

## Professor Sir Bernard Walter Silverman FRS

### Publications

#### Books: authored

1. *Density Estimation for Statistics and Data Analysis*. London: Chapman and Hall. (1986)
2. (with P. J. Green) *Nonparametric Regression and Generalized Linear Models: A Roughness Penalty Approach*. London: Chapman and Hall. (1994)
3. (with J. O. Ramsay) *Functional Data Analysis*. New York: Springer. (1997)
4. (with J. O. Ramsay) *Applied Functional Data Analysis: Methods and Case Studies*. New York: Springer. (2002)
5. (with J. O. Ramsay) *Functional Data Analysis, Second Edition*. (Revised and considerably extended). New York: Springer. (2005)

#### Books: edited

6. (with G. A. Barnard, G. E. P. Box, D. R. Cox, and A. H. Seheult). *Industrial Quality and Productivity with Statistical Methods: A Joint Symposium of the Royal Society and the Royal Statistical Society*. London: The Royal Society. (1989) Also published as *Phil. Trans. R. Soc. Lond. A*, **327**, 477–638.
7. (with J. C. Vassilicos). *Wavelets: The Key to Intermittent Information?*. Oxford University Press. (2000). Also published as *Phil. Trans. R. Soc. Lond. A*, **357**, 2393–2625.

#### Major published reports

8. *GM Science Review: First Report*. Department of Trade and Industry, 296 pp.<sup>1</sup> (2003)
9. *GM Science Review: Second Report*. Department of Trade and Industry, 116 pp.<sup>10</sup> (2004)
10. *The UK's Science and Mathematics Teaching Workforce: a 'State of the Nation' Report*. The Royal Society, 109pp.<sup>2</sup> (2007)
11. *Science and mathematics education, 14–19: A 'state of the nation' report on the participation and attainment of 14–19 year olds in science and mathematics in the UK, 1996–2007*. The Royal Society, 199pp.<sup>11</sup> (2008)
12. *Research and Development in Forensic Science: a Review*<sup>3</sup>. Home Office. (2011)
13. (with Kevin Bales and Bodean Hedwards) *Modern Slavery Research: the UK Picture*. Independent Anti-Slavery Commissioner and University of Nottingham. Available at [iascresearch.nottingham.ac.uk](http://iascresearch.nottingham.ac.uk). 76pp and interactive database. (2018)

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<sup>1</sup> Jointly authored: I took a lead role in drafting the summary versions.

<sup>2</sup> Authored by a Royal Society Working Group; see <http://royalsociety.org/education/policy/state-of-nation/>

<sup>3</sup> <http://www.homeoffice.gov.uk/publications/agencies-public-bodies/fsr/forensic-science-review/>

