Institution: London School of Economics and Political Science

Unit of Assessment: 10: Mathematical Sciences

a. Overview

The LSE Departments of Mathematics and of Statistics together form a group of researchers who are committed to outstanding research in their areas, appropriate within the context of a leading social sciences institution. Research is organised in three main research groups within the Department of Mathematics *(discrete mathematics & algorithms*, *financial mathematics & control theory* and *mathematical game theory*) as well as in the Department of Statistics (*risk & stochastics*, *social statistics* and *time series*). The *financial mathematics & control theory* and the *risk & stochastics* groups share seminars and are strongly linked in their research activities; otherwise, research in the two departments operates quite separately. The Department of Statistics also hosts the *Centre for the Analysis of Time Series* (*CATS*) directed by Professor Smith that runs externally-funded research programs oriented to substantive fields, such as climate change.

The departments continue to attract outstanding PhD students, and their programmes continue to be very effective in placing them in academic and non-academic posts. Both departments attract distinguished international visitors. They also see clear benefits from the increasing cooperation between the two departments and from a growing number of contacts with related researchers in other LSE departments.

b. Research strategy

Strategy in the two departments is focussed at the research group level. Each research group has the ambition to be world-leading in its field. Vibrant seminar activity at LSE, active participation in numerous conferences, and extensive interaction with internationally leading researchers, ensure that the groups operate at the global cutting edge of their research specialisms. Appointment strategy has sought to ensure that each group has sufficient critical mass to support an internationally distinctive body of research. Engagement with exciting new areas of research within each field has been facilitated by new appointments.

The themes of the research groups have been identified historically as ones which can benefit from the unique comparative advantage stemming from LSE's focus on the social sciences. Thus, themes have been adopted with a view to developing synergies with leading LSE research groups in disciplines such as economics, finance and management. This context has also informed the two departments' distinctive ambition to be the foremost centres in the UK for mathematics and statistics in the social sciences. The most long-standing groups are in *discrete mathematics & algorithms*, *mathematical game theory, social statistics* and *time series.* Since Professor Smith took over as Director of *CATS* before RAE2008*,* its focus has become distinct from that of the *time series* research group, with the former now working closely with the LSE Grantham Research Institute on Climate Change and the Environment and the latter operating more closely with the Econometrics group in the Department of Economics. The *financial mathematics & control theory* and the *risk & stochastics* groups, while somewhat newer than the other groups, were already well-established by RAE2008. The *decision support & risk* group, which featured in the RAE2008 return for the Department of Statistics, has been discontinued with the retirement of Professor Wynn.

Since 2008, the strategic focus has been on realising the ambition to be world-leading in each of the fields represented by the research groups. There has been no attempt to introduce new groups, nor to restructure the 2008 grouping, other than by discontinuing the *decision support & risk* group. Major strengthening has taken place through 21 new academic appointments since 2008: 1 professor and 9 lecturers in the Department of Mathematics and 2 professors, 3 readers and 6 lecturers in the Department of Statistics. New appointments have been made across all research groups and the remaining part of this section describes, separately by group, developments and achievements over the assessment period and strategic plans for future research, including some details of the new appointments.

Discrete Mathematics & Algorithms (Mathematics Dept.)
This group currently has eight members, of whom three were appointed after RAE2008. Professor Biggs, who was the first appointment in discrete mathematics at LSE, remains active since he became Emeritus in 2006. The group also has an associate member (Professor Sorkin), whose main position is in the LSE Department of Management. The research areas covered by the group vary from pure mathematical ones (including extremal and structural properties of graphs and hypergraphs, random structures, probabilistic methods, and combinatorial geometry) to more applicable ones (including machine learning, sublinear algorithms for massive data sets, and algorithmic aspects of discrete mathematics in general). Established international collaborations include Emory University Atlanta, Australian National University, Dartmouth College, Georgia Institute of Technology, Hungarian Academy of Sciences, ENS Lyon, Technical University Munich, Adam Mickiewicz University Poznan, Charles University Prague, Rutgers University, University of Sao Paulo, ETH Zurich.

In the future, the group plans to build on its current strengths. In the area of extremal combinatorics, its aims include the development of tools that do not rely on regularity methods, with a view to establishing essentially better bounds for new as well as old results, and developing closer connections between extremal combinatorics and combinatorial geometry. Increasing collaboration with mathematically-oriented researchers in the management science group at the LSE Department of Management has encouraged the expansion of research in discrete algorithms as well as the development of new approaches to approximation, heuristic and randomised algorithms. The group plans to strengthen these connections further, together with the *mathematical game theory* group. Enhanced connections between research in the design and analysis of algorithms and in understanding the structure of the underlying combinatorial objects will benefit all strands of research in the group.

