ColAUMS Space

Newsletter of the AUMS | Issue 4, 2021

In this issue

Upcoming events

Meet & Greet	-	06/08
Quiz night	-	12/08
Industry night	-	19/08

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Need a membership?
See us at our next event to sign up or use the link below!
Q PAY link

Introduction

Hi everyone and welcome to the second semester of 2021. Due to the unfortunate time of the delta variant having spread to Adelaide earlier this month, the semester may have gotten off on the wrong foot. However, AUMS has been prepared and there will be online activities organised for our semester for online students! With the restrictions easing, there are many in person events lined up later in the semester as well alongside proper Covid guidelines. In this issue of AUMS, we have an article on Chaos, tips on how to be a better maths student, and as usual a puzzle! Good luck to all the new and continuing students, and I wish you all the best for this semester.

- Jieun Kim, ColAUMS editor

A Brief History of Chaos

You've probably heard of chaos theory through the butterfly effect; the metaphorical image that a butterfly flapping its wings will cause a tornado several weeks later on the other side of the world. But what does this actually mean mathematically? One way of thinking of chaos is sensitivity to initial conditions. A very small change to the initial state of a system results in a very different outcome. A chaotic system is completely deterministic, but results can seem random and as a result it becomes practically impossible to predict the future behaviour of the system.

Chaos theory came to prominence with the development of the electronic computer, as scientists were able to quickly perform calculations which previously had to be done by hand. Complicated, non-linear systems could be solved automatically. One of the main pioneers of chaos, Edward Lorenz, came across the idea accidental when, in 1961, he was simulating a weather model on a digital computer[a].

[a] This computer was first manufactured in 1956, had 15 kilobytes of memory, weighed 360kg and cost $47,000!

One day, wanting to repeat an interesting sequence of results, Lorenz retyped the numbers into his computer and reran the simulation. However, the results were completely different. Not just off by a little bit, but describing a completely different weather state. The numbers he re-entered were rounded off by just three decimal places, but this was enough to cause the discrepency. The conditions differed only slightly, but had resulted in completely different outcomes.

This wasn't the first time this type of behaviour had been seen. In biology, simple discrete models[a] of population would misbehave and jump around seemingly at random. At first, this unexplained behaviour was assumed to be the fault of missing features from the real population.

Key to chaos theory was the realisation that this behaviour is actually a fundamental part of the system, rather than the fault of numeric imprecision. There was no problem with the model, no unexplained factor. Non-linearities were causing nearby points to do bizarre things. This discovery unlocked a whole new area of mathematics which has since been applied to understand turbulence in fluid flow, the stock market, the length of coastlines, road traffic, quantum theory and many other fields.

Chaos is also the reason why long-term weather forecasts are rubbish. The atmosphere is full of so many interacting factors and non-linearities that it's a prime example of a vastly chaotic system. Measurement error will always exist, so accurate predictions of the weather more than a couple of weeks in advanced is fundamentally impossible. Chaos wasn't all doom and gloom for weather forecasting though, and has led to huge improvements in the area. Recognising that measurements are not perfect, forecasters now use ensemble models, averaging across many simulations.

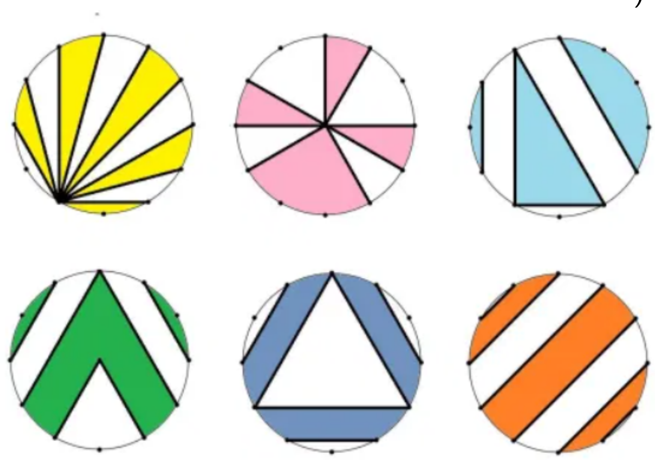
Chaos theory remains a huge area of open research across many disciplines. We are still finding new places to apply it and understand the underlying patterns which cause such dramatic behaviour.

- Liam Blake, AUMS Vice President

[a]The discrete logistic map is particularly wild compared to its continuous sibling.

Puzzle

What fraction of each circle is shaded? (The 12 dots are equally spaced; the only point used inside the circle is the centre.)



https://mathwithbaddrawings.com/2018/10/03/twenty-questions-of-maddening-delicious-geometry/

What makes a good maths student?

Mathematics can be very challenging. Many students choose not to continue taking higher level maths. However, this brings into question the kind of skills we need to adopt to be become better at maths. Here are some research backed tips.

In a recent study lead by Malanchini, qualities related to openness, such as intellectual curiosity and confidence resulted students doing better in maths. It turned out being open to new ideas, wanting to explore an interesting topic was a greater contributing factor than conscientiousness – diligence and perseverance. If you enjoy maths, don't be shy and try going beyond your homework exercises. It may lead you to be even more curious and confident in maths.

The second tip was from a book called *A Mind for Numbers* by Barbara Oakley.

There are two main ways your brain thinks. Focused mode is when your brain focused on knowledge that you already know. You concentrate your attention to one thing, and you can solve problems that you know how to go about with accuracy. Then there is the Diffused mode, where the brain thinks outwards and can generate creative new ideas. This kind of thinking can help you get unstuck on a problem by seeing things from a different perspective.

In most instances, a good maths student makes use of both modes of thinking and switches back and forth as needed. The key takeaway was that when we come across a new problem, we need to use focused mode to first concentrate on the problem, but be okay with leaving it for a while so that diffused mode can take over and our brain tries to figure it out in the background.

Everyone has moments where we get stuck on a problem and feel frustrated by maths. Nevertheless, if we continue to be curious and bold, whilst also using focused and diffused modes of thinking, some of the intricacies of maths may become clearer. I highly recommend you have a read of the actual study by Malanchini and *A Mind for Numbers*if you want to find out more.https://doi.org/10.1037/pspp0000224https://barbaraoakley.com/books/a-mind-for-numbers/ *- Jieun Kim,*

ColAUMS editor