LMS Women in Mathematics 16 June 2021
Abstracts - Invited Talks

Professor Claire Miller, University of Glasgow
Data fusion for environmental applications
The surface water quality for lakes and rivers is routinely monitored to protect ecosystem, animal and human health and for compliance reporting to policymakers. Current monitoring strategies enable measurements of water quality determinands to be obtained through, for example, long-term monitoring programmes, automatic sensor monitoring data, drone data and data from processed satellite retrievals. Each individual data source can potentially be limited in the information available. When multiple sources of data are available for the same waterbody, the challenge lies in appropriately combining the available data streams where we potentially have large volumes of data in space and time, missing data, uncertainty in data retrievals and different spatial and temporal support across the data sources. This presentation will give examples of some recent and current statistical work in this area to develop suitable data fusion approaches with the aim of providing improved estimation of, for example, water quality and associated measures of uncertainty.

Dr Katherine Tant, University of Strathclyde
Mathematics for a Safer World
The oil and gas, nuclear and aerospace industries are just a subset of the sectors dependent on the routine maintenance of safety critical structures. To mitigate the risk of catastrophic failure, the structural integrity of key components within these industries must be assessed regularly. Ultrasonic non-destructive testing (UNDT) is a technique which involves the transmission of mechanical waves through a solid object. Just like in medical ultrasound, these waves can be passed through the object and subsequently recorded without disturbing its internal composition. Thus large networks of ultrasonic sensors are often deployed to carry out safety inspections, resulting in large quantities of noisy data for which mathematical algorithms are required to decipher. In the first part of this talk, I will describe some of the challenging mathematical problems associated with looking inside solid objects and discuss the advantages of working at the interface between industry and academia. In the second part, I will talk about Homeward Bound, a global leadership initiative that I am participating in which aims to promote the role of women in the STEM disciplines.

Dr Paola Iannone, University of Loughborough
Learning about proof with LEAN
Much of the mathematics education literature concerned with the university level is dedicated to investigate the difficulties that first year undergraduate students have with proof. Proof is one of the first stumbling blocks students encounter when they join a mathematics degree and one that needs to be overcome in order to become 'good' mathematics students and fully fledged members of the mathematics community. Among these difficulties there are the problematic use of formal language, the difficulties with the rigour of proof or with the logical structure of proof and the lack of identification of main mathematical objects involved in the proof and their properties. The difficulties that students have with engaging with proof in their first year are so widespread that several teaching interventions have tried to alleviate them, including the use of programming software in pure mathematics modules. In this talk I will present findings from a project that investigated the impact of the engagement with the automated theorem prover LEAN (https://leanprover.github.io) on students' proof writing and proof production when used in a first year transition to proof module.

Dr Laura Ciobanu, Heriot-Watt University
Solving equations in groups (but not teams)
For a group or semigroup or ring G, solving equations where the coefficients are elements in G and the solutions take values in G can be seen as akin to solving systems of linear equations in linear algebra, Diophantine equations in number theory, or more generally polynomial systems in algebraic geometry. I will give a short survey containing results from both mathematics and computer science about solving equations in infinite nonabelian (semi)groups, with emphasis on the free ones. In particular, I will explain that the solutions to equations can be beautifully described in terms of formal languages, and that the latest techniques involving string compression produce optimal space complexity algorithms.

Dr Jill Miscandlon, University of Strathclyde
From Mathematics to Manufacturing
Manufacturing challenges lie all around, from the drive for zero carbon transport to the development of AI assisted instruments to aid the aging population. The technical difficulties within each challenge are immense and for them to be overcome in a timely manner, engineering research requires the input of scientists, especially mathematicians. Mathematical training allows you to approach any problem- regardless of context- and develop a logical and successful solution. In my talk, I will give some examples of the challenges within engineering today, especially focused on the need for electric propulsion solutions, and novel manufacturing techniques that will help us to achieve our goals.

Dr Tiffany Wood, University of Edinburgh
Underpinning innovation with mathematics
Physics is the application of mathematical equations describing forces and energy and is a guiding tool that helps her, and her colleagues, understand how the microstructure of mixed ingredients is formed, how it changes and how it flows. Most commonly she works with companies who manufacture every-day consumer products, e.g. over-the-counter medicines, decorative paints and foods to help them improve manufacturing efficiencies and product stability. During this talk she will talk about the benefits of bringing together diversity of thought and how her background in liquid crystal and colloid physics combined with formulation science has led to a new invention that could create better consumer products.