Mathematical Game Theory (Mathematics Dept.)
This group currently has five members, including three appointed since RAE2008. Game theory is a major tool and paradigm for economic theory. As a result, most game theory scholars now work in economics departments. Along with Paris and Jerusalem/Tel Aviv, LSE has one of the few mathematics departments with a concentration of game theorists. The mathematical aspects of game theory are the main focus of the group. Research topics include the economics and the strategic use of information, entropy methods, models of bounded rationality, games of incomplete information, stochastic games, and the computational and geometric structures of equilibria in games. Within LSE, the *mathematical game theory* group collaborates with the LSE Department of Management. Established international collaborations include Universities in Paris (Paris 6, Dauphine, Paris School of Economics), Pisa, ETH Zurich, Warsaw, Göttingen, Barcelona, Valencia, Tel Aviv, Jerusalem, Princeton, Stanford, and Yale.

The group's plans for the future build on its current strengths. Central themes include: the understanding of strategic behaviour with bounded information, memory, and computational power; the diffusion of behaviour and information in networks of strategic agents; the computational complexity of game-theoretic solution concepts.

Financial Mathematics & Control Theory (Mathematics Dept.)
This group currently has eight members, including four recruited since RAE2008. This group and the *risk & stochastics* group in the Department of Statistics together form one of the biggest concentrations of researchers in the area internationally. The research of the group covers a wide range of topics in mathematical finance, optimal control and optimal stopping. Within LSE, the group has strong links with the Financial Markets Group, apart from the *risk & stochastics* group. Established international collaborations include UC Berkeley, Columbia University, Humboldt University of Berlin, Karlsruhe Institute of Technology, University of Freiburg, University of Duisburg-Essen, University of Evry Val d'Essonne, University of Paris Est, Steklov Institute of Mathematics in Moscow, University of Sydney and University of Vaase.

The group plans to build on its existing strengths and expertise, and to develop its research activity

in several directions. The ambition is to make theoretical advances that will be instrumental in the development of a mathematical finance theory that will enhance the stability of financial markets. In particular, it is envisaged that the group's future research will investigate markets with asymmetric information and/or liquidity and other constraints, alternative markets such as energy markets, new developments in portfolio optimisation and equilibrium theories, new mathematical approaches to behavioural finance, new statistical methods in financial mathematics, new models of counterparty risk, and new methodological approaches and developments in stochastic control and optimisation, optimal stopping and stochastic games. Ground-breaking research activity in these directions will inevitably involve the development of genuinely new theory in the fields of stochastic processes and stochastic analysis.

Risk & Stochastics (Statistics Dept.)
This group has seen four new appointments since RAE2008. During this period, Norberg retired and Rheinlander left for a Chair at Vienna University of Technology. Research spans a variety of topics, with the common element being the development and utilisation of advanced techniques involving the theory of probability and stochastic processes. The group has become a vital part of an international network whose core interests are in actuarial science, mathematical finance and their interface. In particular, the group has strong links with Boston University, University of Technology Sydney, Columbia University, University of Ulm, University of Cologne, Catholic University of Leuven, Ecole Polytechnique, University Paris-Dauphine, HEC Montreal, University of Verona, University Paris VI and ETH Zurich.

One of the group's research aims is towards merging the quantitative fields of insurance and finance into a coherent unit, under the general framework of risk management. This long-term project is ambitious and has wide scope: not only does it aim at a unified treatment of the aforementioned areas, but closer connections with the theory of economics are sought, incorporating such elements as financial equilibrium, information asymmetry, model risk quantification, model uncertainty and transaction costs.

Social Statistics (Statistics Dept.)
Three new appointments have been made since RAE2008. In line with its strategic aim in 2008, the group has built upon its strong links with the LSE Department of Methodology, through a co-hosted ESRC-funded project on latent variable modelling methods for the analysis of cross-national survey data (2010-12). This research is now being developed further on an ESRC-funded project in collaboration with the European Social Survey (ESS) Core Scientific Team. New appointments led to fresh lines of research in sample surveys and in causality.