## Refereed journal publications

15. On a Gaussian process related to multivariate probability density estimation. *Math. Proc. Camb. Phil. Soc.*, **80**, 135–144. (1976).
16. Limit theorems for dissociated random variables. *Adv. Appl. Prob.*, **8**, 806–819. (1976).
17. Weak and strong uniform consistency of the kernel estimate of a density and its derivatives. *Ann. Statist.*, **6**, 177–184. (1978).
18. Density ratios, empirical likelihood and cot death. *Applied Statistics*, **27**, 26–33. (1978).
19. Choosing a window width when estimating a density. *Biometrika*, **65**, 1–11. (1978).
20. Distances on circles, toruses and spheres. *J. Appl. Prob.*, **15**, 136–143. (1978).
21. (with T.C. Brown). Short distances, flat triangles and Poisson limits. *J. Appl. Prob.*, **15**, 815–825. (1978).
22. (with F.J. Guild). The microstructure of glass fibre reinforced polyester. *Journal of Microscopy*, **114**, 131–141. (1978).
23. (with B.D. Ripley). Quick tests for spatial interaction. *Biometrika*, **65**, 641–2. (1978).
24. (with T.C. Brown). Rates of Poisson convergence for U statistics. *J. Appl. Prob.*, **16**, 428–432. (1979).
25. (with C.Y. Barlow and others). Grain to grain variations in NbC particle size in an austenitic stainless steel. *Journal of Materials Science*, **14**, 423–430. (1979).
26. (with P.J. Green). Constructing the convex hull of a set of points in the plane. *Computer Journal*, **22**, 262–266. (1979).
27. (with P.J.L. Wallis). Efficient implementation of the Ada overloading rules. *Information Processing Letters*, **10**, 120–123. (1980).
28. Some asymptotic properties of the probabilistic teacher. *IEEE Trans. Inf. Theory*, **26**, 246–249. (1980).
29. (with D.M. Titterton). Minimum covering ellipses. *SIAM J. Sci. Stat. Comp.*, **1**, 401–409. (1981).
30. Using kernel density estimates to investigate multimodality. *J. Roy. Statist. Soc. B*, **43**, 97–99. (1981).
31. (with H.W. Lotwick). Convergence of spatial birth-and-death processes. *Math. Proc. Camb. Phil. Soc.*, **90**, 155–165. (1981).
32. (with T.C. Brown and R.K. Milne). A class of two-type point processes. *Z. Wahrscheinlichkeitstheorie verw. Geb.*, **58**, 299–308. (1981).
33. Kernel density estimation using the fast Fourier transform. Algorithm AS176, *Appl. Stat.*, **31**, 93–99. (1982).
34. (with M.H.J. Keenan and A.H. Rose). Effect of plasma-membrane phospholipid unsaturation of solute transport into *Saccharomyces cerevisiae* NCYC 366. *J. Gen. Microbiol.*, **128**, 1447–1455. (1982).
35. (with A. Wheals). Unstable activator model for size control of the cell cycle. *J. Theor. Biol.*, **97**, 505–510. (1982).
36. On the estimation of a probability density function by the maximum penalized likelihood method. *Ann. Statist.*, **10**, 795–810. (1982).
37. (with H.W. Lotwick). Methods for analysing spatial processes of several types of points. *J. Roy. Statist. Soc. B*, **44**, 406–413. (1982).

38. (with Y.P. Mack). Weak and strong uniform consistency of kernel regression estimates. *Z. Wahrscheinlichkeitsth. verw. Geb.*, **61**, 405–415. (1982).
39. Convergence of a class of empirical distribution functions of dependent random variables. *Ann. Probab.*, **11**, 745–751. (1983).
40. Spline smoothing: the equivalent variable kernel method. *Ann. Statist.*, **12**, 898–916. (1984).
41. A fast and efficient cross-validation method for smoothing parameter choice in spline regression. *J. Amer. Statist. Ass.*, **79**, 584–589. (1984).
42. (with A.J. Baddeley). A cautionary example on the use of second-order methods for analysing point patterns. *Biometrics*, **40**, 1089–1093. (1984).
43. Some aspects of the spline smoothing approach to non-parametric regression curve fitting (with Discussion). *J. Roy. Statist. Soc. B.*, **47**, 1–52. (1985).
44. Two books on density estimation. *Ann. Statist.*, **13**, 1630–1638. (1985).
45. (with J.D. Wilson). A beta-binomial model for library survey data. *Journal of Documentation*, **43**, 112–124. (1987).
46. (with J.T. Wood). The nonparametric estimation of branching curves. *J. Amer. Statist. Ass.*, **82**, 551–558. (1987).
47. (with G.A. Young). The bootstrap: to smooth or not to smooth? *Biometrika*, **74**, 469–479. (1987).
48. (with M.J. Buckley and G.K. Eagleson). The estimation of residual variance in nonparametric regression. *Biometrika*, **75**, 189–199. (1988).
49. (with J.H. Friedman). Flexible parsimonious smoothing and additive modeling (with Discussion and Response). *Technometrics*, **31**, 1–39. (1989).
50. (with M. C. Jones). An orthogonal series density estimation approach to reconstructing positron emission tomography images. *Journal of Applied Statistics*, **16**, 177–191. (1989).
51. (with M. C. Jones). E. Fix and J. L. Hodges (1951): an important unpublished contribution to nonparametric discriminant analysis and density estimation. *International Statistical Review*, **57**, 233–247. (1989).
52. (with M. C. Jones, J. D. Wilson and D. W. Nychka). A smoothed EM approach to indirect estimation problems, with particular reference to stereology and emission tomography (with Discussion). *J. Roy. Statist. Soc. B.*, **52**, 271–324. (1990).
53. (with I. M. Johnstone). Speed of estimation in positron emission tomography. *Ann. Statist.*, **18**, 251–280. (1990).
54. (with D.R. Cox, C.A. Moser, D. Hutchison, D. Holt, S. M. Gore and P.G. Moore) *Official Statistics: counting with confidence*. The Report of a Working Party on Official Statistics in the UK. London: Royal Statistical Society, (1990). Subsequently published as *J. Roy. Statist. Soc. A.*, **154**, 23–44. (1991).
55. (with J. A. Rice). Estimating the mean and covariance structure nonparametrically when the data are curves. *J. Roy. Statist. Soc. B.*, **53**, 233–244. (1991).
56. (with C. Jennison, J. Stander and T.C. Brown). The specification of edge penalties for regular and irregular pixel images. *IEEE Trans. Pattern Analysis and Machine Intelligence*, **12**, 1017–1024. (1990).
57. (with I. M. Johnstone). Discretization effects in statistical inverse problems. *J. Complexity*, **7**, 1–34. (1991).

