Curriculum Vitae

Emeritus Professor Anthony O'Hagan

Personal

Born 8th March, 1948. Married 1967. Four children

Education

1966–1969 University College, London, studying for BSc.

1967, 1968 Egon Pearson and Karl Pearson Prizes for statistics

1969 BSc Statistics with First Class Honours

1969 Science Faculty Medal

1971–1973 University College, London, researching for PhD, title "Bayes Estimation of Structural Parameters in the Simultaneous Equations Model"

1974 PhD Statistics

Employment

1969–1971 Central Electricity Generating Board, London. Research Officer.

1973–1975 University of Dundee. Lecturer in Statistics, Department of Mathematics.

1975–1987 University of Warwick. Lecturer in Statistics, Department of Statistics.

1987–1990 University of Warwick. Senior Lecturer, Department of Statistics.

1990–1998 University of Nottingham. Professor of Statistics, Department of Mathematics.

1999–2008 University of Sheffield. Professor of Statistics, Department of Probability and Statistics.

I retired in February, 2008, although I had a part-time position at Sheffield until September, 2012.

1. Publications

Books

O'Hagan, A. (1988). *Probability: Methods and Measurement.* Chapman and Hall, London. 290pp. ISBN 0-412-29530-X (hardback), 0-412-29540-7 (paperback).

O'Hagan, A. (1994). *Kendall's Advanced Theory of Statistics Volume 2B, Bayesian Inference.* Edward Arnold, London. 330pp. ISBN 0-340-52922-9.

Barnett, V. and O'Hagan, A. (1997). *Setting Environmental Standards: The Statistical Approach to Handling Uncertainty and Variation.* Chapman and Hall, London. 111pp. ISBN 0412-82620-8.

O'Hagan, A. and Luce, B. R. (2003). *A Primer on Bayesian Statistics in Health Economics and Outcomes Research.* MEDTAP International Inc.; Bethesda, Maryland. 73pp. ISBN 0-9743641-0-X.

O'Hagan, A. and Forster, J. J. (2004). *Kendall's Advanced Theory of Statistics Volume 2B, Bayesian Inference.* Second edition. Edward Arnold, London. 480pp. ISBN 0-340-80752-0.

O'Hagan, A., Buck, C. E., Daneshkhah, A., Eiser, J. R., Garthwaite, P. H., Jenkinson, D. J., Oakley, J. E. and Rakow, T. (2006). *Uncertain Judgements: Eliciting Expert Probabilities.* John Wiley and Sons, Chichester. 328pp. ISBN 0-470-02999-4.

O'Hagan, A. and West, M. (eds.) (2010). *The Oxford Handbook of Applied Bayesian Analysis.* Oxford University Press, Oxford. 889pp. ISBN 978-0-19-954890-3 (hardback), 978-0-19-870317-4 (paperback, 2013).

Research Papers

[1] O'Hagan, A. (1973). Bayes estimation of a convex quadratic. *Biometrika* 60, 565–571.

[2] O'Hagan, A. and Leonard, T. (1976). Bayes estimation subject to uncertainty about parameter constraints. *Biometrika* 63, 201–203.

[3] O'Hagan, A. (1976). On posterior joint and marginal modes. *Biometrika* 63, 329–333.

[4] O'Hagan, A. (1977). A general structure for inference about variances and covariances. In *Recent Developments in Statistics* (J. R. Barra et al. editors), 545–549. North-Holland.

[5] Haitovsky, Y. and O'Hagan, A. (1977). A Bayesian simultaneous equation theory applied to an underidentified econometric model. In *Modelling for Government and Business* (C. A. Van Bochove et al. editors), 33–52. Martinus Nijhoff, Leiden.

[6] O'Hagan, A. (1978). Curve fitting and optimal design for prediction (with discussion). *Journal of the Royal Statistical Society B* 40, 1–42.

[7] O'Hagan, A. (1979). On outlier rejection phenomena in Bayes inference. *Journal of the Royal Statistical Society B* 41, 358–367.

[8] O'Hagan, A. (1981). A moment of indecision. *Biometrika* 68, 329–330.

[9] Burridge, J. and O'Hagan, A. (1983). Job times and office performance. *The Statistician* 32, 264–272.

[10] O'Hagan, A. (1984). Motivating principal components, and a stronger optimality result. *The Statistician* 33, 313–315.

[11] O'Hagan, A. (1985). Shoulders in hierarchical models. In *Bayesian Statistics 2* (J. M. Bernardo et al. editors), 697–710. Elsevier (North-Holland).

[12] Wolverson, R. L., Blacklock, A. R. E., Geddes, J. R. and O'Hagan, A. (1986). Factors influencing post-operative hospital stay after transurethral resection of the prostate gland. *British Journal of Urology* 58, 161–163.

[13] O'Hagan, A. (1987). Bayes linear estimators for randomized response models. *Journal of the American Statistical Association* 82, 580–585.

[14] O'Hagan, A. (1987). Exploring a high-dimensional posterior density. *Computational Statistics Quarterly* 3, 85–96.

[15] O'Hagan, A. (1987). Monte Carlo is fundamentally unsound. *The Statistician* 36, 247–249.

[16] O'Hagan, A. and Berger, J. O. (1988). Ranges of posterior probabilities for quasi-unimodal priors with specified quantiles. *Journal of the American Statistical Association* 83, 503–508.

