

## Chapter 5

# What Else?

We have, of course, only scratched the surface of calculus. This section includes some concepts just outside the scope of the course which you may be interested in. You may even one day find this section useful.

### Non-linear ODEs

Real life situations do not always give nice ODEs which we can solve. There are of course lots more methods for dealing with ODEs which we have not covered.

### Complex numbers

We have touched on the use of  $i$  to represent  $\sqrt{-1}$  and complex numbers. Complex numbers pop up in a surprisingly large number of real applications. Watch out for them.

### Partial derivatives

When we have a function of multiple variables, we can look at the derivative with respect to each variable. These are written with  $\partial$  instead of  $d$ .

**Example**

If  $y = zx + x^2$ , then

$$\frac{\partial y}{\partial x} = z + 2x$$

and

$$\frac{\partial y}{\partial z} = x.$$

**Partial differential equations****Example**

$$\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2} = 0$$

As with ODEs, numerical methods are often required to approximate the solutions of PDEs. This is what I am doing my research on!