The group is currently at an exciting stage of its development. Following a low point after its only professor, Skrondal, returned to Norway in 2009, the group has been strengthened by the appointment of two professors since 2011. It plans to draw on its experience of social science disciplines, including sociology, criminology, demography, psychology and public opinion, to strengthen links with research in such fields at LSE and elsewhere, thereby motivating new lines of methodological research, and building on areas of expertise, such as in latent variable, longitudinal and multilevel modelling. The group also seeks to include in its agenda methodological challenges arising from new forms of data, such as linked administrative databases, drawing on cooperation with data-orientated groups like the ESS team. Whilst grounding in applied social science research is deemed essential, the ambition is to be the group undertaking the strongest research in statistical methodology within the UK social statistics community.

Time Series (Statistics Dept.)
Time series is a long-standing strength in the department and the group saw expansion during the assessment period. There were four new appointments and one retirement (Professor Tong). The group is actively engaged in several frontiers of time series research including high-dimensional modelling, nonstationary processes, and nonlinear modelling. The group maintains a high-profile presence in leading statistical journals and at international conferences/workshops.
Within LSE, the group has close links with the econometrics group in the Department of Economics, including joint research projects, joint PhD supervision and a joint weekly

Econometrics and Statistics seminar series. International collaborations include Princeton University, University of California at Davis, Rutgers University, University of Wisconsin-Madison, University Joseph Fourier (Grenoble), University of Brussels, Université Catholique de Louvain, University of Hong Kong, Peking University and Seoul National University. The group has also engaged with many users of time series methods, providing substantial consultancy to major industrial companies and banks.

The group is determined to maintain its presence at the international frontier of time series research. In particular, future research will feature (a) high-dimensional time series, (b) nonlinear and complex models, (c) nonstationary processes, (d) high-frequency data, and (e) combinations of (a) – (d) above. While (a) – (c) are the continuation of the current research within the group, the development of (d) and (e) reflect both new challenges in the modern information age and the development of large scale data analytic techniques.

The Department of Statistics also hosts the _Centre for the Analysis of Time Series_ (_CATS_). The Centre has a methodological focus on nonlinear dynamical systems, with an emphasis on model inadequacy, probability forecasting and decision-making. It runs research programs in climate change and weather forecasting, with external funds and links to the LSE Grantham Research Institute on Climate Change and the Environment.

c. People, including:
i. Staffing strategy and staff development

Following the strategy described in RAE2008, the Department of Mathematics originally strengthened the _financial mathematics & control theory_ group and then strengthened all of its three research groups by a total of ten new appointments. Similarly, the Department of Statistics strengthened its three research groups by eleven new appointments. In all these appointments, diversification rather than mere complementarity has been a major consideration.

Although the two departments' research can broadly be viewed in the context of their three research specialisms, people have been actively encouraged to pursue their own research agendas. At the same time, strong collaborations across the research groups have emerged. Overall, there are several formal and informal forums run by the six research groups and CATS in the two departments. These create a stimulating and congenial research environment. Postdoctoral researchers and PhD students actively participate in these forums.

The two departments and the School have several mechanisms and practices for promoting research and for nurturing, sustaining and developing an active and vital research culture. Every member of the department is assigned a mentor with whom they meet several times a year to discuss their career development plans, aspirations and achievements. The Teaching and Learning Centre (TLC) is responsible for further academic development. Teaching loads are low by international standards: a full load consists of approximately 100 contact hours (lectures and classes) per year.

LSE recently introduced a _New Academic Career_ structure. This structure has two career milestones for newly appointed early-career staff: a light-touch Interim Review at, typically, 2 years, and a rigorous Major Review and Promotion (to Associate Professor) at most 8 years after the start of employment. The reviews are made against well-defined criteria for research, teaching and citizenship. The Major Review and Promotion invites the opinion of external referees, as well as the opinion of the standing departmental experts.

Early-career researchers are encouraged and supported by being given reduced teaching loads (under 50 contact hours) in their first year and relatively light administrative loads until they pass Major Review. Usually, their mentor is a senior member of the research group that the mentee belongs to. The TLC also provides a comprehensive induction programme to all new recruits.

During this REF assessment period, LSE also introduced a new _Academic Career Development_

(ACD) Scheme, designed to ensure that staff receive the best possible advice in relation to their career and professional development. The scheme is intended to be a two-way discussion of progress, strengths and development areas, as well as sharing of future plans. For members of staff pre-Major Review and through the first five years post-Major Review, the ACD takes place on an annual basis. Thereafter, it takes place on a biennial basis and on a triennial basis for professors. For research-only staff, a similar career development review process takes place on an annual basis.