58. (with C. K. Carter and G. K. Eagleson). A comparison of the Reinsch and Speckman splines. *Biometrika*, **79**, 81–91. (1992).
59. (with N. R. Franks, A. Wilby and C. Tofts). Self-organizing nest construction in ants: sophisticated building by blind bulldozing. *Animal Behaviour*, **44**, 357–375. (1992).
60. (with D. A. Cook, P. McCombie and D. Rattray) The measurement and checking of the accuracy of small strain measurements during testing of model brick walls. *Masonry International: Journal of the British Masonry Society*, **6**, 82–88. (1993).
61. (with S. E. Leurgans and R. A. Moyeed). Canonical correlation analysis when the data are curves. *J. Roy. Statist. Soc. B.*, **55**, 725–740. (1993).
62. (with S. D. Pezzulli). Some properties of smoothed principal components analysis for functional data. *Computational Statistics*, **8**, 1–16. (1993).
63. (with P. C. Taylor). Block diagrams and splitting criteria for classification trees. *Statistics and Computing*, **3**, 147–161. (1993).
64. (with J. Stander) Temperature schedules for simulated annealing. *Statistics and Computing*, **4**, 21–32. (1994).
65. (with G. P. Nason) The discrete wavelet transform in S. *J. Comp. Graph. Stat.*, **3**, 163–191. (1994).
66. (with L.J. Notarianni, S.E. Oliver, P. Dobrocky and P.N. Bennett) Caffeine as a metabolic probe: A comparison of the metabolic ratios used to assess CYP1A2 activity. *Br. J. Clin. Pharmacol.*, **39**, 65–69. (1995).
67. Incorporating parametric effects into functional principal components analysis. *J. Roy. Statist. Soc. B*, **57**, 673–689. (1995).
68. (with J. Stander) Minimax estimation of linear functionals, particularly in nonparametric regression and positron emission tomography. *Computational Statistics*, **10**, 259–283. (1995).
69. Smoothed functional principal components analysis by choice of norm. *Ann. Statist.*, **24**, 1–24. (1996).
70. (with D. Bloch) Monotone discriminant functions and their applications in rheumatology. (1997). *J. Amer. Statist. Assoc.*, **92**, 144–153.
71. (with I. M. Johnstone) Wavelet threshold estimators for data with correlated noise. (1997). *J. Roy. Statist. Soc. B.*, **59**, 319–351.
72. (with J. O. Ramsay and N. Heckman) Spline smoothing with model-based penalties. *Behavior Research Methods, Instruments, and Computers*, **29**, 99–106. (1997).
73. (with F. Abramovich) Wavelet decomposition approaches to statistical inverse problems. *Biometrika*, **85**, 115–129. (1998).
74. (with A. M. Wilson, T. J. Seelig and R. A. Shield) The effect of foot imbalance on point of force application in the horse. *Equine Veterinary Journal*, **30**, 540–545. (1998).
75. (with F. Abramovich and T. Sapatinas) Wavelet thresholding via a Bayesian approach. (1998). *J. Roy. Statist. Soc. B.*, **60**, 725–749.
76. (with J. O. Ramsay) The progesterone data: will simpler functional data analyses suffice? *J. Amer. Statist. Assoc.*, **93**, 988–990. (1998).
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79. (with L. Shepstone, J. Rogers, J. R. Kirwan) The shape of the distal femur: A palaeopathological comparison of eburnated and non-eburnated femora. *Annals of the Rheumatic Diseases*, **58**, 72–78. (1999).
