To-do list
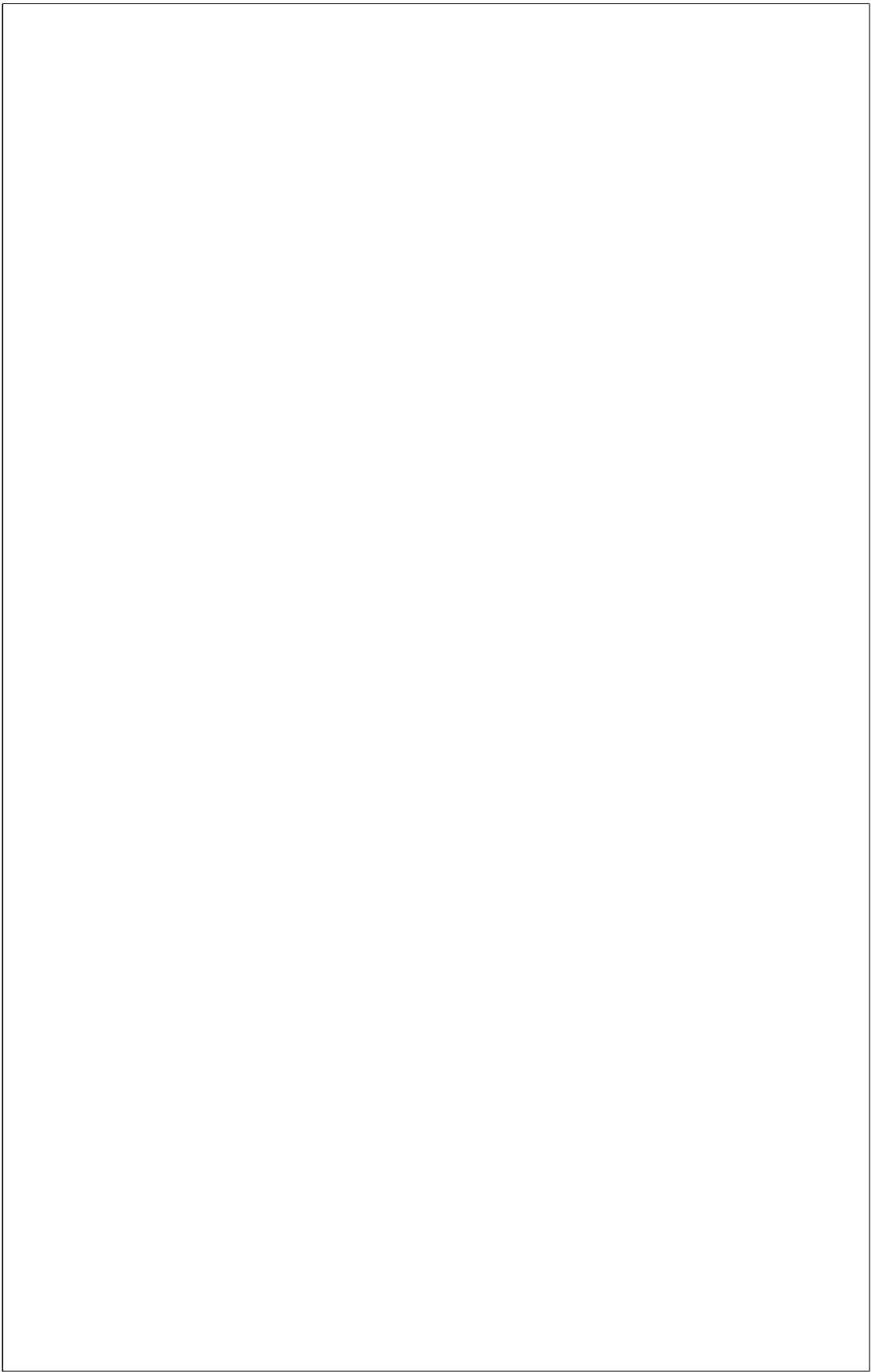
Contents

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PhD thesis: 'Regression modelling using Fisher information covariance kernels (I-priors)'

Chapter 1

Preceding chapters

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Bibliography

Agresti, Alan and Jonathan Hartzel (2000). "Tutorial in biostatistics: Strategies comparing treatment on binary response with multi-centre data". In: *Statistics in Medicine* 19, pp. 1115–1139.

