

School of Mathematics and Statistics

Strategic Plan 2020/21 – 2025/26

Our Aspiration

We will be the best in all that we do, having a collaborative, inclusive and innovative approach to continually evaluate our teaching and research activities, resonating with the University of St Andrews motto of αἰὲν ἀριστεύειν, 'Ever to Excel'. We will consolidate and enhance our international reputation in our areas of research strength by identifying opportunities for diversifying and increasing funding. We will increase our global impact, international collaborations and connectivity, recruiting staff who are world-leaders in their fields to enhance excellence in all our research groups whilst developing in new directions to remain at the cutting edge. We will strive to continue delivering high-quality degree programmes at both undergraduate and postgraduate level, providing an excellent student experience to all our students. We will be the top School for Mathematics and Statistics in Scotland and Top 10 in the UK, maintaining our internationally recognised position as destination of choice for the very best staff and most promising students studying Mathematics and Statistics.

Mathematics and Statistics St Andrews: Distinguishing and Distinguished

The School has three well established, internationally recognised divisions where it continues to focus its growth: Applied Mathematics, Pure Mathematics and Statistics. We are one of the very few Schools of Mathematics which conducts research in the History of Mathematics and includes it as part of the curriculum. We also host one of the oldest and most prestigious mathematics chairs in the UK: the St Andrews Regius Chair of Mathematics, founded in 1668, and currently held by Professor Kenneth Falconer, FRSE.

Teaching Excellence

We are a small school when compared with our peers but have a rich history and are renowned for the quality of our teaching. We have an extremely strong recruitment profile across all of our undergraduate and postgraduate programmes, with some of the highest undergraduate entry requirements in the UK. Students from across the world see us as a destination of choice thanks to our diverse curriculum and academically strong community, and our applications are oversubscribed in all categories (home, RUK and international).

Our relatively small size means we can prioritise a unique and personal experience for all our students. Undergraduates benefit from our small group teaching practices, quickly getting to know members of staff, developing these relationships as they move through their Honours study and final year projects. Recent renovations in the Mathematical Institute have focused on improving the student experience by creatively developing communal and collaborative space for our students. Our postgraduate students join a diverse community of scholars who are internationally linked through their research and students are encouraged to integrate themselves into School activities, working alongside staff to actively take part in our teaching activities. Students graduating from our MMath, BSc and MA degrees are some of the best qualified mathematics and statistics graduates in the country with 93.6% of our graduates entering employment or further study upon graduating and 88.3% of graduates entering graduate level employment or further studies.

World Leading Research

Research in the School of Mathematics and Statistics at St Andrews focuses on a number of 'trademark' areas across the mathematical sciences. Activity is structured across our research groups, all of which are internationally renowned and are headed by world-leaders in their fields: Algebra & Combinatorics, Analysis, Mathematical Biology, Statistical Ecology, Statistical Medicine and Molecular Biology, Solar and Magnetospheric Theory, and Vortex Dynamics. The School is a founding partner in several interdisciplinary centres with other Schools in St Andrews: the Centre for Research into Ecological and Environmental Modelling (CREEM), the Centre for Interdisciplinary Research in Computational Algebra (CIRCA), the Scottish Oceans Institute (SOI) and the Mackenzie Institute for Early Diagnosis. We are also a founding member of the multi-institutional National Centre for Statistical Ecology which consists of educational institutions, governmental and non-governmental partners working together to innovate statistical methods for conservation purposes. Through both its core research areas and our interdisciplinary centres, research in the School actively contributes to the

University's priority areas of Evolution, Behaviour, and Environment; Health, Infectious Disease, Wellbeing; and Sustainability. The School has been at the forefront of High-Performance Computing within the University since 1991 and also provides a unique mathematical resource in the award-winning MacTutor History of Mathematics website which is the most widely used and influential web-based resource on the history of mathematics globally. Our research is underpinned by a diverse range of funders including RCUK (EPSRC, STFC, NERC, MRC), ERC, the Leverhulme Trust, the Carnegie Trust, Cancer Research UK and international governmental agencies.

Entrepreneurial Impact

Impact activities throughout the School reflect our entrepreneurial strengths and ability to have a global impact.