80. (with G. E. Williams, A. M. Wilson and A. E. Goodship) Disease-specific changes in equine ground reaction force data documented by use of principal components analysis. *American Journal of Veterinary Research*, **60**, 549–555. (1999).
81. Wavelets in statistics: beyond the standard assumptions. *Phil. Trans. R. Soc. Lond. A* **357**, 2459–2473 (1999)
82. (with F. Abramovich and T. Sapatinas) Stochastic expansions in an overcomplete wavelet dictionary. *Probability Theory and Related Fields*, **117**, 133–144. (2000).
83. (with A. Kovac) Extending the scope of wavelet regression methods by coefficient-dependent thresholding. *J. Amer. Statist. Assoc.*, **95**, 172–183. (2000).
84. (with C. M. Swain and R. R. Rodgers) Life after Bakke Where Whites and Blacks Agree: Public Support for Fairness in Educational Opportunities. *Harvard BlackLetter Law Journal*, **16**, 147–184. (2000).
85. (with L. Shepstone, J. Rogers, J. R. Kirwan) The distribution of distal femoral osteophytes in a human skeletal population. *Annals of the Rheumatic Diseases*, **59**, 513–520. (2000).
86. (with J. Warren Beck, David A. Richards, R. Lawrence Edwards, Peter L. Smart, Douglas. J. Donahue, Sofia Hererra-Osterheld, George. S. Burr, Leal Calsoyas, A. J. Timothy Jull, and Dana Biddulph) Extremely Large Variations of Atmospheric  $^{14}\text{C}$  Concentration During the Last Glacial Period. *Science*, **292**, 2453–2458. (2001)
87. (with L. Shepstone, J. Rogers, J. R. Kirwan) The shape of the intercondylar notch of the human femur: a comparison of osteoarthritic and non-osteoarthritic bones from a skeletal sample. *Annals of the Rheumatic Diseases*, **60**, 968–973. (2001).
88. (with T. T. Cai) Incorporating information on neighboring coefficients into wavelet estimation. *Sankhya Series B*, **63**, 127–148. (2001).
89. (with T. R. Downie) A wavelet mixture approach to the estimation of image deformation functions. *Sankhya Series B*, **63**, 181–198. (2001).
90. (with D. R. M. Herrick and G. P. Nason) Some new methods for wavelet density estimation. *Sankhya Series A*, **63**, 394–411. (2001).
91. (with S. Barber and G. P. Nason) Posterior probability intervals for wavelet thresholding. *J. Royal Statist. Soc. Ser. B.*, **64**, 189–205. (2002).
92. (with I. M. Johnstone) Boundary coiflets for wavelet shrinkage in function estimation. *J. Appl. Prob.*, **41A**, 81–98. (2004).
93. (with I. M. Johnstone) Needles and straw in haystacks: Empirical Bayes estimates of possibly sparse sequences. *Ann. Statist.*, **32**, 1594–1649. (2004).
94. (with G. M. James) Functional adaptive model estimation. *J. Amer. Statist. Assoc.*, **100**, 565–576. (2005).
95. (with I. M. Johnstone) EbayesThresh: R programs for Empirical Bayes thresholding. *Journal of Statistical Software*, **12.8**, 1–38 and software package. (2005).
96. (with I. M. Johnstone) Empirical Bayes selection of wavelet thresholds. *Ann. Statist.*, **33**, 1700–1752. (2005).
97. (with T. Bell, J. A. Newman, S. L. Turner and A. K. Lilley.) The contribution of species richness and composition to bacterial services. *Nature*, **436**, 1157–1160. (2005).