Personal research fellowships: Lewis is the holder of a Royal Society University Research Fellowship (2007-present). Skinner held an ESRC Professorial Fellowship in 2010-13.

International staff appointments: During the assessment period, the majority of new academic staff appointments have been international: seven out of ten in the Department of Mathematics and nine out of eleven in the Department of Statistics. Currently in both departments more than 75% of staff originate from outside the UK. Rheinlander left a Readership position for a Chair at Vienna University of Technology.

International visitors: During the assessment period, there have been in excess of 110 and 80 international visitors in the Departments of Mathematics and Statistics, respectively. These include Albert Shiryaev and Jean Jacod, who have given special lecture programmes during their visits, as well as the Polya Prize & Gödel Prize winner Noga Alon, the Nobel Prize winner Alvin Roth and the Polya Prize & Abel Prize winner Endre Szemerédi. LSE Visiting Professors appointed in this period include Jianqing Fan (Princeton University), Peter Hall (University of Melbourne), Soumendra Lahiri (Texas A&M University), Rüdiger Kiesel (University of Ulm), Albert Shiryaev (Steklov Mathematical Institute) and Marc Yor (Paris VI).

Equalities and diversity: The two departments share the strong LSE culture that promotes equality and diversity. Research active permanent members of the Department of Mathematics are about 15% female, with the figure rising to 40% of the relevant recruits during the last five years. Among the academic staff in the Department of Statistics, 25% are female. In the period since 2008, three women were promoted or appointed to a chair in this department. The Department of Mathematics is actively involved in the School's participation in the Gender Equality Charter Mark trials of the Equality Challenge Unit.

The Concordat to support the career development of researchers: The School has been monitoring the development of the revised Concordat to Support the Career Development of Researchers 2008 and has been taking a proactive approach to ensure that its policies and practices in relation to research staff are closely aligned with the key principles of the Concordat. A two-year Concordat Action Plan has been developed which identifies key areas that require further action. The action plan also incorporates themes that have been highlighted through the 2009 Careers in Research Online Survey (CROS) as well as the 2009 LSE Staff Survey. As a result, the School is currently undertaking a range of actions, including: improving the accessibility of information for research staff on the LSE website; ensuring that recruitment procedures are fully aligned with the Concordat; ensuring that an effective research staff promotions process is in place; providing workshops for new Principal Investigators, and providing guidance on supporting and managing research staff. Further, the School has established a bridging fund to retain researchers who are in between research contracts.

ii.   Research students

Since the RAE2008, 18 and 25 students have successfully completed their PhD and graduated from the Departments of Mathematics and Statistics, respectively. The average length of their study period has been 4 years. A majority of the students seek and find employment outside the academic world after graduation, especially in finance. Places where graduands found tenure-track or tenured academic positions include Bristol, China, Kuwait, Leeds, Liverpool and Singapore. At present, there are 15 and 24 MPhil/PhD students in the Departments of Mathematics and Statistics, respectively.

Monitoring and support: Each department has a Doctoral Programme Director (DPD), who has overall responsibility for the management of the department's PhD programme. The DPD meets representatives of the research students at least twice per academic year. The LSE Consultative Forum for Research Students, chaired by the Dean of the Graduate School, meets three times a year and is attended by a PhD student representative from each of the departments.

Each student has a first supervisor, whom they meet frequently, as well as a second supervisor, who might be actively involved with the student's supervision. Students are given a comprehensive induction to their department and their programme of studies at the start of their studies. They are required to complete a progress and assessment form regularly. These forms provide a mechanism for monitoring progress and allow supervisors and the DPDs to identify areas of difficulty early in the progress of the PhD. There are regular reviews of the progress of research students by the departments' Research Committees and any issue raised is discussed between the supervisors and the DPD. An upgrade from MPhil to PhD is decided by a panel that includes members of staff not involved in supervision.

Each full time PhD student is provided with their own desk and PC in a shared office or open-plan workspace. All research students have access to individual and central funds for research expenses such as the purchase of relevant literature, conference attendance and other research visits. Continuing and specialist needs are identified during discussions between students and supervisors. These may include lecture courses from other departments, library skills courses and training in the use of specialist computer packages. Training needs are addressed as part of regular meetings with supervisors and with the DPD. PhD students are expected to regularly attend research seminars. Additionally, both departments have more informal seminar series in which students are expected to participate actively.