[17] O'Hagan, A. (1988). Modelling with heavy tails. *Bayesian Statistics 3*, J. M. Bernardo *et al* (Eds.), 345–359. Oxford University Press.

[18] Berger, J. O. and O'Hagan, A. (1988). Ranges of posterior probabilities for unimodal priors with specified quantiles. *Bayesian Statistics 3*, J. M. Bernardo *et al* (Eds.), 45–66. Oxford University Press.

[19] O'Hagan, A. (1990). On outliers and credence for location parameter inference. *Journal of the American Statistical Association* 85, 172–176.

[20] O'Hagan, A. (1990). Variance of an arithmetic expression – an example of symbolic computation and recursion. *Vector* 6, no. 3, 80–87.

[21] Woodward, E. G., Moodaley, L. C. and O'Hagan, A. (1990). Predictors for likelihood of corneal transplantation in keratoconus. *Eye* 4, 493–496.

[22] O'Hagan, A., Woodward, E. G. and Moodaley, L. C. (1990). Practical Bayesian analysis of a simple logistic regression: predicting corneal transplants. *Statistics in Medicine* 9, 1091–1101.

[23] O'Hagan, A. (1991). Bayes-Hermite quadrature. *Journal of Statistical Planning and Inference* 29, 245–260.

[24] O'Hagan, A. (1992). Some Bayesian numerical analysis (with discussion). In *Bayesian Statistics 4*, J. M. Bernardo *et al* (Eds.), 345–363. Oxford University Press.

[25] O'Hagan, A., Glennie, E. B. and Beardsall, R. E. (1992). Subjective modelling and Bayes linear estimation in the UK water industry. *Applied Statistics* 41, 563–577.

[26] O'Hagan, A. and Wells, F. S. (1993). Use of prior information to estimate costs in a sewerage operation. In *Case Studies in Bayesian Statistics*, C. Gatsonis, J. S. Hodges, R. E. Kass and N. D. Singpurwalla (eds.), 118–163. Springer-Verlag: New York.

[27] van Batenburg, P. C., O'Hagan, A. and Veenstra, R. H. (1994). Bayesian discovery sampling in financial auditing: a hierarchical prior model for substantive test sample sizes. *The Statistician* 43, 99–110.

[28] O'Hagan, A. and Le, H. (1994). Conflicting information and a class of bivariate heavy-tailed distributions. In *Aspects of Uncertainty: a Tribute to D. V. Lindley*, A. F. M. Smith and P. R. Freeman (eds.), 311–327. Wiley: Chichester.

[29] O'Hagan, A. (1994). Bayesian methods in asset management. In *Statistics for the Environment 2, Water-related issues*, 235–247. V. Barnett and K. F. Turkman (eds.). Wiley: Chichester.

[30] O'Hagan, A. (1994). Robust modelling for asset management. *Journal of Statistical Planning and Inference* 40, 245–259.

[31] O'Hagan, A. (1995). Fractional Bayes factors for model comparison (with discussion). *Journal of the Royal Statistical Society B* 57, 99–138.

[32] Kadane, J. B. and O'Hagan, A. (1995). Using finitely additive probability: uniform distributions on the natural numbers. *Journal of the American Statistical Association* 90, 626–631.

[33] Goldstein, M. and O'Hagan, A. (1996). Bayes linear sufficiency and systems of expert posterior assessments. *Journal of the Royal Statistical Society B* 58, 301–316.

[34] Haylock, R. G. and O'Hagan, A. (1996). On inference for outputs of computationally expensive algorithms with uncertainty on the inputs. In *Bayesian Statistics 5*, J. M. Bernardo *et al* (eds.). Oxford University Press, 629–637.

[35] Kennedy, M. and O'Hagan, A. (1996). Iterative rescaling for Bayesian quadrature. In *Bayesian Statistics 5*, J. M. Bernardo *et al* (eds.). Oxford University Press, 639–645.

[36] O'Hagan, A. (1997). The ABLE story: Bayesian asset management in the water industry. In *The Practice of Bayesian Analysis*, S. French and J. Q. Smith (eds.). Arnold,

173–198.

[37] O'Hagan, A. (1997). Properties of intrinsic and fractional Bayes factors. *Test* 6, 101–118.

[38] O'Hagan, A. and Haylock, R. G. (1997). Bayesian uncertainty analysis and radiological protection. In *Statistics for the Environment 3, Pollution Assessment and Control*, 109–128. V. Barnett and K. F. Turkman (eds.). Wiley: Chichester.

[39] O'Hagan, A. (1998). Eliciting expert beliefs in substantial practical applications. *The Statistician* 47, 21–35 (with discussion, pp 55–68).

[40] Le, H. and O'Hagan, A. (1998). A class of bivariate heavy-tailed distributions. *Sankhyā B* 60, 82–100.

[41] O'Hagan, A., Kennedy, M. C. and Oakley, J. E. (1999). Uncertainty analysis and other inference tools for complex computer codes (with discussion). In *Bayesian Statistics 6*, J. M. Bernardo *et al* (eds.). Oxford University Press, 503–524.

[42] Ball, F. G., Cai, Y., Kadane, J. B. and O'Hagan, A. (1999). Bayesian inference for ion-channel gating mechanisms directly from single-channel recordings, using Markov chain Monte Carlo. *Proceedings of the Royal Society of London A* 455, 2879–2932.

