

Summary: John Declan BIGGINS

History

Sheffield University: Professor, Sept 1994–April 2018; Senior Lecturer, 1993–94; Lecturer, 1976–92
 Oxford University: MSc, DPhil 1973–76
 Cambridge University: Mathematics Tripos 1970–73

Academic Leadership

- Head of School: 4 years, 2014–2018 (\approx 60 permanent academic staff, \approx 100 staff in all).
- Deputy Head of School: 4 years, 2010–13
- Member of five-strong School Strategy Committee, with particular responsibility for leading on School-wide strategy for taught courses. 2008–10.
- Head of Probability and Statistics: 9 years, 1995–2000; 2003–07. (35–40 staff in all: Academic Department; Statistical Services Unit; Applied Probability Trust Office.)
- Chair of School of Mathematics and Statistics: 1 year, 2004–05.
- Research Leadership: prepared RAE96; contributed significantly to preparation of RAE01; oversight of RAE08 submission. (All for UoA ‘Statistics and Operations Research’).

Research

- Strong contribution in REF ([4], [3], [5], [7]), RAE08 ([8], [9], [11], [14]), RAE01 ([15], [16], [18], [21]), RAE96 ([23], [26], [25], [32]) and RAE92 ([32], [34]).
- Publications ranging from Probability through to applications of Statistics. Research students successfully supervised in both Probability and Statistics.
- History of substantial single author papers and active collaborator — many different co-authors on topics outside my main area.

Professional Activities

- Editorial Board *Jnl. App. Probab.* and *Adv. App. Probab.* 2008–.
- Referee for EPSRC/SERC, Canadian NSERC, US NSF, Australian RC, Leverhulme and European RC grant applications. Regular referee for leading journals.
- Long history of international visits and conference presentations supported by hosts.
- Experienced PhD examiner.

Teaching

- Teaching experience, and innovation, across a wide range, from service teaching to postgraduate, from theoretical to applied.
- Extensive experience in curriculum review and quality assurance.
- External Examiner BSc, MMORSE, University of Warwick, 2009–, MSc (Stats) 2010–
 BSc, Royal Holloway, University of London, 2005–09;
 BSc and MSc (Stats), University of Manchester, 2000–03;
 BSc, Queen Mary, University of London, 1996–2000;
 BSc, University of Teesside, 1989–93.
- External member of periodic review of postgraduate degrees in Mathematical Sciences at the University of Essex. March 2010.
- Member of the NEAB Preparatory Committee for Statistics A level, 1987–93.

Curriculum Vitae: John Declan BIGGINS

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Personal details

Date of Birth: 1 January 1952
 Marital Status: Married (1980)
 Children: Five

Education

1970–73: Cambridge University, Trinity Hall, (Scholarship, 1971–3)
 1973–76: Oxford University, Wolfson College

Qualifications

1973: **B.A.** Cambridge University (Mathematical Tripos)
 1st Class each year

1974: **M.Sc.** Oxford University (by course-work and dissertation)
 Main subject: Statistics
 Subsidiary subjects: Probability, Functional Analysis
An aspect of statistical admissibility — The Stein Estimator.
 (Supervisor: Prof. A.F.M. Smith FRS)

1976: **D.Phil.** Oxford University
Asymptotic Properties of the Branching Random Walk
 (Supervisor: Prof. J.F.C. Kingman FRS)

2009: **Foundation Degree** York St John University
 Subject: Theology and Ministry. Distinction

Previous Appointments: Professor (Oct 1994–April 2018, now retired).
 Senior Lecturer (Jan 1993– Sept 1994).
 Lecturer (Sept 1976–Dec 1992).

Leadership/Administration

In the second half of my academic career I had a variety of significant leadership roles. These involved both responsibility for strategy and for personnel matters.

