Program – MathsTech25

Sat 1st November

8:30am - registration meet on level 5 of Bldg 24, Social Sciences bldg., UQ St Lucia		
Sessions	**Room 603**	**Room 302**
9:00 Session A	Spring Roh	Tom D'Arcy
10:00 Session B	Anna Russell	Jane Pavlides
11:00 Session C	Practice skills session	Rosanna Campbell (via zoom)
11:30 Brunch – Level 5 Lunch room		
Sessions	**Room 603**	**Room 302**
12:00 Session D	Su-Tong Xu	Anna Davidson
1:00 Thanks and close – Level 5 Lunch room		

Spring Roh (Session A) - Using Geogebra to develop students understanding of circle theorems and their proofs.

Circle theorems can be one of the most challenging topics for students in Year 10 (Prep for Specialist) and Year 11 Specialist Mathematics. When I taught this topic during placement, I often heard questions like, "Wait, how is that Circle Theorem 1? It looks completely different!" Students frequently struggle to connect textbook theorems with actual problems, especially when diagrams don't look exactly like the examples they've memorised. The static nature of textbook images doesn't help with flexible thinking, and students often miss the underlying relationships.

In this session, I'll share GeoGebra resources and approaches I've found helpful for building students' conceptual understanding of circle theorems. I'll also provide a set of basic GeoGebra tools for circle geometry, so you can create your own examples and questions tailored to your lessons. I look forward to seeing you in November!

This session addresses syllabus objectives:
Specialist Mathematics Topic 3: Circle and geometric proofs

- Prove the circle properties:
    - the angle at the centre subtended by an arc of a circle is twice the angle at the circumference subtended by the same arc
    - an angle in a semicircle is a right angle
    - angles at the circumference of a circle subtended by the same arc are equal – the alternate segment theorem
    - the opposite angles of a cyclic quadrilateral are supplementary and its converse
    - a tangent drawn to a circle is perpendicular to the radius at the point of contact and its converse.
- solve problems finding unknown angles and lengths and prove further results using the circle properties listed above.

Tom D'Arcy (Session A)

Using Desmos for Teaching Relations in Mathematical Methods

Relations are a foundational mathematical concept introduced in Unit 1 of the Mathematical Methods Syllabus that is essential for developing students' understanding of relationships

between variables. This mathematical knowledge can allow students to interpret graphs more meaningfully and scaffold subsequent Methods topics such as transformations of functions.

In this session, I'll present two resources in Desmos designed to illustrate the concept of relations through both mapping diagrams and representations on the Cartesian plane. I will then demonstrate how each of these resources can be used to also explain the underlying reasons for function transformations.

This session addresses the following syllabus objectives:

Unit 2 Topic 3: Functions and relations

- Understand the concept of a relation as a mapping between sets, a graph and as a rule or a formula that defines one variable quantity in terms of another.
- Recognise the distinction between functions and relations and use the vertical line test to determine whether a relation is a function.
- Recognise and use function notation, domain and range, and independent and dependent variables.

Anna Russell (Session B) - Using CODAP to develop students' understanding of statistics.

Statistically, students don't like statistics. Yet, statistics is arguably among the most useful topics taught in the mathematics curriculum. So, if students enjoy studying things that are useful, why doesn't statistics follow the trend here?

In this session, we will explore the unique challenges in teaching and learning statistics, especially statistical inference, focusing on Mathematical Methods Unit 4 Topic 4 (Sampling and Proportions). I will present CODAP, a useful software for promoting conceptual understanding in statistics, and will give a crash-course on using the software. Then, I will demonstrate a guide I have created in CODAP which you can use to introduce Topic 4 to your students to spark meaningful discussions in your classrooms and ground this topic in realistic context and enjoyable problem-solving.

