximate the points of intersection of  $f$  and  $g$ . If the suggested interval is inappropriate, use a different interval. Use

```
> solve(f(x)-g(x) =0,x);
```

to accurately determine the points of intersection. Solve  $x^2 = x^3$  by hand. In each case you should have obtained  $x = 0$  and  $x = 1$ .

**Question 1**

Use the plot of  $f(x)$  and  $g(x)$  to determine which function has larger values on the interval  $0 \leq x \leq 1$ . Plot the three expressions  $f(x)$ ,  $g(x)$  and  $f(x) - g(x)$  on one graph. Pictorially, what does  $f(x) - g(x)$  represent?

Execute each of the following maple commands and explain the result. Hand in your explanations and the output of the commands (either as printed output from Maple or handwritten.)

```
> Int(g(x) - f(x), x);
> int(g(x) - f(x), x);
> Int(g(x) - f(x), x=0..1);
> int(g(x) - f(x), x=0..1);
> Int(f(x) - g(x), x);
> int(f(x) - g(x), x);
> Int(f(x) - g(x), x=0..1);
> int(f(x) - g(x), x=0..1);
```

Which of the above integrals represent the area bounded by the curves  $f(x) = x^2$  and  $g(x) = x^3$ ? What is that area?

**Question 2**

Find the area bounded by the two curves  $y = \cos(x)$  and  $y = \sin(x)$  and the x-axis on the interval  $[0, \pi/2]$ . Remember  $\pi$  is written Pi. Be sure to integrate over the appropriate intervals.

**Question 3**

Find the area bounded by the two curves  $x = y^2 - 4y$  and  $x = y$ . In order to graph  $x = y^2 - 4y$  we must use the new command **implicitplot** which is like plot. In order to use implicitplot, first load the plotting package.

```
> with(plots);
> implicitplot({x=y^2-4*y, y=x}, x=-5..5, y=-5..5);
```

Should you integrate with respect to x or with respect to y? Does the area have a top curve? a bottom curve? a left curve? a right curve? or does the area have to be divided into regions?