Akaike, Hirotogu (1973). "Information theory and an extension of the maximum likelihood principle". In: *2nd International Symposium on Information Theory*. Akadémiai Kiadó, pp. 267–281.

Albert, James H. and Siddhartha Chib (1993). "Bayesian Analysis of Binary and Polychotomous Response Data". In: *Journal of the American Statistical Association* 88.422, pp. 669–679. DOI: 10.2307/2290350.

Alpay, Daniel (1991). "Some Remarks on Reproducing Kernel Krein Spaces". In: *The Rocky Mountain Journal of Mathematics* 21.4, pp. 1189–1205. DOI: 10.1216/rmjm/1181072903.

Alvarez, Ignacio, Jarad Niemi, and Matt Simpson (2014). "Bayesian inference for a covariance matrix". In: *26th Annual Conference on Applied Statistics in Agriculture*. DOI: 10.4148/2475-7772.1004.

Balakrishnan, Alampallam V. (1981). *Applied Functional Analysis*. 2nd ed. Springer-Verlag. ISBN: 978-1-4612-5867-4. DOI: 10.1007/978-1-4612-5865-0.

Barbieri, Maria Maddalena and James O. Berger (2004). "Optimal predictive model selection". In: *Annals of Statistics* 32.3, pp. 870–897. DOI: 10.1214/009053604000000238.

Bates, Douglas M., Martin Mächler, Ben Bolker, and Steve Walker (2015). "Fitting Linear Mixed-Effects Models Using **lme4**". In: *Journal of Statistical Software* 67.1, pp. 1–48. DOI: 10.18637/jss.v067.i01.

Beal, Matthew James (2003). "Variational algorithms for approximate Bayesian inference". PhD thesis. Gatsby Computational Neuroscience Unit, University College London.

Beal, Matthew James and Zoubin Ghahramani (2003). "The Variational Bayesian EM Algorithm for Incomplete Data: with Application to Scoring Graphical Model Structures". In: *Bayesian Statistics 7*. Proceedings of the Seventh Valencia International Meeting. Ed. by José M. Bernardo, A. Philip Dawid, James O. Berger, Mike West, David Heckerman, M. J. (Susie) Bayarri, and Adrian F. M. Smith. Oxford University Press, pp. 453–464. ISBN: 978-0-19-852615-5.

Berger, James O. (1985). *Statistical Decision Theory and Bayesian Analysis*. 2nd ed. New York: Springer-Verlag. ISBN: 978-0-387-96098-2. DOI: 10.1007/978-1-4757-4286-2.

Berger, James O. (2006). "The Case for Objective Bayesian Analysis". In: *Bayesian Analysis* 1.3, pp. 385–402. DOI: 10.1214/06-BA115.

Bergsma, Wicher (2018). *Regression and classification with I-priors.* Manuscript in submission. ARXIV: 1707.00274 [math.ST].

Berlinet, Alain and Christine Thomas-Agnan (2004). *Reproducing Kernel Hilbert Spaces in Probability and Statistics.* Boston, MA: Springer. ISBN: 978-1-4613-4792-7. DOI: 10.1007/978-1-4419-9096-9.

Bickel, Peter, David Choi, Xiangyu Chang, and Hai Zhang (2013). "Asymptotic normality of maximum likelihood and its variational approximation for stochastic blockmodels". In: *The Annals of Statistics* 41.4, pp. 1922–1943. DOI: 10.1214/13-AOS1124.

Bishop, Christopher (2006). *Pattern Recognition and Machine Learning.* Springer-Verlag. ISBN: 978-0-387-31073-2.

Blei, David M., Alp Kucukelbir, and Jon D. McAuliffe (2017). "Variational Inference: A Review for Statisticians". In: *Journal of the American Statistical Association* 112.518, pp. 859–877. DOI: 10.1080/01621459.2017.1285773.

Bouboulis, Pantelis and Sergios Theodoridis (2011). "Extension of Wirtinger's Calculus to Reproducing Kernel Hilbert Spaces and the Complex Kernel LMS". In: *IEEE Transactions on Signal Processing* 59.3, pp. 964–978. DOI: 10.1109/TSP.2010.2096420.