98. (with C. Spencer, P. Deloukas, S. Hunt, J. Mullikin, S. Myers, P. Donnelly, D. Bentley and G. McVean.) The influence of recombination on human genetic diversity. *PLoS Genetics*, **2**(9), e148. (2006).
99. Empirical Bayes thresholding: adapting to sparsity when it advantageous to do so. *Journal of the Korean Statistical Society*, **36**, 1–29. (2007).
100. (with T. J. Heaton) A wavelet/lifting scheme based imputation method. *Journal of the Royal Statistical Society, Series B.*, **70**, 567–587. (2008).
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102. (with J. K. Bizley, K. M. M. Walker, A. J. King and J. W. H. Schnupp.) Interdependent encoding of pitch, timbre and location cues in auditory cortex. *Journal of Neuroscience*, **29**, 2064–2075. (2009).
103. Bibliometrics in the Context of the UK Research Assessment Exercise. *Statistical Science* **24**, 15–16. (2009).
104. (with Leen Slaets and Gerda Claeskens) A Multiresolution approach to time warping achieved by a Bayesian prior-posterior transfer fitting strategy. *Journal of the Royal Statistical Society, Series B*, **72**, 673–694. (2010).
105. Crime Statistics: How thoughtful statistics can guide policy. *Journal of the Foundation for Science and Technology* **21**(5), 4–5. (2011).
106. (with George Nicholson, 24 other authors, and the MolPage consortium) Human metabolic profiles are stably controlled by genetic and environmental variation. *Molecular Systems Biology*, **7**: **525**, 1–12. (2011).
107. (with Leen Slaets and Gerda Claeskens) Warping functional data in R and C via a Bayesian multiresolution approach. *Journal of Statistical Software* **55.3**, 1–22 and software package. (2013).
108. (with Kevin Bales and Olivia Hesketh) Modern slavery in the UK: How many victims? *Significance* **12.3**, 16–21. (2015).
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111. (with Todd Landman) Globalization and Modern Slavery. *Politics and Governance* **7**, 275–290. [DOI: 10.17645/pag.v7i4.2233](https://doi.org/10.17645/pag.v7i4.2233) (2020).
112. Multiple Systems Analysis for the quantification of Modern Slavery: Classical and Bayesian approaches (with Discussion). *J. Roy. Stat. Soc. Ser. A*. **183**, 691–736. [DOI: 10.1111/rssa.12505](https://doi.org/10.1111/rssa.12505) (2020).
113. (with Lax Chan and Kyle Vincent) Multiple Systems Estimation for Sparse Capture Data: Inferential Challenges when there are Non-Overlapping Lists. *Journal of the American Statistical Association* **116**, 1297–1306. [DOI: 10.1080/01621459.2019.1708748](https://doi.org/10.1080/01621459.2019.1708748) (2021).
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115. (with Adrian E. Raftery & Hana Ševčíková) The vote package: Single transferable vote and other electoral systems in R. *The R Journal*. **13.2**, 673–696. [DOI:10.32614/RJ-2021-086](https://doi.org/10.32614/RJ-2021-086) (2021).
116. (with Ben Brewster, Grace Robinson, Vicky Brotherton & Dave Walsh). Covid-19 and Child Criminal Exploitation: Implications of the Pandemic for County Lines. *Trends in Organized Crime*. **26**, 156–179. [DOI: 10.1007/s12117-021-09442-x](https://doi.org/10.1007/s12117-021-09442-x) (2023)
117. (with Rowland G. Seymour). How Can We Estimate Modern Slavery Globally? *CHANCE* **36:4**, 22–29. [DOI: 10.1080/09332480.2023.2290950](https://doi.org/10.1080/09332480.2023.2290950) (2023)
118. (with Kyle Vincent & Lax Chan). Bootstrapping multiple systems estimates to account for model selection. *Statistics and Computing* **34**, 44. [DOI: 10.1007/s11222-023-10346-9](https://doi.org/10.1007/s11222-023-10346-9) (2024).