Professional Activities

General professional activities

1. Editorial Board of *Jnl Appl Probab* and *Adv Appl Probab* in 2008–.
2. Referee for grant applications for SERC, EPSRC, Canadian NSERC, US NSF, Australian RC, Leverhulme, and the European RC.
3. Referee for all the major Probability Theory journals, for a variety of others too, including several Physics ones.
4. Member of the EPSRC Peer Review College, 2003–05.
5. External member of periodic review of postgraduate degrees in Mathematical Sciences at the University of Essex. March 2010.
6. External Examiner for higher degrees: M.Sc. by research at Cambridge University (1987); PhDs at: University of Manchester 1997; University of Bath 1998; University of Warwick 2002; University of Bath 2006; University of Warwick 2006; University of Bristol 2011; Paris VI, 2013. Internal examiner for 8 Ph.D. theses.
7. External Examiner for undergraduate degrees: B.Sc. in Mathematical Sciences at the University of Teesside (was Teesside Polytechnic) 1989–1993; BSc, MSci in Mathematics at Queen Mary and Westfield (University of London), 1996–2000; B.Sc, MMath in Mathematics and MSc in Statistics at The University of Manchester, 2000–2003; BSc in Mathematics, Royal Holloway, University of London, 2005–09; BSc and MMORSE degrees at the University of Warwick, 2009–, MSc (Stats) 2010–
8. Long history of reviewing for *Mathematical Reviews* and *Zentralblatt für Mathematik* (about 195 reviews, but I have now stopped).
9. Member of the Executive Committee of the Committee of Professors of Statistics 1999–2004 ; responsible for the production of an annual booklet (and web site) on opportunities for postgraduate studies across the country, 1999–2002.
10. Member of the Preparatory Sub-Committee for Statistics (Advanced Level) of the Joint Matriculation Board (now ‘within’ AQA), 1987–93.

Research related invitations

1. Invited speaker, Olle Nerman Symposium 2017 — From Branching Processes to Clinical Trials, Göthenburg, Sweden. September 1–2, (All expenses covered by organisers.)
2. Invited Lecturer. *Topics in branching processes* (5×1.5hrs). Young Researchers Workshop (Probability at Warwick) 23–27 July 2012
3. Invited speaker, meeting on Branching Structures, Institut Henri Poincaré, Paris, September 2011. (Local expenses covered by organisers.)

4. Invited speaker, Workshop on Branching Processes, Centre International de Rencontres Mathématiques, Luminy, France, April 2011 (Local expenses covered by organisers.)
5. Invited speaker/participant in a workshop at the Banff International Research Station, Alberta, Canada, February 2010. (Local expenses covered by organisers; Royal Society grant for travel.)
6. Invited participant in the Workshop on Branching Processes: Badajoz, Spain, April 2009 (local expenses covered by organisers)
7. Invited contributor to the Festschrift for Sir John Kingman F.R.S. (see [6])
8. Visited Prof A. Barbour at The University of Zurich, in June 2003 (at his expense).
9. Invited speaker at *IWAP 2002*, Caracas, Venezuela, January 2002. (Local expenses covered by organisers; Royal Society grant for travel.)
10. Guest-professor for two weeks in January 1999 at The University of Kiel, Germany, visiting Prof. U. Roesler. (All expenses paid by hosts.)
11. Visited Prof O. Nerman at Göteborg for two weeks in May 1998 and was an invited speaker at *Population Dynamics Workshop*. (All expenses paid by hosts.)
12. Visited Prof. Harry Cohn of Melbourne University for two months (Oct–Dec) in 1997 financed by his ARC grant. Seminars at Melbourne, Monash, Sydney, Canberra and Perth.
13. Invited to participate in *Branching Processes*, Oberwolfach Research Institute, Germany, December 1995. (Local expenses covered by organisers)
14. Invited speaker at *Workshop on Trees*, Versailles 14–16 June, 1995. (All expenses paid.)
15. Invited to participate in the programme *Statistical mechanics and Stochastic analysis* held at the Mittag-Leffler Institute, Stockholm. I attended for one month, May 95. (All expenses paid.)
16. Invited speaker at *Workshop on Epidemic Spread and Population Dynamics*, 2–6, Stockholm, May 1995.
17. Visited Dr Harry Cohn in Melbourne, Australia. July 1–30, 1994. (The travel and part of the subsistence costs was be funded through an SERC grant, the remaining expenses were met by Melbourne University.)
18. Invited speaker at the 12th Australian Statistical Society Conference, 4–8 July 1994.
19. Invited long-term visitor at the year on Emerging Applications of Probability at the Institute of Mathematics and its Applications, Minnesota, in 1994. 7 April – 29 June 1994. (Travel and all local expenses paid by the IMA.)
20. Invited speaker at a Branching Process workshop held in Minnesota, June 13–17, 1994.
21. Invited speaker at the meeting on ‘Stochastic Methods in PDEs’ held at the Isaac Newton Institute for Mathematical Sciences (a ‘research institute’), Cambridge, 13–17 September 1993 as part of the programme on *Random Spatial Process*.
22. Special Invited Speaker at the First World Conference on Branching Processes. Varna, Bulgaria, September 5–12, 1993. (Local expenses covered by organisers; Royal Society grant for travel.)

