AberWorkshops:
Mathematics

Bringing our academic experts to your learners

1872 PRIFYSGOL ABERYSTWYTH UNIVERSITY

What are AberWorkshops?

AberWorkshops give your learners an opportunity to learn and interact with our friendly and engaging academic staff.

Our teaching staff will deliver high quality subject content to your learners, with the aim of not only increasing students' knowledge of the subject matter, but also encouraging them to consider future study within the disciplines of mathematics and statistics.

We have a variety of academic-focussed lectures/ workshops in a number of different topic areas. Whilst all sessions are subject to availability, AberWorkshops are:

- **Flexible in duration**
- **Suitable for small and large audiences**
- **Deliverable to Year 10-13**
- **Available virtually**
- **Available face to face in school / college**
- **Available to be delivered on Aberystwyth University campus**

To make a booking or find out more, e-mail **aberworkshops@aber.ac.uk**

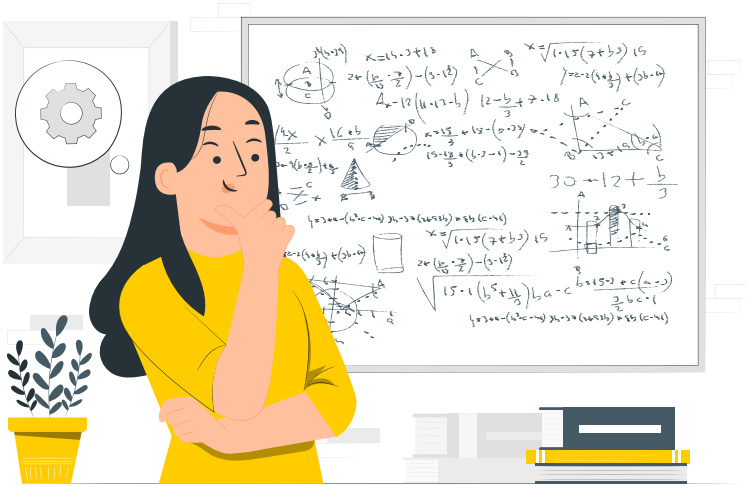
An introduction to the Department of Mathematics

We offer a wide range of flexible schemes. Not only can students study Mathematics with the option of choosing their own mathematical topics according to their interests or career aspirations, but also combine Mathematics with other subjects. For example, our specially designed Financial Mathematics and Data Science schemes are perfect for those with a clear career goal in mind, while Mathematical and Theoretical Physics will be of interest to those wishing to have a rigorous understanding of physical laws.

The Department's 150-year-long history is a testament to its teaching acumen. It has a proud tradition of scholarship and research and has prepared generations of people from all over the world for professional careers and for life in general.

Our lecturers are committed teachers and active researchers, expanding the boundaries of mathematical knowledge. We have particular expertise, which often features in our modules, in topology, operator algebras, spectral theory, the geometry of the complex plane, integral equations, asymptotic methods, quantum information, and biological statistics.

Our curriculum is designed around the current needs of employers and a Mathematics degree will prepare students for a wide range of career destinations for which a high degree of analytical and computational skills are especially valued.



Mathematics AberWorkshops

Mathematics in Sport – Dr Tudur Davies

EN CY IP V

Our sporting heroes possess a special talent, and through skill, dedication, and a highly competitive nature, they have reached the top of their game. Can we also consider them mathematicians? They often use some of the mathematics we learn at school, often without realising that they're doing so. This session could focus on how geometry can be used to find the best position to choose to convert a try from in rugby, or how algebra, in particular sequences and series can be applied to choose the best race strategy in motor sport. The session could also include differential calculus, which can applied to find optimal strategies in sport.

The Mathematics of Soap Bubbles – Prof Simon Cox

EN CY IP V

Spherical bubbles drifting along on a summer breeze illustrate important ideas in Mathematics. The spherical shape is a consequence of the soap film having the least possible area to enclose the air. This suggests that we could use calculus to determine the shapes of several bubbles when they stick together: that is, by looking for turning points of a function describing the total soap film area. This workshop provides an introduction to the practical use of trigonmetry and calculus to solve optimization problems.