### Software packages (R packages unless otherwise stated)

119. EbayesThresh: Empirical Bayes thresholding and related methods. (2002—2005). Now superseded by package below.
120. (with A. Antoniadis, M. Jansen and I. M. Johnstone) EbayesThresh: MATLAB™ software for Empirical Bayes thresholding. (2004).
121. (with L. Slaets and G. Claeskens). MRwarping: Multiresolution time warping for functional data. <https://cran.r-project.org/package=MRwarping> (2013).
122. (with Ludger Evers, Kan Xu, Peter Carbonetto and Matthew Stephens). EbayesThresh: Empirical Bayes Thresholding and Related Methods. R package, available from <https://github.com/stephenslab/EbayesThresh>. (An extension and updating of the original version of 2002.) (2017).
123. (with Hana Sevcikova and Adrian Raftery) Vote: Election Vote Counting. Available from <https://cran.r-project.org/package=vote>. (2018-21).
124. The R package modslavmse for multiple systems analysis. <https://github.com/bernardsilverman/modslavmse/> (2018).
125. (with Lax Chan & Kyle Vincent). SparseMSE: Multiple systems estimation for sparse capture data. <https://CRAN.R-project.org/package=SparseMSE> (2019).

### Other publications and public outputs

126. (with P. Bloomfield and others). Volume and area of oilfields and their impact on order of discovery. Report for U.S. Department of Energy, Princeton University, U.S.A. (1979).
127. (with L.S. Mayer and others). Modelling the rates of domestic crude oil discovery and production. Report for U.S. Department of Energy, Princeton University, U.S.A. (1979).
128. (with K.S. Deffeyes). Hotspot tracks and the thermal maturation of hydrocarbons. Report for U.S. Department of Energy, Princeton University, U.S.A. (1979).
129. Comment on a paper by Good and Gaskins. *J. Amer. Statist. Assoc.*, **75**, 67–68. (1980).
130. Density estimation: Are theoretical results useful in practice? *Asymptotic Theory of Statistical Tests and Estimation*. (ed I.M. Chakravarti). Academic Press, New York, 179–203. (1980).
131. Density estimation for univariate and bivariate data. *Interpreting Multivariate Data* (ed. V. Barnett), Wiley, Chichester, 1981, 37–53.
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136. Poisson limit theory for U-statistics, some applications and a counter-example. *Stochastic Geometry and Stereology* (W. Weil and K.V. Ambartzumian, eds.), Teubner-Verlag, 170–178, (1984).
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142. (with G. P. Nason) The stationary wavelet transform and some statistical applications. *Wavelets and Statistics* (A. Antoniadis and G. Oppenheim, eds.), Lecture Notes in Statistics 103, Springer-Verlag, pp 281–300. (1995).
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149. (with G. K. Ambler). Perfect simulation of spatial point processes using dominated coupling from the past, with application to a multiscale area-interaction point process. (2004).
150. (with G. K. Ambler) Perfect simulation for wavelet thresholding with correlated coefficients. (2004).
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152. Modern Slavery: an application of multiple systems estimation. Home Office. (2014). (available at <https://www.gov.uk/government/publications/modern-slavery-an-application-of-multiple-systems-estimation>)
153. Demonstrating risks is not the same as estimating prevalence. Contribution to a [Symposium](#) on the Global Slavery Index, Delta 8.7 (United Nations University, Centre for Policy Research). (2018).
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155. Should SAGE have a working protocol? [Written evidence submission COV-0016](#) for [House of Lords Science and Technology Committee Inquiry into the Science of COVID-19](#). (2020).
156. (with Ben Brewster and four others) [The impact of COVID-19 on child criminal exploitation](#). Research briefing, Rights Lab, University of Nottingham. (2020).
157. (with Ben Brewster and four others) [Covid-19 Research: Home Affairs Select Committee call for evidence: Home Office preparedness for COVID-19](#). Written submission. Rights Lab, University of Nottingham. (2021).
158. (with Ben Brewster and four others) [COVID-19 and its Impact on the Policing of County Lines Drug Supply](#). Research briefing, Rights Lab, University of Nottingham. (2021).
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