23. Invited speaker at the 6th Vilnius conference. Vilnius, Lithuania, 28 June – 3 July, 1993. (Local expenses covered by organisers.)
24. Invited speaker at the 2nd World Congress of the Bernoulli Society, Uppsala, August 1990. (Royal Society grant for travel and subsistence.)
25. Invited to visit Professor Neveu and his group at Ecole Polytechnique, Paris, at their expense. March 1990.
26. Invited speaker at the workshop on Stochastic Modelling in Biology. Heidelberg August 8–12, 1988. (Funded by German Cancer Research Centre).
27. Invited speaker at the 10th conference on Stochastic Processes and their Applications. Montreal. August 23–28, 1981. (Funded through Canadian NSERC).
28. Invited to visit Chalmers University of Technology, Göteborg, at their expense. September 20–27, 1980.
29. Invited to visit L'Universite de Paris-Sud, Orsay, at their expense. April 13–20, 1980.
30. Invited speaker at a conference on models of biological growth and spread. Heidelberg July 16–21, 1979. (Funded by German Cancer Research Centre).

Research activity

An overview of published research

My research interests have ranged widely. In particular, though my main work is in Probability, I have several papers in Statistics, and have successfully supervised research students in both Probability and Statistics.

The main thread in the research, running right back to my D. Phil, is the branching random walk. Applications of the theory to a number of problems in theoretical computer science, and connections with fractals and non-linear partial differential equations, have increased the profile of the work.

The branching random walk forms part of the general area of branching processes. I have further papers on other aspects of branching processes; specifically, the collaborations with J. D'Souza, N. H. Bingham, O. Nerman and H. Cohn represent work on different areas under this heading. In addition there is one series of papers (with C. Cannings) that deals with a problem in probability theory outside branching processes and I have made more recent excursions into random walk theory, large deviations and random graphs.

For some years I had an interest in the statistical issues involved in combining and scaling examination marks. This falls within the psychometric tradition in statistics, and it is rather different from the probability theory that is my main interest. It turns out that examination marks provide an example of the need for these techniques that throws up some new and interesting theoretical problems. I have supervised a successful research student (K. K. Yue) in this area.

Finally, I have a few papers that are the result of providing statistical expertise to colleagues outside Mathematics. The most notable are a series of collaborations with Prof. T.R. Birkhead F.R.S.

Research supervision

RA supervision: I was sole Investigator on a two-year grant from the Mathematics panel of the EPSRC (1994–6) that funded Owen Jones to work on branching process problems with their roots in fractals. He had three (single-author) papers accepted that were prepared under this grant, two of them substantial ones in good journals.

Ph.D. student supervision: I supervised six PhD students, all of whom completed successfully. Five have been employed for significant periods as lecturers in higher education.

1. K.K. Yue: Scaling and combining examination marks, (1991). (External Examiner: Prof. B. Morgan, Kent). Self-funded.
Senior Lecturer in the School of Professional and Continuing Education, City University, Hong Kong.
2. J.C. D'Souza: The inhomogeneous spatial branching process, (1991). (External Examiner: Prof. N. Bingham, Royal Holloway) EPSRC-funded.
Senior Survey Statistician at the National Centre for Social Research: has been a lecturer at Heriot-Watt, Aberdeen and at two African Universities (as VSO placements)
3. A. Kyprianou: Seneta-Heyde norming in spatial branching processes and associated problems. (1996). (External Examiner: Dr. A. Etheridge, Edinburgh). EPSRC-funded.
Professor at Bath, following a spell with Shell and then lecturing jobs in Edinburgh and Utrecht.
4. S. Janarthanan: Spread in the general spatial branching process (1997). (External Examiner: Prof. R. Doney, Manchester). Commonwealth Scholarship.
Research-level job with Canada Post Corporation.
5. A. Rahimzadeh Sani: Multitype branching processes (1997) (External Examiner: Prof. F. Ball, Nottingham). Iranian Government Scholarship.
Associate Professor at Tarbiat Moallem University of Tehran.
6. D.B. Penman: Coloured random graphs (1998) (supervised jointly with Prof. C. Cannings). (External Examiner: Prof. C. McDiarmid, Oxford). Self-funded.
Senior Lecturer at Essex.