[43] Kornak, J., Haggard, M. P. and O'Hagan, A. (1999). Parameterisation of the BOLD haemodynamic response in fMRI incorporated within a Bayesian multiplicative Markov random field model. In *Spatial Temporal Modelling and its Applications*, K. V. Mardia et al. (eds.), 27–30. Leeds University Press.

[44] Kennedy, M. and O'Hagan, A. (2000). Predicting the output from a complex computer code when fast approximations are available. *Biometrika* 87, 1–13.

[45] Conigliani, C. and O'Hagan, A. (2000). Sensitivity of the fractional Bayes factor to prior distributions. *Canadian Journal of Statistics* 28, 343–352.

[46] Conigliani, C., Castro, J. I. and O'Hagan, A. (2000). Bayesian assessment of goodness of fit against nonparametric alternatives. *Canadian Journal of Statistics* 28, 327–342.

[47] O'Hagan, A., Stevens, J. W. and Montmartin, J. (2000). Inference for the cost-effectiveness acceptability curve and cost-effectiveness ratio. *PharmacoEconomics* 17, 339–349.

[48] Laws, D. J. and O'Hagan, A. (2000). Bayesian inference for rare errors in populations with unequal unit sizes. *Applied Statistics* 49, 577–590.

[49] Garthwaite, P. G. and O'Hagan, A. (2000). Quantifying expert opinion in the UK water industry: an experimental study. *The Statistician* 49, 455–477.

[50] Kennedy, M. C. and O'Hagan, A. (2001). Bayesian calibration of computer models (with discussion). *Journal of the Royal Statistical Society B* 63, 425–464.

[51] O'Hagan, A., Stevens, J. W. and Montmartin, J. (2001). Bayesian cost-effectiveness analysis from clinical trial data. *Statistics in Medicine* 20, 733–753.

[52] O'Hagan, A. and Stevens, J. W. (2001). A framework for cost-effectiveness analysis from clinical trial data. *Health Economics* 10, 302–315.

[53] O'Hagan, A. and Stevens, J. W. (2001). Bayesian assessment of sample size for clinical trials of cost-effectiveness. *Medical Decision Making* 21, 219–230.

[54] Kennedy, M. C., O'Hagan, A. and Higgins, N. (2002). Bayesian analysis of computer code outputs. In *Quantitative Methods for Current Environmental Issues*. C. W. Anderson, V. Barnett, P. C. Chatwin, and A. H. El-Shaarawi (eds.), 227–243. Springer-Verlag: London.

[55] O'Hagan, A. and Stevens, J. W. (2002). The probability of cost-effectiveness. *BMC Medical Research Methodology* 2:5. (Published online at http://www.biomedcentral.com/1471-2288/2/5.)

[56] Gomez Portugal Aguilar, D., Litton, C. D. and O'Hagan, A. (2002). A new piece-wise linear radiocarbon calibration curve with more realistic variance. *Radiocarbon* 44, 195–212.

[57] Laws, D. J. and O'Hagan, A. (2002). A hierarchical Bayes model for rare errors. *The Statistician* 51, 431–450.

[58] Oakley, J. E. and O'Hagan, A. (2002). Bayesian inference for the uncertainty distribution of computer model outputs. *Biometrika* 89, 769–784.

[59] O'Hagan, A. and Stevens, J. W. (2002). Bayesian methods for design and analysis of cost-effectiveness trials in the evaluation of health care technologies. *Statistical Methods in Medical Research* 11, 469–490.

[60] Stevens, J. W. and O'Hagan, A. (2002). Incorporating genuine prior information in cost-effectiveness analysis of clinical trial data. *International Journal of Technology Assessment in Health Care* 18, 782–790.

[61] O'Hagan, A. and Stevens, J. W. (2003). Assessing and comparing costs: How robust are the bootstrap and methods based on asymptotic normality? *Health Economics* 12, 33–49.

[62] O'Hagan, A. (2003). HSSS model criticism (with discussion). In *Highly Structured Stochastic Systems*, P. J. Green, N. L. Hjort and S. T. Richardson (eds), 423–453. Oxford University Press.

[63] van Hout, B. A., Gagnon, D. D., McNulty, P. and O'Hagan, A. (2003). The cost-effectiveness of two new anti-epileptic therapies in the absence of direct comparative data: a first approximation. *PharmacoEconomics* 21, 315–326.

[64] Chilcott, J., McCabe, C., Tappenden, P., O'Hagan, A., Cooper, N. J., Abrams, K. and Claxton, K. (2003). Modelling the cost effectiveness of interferon beta and glatiramer acetate in the management of multiple sclerosis. *British Medical Journal* 326, 522–526.

[65] Stevens, J. W., O'Hagan, A. and Miller, P. (2003). Case study in the Bayesian analysis of a cost-effectiveness trial in the evaluation of health care technologies: Depression. *Pharmaceutical Statistics*, 2, 51–68.

[66] Schmidt, A. M. and O'Hagan, A. (2003). Bayesian inference for non-stationary spatial covariance structure via spatial deformations. *Journal of the Royal Statistical Society B* 65, 745–758.

[67] Bozza, S. and O'Hagan, A. (2003). A Bayesian approach for the estimation of the covariance structure of separable spatio-temporal stochastic processes. In *Between Data Science and Applied Data Analysis*, M. Schader, W. Gaul and M. Vichi (eds), 165–172. Springer-Verlag.

