WHAT IS IMPACT FOR REF? (SCHOOL OF MATHEMATICAL SCIENCES)

REF 2014 Definition: "An effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia."

In essence, impact includes, but is not limited to, an effect on, change or benefit to:

- The activity, attitude, awareness, behaviour, capacity, opportunity, performance, policy, practice, process or understanding
- An audience, beneficiary, community, constituency, organisation or individuals
- In any geographic location whether locally, regionally nationally or internationally.

Impact must occur during the impact period (likely between 1 August 2013 and 31 July 2020) and underpinned by research of at least 2* quality produced by the submitting unit during a given period (likely between 2000 and 2020)

Assessment: Impact is assessed on 'reach' and 'significance' outside academia:

- **Reach** is the extent and breadth of the beneficiaries of the impact
- **Significance** is the degree to which the impact has had an effect

Examples of top case studies from REF 2014

Economic	**Risk On / Risk Off: from academic research to financial market staple** This case study charts the influence of the Risk On / Risk Off (RORO) paradigm, developed in research at the University of Oxford in collaboration with investment bank HSBC. Since 2008, RORO has had a significant economic impact on HSBC as well as wider impact on the thinking and actions of investors and other global market participants. Having begun as a specialised research tool within HSBC's foreign exchange team, the RORO methodology was publicised in the advice that HSBC supply to a wide range of major fund managers, corporate institutions and central banks. The research has led directly to a change in the way that asset managers think about investment decisions, with consequent impact on the investment and risk management strategies they undertake. RORO is regularly featured in the financial press and is becoming increasingly mainstream, with coverage in national and international media aimed at retail investors.
Public policy and services	**Accurate statistical methods for detecting the source of human campylobacteriosis cases in New Zealand leads to an annual reduction of around 90,000 cases per year.** Research at Lancaster led to a novel approach to detect the source of cases of campylobacteriosis (a bacterial foodborne disease). The application of this method to data from New Zealand pin- pointed that New-Zealand's high rate of cases was linked to the eating of contaminated poultry. These results were a key part of the evidence used by New Zealand's Food Safety Authority to introduce a new code of practice for the poultry industry. The impact of this code of practice has been a halving of the number of reported cases of campylobacteriosis in New Zealand (from around 16,000 cases in 2006 to less than 7,000 in 2008). With notification rates estimated as 1 in 10, this corresponds to around 90,000 fewer actual cases per year. The saving for the New Zealand economy during the REF census period has been independently estimated as between £100M and £150M.
Society, culture and creativity	**The use of multilevel statistical modelling has led to improved evidence-based policy making in education and other sectors** Since 2008, statistical research at the University of Bristol has significantly influenced policies, practices and tools aimed at evaluating and promoting the quality of institutional and student learning in the education sector in the UK and internationally. These developments have also spread beyond the education sector and influence the inferential methods employed across government and other sectors. The underpinning research develops methodologies and a much-used suite of associated software packages that allows effective inference from complicated data structures, which are not well-modelled using traditional statistical techniques that assume homogeneity across observational units. The ability to analyse complicated data (such as pupil performance measures when measured alongside school, classroom, context and community factors) has resulted in a significant transformation of government and institutional policies and their practices in the UK, and recommendations in Organisation for Economic Co-operation and Development (OECD) policy documents. These techniques for transforming complex data into useful evidence are well-used across the UK civil service, with consequent policy shifts in areas such as higher education admissions and the REF2014 equality and diversity criteria.
Health	**Statistical methods for urgent medical care call centres and sustainable transport** The Northern Doctors Urgent Care Group, a not-for-profit organisation that delivers out-of-hours urgent medical services for the NHS, achieved significant efficiency savings and improvements in-patient care as a result of adopting statistical assessment and forecasting processes, developed by Durham University. These

	improved processes also featured in the Group's successful competitive bids for two new contracts worth £9.2M per year. In addition, the Durham methodology was adapted to assess the results of a Government programme to encourage cycling in six UK towns, producing data on cycle use that helped to influence subsequent allocations of about £700M for sustainable transport projects.
Practitioners and professional services	**Investigating the sinking of the M.V. Derbyshire and the setting of global design standards for bulk carriers using statistical extreme value research** Research on extreme value methods by Heffernan and Tawn at Lancaster, which proved critical in determining the conclusions of the High Court's investigation of the sinking of the M.V. Derbyshire, also identified that design standards for the strength of hatch covers of ocean-going carriers (bulk carriers, ore carriers and combination carriers) needed to be increased by 35%. This new level was set as a worldwide mandatory standard in 2004. During the REF census period this change has impacted on the design of 1720 new carriers and strengthening for the 5830 in service. There have been no sinkings of ocean-going bulk carriers since the new design standards were introduced in 2004, whereas on past evidence over 100 such sinkings of ocean-going bulk carriers would have been expected in the REF census period.
Environment	**Uncertainty quantification for UK climate change legislation, and for climate change impact assessment** Climate change is one of the defining challenges of our time. The net costs of climate change in the UK could be tens of billions of pounds per year in the 2050s, and tidal flooding alone could affect over half a million UK properties by 2100. Dr Jonathan Rougier worked with the UK Met Office (UKMO) to produce the climate scenarios for the UK Climate Impacts Programme (UKCIP) 2009 report (UKCP09). His research and advice (funded as a UKMO External Expert) was critical in a key innovation in the UKCP09: a comprehensive uncertainty assessment. A Director of the UKCIP writes "The UKMO team with Dr Rougier [have] put the UK at the leading edge of the science and service aspects of providing climate information for users". The UKCP09 formed the basis of the UK Climate Change Risk Assessment and the recommendations of the UK National Adaptation Programme, which was submitted to Parliament as part of the Government's obligations under the Climate Change Act. The UKCP09 has been used for the assessment of the impact of climate change by hundreds of organisations, including agencies and non-governmental organisations (NGOs), utilities companies, consultancies, and County Councils and Local Authorities.

Examples of evidence

Economic	Business performance measures (e.g., sales, turnover, profits, etc.), new investment funding for start-up businesses or new activities of existing businesses, job creation/protection, licences awarded and brought to market
Public policy and services	Documented evidence of policy debate (e.g., in Parliament, the media, material produced by NGOs) and of changes to public policy/legislation/regulations, measures of improved public services, and improved international welfare
Society, culture and creativity	Visitor/audience numbers and feedback, critical reviews in professional publications, public debate in media or other fora, increased attainment or improved engagement with science in non-HE education
Health	Evidence from clinical trials, measures of improved patient outcomes and public health, changes to clinical guidelines, take up of new/improved products that improve the quality of life in developing countries
Practitioners and prof.l services	Inclusion of research in industry standards of authoritative guidance, references by practitioners describing the impact, new or modified professional or technical standard, changes in knowledge or capability of individuals
Environment	Sales of new/improved products, impacts on particular projects/processes, evidence of generic environmental impact across a sector, inclusion in government policy papers, legislation and industry guidance, impact in planning decision outcomes

Further tips:

- Focus on who benefited and in what way, and why it matters
- Independent documentation of the evidence is preferred, e.g., by an independent authority
- Whenever possible, quantitative indicators should be included
- Impact could be direct, indirect, linear, non-linear, planned or unplanned as long as there is a demonstrable link back to the research. On-going engagement is positive, but not necessary
- It can include changes or benefits resulting from research that leads to a decision *not* to undertake a particular course of action, e.g., not to use a particular building material
- Impact can materialise much later than when the research was undertaken, so it's worth following up
- Provide evidence that the research at QMUL made a distinct and material contribution to the impact claimed