Teaching

Sheffield's well-established MSc and extensive undergraduate programme in Statistics, have provided an excellent opportunity to develop a broad perspective on the teaching of the subject. In research terms I am a theoretician, but this has not constrained my teaching or my thinking about what should be taught. In a sound statistical education there must be a balance between theory and practice. My experience has equipped me well to maintain this balance.

My teaching experience covers the whole range of Probability and Statistics and some Operations Research:

- I taught at all levels, from the most elementary service course (Statistics for Social Science students, where the typical Mathematics level was grade C at GCSE) through to various courses at MSc level.

- I taught very theoretical options (Probability, Measure and Integral; Stochastic Processes), very practical ones (Linear Models; Statistical Methods; Practical and Applied Statistics), and a variety in between.
- About half the courses I taught to Mathematics' students have involved some element of project work.
- I have supervised 37 MSc dissertations to completion, mainly on statistical topics.

I also have extensive experience on the broader issues associated with teaching:

- Actively involved in curriculum design, and innovation in teaching and assessment at Department and School (of Mathematics and Statistics) level for more than thirty years.
- I had considerable involvement in teaching development and quality assurance, in particular in the Quality Assurance Agency visitation in 1998 and in an Independent Evaluation of Teaching the School received in 2006. More recently, as Deputy Head of the School, I had significant involvement in the School's Periodic Review of Learning and Teaching in November 2010 and again in 2017.
- External Examiner for undergraduate degrees at five different Universities at various times.
- I served for 6 years on the NEAB committee that considered the A and A/S level draft examination papers in Statistics.

Publications

Published Papers

1. BIRKHEAD, T. R., THOMPSON, J. E., AND BIGGINS, J. D. (2017). Egg shape in the Common Guillemot *Uria aalge* and Brunnich's Guillemot *U. lomvia*: not a rolling matter? *Journal of Ornithology*, **158**, 679–685.
2. BIRKHEAD, T. R., THOMPSON, J. E., JACKSON, D., AND BIGGINS, J. D. (2017). The point of a Guillemot's egg. *Ibis*, **159**(2), 255–265.
3. ALSMEYER, G, BIGGINS, J.D. & MEINERS, M. The Functional Equation of the Smoothing Transformation. *Annals of Probability* (2012), **40** 2069–2105
4. BIGGINS J.D. Spreading speeds in reducible multitype branching random walk. *Annals of Applied Probability* (2012), **22** 1778–1821.
5. BIGGINS J.D., HAMBLY B.M. AND JONES, O.D. Multifractal spectra for random self-similar measures via branching processes. *Adv. Appl. Probab* **43** (2011) 1–39
6. BIGGINS, J.D. Branching out. In *Probability and Mathematical Genetics: Papers in Honour of Sir John Kingman*. Editors: N.H. Bingham, C.M. Goldie; Cambridge University Press, 2010, 112–133
7. BIGGINS, J.D. AND PENMAN, D.B. Large Deviations in randomly coloured random graphs. *Electronic Communications in Probability* (2009) **14**, 290–301.
8. BIGGINS J.D. The growth of iterates of multivariate generating functions. *Trans. Amer. Math. Soc.* (2008) **360**, 4305–4334.
9. BIGGINS, J.D. AND RAHIMZADEH SANI, A. Convergence results in multitype, multivariate branching random walk. *Adv. Appl. Probab.* (2005) **37**, 681–705.