[68] Heiner, K. W., O'Hagan, A. and Laws, D. J. (2003). Bayesian statistical models for financial audits. In *Challenging the Boundaries of Symbolic Computation*, P. Mitic, P. Ramsden and J. Carne (eds.). Imperial College Press.

[69] O'Hagan, A. and Stevens, J. W. (2004). On estimators of medical costs with censored data. *Journal of Health Economics* 23, 615–625.

[70] O'Hagan, A. and Oakley, J. E. (2004). Probability is perfect, but we can't elicit it perfectly. *Reliability Engineering and System Safety* 85, 239–248.

[71] Oakley, J. E. and O'Hagan, A. (2004). Probabilistic sensitivity analysis of complex models: a Bayesian approach. *Journal of the Royal Statistical Society B* 66, 751–769.

[72] Papathomas, M. and O'Hagan, A. (2005). Updating beliefs for binary variables. *Journal of Statistical Planning and Inference* **135**, 324–338.

[73] Garthwaite, P. H., Kadane, J. B. and O'Hagan, A. (2005). Statistical methods for eliciting probability distributions. *Journal of the American Statistical Association* **100**, 680–701.

[74] Claxton, K., Sculpher, M., McCabe, C., Briggs, A., Buxton, M., Brazier, J., Akehurst, R. and O'Hagan, A. (2005). Probabilistic sensitivity analysis for NICE technology assessment: not an optional extra. *Health Economics* **14**, 339–347.

[75] O'Hagan, A., McCabe, C., Akehurst, R. L., Brennan, A., Briggs, A., Claxton, K., Fenwick, E., Fryback, D., Sculpher, M., Spiegelhalter, D. J. and Willan, A. (2005). Incorporation of uncertainty in health economic modelling studies. *PharmacoEconomics* **23**, 529–536.

[76] O'Hagan, A., Stevens, J. W. and Campbell, M. J. (2005). Assurance in clinical trial design. *Pharmaceutical Statistics* **4**, 187–201.

[77] Kharroubi, S. A., O'Hagan, A. and Brazier, J. E. (2005). Estimating utilities from individual health state preference data: a nonparametric Bayesian method. *Applied Statistics* **54**, 879–895.

[78] Andrade, J. A. A. and O'Hagan, A. (2006). Bayesian robustness modelling using regularly varying distributions. *Bayesian Analysis* **1**, 169–188.

[Published online at http://ba.stat.cmu.edu/journal/2006/vol01/issue01/andrade.pdf]

[79] Buck, C. E., Gomez Portugal Aguilar, D., Litton, C. D. and O'Hagan, A. (2006). Bayesian nonparametric estimation of the radiocarbon calibration curve. *Bayesian Analysis* **1**, 265–288.
[Published online at http://ba.stat.cmu.edu/journal/2006/vol01/issue02/buck265-288.pdf].

[80] Grist, E. P. M., O'Hagan, A, Crane, M., Sorokin, N., Sims, I. and Whitehouse, P. (2006). Bayesian and time-independent species sensitivity distributions for risk assessment of chemicals. *Environmental Science and Technology* **40**, 395–401.

[81] O'Hagan, A. (2006). Bayesian analysis of computer code outputs: a tutorial. *Reliability Engineering and System Safety* **91**, 1290–1300.

[82] Kennedy, M. C., Anderson, C. W., Conti, S. and O'Hagan, A. (2006). Case studies in Gaussian process modelling of computer codes. *Reliability Engineering and System Safety* **91**, 1301–1309.

[83] McCabe, C., Brazier, J., Gilks, P., Tsuchiya, A., Roberts, J., O'Hagan, A. and Stevens, K. (2006). Using rank data to estimate health state utility models. *Journal of Health Economics* **25**, 418–431.

[84] O'Hagan, A. (2006). Science, subjectivity and software (comment on articles by Berger and by Goldstein). *Bayesian Analysis* **1**, 445 – 450.
[Published online at https://projecteuclid.org/euclid.ba/1340371043].

[85] Connock, M., Burls, A., Frew, E., Fry-Smith, A., Juarez-García, A., McCabe, C., Wailoo, A., Abrams, K., Cooper, N., Sutton, A., O'Hagan, A. and Moore, D. (2006). The clinical effectiveness and cost-effectiveness of enzyme replacement therapy for Gaucher's disease: a systematic review. *Health Technology Assessment* **10**, no. 24.

[86] O'Hagan, A. (2006). Research in elicitation. In *Bayesian Statistics and its Applications*, S. K. Upadhyay, U. Singh and D. K. Dey (eds.), 375–382. Anamaya: New Delhi.

[87] Tancredi, A., Anderson, C. W. and O'Hagan, A. (2006). Accounting for threshold uncertainty in extreme value estimation. *Extremes* **9**, 87–106.

[88] Kharroubi, S. A., Brazier, J. E. and O'Hagan, A. (2007). Modelling covariates for the SF-6D standard gamble health state preference data using a nonparametric Bayesian method. *Social Science and Medicine* **64**, 1242–1252.

[89] Kharroubi, S. A., Brazier, J. E., Roberts, J. and O'Hagan, A. (2007). Modelling SF-6D health state preference data using a nonparametric Bayesian method. *Journal of Health Economics* **26**, 597–612.

[90] Boxall, J. B., O'Hagan, A., Pooladsaz, S., Saul, A. J. and Unwin, D. M. (2007). Estimation of burst rates in water distribution mains. *Water Management* **160**, 73–82.