Along Came a Spider – Dr Rob Douglas

EN CY IP V

If you add an infinite list of positive real numbers together, sometimes it will sum to a finite number; for other examples it will be bigger than any finite number. We investigate how to analyse such problems, and consider what complications are introduced when the numbers summed could be of either sign.

Key:

- EN Can be delivered in English
- CY Can be delivered in Welsh
- IP Can be delivered in person
- V Can be delivered virtually

Fractals – Prof Simon Cox

EN CY IP V

A sphere is three-dimensional and a circular disc is two-dimensional. What would it mean for a shape to have a dimension intermediate between one and two or between two and three? A well-known example is the Koch snowflake, but there are many others. Objects with non-integer dimension are useful in applications as diverse as computer graphics, medicine, and wireless communication.

In this workshop we discuss a method to determine the dimension of any constructed shape. It is based on similar shapes and manipulating expressions involving powers of numbers. For GCSE students we will use a calculator to solve the equations for the dimension; for A-level students it is an application of logarithms and an introduction to limits, recursion, and self-similarity.

A differential equations whodunnit – Dr Adam Vellender

EN CY IP V

In applied mathematics, many physical phenomena can be described by equations in which the derivative of a sought-after function appears - these are called differential equations. This talk builds on the A-level basics of differentiation and integration, showing students how to use those tools to develop a technique to solve a simple type of differential equation. We then use this knowledge to solve an exciting murder mystery. A body has been found and the suspects each have a gap in their alibi, so when did the murderous act take place and who was the murderer? Differential equations will let us solve the case!

Scaling laws and Dimensions – Dr Adil Mughal

EN CY IP V

What is the largest size a land-walking animal could be? Which will live longer a blue whale or a mouse? Both of these questions are examples of scaling laws in biology. From simple geometric considerations it is possible to make an educated guess about the answers to questions such as these and to use simple dimensional arguments to anticipate many of the laws of physics. In this workshop we will look at the basics of "dimensional analysis" and the use of scaling laws. For GCSE students this will serve as a practical application of linear equations and algebra; for A-level students it will provide insight into quantities and units in mechanics.

The Monty Hall Problem – Dr Alex Pitchford

EN CY IP V

An apparent paradox in which the chances of winning the "Stay or Switch" game under different strategies is counter intuitive for many people. The problem is most likely ancient, but was made famous through its connection with the Lets Make a Deal game show, hosted by Monty Hall. This talk unravels the paradox, explaining how one strategy has a much better chance of winning than the other. The problem is solved using analysis based on conditional probability and the solution is demonstrated with a Python code simulation of the game. There is also an interactive game, a variation of the original Stay or Switch game, that helps correct the counter intuition.

Quantum Computing – Dr Alex Pitchford

EN CY IP V

Quantum of computing may be on the cusp of realisation as a tool for performing some types of calculation much faster than traditional digital computers. The main focus of the introduction to the subject is how matrices are used describe how the quantum gates operate on quantum state vectors, with activities for participants to complete. The history, potential applications (and dangers) and some of the physical systems that are being developed to perform quantum computations are also introduced. Some information will be provided on the open-source software tools used for simulating quantum dynamics, which is Alexander Pitchford's main research focus, and how open-source software development projects work.

Non-transitive dice and curious probability – Dr Kim Kenobi

EN CY IP V

Regular six-sided dice have the numbers 1 to 6 on the faces. You are probably familiar with some probabilistic statements, e.g. the probability of rolling an even number is 3/6 = 1/2 or if you roll two dice and add them together, there is a 1 in 36 chance of a total of 12. What happens if we allow for different numbers on the six sides? For example, suppose we have 3, 3, 3, 3, 8, 8 on the faces of one die and 0, 5, 5, 5, 5, 5 on the faces of the other. What is the probability that the roll on the first die is higher than the roll on the second?

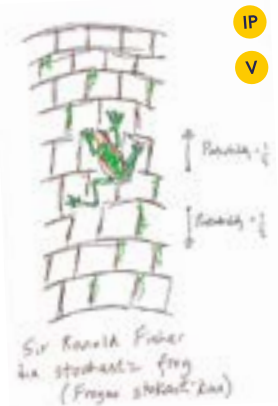
Is it possible to choose numbers on the faces of a set of dice in such a way that the first die has a higher than 50% chance of beating the second die, the second die has a higher than 50% chance of beating the third die and so on, finishing with the last die having a 50% chance of beating the first die, i.e. completing the loop?