10. BIGGINS, J.D. AND KYPRIANOU, A.E. Fixed points of the smoothing transform: the boundary case. *Electronic Journal In Probability* (2005) **10**, 609–631.
11. BIGGINS, J.D. AND KYPRIANOU, A.E. Measure change in multitype branching. *Adv. Appl. Probab* (2004) **36**, 544–581.
12. BIGGINS, J.D. Large deviations for mixtures. *Electronic Communications in Probability* (2004) **9**, 60–71.
13. BIRKHEAD, T.R., CHALINE, N., BIGGINS, J.D., BURKE, T. AND PIZZARI, T. Non-transitivity of paternity in a bird. (2004) *Evolution*, **58**, 416–420.
14. BIGGINS, J.D. Random walk conditioned to stay positive. *Jnl. Lond. Math. Soc.* (2003) **67**, 259–272.
15. BIGGINS, J.D., COHN, H. AND NERMAN, O. Multitype branching in varying environment. *Stoc. Proc. Appl.* (1999) **83**, 357–400.
16. BIGGINS, J.D. Lindley-like equations in the branching random walk. *Stoc. Proc. Appl.* (1998) **75**, 105–133.
17. BIRKHEAD, T.R. AND BIGGINS, J.D. Sperm competition mechanisms in birds: models and data. *Behavioural Ecology* (1998) **9**, 253–260.
18. BIGGINS, J.D. AND KYPRIANOU, A.E. Seneta-Heyde norming in the branching random walk. *Ann. Probab.* (1997) **25**, 337–360.
19. BIGGINS, J.D., AND GREY, D.R. A note on the growth of random trees. *Statistics and Probability Letters* (1997), **32**, 339–342.
20. BIGGINS, J.D. AND KYPRIANOU, A.E. Branching random walk: Seneta-Heyde norming. In *Trees: Proceedings of a Workshop held in Versailles June 14–16, 1995*, eds B. Chauvin, S. Cohen, A. Rouault. Birkhäuser, Basel. (1996) 31–50
21. BIGGINS, J.D. How fast does a general branching random walk spread? In *Classical and Modern Branching processes*, (K.B. Athreya, P. Jagers, eds.). *IMA Volumes in Mathematics and its Applications* (1997) **84**, 19–40. Springer-Verlag, New York.
22. BIRKHEAD T.R., WISHART, G.J. AND BIGGINS, J.D. Sperm precedence in the domestic fowl. *Proc. R. Soc. B* (1995) **261** 285–292.
23. BIGGINS, J.D. The growth and spread of the general branching random walk *Annals of Applied Probability*, (1995) **5**, 1008–1024.
24. BIGGINS, J.D. AND YUE, K.K. A likelihood approach to scaling examination marks. *Austral. J. Statist.* (1995) **37**, 273–282.
25. BIGGINS, J.D. AND BINGHAM, N.H. Large deviations in the supercritical branching process. *Adv. Appl. Probab.* (1993) **25** 757–772.
26. BIGGINS, J.D. AND D’SOUZA, J.C. The supercritical Galton-Watson process in varying environments — Seneta-Heyde norming. *Stoc. Proc. Appl.* (1993) **48** 237–249.
27. BIGGINS, J.D. AND NADARAJAH, S. Near-constancy of the Harris function in the simple branching process. *Stoc. Models.* (1993) **9**, 435–444
28. BIGGINS, J.D. AND YUE, K.K. Scaling and combining examination marks. *Brit. J. Math. Statist. Psych.* (1993) **46**, 153–179.
29. D’SOUZA, J.C. AND BIGGINS, J.D. The Supercritical Galton-Watson process in varying environments. *Stoc. Proc. Appl.* (1992) **42**, 39–47.

30. BIGGINS, J.D. Martingale convergence and large deviations in the branching random walk. *Theory Probab. and Appl.* (1992) **37**, 301–306.
31. D’SOUZA, J.C. AND BIGGINS, J.D. The supercritical Galton-Watson process in varying environments, *Theory Probab. and Appl.* (1992) **37**, 206–207.
32. BIGGINS, J.D. Uniform convergence of martingales in the branching random walk *Ann. Probab.* (1992), **20**, 137–151.
33. BIGGINS J.D., LUBACHEVSKY, B., SHWARTZ, A. AND WEISS A. Branching random walk with a barrier, *Ann. Appl. Probab.* (1991) **1**, 573–581.
34. BIGGINS, J.D. AND BINGHAM, N.H. Near-constancy phenomena in branching processes. *Math. Proc. Camb. Phil. Soc.* (1991), **110**, 545–558.
35. BIGGINS, J.D. Uniform convergence of martingales in the one-dimensional branching random walk. *IMS lectures notes — Monograph Series. Selected proceedings of the Sheffield Symposium on Applied Probability, 1989*, Eds. I.V. Basawa and R.L. Taylor. (1991), **18**, 159–173.
36. BIGGINS, J.D. The central limit theorem for the supercritical branching random walk, and related results. *Stoc. Proc. Appl.* (1990), **34**, 255–274.
37. BIGGINS, J.D. Variants of the simple branching process. In *Stochastic Modelling in Biology; relevant mathematical concepts and recent applications*. Ed. P. Tautu. World Scientific, London. (1990), 250–266.
38. BIGGINS, J.D. AND CANNINGS, C. Formulae for mean restriction fragment lengths and related quantities, *Am. J. Hum. Genet.* (1987), **41**, 258–265.
39. BIGGINS, J.D. A note on repeated sequences in Markov Chains. *Adv. Appl. Probab.* (1987), **19**, 739–742.
40. BIGGINS, J.D. AND CANNINGS, C. Markov renewal processes, counters and repeated sequences in Markov Chains. *Adv. Appl. Probab.* (1987), **19**, 521–545.
41. BIGGINS, J.D. AND GÖTZ, T. Expected population size in the generation-dependent branching process, *Jnl. Appl. Probab.* (1987), **24**, 304–314.
42. BIRKHEAD, T.R. AND BIGGINS, J.D. Reproductive synchrony and Extra-pair Copulation in Birds. *Ethology* (1987), **74**, 320–334.
43. BIGGINS, J.D., LOYNES, R.M., AND WALKER, A.N.. Combining Examination Marks, *Brit. J. Math. Statist. Psych.* (1986), **39**, 150–167.
44. T.R. BIRKHEAD, E. GREENE, J.D. BIGGINS, D.N. NETTLESHIP. Breeding site characteristics and reproductive success in thick-billed murre, *Can. J. Zool.* (1985), **63**, 1880–1884.
45. R.A. PRIMHAK, J.D. BIGGINS, J.N. TSANAKAS, A. HATZIMICHAEL, R.D.G. MILNER, J.G. KARPOUZAS. Factors affecting the peak expiratory flow rate in children, *Brit. J. Dis. Chest* (1984), **78**, 26–35.
46. BIGGINS, J.D. AND SHANBHAG, D.N. Some divisibility problems in branching processes. *Math. Proc. Camb. Phil. Soc.* (1981), **90**, 321–330.
47. BIGGINS, J.D. Limiting point processes in the branching random walk. *Z. Wahrsch. verw. Geb.* (1981), **55**, 297–303.
48. BIGGINS, J.D. Spatial spread in branching processes. *Lecture Notes in Biomathematics, Biological Growth and Spread*. (Eds. W. Jäger, H. Rost, P. Tautu). Springer. (1980), **38**, 57–67.