[91] Oakley, J. E. and O'Hagan, A. (2007). Uncertainty in prior elicitations: a nonparametric approach. *Biometrika* **94**, 427–441.

[92] Brennan, A., Kharroubi, S. A., O'Hagan, A. and Chilcott, J. (2007). Calculating partial expected value of information in cost-effectiveness models. *Medical Decision Making* **27**, 448–470.

[93] O'Hagan, A., Stevenson, M. and Madan, J. (2007). Monte Carlo probabilistic sensitivity analysis for patient level simulation models: Efficient estimation of mean and variance using ANOVA. *Health Economics* **16**, 1009–1023.

[94] Gosling, J. P., Oakley, J. E. and O'Hagan, A. (2007). Nonparametric elicitation for heavy-tailed prior distributions. *Bayesian Analysis* **2**, 693–718. [Published online at http://ba.stat.cmu.edu/journal/2007/vol02/issue04/gosling.pdf].

[95] Kennedy, M. C., O'Hagan, A., Anderson, C. W., Lomas, M., Woodward, F. I., Heinemeyer, A. and Gosling, J. P. (2008). Quantifying uncertainty in the biospheric carbon flux for England and Wales. *Journal of the Royal Statistical Society A* **171**, 109–135.

[96] McCabe, C., Claxton, K. and O'Hagan, A. (2008). Why licensing authorities need to consider the net value of new drugs in assigning review priorities: Addressing the tension between licensing and reimbursement. *International Journal of Technology Assessment in Health Care* **24**, 140–145.

[97] Pickin, M., Cooper, C.L., Chater, T., O'Hagan, A., Abrams, K.R., Cooper, N.J., Boggild, M. Palace, J., Ebers, G., Chilcott, J.B., Tappenden, P. and Nicholl, J. (2009). The Multiple Sclerosis Risk Sharing Scheme Monitoring Study – early results and lessons for the future. *BMC Neurology* **9**:1. [Published online at http://www.biomedcentral.com/1471-2377/9/1/abstract].

[98] Conti, S., Gosling, J.P., Oakley, J.E. and O'Hagan, A. (2009). Gaussian process emulation of dynamic computer codes. *Biometrika* **96**, 663–676.

[99] Bastos, L. S. and O'Hagan, A. (2009). Diagnostics for Gaussian process emulators. *Technometrics* **51**, 425–438.

[100] Nixon, R.M., O'Hagan, A., Oakley, J.E., Madan, J., Stevens, J.W., Bansback, N. and Brennan, A. (2009). The Rheumatoid Arthritis Drug Development Model: a case study in Bayesian clinical trial simulation. *Pharmaceutical Statistics* **8**, 371–389.

[101] Heiner, K. W., Kennedy, M. C. and O'Hagan, A. (2010). Sequential multilocation auditing and the New York food stamps program. In *The Oxford Handbook of Applied Bayesian Analysis*, O'Hagan, A. and West, M. (eds.), pp 653–678. Oxford University Press, Oxford.

[102] Conti, S. and O'Hagan, A. (2010). Bayesian emulation of complex multi-output and dynamic computer models. *Journal of Statistical Planning and Inference* **140**, 640–651.

[103] Moala, F. M. and O'Hagan, A. (2010). Elicitation of multivariate prior distributions: a nonparametric Bayesian approach. *Journal of Statistical Planning and Inference* **140**, 1635–1655.

[104] Kharroubi, S. A., Brazier, J. E. and O'Hagan, A. (2010). A comparison of United States and United Kingdom EQ-5D health state valuations using a nonparametric Bayesian method. *Statistics in Medicine* **29**, 1622–1634.

[105] Schmidt, A. M., Guttorp, P. and O'Hagan, A. (2011). Considering covariates in the covariance structure of spatial processes. *Environmetrics* **22**, 487–500.

[106] Mihaylova, B., Briggs, A., O'Hagan, A. and Thompson, S. G. (2011). Review of statistical methods for analysing healthcare resources and costs, applicable to clinical trial data. *Health Economics* **20**, 897–916.

[107] Andrade, J. A. A. and O'Hagan, A. (2011). Bayesian robustness modelling of location and scale parameters. *Scandinavian Journal of Statistics* **38**, 691–711.

[108] Witte, S., Schmidli, H., O'Hagan, A. and Racine, A. (2011). Designing a non-inferiority study in kidney transplantation: a case study. *Pharmaceutical Statistics* **10**, 427–432.

[109] O'Hagan, A. (2012). Probabilistic uncertainty specification: Overview, elaboration techniques and their application to a mechanistic model of carbon flux. *Environmental Modelling and Software* **36**, 35–48.

[110] O'Hagan, A. and Pericchi, L. (2012). Bayesian heavy-tailed models and conflict resolution: a review. *Brazilian Journal of Probability and Statistics* **26**, 372–401.

[111] Griffiths, R.I., Barron, R.L., Gleeson, M.L., Danese, M.D., O'Hagan, A., Chia, V.M., Legg, J.C. and Lyman, G.H. (2012). Granulocyte-colony stimulating factor use and medical costs after initial adjuvant chemotherapy in older patients with early-stage breast cancer. *Pharmacoeconomics* **30**, 103–118.

[112] Griffiths, R.I., Gleeson, M.L., Danese, M.D. and O'Hagan, A. (2012). Inverse probability weighted least squares regression in the analysis of time-censored cost data: an evaluation of the approach using SEER-Medicare. *Value in Health* **15**, 656–663.