The study of distance sampling methods has led to the development of *Distance*, a software package which is now the industry global standard for distance sampling used by government agencies and NGOs for conservation activities worldwide. We have developed marine statistical methods used across a range of marine industries to assess and reduce the environmental impact of human activities on marine mammals and seabirds, specifically the impact of naval sonars on marine species and impact of the Deepwater Horizon oil spill disaster. We have pioneered new ways of digitally monitoring wildlife, allowing the extension of surveys into areas where human surveyors cannot gather data, through the use of GPS tags, camera traps and hydrophones. This has been fundamental in reducing poaching in Namibia and the conservation of snow leopards, gibbons, frogs and other species. Additionally, this work has changed conservation policies in the Baltic Sea, facilitating the creation of one million hectares of Marine Protected area. CREEM works closely with SMRU Consulting, providing leading consultancy on marine mammal research, delivering innovative, robust and environmentally sound solutions to organisations active in the marine environment.

Our MacTutor History of Mathematics archive is one of the most accessed resources worldwide for mathematics and history with an average of 2 million hits a week. Together with Computer Science our School is one of a small number of centres worldwide that coordinate the collaborative effort to further develop GAP (Groups, Algorithms, and Programming), free open-source software for discrete computational algebra used globally. In Applied Mathematics we undertaken fluid flow modelling in the Clyde and have collaborated with the Met Office to use our models of the Sun's global magnetic field to forecast Space Weather, with Lockheed Martin to fine-tune specification for satellite observing instrumentation, with clinicians in Ninewells Hospital Dundee to predict the spread of cancer and optimise chemotherapy treatment, and with epidemiologists in Ann Arbor to develop new therapeutic approaches for multi-drug resistance in tuberculosis.

It is our intention to build on these and wider strengths while investing in new areas of interest to ensure we continue to have global impact while working with industrial partners and other external stakeholders. We will celebrate our successes, working alongside the University's Development Team to share activities with our global alumni, business leaders and donors.

People: Unity through Equality, Diversity and Inclusion

The mission of our School is to deliver both teaching of the highest quality and carry out world-class research. It is imperative that these activities take place in an inclusive environment in which achievement does not depend on gender, ethnicity, nationality or religious beliefs and hence we strive to establish such an environment. Due to the School wishing to advance equality beyond gender, such as progressing race or disability diversity and intersectionality, the School collectively expanded the Athena Swan Self-Assessment Team into the Equality, Diversity and Inclusion (EDI) Committee.



As a School we consistently recruit more female UG students than the national average and are focusing on working across our UG, MSc programmes and within our PGR offerings to further increase diversity and ensure our programmes are attractive and accessible to a wide range of applicants in the coming years. We will do this through the offering of targeted scholarships, outreach and recruitment.

The School has undertaken a statistical analysis of gender degree classification difference to understand how differences arise and is proactively looking at activities towards supporting the reduction of this difference. In addition, student summer scholarship funding for student led EDI related projects (e.g. curriculum audit, widening participation) is being ringfenced from 2021/22 onwards.

In the period 2012 – 2015, and for the combined grades of Lecturer, Researcher and Professor, there was a considerably larger percentage of female staff in our School when compared to similar Schools across the UK (AS Application 2016/HR & HESA Data). The School provides mentoring and support to all new and early career staff ensuring their activities are aligned to support future promotion. Staff across the School are supported in applying for promotion with 65% of our applications being successful since 2017. The EDI committee is leading initiatives to support the recruitment of underrepresented groups to the School through targeted advertising of vacancies and developing networks with organisations supporting underrepresented mathematicians.

Achieving our Ambitions

Research & Impact Strategy

The School is committed to bringing together staff, students and alumni to provide a world-class research and education environment that our community feels part of and connected to. To do this we will capitalise on and enhance our international research reputation in our core expertise in Applied Mathematics, Pure Mathematics and Statistics, investing in growing these divisions organically, enhancing intra-disciplinary connections within the School and interdisciplinary networks across St Andrews and beyond. We already work collaboratively across our research strengths with the Schools of Computer Science, Physics & Astronomy, Biology and Medicine. We will further develop these links as well as widening them to other relevant Schools such as Geography & Sustainable Development, with whom we have recently started working closely with in relation to statistical ecology. Given our relatively small size, our research strategy is to focus on our core research strengths through the appointment of new staff who in addition to consolidating and further developing these key areas will enhance our research portfolio. In turn this will allow us to further diversify avenues of funding and build networks to take advantage of large, collaborative funding calls. In particular, we will:

- Reinforce the work of CREEM within the Statistics division, linking with the Pure division in the area of probability, and developing research collaborations in bio-medical statistics alongside the School of Medicine and the wider Mackenzie Institute. We will further develop our activities in big data, data science and analysis, increasing and seeking new research collaborations with the Schools of Computer Science, Biology, Physics and Geography and Sustainable Development.
- Develop and extend the considerable probabilistic and stochastic expertise in the Analysis Group in a direction to create new links with other School groups such as Algebra, Statistical Medicine, Mathematical Biology and Vortex Dynamics. We will support the further development of CIRCA through exploiting our significant links between those with computational algebra expertise and the School of Computer Science.
- Diversify the Solar group within the Applied division, through recruitment in areas such as space weather or solar interior modelling to extend the group's core expertise. Upcoming appointments in the area of computational modelling will establish interdisciplinary links with the Vortex and Mathematical Biology groups.

We will utilise our global research links making use of current synergies and the interdisciplinary nature of our existing research to consolidate ourselves as competitors and collaborators in a diverse range of research funding calls, ensuring this is linked to growth within our postdoctoral research positions and PGR student numbers. To achieve this, we will:

- Support the development of the Mathematical Biology Group, linking it across School disciplines such as Statistical Medicine and Molecular Biology to increase our access to new sources of

funding, such as BBSRC, MRC, GCRF, Wellcome Trust, Cancer Research UK and other charitable bodies we already work alongside (e.g. Prostate Cancer UK).

- Support CREEM in further cementing their status as the world leading group in the study of statistical ecology through the appointment of a replacement Chair in 2021.
- Ensure we are in a position to take advantage of the newly announced additional £300 million EPSRC funding for UK Mathematics, making sure our staff are pursuing all relevant funding calls.
- Work alongside the University to secure funding for School based scholarships for PGR students, partaking in the Handsel scheme where relevant.
- Identify and secure externally funded scholarships from charitable trusts such as the Leverhulme Trust, Medical Research Scotland, the Carnegie Trust and the Melville Trust.
- Apply for Doctoral Training Grants alongside our key partners within the Schools of Computer Science, Physics & Astronomy, Biology and Medicine.
- Continue to maintain awareness of the political landscape to ensure we are prepared for changes to Horizon 2020 and ERC funding, maintaining competitiveness in any new calls for funding.
- Support knowledge transfer for GAP through research-teaching linkage, workshops for GAP users, new technological developments (such as Jupyter notebooks) that facilitate the use of GAP.

We will continue to focus on having global impact. Our case studies for REF 2021 are truly international and we will build on this reputation as we move forwards. To achieve this, we will:

- Establish an Impact and Entrepreneurial Advisory Board consisting of business leaders and University Court Members to act as an external advisory board, meeting formally once per year.
- Establish proactive working relationships with the Global Office to connect with our alumni and expand our global network of research collaborations developing our global reputation.

Building upon our Excellence in Teaching

We will develop and enhance our global reputation in teaching through attracting and supporting the best students and staff regardless of background while continuing to be leaders in delivering education, celebrating critical thinking and encouraging our students to be innovative and creative in their practical application of mathematics and statistics. To achieve this, we will:

