Maths 190 Lecture 18

- **Topic for today**: Chaos!
- **Question of the day**: Why can we predict the tides but not the weather?

Does round-off error matter?

What is $\sqrt{2}$ on your calculator?

Does the round-off error matter?

Does round-off error matter?

A simple rule:

1. Pick a number between 0 and 1.
2. Multiply by 180
3. Press 'SIN'. Write down the answer.
4. Repeat 2 and 3 until you have 25 numbers.

Now pick a number half way down your list and start again. Do you get the same numbers?

Results of the iteration

Using a starting point of 0.287, and with 8 decimal places of accuracy:

Results of the iteration

Using a starting point of 0.287, and with 8 decimal places of accuracy, but with a power cut after 5 iterations:

Duelling calculators

- Work with your neighbour. Each use your own calculator. Both start with the **same** number and repeat the previous exercise.
- Do your calculators agree?

Small changes can make big differences!

- How far in advance can we predict the weather?
- The "butterfly effect" affects predictions about planetary motion, weather patterns and other complex systems.

Chaos

Systems that

- have some repetitive elements in their behaviour, but
- have sensitive dependence on initial conditions

are sometimes called **chaotic**.

The best models of our weather are known to display chaotic dynamics under some conditions.

Important ideas from today:

Simple repeating rules can lead to unexpected complex behaviour.

A small change in where you start can lead to huge differences in where you end up.