[113] Cripps, E., O'Hagan, A. and Quaife, T. (2013). Quantifying uncertainty in remotely sensed land cover maps. *Stochastic Environmental Research and Risk Assessment* **27**, 1239–1251.

[114] O'Hagan, A. (2014). Eliciting and using expert knowledge in metrology. *Metrologia* **15**, S237–S244.

[115] Brynjarsdóttir, J. and O'Hagan, A. (2014). Learning about physical parameters: The importance of model discrepancy. *Inverse Problems* **30**, 114007 (24pp), November 2014.

[116] Zapata-Vazquez, R., O'Hagan, A. and Bastos, L. S. (2014). Eliciting expert judgements about a set of proportions. *Journal of Applied Statistics* **41**, 1919–1933.

[117] Schmidli, H., Gsteiger, S., Roychoudhury, S., O'Hagan, A., Spiegelhalter, D. and Neuenschwander, B. (2014). Robust meta-analytic-predictive priors in clinical trials with historical control information. *Biometrics* **70**, 1023–1032.

[118] O'Hagan, A. (2019). Expert Knowledge Elicitation: Subjective but Scientific. *The American Statistician*, **73**:sup1, 69–81, doi: 10.1080/00031305.2018.1518265.

[119] Brownstein, N. C., Louis, T. A., O'Hagan, A. and Pendergast, J. (2019). The Role of Expert Judgment in Statistical Inference and Evidence-Based Decision-Making. *The American Statistician*, **73**:sup1, 56–68, doi: 10.1080/00031305.2018.1529623.

[120] Neuenschwander, B., Weber, S., Schmidli, H. and O'Hagan, A. (2020). Predictively Consistent Prior Effective Sample Sizes (with discussion). *Biometrics* **76**, 578–605, doi: 10.1111/biom.13252.

[121] Jurek, L., Balthazar, M., Gulati, S., Novakovic, N., Núñez, M., Oakley, J. and O'Hagan, A. (2021). Response (minimum clinically relevant change) in ASD symptoms after an intervention according to CARS-2: consensus from an expert elicitation procedure. *European Child and Adolescent Psychiatry* **31**, 1–10. doi: 10.1007/s00787-021-01772-z.

[122] Cox, M. and O'Hagan, A. (2022) Meaningful expression of uncertainty in measurement. *Accreditation and Quality Assurance* **27**, 19–37. doi: 10.1007/s00769-021-01485-5.

[123] Holzhauer, B., Hampson, L.V., Gosling, J.P., Bornkamp, B., Kahn, J., Lange, M.R., Luo, W-L., Brindicci, C., Lawrence, D., Ballerstedt, S. and O'Hagan, A. (2022) Eliciting judgements about dependent quantities of interest: The SHeffield ELicitation Framework extension and copula methods illustrated using an asthma case study. *Pharmaceutical Statistics* **21**, 1005-1021. http://doi.org/10.1002/pst.2212

Note:

- Papers [6], [31] and [50] were Royal Statistical Society Research Section "read papers". Such papers are deemed to be of high quality and interest. These papers have gathered a total of more than 5000 citations (Google Scholar, accessed October, 2020).
- Paper [65] was named as the best paper of 2003 by the journal, *Pharmaceutical Statistics*.
- Paper [76] was selected as the highlight of ten years of the journal, *Pharmaceutical Statistics*, for their 10th anniversary celebration
- Paper [114] was selected for special promotion as a 'Highlight of 2014' article by *Metrologia*.
- Paper [115] was selected by the editors of *Inverse Problems* as one of their 'Highlights of 2014' collection.
- Paper [120] was named as a highly cited paper of 2020 by *Biometrics*.

Reports

European Food Safety Authority (2014). Guidance on Expert Knowledge Elicitation in Food and Feed Safety Risk Assessment. *EFSA Journal* 2014;**12**(6):3734, 278 pp. doi:10.2903/j.efsa.2014.3734

Other publications

Many published discussions, several reviews, some pedagogical publications.

2. Other Academic Activities

Research Grants and Contracts over £1000

1. From the Science and Engineering Research Council, a grant of £18,000 for a four-month international research symposium on Applied Bayesian Statistics at Warwick from May to September 1986. Further support, totalling over £10,000 was donated by British industry.

2. From the University Grants Committee, a grant of £28,000 under the Computers In Teaching Initiative. The project, entitled 'APL in Statistics', was to investigate over a period of three years the use of the APL language in teaching Statistics.

3. From the National Audit Office, two contracts of value £20,000 (1994–95) and £16,000 (1997) for research into Bayesian sampling methods and inference in auditing. The specific problems addressed in this research concerned inference when the incidence of errors in the sampled accounts is very low, combined with sampling from populations with complex structures. Papers [48] and [57] arose from this work.

4. From the Engineering and Physical Sciences Research Council, jointly with F. G. Ball, a grant of £71,700 for a two-year research programme (1995–97) into the application of Gibbs sampling to obtain inference from ion channel data. Paper [42] arose from this work.

5. From the Engineering and Physical Sciences Research Council, a grant of £105,685 for a three-year research programme (1995–98) into Bayesian uncertainty analysis and computer model inadequacy, with support from the National Radiological Protection Board. Papers [41], [44] and [50] arose from this work.