- To welcome exceptional students from across Scotland, the rest of the UK, EU and Overseas, while widening participation through working alongside the University in supporting students with targeted scholarships.
- Prioritise the delivery of an excellent academic experience with a focus on small group teaching supported by the University through the expansion in staffing resource to maintain and improve our student-staff ratios.
- Offer programmes of unrivalled flexibility, exploiting the compact nature of the University to allow students to link across disciplines, through extensive joint degree offerings and truly interdisciplinary work including Vertically Integrated Projects.
- Ensure we encourage and celebrate the range of areas our students will move into on graduation through offering a flexible system where each student has opportunity to tailor their curriculum and experiences for their future ambitions.
- Strengthen co- and extra-curricular links with industry, the Careers Centre and our new Advisory Impact Board, further enhancing discipline-based education, producing graduates who become leaders and innovators with strong analytical and computational skills, highly sought by industry.
- Modernise how we teach computational mathematics and statistics through re-imagining the delivery of computer labs, developing new modules in mathematical and statistical computing and integrating technology enhanced learning across our curriculum (such as RStudio Cloud, Jupyter notebooks and online assessment).
- Explore the development of new modules in History of Mathematics, possibly at Postgraduate level, following the successful introduction of a module in the MA in Combined Studies.
- Enhance our process of curriculum review, ensuring we are outward looking and that our programmes continue to be informed and delivered by our leading researchers, incorporating areas of evolving contemporary demand such as financial mathematics.
- Strengthen our core teaching leadership team through adding new members to drive change and manage day-to-day teaching activity to support the School advance its wider strategic aims, and in doing so further increase its student satisfaction from its already excellent starting point.

- Through the development and implementation of School and University action plans and the integration of our new Wellbeing Officer into School activities, actively support the creation of an environment which is socially responsible and sustainable, supportive of wellbeing with an inclusive culture which celebrates diversity.

We are committed to growing student numbers across the School. We would like to see UG numbers increase by 80FTE and PGT numbers by 26FTE by 2025/26 (specifically within new MSc programmes in Mathematical Biology and Statistical Ecology). In addition, we want to work alongside our key partners in Physics & Astronomy and Computer Science to support their growth, developing student pathways to ensure we are enhancing student experience in all three Schools.

People and Environment

A Creative, Adaptive and Vibrant Environment for Students and Staff

We will grow our academic staffing component alongside our undergraduate and postgraduate numbers, with an ultimate aim of reducing our staff student ratio to under 13. While investing in our staffing levels we will commit to increasing postgraduate research scholarships, expanding support for our small group teaching at sub-honours. We will ensure the sustainability and growth of our current academic community and research strengths by making high quality appointments across our three divisions, looking for individuals who contribute to our existing areas of expertise while also reaching into new and interesting areas, aligning our growth to the needs of the School and the ever evolving and dynamic funding landscape.

With a substantial increase in student numbers and further growth anticipated, the School will continue to redefine and professionalise our administrative activities unburdening academic staff of administrative duties, transferring these to a professional services function, fit to support further expansion of the School. This will allow academics to focus on research and teaching activities while fostering a culture of service improvement and continuous development. We will work alongside the wider University in the development of the School's professional service function, enhancing relationships with all Central Units, linking into communities of practice and mentoring schemes to ensure staff and students have access to an empowered, confident and proactive support service.

We will invest in technical support across the School, re-defining how we integrate the use of technology to support a modern approach to the delivery of a mathematical curriculum and enhancing our computational skills provision. We will implement a structure which provides frontline support to staff and students working alongside IT Services to ensure we have state of the art, functional facilities for all to use. In addition, technical staff will support the development of our teaching methods, developing the provision of materials to students through utilising web-based technology.

The most significant challenge facing the School is the lack of a central building to hold all School staff across all divisions and overcrowding of current teaching facilities. We want to nurture our community and give our staff and students the best possible facilities to undertake studies and research. We will therefore work alongside the University to ensure that we develop a new building with state-of-the-art teaching facilities to be used by Schools across the North Haugh as well as to house all three of our divisions and provide innovative social spaces for our undergraduate and postgraduate students. In the meantime, we will work alongside Estates to ensure the Mathematics Institute is suitably refurbished, utilising opportunities to add to current space through the repurposing of space such as transforming old server rooms into collaborative teaching and tutorial space.

Equality, Diversity and Wellbeing

The School is continually working alongside staff and students to address individual and collective wellbeing across our community. We have developed a workload model and continually refine and review teaching and administrative workloads to ensure they are feasible for staff and support the delivery of research and teaching excellence. The School's Equality, Diversity and Inclusion (EDI) Committee drives change within the School by raising awareness of equality, diversity and inclusion activities while embedding transparency and fairness in all School practices. The School is engaged in achieving Athena Swan Silver certification and is committing a portion of its operational budget to ensure the EDI Committee has the resources it needs to deliver School-wide events such as wellbeing days and training events, working closely with Student Services, CAPOD and Occupational Health.