In this highly interactive workshop, we will look at the probabilities associated with a set of so-called non-transitive dice – a curious mathematical collection. Play against your friends and make sure you can always win!

The Stochastic Frog in an Infinite Well: An Introduction to Random Walks – Dr Kim Kenobi

EN CY IP V

Sir Ronald Fisher, the stochastic frog (Frogus stokastikus) is in trouble. Stuck in an infinite well, his energy is depleted. For each minute of effort, he finds that he either climbs up one brick (with probability ½) or falls down one brick (also with probability ½). What can we say about his (probabilistic) plight? In this interactive workshop, we will explore the use of probability and counting arguments to consider questions about Ronald's chances of achieving certain gains (all be they negligible against the backdrop of the infinitude of his well). (Don't worry, at the end we will allow this mighty tamer of randomness to find that maybe there is an end to his toils after all).



Beauty beyond the eye of the beholder: an algebraic approach to symmetry - Dr Gwion Evans

EN CY IP V

Beauty, harmony and regularity have been associated with visual and musical symmetries since time immemorial. In this interactive workshop we will explore how algebra, specifically group theory, provides a means to understand these symmetries and reveal other surprising hidden symmetries underlying mathematical, musical and physical phenomena. This workshop will cover the following topics for students studying:

- **GCSE Mathematics:** symmetries of the plane, including reflections and rotations, basic geometry (properties of polygons) and trigonometry, quadratic equations.
- **A-level Mathematics:** in addition to the above, solutions of polynomial (e.g., cubic) equations, composition of functions.
- **A-level Further Mathematics:** in addition to the above, using matrices to represent 2-D transformations, relationships between roots and coefficients of polynomials, complex numbers.

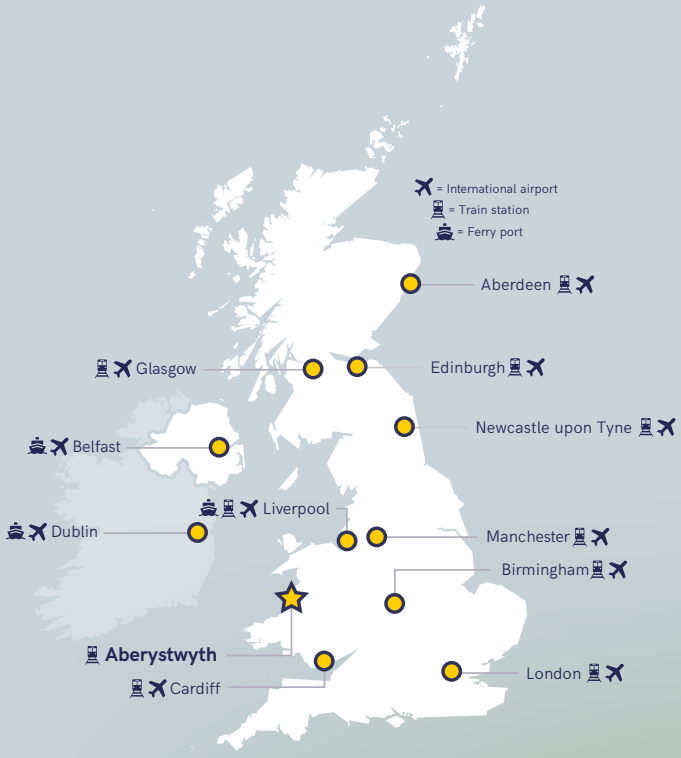
Key:

EN Can be delivered in English

CY Can be delivered through the medium of Welsh

IP Can be delivered in person

V Can be delivered virtually



Department of Mathematics,
Aberystwyth University,
Penglais, Aberystwyth,
Ceredigion, SY23 3BZ

+44 (0) 1970 62 2802
maths@aber.ac.uk
/mathsataber
@mathsataber

Designed and produced by
Global Marketing and Student Recruitment,
Aberystwyth University 2023.

112542-10.23
Imagery credit: freepik.com/stories

Printed on
100% recycled paper