6. From the Engineering and Physical Sciences Research Council, a grant of £2,750 for two visits by Professor J. B. Kadane to Nottingham in 1996, to carry out joint research in finitely-additive probability modelling.

7. From a consortium of water companies, a contract of value £25,500 for a research student to work with me (1996–99) on Bayesian methods for systems of expert assessments. Paper [70] arose from this work.

8. From the National Radiological Protection Board (£26,000), the Environment Agency (£15,000) and WRc plc (£500), funding to continue the research begun under grant number 5 above (1998–2000). Paper [54] arose from this work.

9. From the Natural Environment Research Council, a grant entitled "Risk based approaches to the derivation and expression of environmental quality standards" (1999–2002). I was co-investigator with Dr Mark Crane (Royal Holloway); my component was £21,726. Paper [80] arose from this work.

10. From the Engineering and Physical Sciences Research Council, a grant of £13,600 for a research workshop on "Statistical analysis of computer code outputs" (April 2000).

11. From the Engineering and Physical Sciences Research Council, a Realising Our Potential Award entitled "Bayesian elicitation of expert opinion" (2000-2002), value £86,940. Papers [70] and [91] arose from this grant.

12. From the Engineering and Physical Sciences Research Council, under its initiative "Water Infrastructure and Treatment Engineering", a grant of £170,080, entitled "Relationship between condition and serviceability of water distribution systems" (2001–2004). This project also had support from seven water companies, including substantial financial contributions. Paper [90] arose from this grant.

13. From the Natural Environment Research Council, a grant for a Centre of Excellence in earth observation science, entitled "Centre for Terrestrial Carbon Dynamics" (2002–2007). This is a collaboration with other departments in Sheffield (led by the Sheffield Centre for Earth Observation Science) and other institutions. The total budget was £2,251,331, of which about £200,000 is associated with statistics research led by myself and Professor Clive Anderson. Papers [81], [82], [95] and [113] arose from this work.

14. From the Tyndall Centre, a grant entitled "Uncertainties in the Integrated Assessment Process" (2002–2005). This is led by Peter Challoner at the Southampton Oceanography Centre. The total grant of £205,586 includes £1,200 for me to attend meetings as an adviser.

15. From the Natural Environment Research Council, under its Rapid Climate Change initiative, a grant entitled "The probability of rapid climate change" (2003–2006). This is also led by Peter Challoner at the Southampton Oceanography Centre. The total grant of over £200,000 included £1,060 for me to attend meetings as an adviser.

16. From the National Health Service's Research Methodology Programme, a grant entitled "Elicitation of individuals' knowledge in probabilistic form" (2003–2006), value £150,000. The 2006 book on expert elicitation arose from this work.

17. From the National Health Service's Research Methodology Programme, a grant entitled "Assessing and comparing mean costs of health care in health economic evaluations based on clinical trials" (2005–2007). The project was led by Simon Thompson at the MRC Biostatistics Unit in Cambridge, and about £10,000 of the total grant of £99,851 was for my part of the project. Paper [106] arose from this work.

18. From Research Councils UK, a grant entitled "Managing Uncertainty in Complex Models" (2006–2010). I was the leader of this project, which included also four other universities. The total budget was £2,167,671. Many publications arose from this project, including [98], [99] and [102] above.

19. From the Engineering and Physical Sciences Research Council, in their programme to increase interaction between mathematics, engineering and information sciences, a grant entitled "Bridging the Gaps" (2007–2009). I was a co-investigator representing mathematics. The total value was £350,842.

20. From Research Councils UK, a grant entitled "MUCM2" (2010–2012), providing an additional £956,550 to research new directions following grant number 18 above.

Centre for Bayesian Statistics in Health Economics

Until my retirement, I was Director of the Centre for Bayesian Statistics in Health Economics (CHEBS). This is a joint venture at Sheffield University between the Department

of Probability and Statistics and the School of Health and Related Research, founded as a direct result of my research into applications of Bayesian methods in the area of health economics. CHEBS received funding of over £200,000 from the pharmaceutical industry, and grants numbers 16 and 17 above were formally associated with CHEBS.

Research students

Since retirement I no longer supervise research students. Previous PhD students wholly (or in some cases jointly) supervised by me: Houshang Mashhoudy, Richard Haylock, Marc Kennedy, Caterina Conigliani (winner of Italian thesis prize), Jeremy Oakley (winner of the international Savage thesis prize), John Kornak, Michail Papathomas, Alexandra Schmidt, Delil Gómez Portugal Aguilar, Silvia Bozza, Andrea Tancredi, Ailton Andrade (finalist for the Savage thesis prize), John Paul Gosling, Kevin McNally, Fernando Moala, Leo Bastos, Rita Zapata Vazquez, John Stevens, Peter Gregory.

Conferences and seminars

Invited papers for numerous international conferences, including the 3rd, 4th and 6th Valencia international meetings on Bayesian statistics (1987, 1991, 1998). Seminars given at numerous universities. I have been the senior organiser for two conferences on Practical Bayesian Statistics, the second being the Royal Statistical Society's 1997 conference.

Societies

Royal Statistical Society. Fellow since 1970

1977, 1994, 1997 and 2000 Read papers (numbers [6], [31], [39] and [49] above) to Ordinary Meetings.

1980–1983 and 1997–2000 Committee of Research Section.

2000–2003 Council.

2004–2013 Editorial Board of *Significance* magazine.