49. BIRKHEAD, T.R., BIGGINS, J.D. AND NETTLESHIP, D.N. Non-random intra-colony distribution of bridled guillemots, *Uria aalge*, *J. Zool. Lond.* (1980), **192**, 9–16.
50. BIGGINS, J.D. AND GREY, D.R. Continuity of limit random variables in the branching random walk. *Jnl. Appl. Probab.* (1979), **16**, 740–749.
51. BIGGINS, J.D. Growth rates in the branching random walk. *Z. Wahrsch. verw. Geb.* (1979), **48**, 17–34.
52. BIGGINS, J.D. The asymptotic shape of the branching random walk. *Adv. Appl. Probab.* (1978), **10**, 62–84.
53. BIGGINS, J.D. Chernoff’s Theorem in the branching random walk. *Jnl. Appl. Probab.* (1977), **14**, 630–636.
54. BIGGINS, J.D. Martingale convergence in the branching random walk. *Jnl. Appl. Probab.* (1977), **14**, 25–37.
55. BIGGINS, J.D. The first and last birth problems for a multitype age-dependent branching process. *Adv. Appl. Probab.* (1976), **8**, 446–459.

Abstracts and other short non-refereed contributions

56. Spatial spread in branching processes. *Adv. Appl. Probab.* (1980), **12**, 549
57. Large deviations and the branching random walk. *Stoc. Proc. Appl.* (1982), **12**, 123
58. Seconded vote of thanks at the RSS Symposium on Stochastic Networks. *Jnl. Royal Statist. Soc. B* (1985), **47**, 417–418.
59. Contribution to the discussion of ‘Statistical and Decision Theoretic aspects of examination assessment’ by S. French. *Trab. de Estadística* (1990), **5**, 95–97.

Unpublished research reports

60. BIGGINS, J.D. On repeated sequences in Markov chains (1986). Research Report 279/86; Department of Probability and Statistics, University of Sheffield.
61. BIGGINS, J.D. AND BIRKHEAD, T.R. Female risk and extra-pair copulation, (1986). Research Report 282/86, Department of Probability and Statistics, University of Sheffield.
62. BIGGINS, J. D. AND RAHIMZADEH SANI, A. (2004). Extended Perron–Frobenius results. Preprint 539/04, Department of Probability and Statistics, University of Sheffield (February 2004).

Papers submitted or being revised

63. BIRKHEAD, T. R., THOMPSON, J.E., BIGGINS, J. D. AND MONTGOMERIE R. (2018). The evolution of egg shape in birds: selection during the incubation period.
64. BIGGINS, J. D., THOMPSON, J.E., AND BIRKHEAD, T. R. (2018). Accurately quantifying the shape of birds’ eggs.