Breiman, Leo (2001). "Random Forests". In: *Machine Learning* 45.1, pp. 5–32. DOI: 10.1023/A:1010933404324.

Breiman, Leo and Jerome H. Friedman (1985). "Estimating Optimal Transformations for Multiple Regression and Correlation". In: *Journal of the American Statistical Association* 80.391, pp. 590–598. DOI: 10.1080/01621459.1985.10478157.

Breslow, Norman E. and David G. Clayton (1993). "Approximate Inference in Generalized Linear Mixed Models". In: *Journal of the American Statistical Association* 88.421, pp. 9–25. DOI: 10.2307/2290687.

Bunch, David S. (1991). "Estimability in the multinomial probit model". In: *Transportation Research Part B: Methodological* 25.1, pp. 1–12. DOI: 10.1016/0191-2615(91)90009-8.

Bürkner, Paul-Christian (2017). "brms: An R Package for Bayesian Multilevel Models Using Stan". In: *Journal of Statistical Software* 80.1, pp. 1–28. DOI: 10.18637/jss.v080.i01.

Butler, John S. and Robert Moffitt (1982). "A computationally efficient quadrature procedure for the one-factor multinomial probit model". In: *Econometrica* 50.3, pp. 761–764. DOI: 10.2307/1912613.

Cannings, Timothy I. and Richard J. Samworth (2017). "Random-projection ensemble classification". In: *Journal of the Royal Statistical Society: Series B (Statistical Methodology)* 79.4, pp. 959–1035. DOI: 10.1111/rssb.12228.

Carlin, Bradley P. and Siddhartha Chib (1995). "Bayesian Model Choice via Markov Chain Monte Carlo Methods". In: *Journal of the Royal Statistical Society: Series B (Statistical Methodology)* 57.3, pp. 473–484.

Carpenter, Bob, Andrew Gelman, Matthew Hoffman, Daniel Lee, Ben Goodrich, Michael Betancourt, Marcus Brubaker, Jiqiang Guo, Peter Li, and Allen Riddell (2017).

"Stan: A Probabilistic Programming Language". In: *Journal of Statistical Software* 76.1, pp. 1–32. DOI: `10.18637/jss.v076.i01`.

Casella, George (1985). "An Introduction to Empirical Bayes Data Analysis". In: *The American Statistician* 39.2, pp. 83–87. DOI: `10.2307/2682801`.

Casella, George and Roger L. Berger (2002). *Statistical Inference*. 2nd ed. Pacific Grove, CA: Duxbury. ISBN: 978-0-534-24312-8.

Casella, George, F. Javier Girón, M. Lina Martínez, and Elías Moreno (2009). "Consistency of Bayesian procedures for variable selection". In: *The Annals of Statistics* 37.3, pp. 1207–1228. DOI: `10.1214/08-AOS606`.

Casella, George and Elías Moreno (2006). "Objective Bayesian Variable Selection". In: *Journal of the American Statistical Association* 101.473, pp. 157–167. DOI: `10.1198/016214505000000646`.

Chan, Jennifer S. K. and Anthony Y. C. Kuk (1997). "Maximum Likelihood Estimation for Probit-Linear Mixed Models with Correlated Random Effects". In: *Biometrics* 53.1, pp. 86–97. DOI: `10.2307/2533099`.

Chen, Dong, Peter Hall, and Hans-Georg Müller (2011). "Single and Multiple Index Functional Regression Models with Nonparametric Link". In: *The Annals of Statistics* 39.3, pp. 1720–1747. DOI: `10.1214/11-AOS882`.

Chen, Yen-Chi, Y. Samuel Wang, and Elena A. Erosheva (2018). "On the use of bootstrap with variational inference: Theory, interpretation, and a two-sample test example". In: *Annals of Applied Statistics* to appear. ARXIV: `1711.11057 [stat.ME]`.