International Society for Bayesian Analysis. Elected Fellow 2016

Programme Council, 2000–2002 (Chair, 2001).

Board of Directors, 2000–2003.

National and international service

Science and Engineering Research Council. Member of Statistics Panel, 1992–1994.

Engineering and Physical Sciences Research Council. Member of Mathematics College, 1995–2000. Chair of Mathematics Programme Evaluation Panel, 1998. Member of Peer Review College, 2000–2008.

Medical Research Council. Member of College of Experts, 2005–2008.

National Health Service Research Methodology panel, 2002–2007.

European Science Foundation Scientific Network and Scientific Programme on Highly Structured Stochastic Systems. Joint proposer and committee member, 1993–1996 (Network) and 1997–2001 (Programme).

British Association for the Advancement of Science. President of Mathematics Section, 2001–2002.

3. Teaching

In addition to undergraduate teaching while employed at various universities, I have also been active in giving specialist short courses.

In the summer of 2000 I gave a two-week intensive course on Bayesian statistics to MSc and PhD level students in Helsinki. This was at the invitation of StatNet, an organisation in Finland whose role is to provide special courses at a national level, so students came from all over Finland.

In the summer of 2003 I gave a short course on Bayesian Statistics to British PhD students, as part of a joint initiative of the Royal Statistical Society, the Engineering and Physical Sciences Research Council and the Economic and Social Research Council, aimed at strengthening the mathematical foundations of tomorrow's statistical researchers through a series of courses on the theoretical underpinnings of statistics. This course was repeated in 2005 and 2007.

In 2008, Sheffield University colleague Jeremy Oakley and I developed the SHELF (Sheffield Elicitation Framework) package for elicitation of expert knowledge. SHELF comprises guidance, templates and some software and is intended to help people with limited experience as facilitators to conduct expert elicitation effectively. I have given short courses on elicitation, drawing on SHELF, to a variety of organisations. Version 4, a major upgrade, was released in June, 2019. SHELF is in routine use in two major international pharmaceutical companies.

Since my retirement, I have continued to give short courses as requested by various organisations. Topics include elicitation, Bayesian statistics and uncertainty quantification.

I am also the developer of the First Bayes software package to assist in the teaching and learning of elementary Bayesian statistics. It runs on PCs, as a fully Windows based application, and is available free from my website. Over the years it has been downloaded thousands of times and used in numerous university courses worldwide.

4. Consulting

I have been involved as a consultant in a variety of practical applications of Bayesian statistics. The first of these was for water companies, where I assisted in estimating capital investment needs for asset management from 1987, before the privatisation of the English and Welsh water authorities, to about 2000. I have acted as consultant to companies representing half the British water industry. In 1994, the methodology that I developed was implemented in software funded by a consortium of water companies, and a new version was launched in 1998. The approach has also been applied to Railtrack (the UK railways infrastructure company), the Hong Kong Water Supplies Department, Metrail (an Australian railway) and the London Underground. I was a consultant in all these applications. Papers [25], [26], [29], [30], [33], [36], part of [39] and [48] arise from this work, which has had a strong research element. Research grant number 12 resulted from this extensive involvement with the water industry. The work with London Underground won the 2010 IET Innovation Award by the Institution of Engineering and Technology, in the Asset Management category.

In 1994 I conducted a project to elicit expert judgements on the hydrogeology of some rocks in the neighbourhood of Sellafield, as part of the assessment by Her Majesty's Inspectorate of Pollution of proposals for deep disposal of nuclear waste. This work formed the other part of the paper [39] which was read to an ordinary meeting of the Royal Statistical Society. My ongoing research in expert knowledge elicitation has been recognised by the SHELF package that I co-developed with Jeremy Oakley being adopted by organisations in a variety of sectors. In particular, GSK (formerly GlaxoSmithKline) routinely use the methods we developed as a core part of their decision-making on drug development.

Professor Vic Barnett (University of Nottingham) and I prepared a report in 1997, at the request of the Royal Commission on Environmental Pollution, on the use of statistics in the setting of environmental pollution standards. The Commission organised a two-day international seminar to discuss the issues raised in our report. The report was discussed also at a meeting of the Royal Statistical Society's Study Group on Environmental Statistics, and has been published by Chapman and Hall. Research grant number 9 is a direct result of this work.

One of my most active areas of consultancy has been health economics, where I have worked both with the pharmaceutical industry and with the UK regulatory body NICE (the National Institute for Health and Clincal Excellence). I have worked extensively with AstraZeneca Pharmaceuticals to apply Bayesian methods in health economics, and papers [47], [51], [52], [53], [55], [59], [60], [61], [65] and [69] arise from this work. Paper [63] arises from consultancy with another pharmaceutical company, Johnson and Johnson, and paper [64] from my contribution to a contract for NICE which led subsequently to paper [97]. Paper [65] was named as the best paper of 2003 by the journal, *Pharmaceutical Statistics*.

Since my retirement I continue to be active in a wide range of application areas with various clients.

5. University Administration

At Warwick University, I was chairman of the Statistics Department for four years, and served for several years on the Science Faculty Board and the Computing Policy Committee.

At Nottingham University I was head of the Statistics Section, and was also head of the Mathematics Department in 1993–96. I served on Senate, the Board of Science and the Cripps Computing Centre Committee.

At Sheffield University, I was head of the Department of Probability and Statistics (2000-01), and Director of the Centre for Bayesian Statistics in Health Economics (2001–2008).