Training via graduate schools: PhD students are strongly encouraged to take relevant courses at the *London Taught Course Centre for PhD Students in the Mathematical Sciences* (LTCC) (http://www.ltcc.ac.uk/) and the *London Graduate School in Mathematical Finance* (LGSMF) (http://www.londonmathfinance.org.uk/).

Both departments are founding members of the LTCC, which began in 2006/7. This provides a programme of courses for PhD students at various stages of their study. The departments have given their full commitment in offering courses and releasing staff to teach on it. The scheme is a valuable opportunity for PhD students to have both advanced specialist teaching in their chosen field and acquire insight into exciting new developments across statistics and pure and applied mathematics. The two departments have also been among the founding members of the LGSMF, a consortium of the mathematical finance groups in Birkbeck, Brunel University, Cass Business School, Imperial College, King's College, LSE and UCL. Its main purpose has been to provide a programme of advanced courses in mathematical finance, primarily but not exclusively for first-year PhD students. In particular, the Department of Statistics is responsible for organising an annual 'LGSMF PhD Day', which provides a platform for PhD students from the various institutions to present their work. Also, both departments have been founding members of the EPSRC supported *Doctoral Centre in Financial Computing*, a collaboration of LSE with UCL and LBS. In recent years, every PhD student in the departments has attended several courses in the LTCC and/or the LGSMF.

d. Income, infrastructure and facilities

Libraries: LSE has the foremost social science library in the UK, with an extensive range of electronic resources, including MathSciNet, ISI Web of Science, JSTOR, IBSS and Econlit. The online collection covers more than 350 individual journals in the mathematical sciences, with 45 mathematics titles and 57 statistics titles also available in print.

IT provision: There is an excellent research computing infrastructure with a standard Windows network, support for Linux and Mac workstations, and dedicated Linux servers for researchers doing heavy computation. LSE IT Services provides support for workstations and servers (web,

home, applications, file and wiki servers). Specialist as well as standard software is supported and the School has dedicated technical support teams allocated to academic departments.

Staff research funds: School and departmental staff research funds encourage and support research activity by academic staff, with annual allocations of at least £1.9k per annum per staff member in both departments. These funds can be used for a variety of purposes, including conferences and academic visits, personal IT equipment and the purchase of specialist publications. International conference expenses may be supplemented by departmental funds when necessary. All staff members attending international conferences/workshops as invited speakers or to present papers have received the necessary funds to participate. Funds are also available from both the School and the departments to facilitate visits to the departments.

Research support: Each department has a full-time dedicated research administrator to facilitate research grants by monitoring grant calls, helping staff with submission procedures and budgets, liaising with the LSE Research Division, and networking and linking to outside organisations such as research partners and research funding bodies, including the EU. The research administrators also serve the departments' Research Committees and liaise with their Chairs. Experienced academic staff members actively provide guidance to less experienced staff with research grant applications, including commenting on drafts as well as facilitating links with partners.

Seminars: There are several LSE seminar series, attended by staff and research students. Those include the *Department of Statistics Seminar*, the *Joint Econometrics and Statistics Seminar*, the *Seminar on Discrete Mathematics and Game Theory* and the *CATS 'Roasts' informal seminars* in the departments, as well as seminars in the *Department of Methodology*, the *Management Science Group* and the *Financial Markets Group* elsewhere in LSE. In addition, the departments are founders and co-organisers of the *London Mathematical Finance Seminar Series*, together with King's College and UCL. The Department of Mathematics has two more informal seminar series that are mostly aimed at the needs and training of PhD students.

Consultancies and professional services: Staff in the Department of Statistics provide consultancy services on request from staff and research students from other departments within LSE. External Consultancies include Barclays Bank (Yao, since 2012), BBC (Kuha, 2010; Fryzlewicz, 2012-13), Bonamy Finch (Fryzlewicz, 2012), BrandScience (Fryzlewicz, 2012), Department of Health (Skinner, 2013), EDF (Yao, since 2010), Home Office (Skinner, 2012-13) and Winton Capital Management (Yao, 2011).

Research income: During the assessment period, Statistics and Mathematics jointly have £1.9 million of active research grants. These grants were awarded under open competition.