Cheng, Ching-An and Byron Boots (2017). "Variational Inference for Gaussian Process Models with Linear Complexity". In: *Advances in Neural Information Processing Systems 30 (NIPS 2017)*. Ed. by Isabelle Guyon, Ulrike Von Luxburg, Samy Bengio, Hanna Wallach, Rob Fergus, S. V. N. Vishwanathan, and Roman Garnett, pp. 5184–5194. ARXIV: `1711.10127 [stat.ML]`.

Chipman, Hugh, Edward I. George, and Robert E. McCulloch (2001). "The Practical Implementation of Bayesian Model Selection". In: *Model Selection*. Ed. by P. Lahiri. Vol. 38. Institute of Mathematical Statistics, pp. 65–134. DOI: `10.1214/lnms/1215540964`.

Chopin, Nicolas (2011). "Fast simulation of truncated Gaussian distributions". In: *Statistics and Computing* 21.2, pp. 275–288. DOI: `10.1007/s11222-009-9168-1`.

Cohen, Serge (2002). "Champs localement auto-similaires". In: *Lois d'échelle, fractales et ondelettes*. Ed. by Patrice Abry, Paulo Gonçalves, and Jacques Lévy Véhel. Vol. 1. Hermès Sciences Publications. ISBN: 978-2-7462-0409-6.

Damien, Paul and Stephen G. Walker (2001). "Sampling Truncated Normal, Beta, and Gamma Densities". In: *Journal of Computational and Graphical Statistics* 10.2, pp. 206–215. DOI: `10.1198/10618600152627906`.

Dansie, Brenton R. (1985). "Parameter estimability in the multinomial probit model". In: *Transportation Research Part B: Methodological* 19.6, pp. 526–528. DOI: `10.1016/0191-2615(85)90047-5`.

Davidian, Marie and David M. Giltinan (1995). *Nonlinear Models for Repeated Measurement Data*. Chapman & Hall/CRC. ISBN: 978-0-412-98341-2.

Davison, Anthony Christopher (2003). *Statistical Models*. Cambridge University Press. ISBN: 978-0-511-81585-0. DOI: `10.1017/CBO9780511815850`.

Dean, Angela and Daniel Voss (1999). *Design and Analysis of Experiments*. Springer. ISBN: 978-0-387-98561-9. DOI: 10.1007/978-3-319-52250-0.

Dellaportas, Petros, Jonathan J. Forster, and Ioannis Ntzoufras (2002). "On Bayesian model and variable selection using MCMC". In: *Statistics and Computing* 12.1, pp. 27–36. DOI: 10.1023/A:1013164120801.

Dempster, Arthur P, Nan M Laird, and Donald B. Rubin (1977). "Maximum likelihood from incomplete data via the EM algorithm". In: *Journal of the Royal Statistical Society: Series B (Statistical Methodology)*, pp. 1–38.

Denwood, Matthew (2016). "**runjags**: An R Package Providing Interface Utilities, Model Templates, Parallel Computing Methods and Additional Distributions for MCMC Models in JAGS". In: *Journal of Statistical Software* 71.9, pp. 1–25. DOI: 10.18637/jss.v071.i09.

Deterding, David Henry (1990). "Speaker Normalization for Automatic Speech Recognition". PhD thesis. University of Cambridge.

Diggle, Peter, Paula Moraga, Barry Rowlingson, and Benjamin Taylor (2013). "Spatial and Spatio-Temporal Log-Gaussian Cox Processes: Extending the Geostatistical Paradigm". In: *Statistical Science* 28.4, pp. 542–563. DOI: 10.1214/13-STS441.

Diggle, Peter, Pingping Zheng, and Peter Durr (2005). "Nonparametric estimation of spatial segregation in a multivariate point process: bovine tuberculosis in Cornwall, UK". In: *Journal of the Royal Statistical Society: Series C (Applied Statistics)* 54.3, pp. 645–658. DOI: 10.1111/j.1467-9876.2005.05373.x.

Duane, Simon, Anthony D Kennedy, Brian J. Pendleton, and Duncan Roweth (1987). "Hybrid Monte Carlo". In: *Physics Letters B* 195.2, pp. 216–222. DOI: 10.1016/0370-2693(87)91197-X.

Durrande, Nicolas, David Ginsbourger, Olivier Roustant, and Laurent Carraro (2013). "ANOVA kernels and RKHS of zero mean functions for model-based sensitivity analysis". In: *Journal of Multivariate Analysis* 115, pp. 57–67. DOI: 10.1016/j.jmva.2012.08.016.