This session addresses syllabus objectives:

Mathematical Methods Unit 4 Topic 4: Sampling and proportions

- Understand the concept of a random sample.
- Understand sources of bias in samples, and procedures to ensure randomness

Understand the concept of the sample proportion $\hat{p}$as a random variable whose value varies between samples, and the formulas for the mean p and standard deviation $\sqrt{\frac{p(1-p)}{n}}$ of the sample proportion $\hat{p}$, where n is the sample size.

Jane Pavildes (Session B) - Using Desmos to develop students' conceptual understanding of differentiation.

This presentation explores the use of Desmos as an applet to teach first principles differentiation through a visual and interactive approach. The applet demonstrates the relationship between rate of change and the limit as the difference between two points approaches zero. The aim is to address a common gap in student understanding, where first principles is often viewed as a formula or method to memorise rather than a concept to understand and further build on. By using Desmos to model this process, the approach supports students in developing a clearer, more conceptual understanding of differentiation from first principles.

This session addresses syllabus objectives:

Unit 2 Topic 3: Introduction to differential calculus

- Interpret the derivative as the instantaneous rate of change.
- Interpret the derivate as the gradient of a tangent line of the graph $y = f(x)$.
- Understand the concept of the derivative as a function.
- Use the rule $\lim_{h \to 0} \frac{f(x+h)-f(x)}{h}$ to determine the derivative of simple power functions and polynomial functions from first principles.

Rosanna Campbell (Session C) - Using Desmos to link the unit circle to the graphs of sine, cosine, and tangent.

In Year 10 and Mathematical Methods, students are introduced to the unit circle, solving trigonometric equations, and the graphs of sine, cosine, and tangent. Although intrinsically connected, students often miss the important connection between these ideas. This impacts students' ability to engage in Methods and Specialist as they frequently encounter these functions in the modelling of periodic phenomena, trigonometry, calculus, and probability.

In this session, we'll explore Desmos' powerful ability to not only consolidate the teaching of unit circle, but also for establishing the connection between the unit circle and the graphs of sine, cosine, and tangent. We'll discuss practical strategies — and even give one a go — that you can use in the classroom to help strengthen your students understanding of these relationships.

Unit 2 Topic 4: Trigonometric functions

- Define and use radian measure and understand its relationship with degree measure.
- Understand the unit circle definition of cos(θ), sin(θ) and tan(θ) and periodicity using radians.
- Sketch the graphs of y = sin(x), y = cos(x) and y = tan(x) on extended domains.

Session D - Vectors in motion: Building conceptual understanding of vectors in context

Motion is a fundamental aspect of reality, and for mathematics students, one way to explore it is through the study of vectors. This area enables students to engage with physical quantities in contexts that go beyond direct measurement, helping them interpret and model real-world situations. To support this learning, students benefit from resources that consolidate foundational knowledge and deepen their understanding of vector mathematics as they progress.

I will be sharing and discussing resources designed to enhance students' grasp of vectors, followed by a deeper exploration of bodies in equilibrium and inclined planes. These topics will be presented in a carefully sequenced learning pathway to provide meaningful opportunities for conceptual development.

- Examine examples of vectors including displacement, velocity and force
- Model and solve problems that involve motion of a body in equilibrium situations, including vector applications related to smooth inclined planes (excluding situations with pulleys and connected bodies).

Session D - Vectors in Space: Using GeoGebra to develop spatial reasoning and conceptual understanding

When first tackling vectors and making the jump into three dimensions, many students struggle with spatial reasoning and conceptually understanding formulas. This can prevent students from

flexibly moving between algebraic and geometric representations to creatively solve problems. I argue that GeoGebra can be used to better engage students, develop conceptual understanding and make connections between representations.

I will provide and demonstrate the use of a set of activities on GeoGebra that target conceptual understanding of vectors in Specialist Mathematics. I will also outline the basics of GeoGebra to support teachers in utilising this resource to enhance their teaching of vectors.

This PD will cover various concepts from the study of vectors across Unit1 and Unit 3.