Major grants over the period include:
- Kalogeropoulos: Bayesian inference on implied volatility: £129,460 (EPSRC) 2013-15.
- Kuha: (i) Latent variable modelling of categorical data – tools of analysis for cross-national surveys: £215,00 (ESRC) 2010-12; (ii) Item nonresponse and measurement error in cross-national surveys: £153,797 (ESRC) 2013-14.
- Rheinlander: Valuation of insurance derivatives: £73,014 (EPSRC) 2007-09.
- Sasane: Algebraic-analytical aspects of stability problems in control theory: 1,900,000 SEK (£185,000) (Swedish Research Council) 2011-14.
- Skinner: Enhancing the use of information on survey data quality: £396,028 (ESRC) 2011-13.
- Smith: End-to-end quantification of uncertainty for impacts prediction (EQUIP): £185,630 (NERC) 2010-12.
- Smith: Risk assessment probability and impact team (RAPIT): £67,115 (NERC) 2009-13.
- Wynn: Managing uncertainty in complex models: £295,000 (EPSRC) 2006-10.
- Yao: High-dimensional time series, common factors and nonstationarity: £331,455 (EPSRC) 2010-13.

Further grants recently approved include:
- Geneletti: The regression discontinuity design: a novel approach to evaluating the effects of

drugs and treatments in primary care: £19,262 (MRC) 2013-16.
▪ Kardaras: Topics in probability and convexity in finance: 100,000 Euros (Marie Curie International Career Integration Grant) 2013-17.

Following discussion with HEFCE about problems with HESA data, it was agreed that we should note here that the distribution of income between funder categories in the data presented in REF4b understates EU industry income and overstates non-EU industry. The total income figures for each year are unaffected.

In 2012-13 LSE introduced a new scheme designed to provide significantly increased incentives to staff to win research funding. The scheme supports financial rewards to principal investigators and co-investigators and research infrastructure and investment funds (RIIF) to the departments. Both rewards are a percentage of the net overhead income on a research project. The RIIF funds are managed by the departmental research committees with a view to supporting research staff and promoting funded research projects, e.g. through seed funding for new proposals.

e. Collaboration and contribution to the discipline or research base

Within the Mathematical Sciences disciplines

Research is strongly collaborative, as indicated by the multiple authorships of many of the publications. Collaboration is a common outcome of the strategy to interact with internationally-leading researchers by promoting their visits to LSE and by LSE researchers participating in research events. Some of the externally-funded research is also collaborative, for example the 'Managing uncertainty in complex models' grant involved the collaboration of five UK universities. Contributions to the discipline through participation in learned societies, through research conference organisation and presentations, and through editorial work on academic journals, is encouraged. Examples are listed below.

Leadership in learned societies:
▪ Fryzlewicz: Secretary of the Research Section of the Royal Statistical Society (2011-12).
▪ Kuha: Chair of Social Statistics Section of the Royal Statistical Society (2010-12).
▪ Skinner: Council Member of Royal Statistical Society (2005-09).
▪ Steele: Member of Academic Affairs Committee of the Royal Statistical Society (since 2013)
▪ Van den Heuvel: Member of the British Combinatorial Committee (since 2009).
▪ Von Stengel: Vice President for Communications of the Game Theory Society (since 2006).
▪ Yao: Council Member of Institute of Mathematical Statistics (since 2011).

Conference organisers/(Co-)Chairs include:
▪ "Financial Time Series Analysis: High-dimensionality, Nonstationarity and the Financial Crisis" in Singapore (Fryzlewicz and Yao, 2012).
▪ "Data Linkage and Anonymisation", Scoping Meeting for programme, Isaac Newton Institute, Cambridge (Skinner, 2013).
▪ Dagstuhl Computer Science Workshops on "Equilibrium Computation" (von Stengel, 2010) and "Interface of Computation, Game Theory, and Economics" (von Stengel, 2013).
▪ Workshop on "Computational Game Theory", Stony Brook (von Stengel, 2013).
▪ Oberwolfach Workshop on "Statistical inference for complex time series data: nonstationarity, high dimensionality and high frequency" (Yao, 2013).
▪ Oberwolfach mini-Workshop on "Semiparametric Modelling of Multivariate Economic Time Series with Changing Dynamics" (Yao, 2010).
▪ 3rd and 6th International Conferences of the ERCIM Working Group on Computational & Methodological Statistics (ERCIM 2010 and ERCIM 2013), LSE co-sponsor.

Keynote talks include:
▪ Frontiers in Financial Mathematics, Dublin and Advanced Finance and Stochastics, Moscow (Kardaras, 2013).
▪ 25th Summer Topology Conference (Ostaszewski, 2010).
▪ Graybill Conference on Modern Survey Statistics, Colorado, and 6th International Conference

of the ERCIM Working Group on Computational & Methodological Statistics, London (Skinner, 2013).
- 8th IEEE International Conference on eScience, Chicago (Smith, 2012).
- International Conference on Discrete Mathematics, Mysore, India, and 24th British Combinatorial Conference (van den Heuvel, 2008 and 2013).
- Games 2008, Annual ESF Conference, Warsaw, SING 5 Conference on Game Theory, Amsterdam, and Computational Management Science, Montreal (von Stengel, 2008, 2009 and 2013).
- 4th CSDA International Conference on Computational and Financial Econometrics and 3rd International Conference of the ERCIM Working Group on Computing & Statistics, London (Yao, 2010).
- 5th International Workshop in Applied Probability, IWAP, Madrid (Zervos, 2010).

Journal editorships:
Combin. Probab. Comput. (Brightwell, Managing Editor, 1992-2008), J. R. Stat. Soc. Ser. C (Skinner, Editor, 2007-10), J. Privacy & Confidentiality (Skinner, Editor, since 2008), Statist. Sinica (Yao, Editor, since 2011), Internat. J. Game Theory (von Stengel, Co-Editor, since 2008).

Associate Editorships include: Ann. Statist. (Yao, 2004-12), Brit. J. Math. Statist. Psych. (Kuha, since 2013), Combin. Probab. Comput. (Brightwell, since 2009), Games Econom. Behav. (von Stengel, since 2006), IMA J. Math. Control Inform. (Zervos, since 2007), Internat. J. Game Theory (Simon, 2003-09), Int. J. Theor. Appl. Finance (Zervos, since 2011), J. Amer. Statist. Assoc. (Yao, since 2012), J.R. Stat. Soc. Ser. A. (Steele, 2005-08), J. R. Stat. Soc. Ser. B (Fryzlewicz, 2006-10), J. R. Stat. Soc. Ser. C (Kuha, 2009-12; Bergsma, since 2013), J. Statist. Plan. Inf. (Lam, since 2012), J. Surv. Stat. Meth. (Skinner, since 2012), Math. Oper. Res. (von Stengel, since 1998; Gossner, since 2008), Oper. Res. Lett. (Gossner, since 2011), Order (Brightwell, since 1992), Statist. Sinica (Lam, since 2011), Theory and Decision (Gossner, since 2006).

Guest (Co)-Editors: Discrete Appl. Math. (Anthony, 2008), Discrete Math. (van den Heuvel, since 2009), Econom. Theory (von Stengel, 2010), Risks (Dassios, 2013), Stochastics (Zervos, 2012).

Fellowships, awards and prizes
- Cho: Royal Statistical Society Research Prize (2013).
- Fryzlewicz: Royal Statistical Society Guy Medal in Bronze (2013).
- Skinner: Royal Statistical Society West Prize (2009), CBE (2010).
- Steele: Fellow of British Academy (elected 2009), OBE (2011).
- Yao: American Statistical Association Fellowship (elected 2009).

Across disciplines and sectors
In line with the strategy to advance research in the context of the social sciences and to achieve synergies with researchers in substantive social science disciplines, there is a focus on interdisciplinary research. Examples of funded projects with strong interdisciplinary elements are:
- Kuha: The Role of Education in Intergenerational Social Mobility: ESRC (Grant holder: Bukodi, Oxford Institute of Social Policy, University of Oxford) Mar 2012.
- Kuha: Scientific Indicators of Confidence in Justice: Tools for Policy Assessment (EuroJustis): EU FP7 (Grant holder: Hough, Institute for Criminal Policy Research, Birkbeck, London) 2008-11.
- Kuha: New European Crimes and Trust-Based Policy (Fiducia): EU FP7. (Grant holder: Maffei, Department of Criminal Sciences, University of Parma) 2012-15.
- Zervos: LSE local coordinator of the European Network "A Topological Approach to Cultural Dynamics" (ATACD) 2007-10.

Collaboration with organisations outside academia on real-world problems has inspired additional lines of research. The weather forecasting Impact Case Study provides one example of such cooperation with companies in the energy sector and with meteorological offices. More examples are provided in the Impact template in REF3a.