Duvenaud, David (2014). "Automatic Model Construction with Gaussian Processes". PhD thesis. University of Cambridge.

Eddelbuettel, Dirk and Romain Francois (2011). "**Rcpp**: Seamless R and C++ Integration". In: *Journal of Statistical Software* 40.8, pp. 1–18. DOI: 10.18637/jss.v040.i08.

Efron, Bradley and David V. Hinkley (1978). "Assessing the accuracy of the maximum likelihood estimator: Observed versus expected Fisher information". In: *Biometrika* 65.3, pp. 457–483. DOI: 10.1093/biomet/65.3.457.

Embrechts, Paul and Makoto Maejima (2002). *Selfsimilar Processes*. Princeton, NJ: Princeton University Press. ISBN: 978-0-691-09627-8.

Fernández, Carmen, Eduardo Ley, and Mark F. J. Steel (2001). "Benchmark priors for Bayesian model averaging". In: *Journal of Econometrics* 100.2, pp. 381–427. DOI: 10.1016/S0304-4076(00)00076-2.

Ferraty, Frédéric and Philippe Vieu (2006). *Nonparametric Functional Data Analysis*. New York: Springer. ISBN: 978-0-387-30369-7. DOI: 10.1007/0-387-36620-2.

Fisher, Ronald Aylmer (1922). "On the mathematical foundations of theoretical statistics". In: *Philosophical Transactions of the Royal Society A* 222.594-604, pp. 309–368. DOI: 10.1098/rsta.1922.0009.

Fouskakis, Dimitris and David Draper (2008). "Comparing Stochastic Optimization Methods for Variable Selection in Binary Outcome Prediction, With Application to Health Policy". In: *Journal of the American Statistical Association* 103.484, pp. 1367–1381. DOI: 10.1198/016214508000001048.

Fowlkes, Charless, Serge Belongie, Fan Chung, and Jitendra Malik (2004). "Spectral grouping using the Nyström method". In: *IEEE Transactions on Pattern Analysis and Machine Intelligence* 26.2, pp. 214–225. DOI: 10.1109/TPAMI.2004.1262185.

Fowlkes, Charless, Serge Belongie, and Jitendra Malik (Dec. 2001). "Efficient Spatiotemporal Grouping Using the Nyström Method". In: *Proceedings of the 2001 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR 2001)*. Vol. 1. Kauai, HI, pp. 231–238. DOI: 10.1109/CVPR.2001.990481.

Friedman, Jerome H., Trevor Hastie, and Robert Tibshirani (2001). *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*. 2nd ed. New York: Springer-Verlag. ISBN: 978-0-387-84857-0. DOI: 10.1007/978-0-387-84858-7.

George, Edward I. and Robert E. McCulloch (1993). "Variable Selection Via Gibbs Sampling". In: *Journal of the American Statistical Association* 88.423, pp. 881–889. DOI: 10.2307/2290777.

Geweke, John (1989). "Bayesian Inference in Econometric Models Using Monte Carlo Integration". In: *Econometrica* 57.6, pp. 1317–1339. DOI: 10.2307/1913710.

— (1991). "Efficient Simulation from the Multivariate Normal and Student-*t* Distributions Subject to Linear Constraints and the Evaluation of Constraint Probabilities". In: *Computing Science and Statistics: the Twenty-Third Symposium on the Interface*. Ed. by Elaine M. Keramidas, pp. 571–578.

— (1996). "Variable Selection and Model Comparison in Regression". In: *Bayesian Statistics 5*. Proceedings of the Fifth Valencia International Meeting. Ed. by José M. Bernardo, James O. Berger, A. Philip Dawid, and Adrian F. M. Smith. Oxford University Press. ISBN: 978-0-19-852356-7.

Geweke, John, Michael Keane, and David Runkle (1994). "Alternative Computational Approaches to Inference in the Multinomial Probit Model". In: *The Review of Economics and Statistics* 76.4, pp. 609–632. DOI: 10.2307/2109766.

Girolami, Mark and Simon Rogers (2006). "Variational Bayesian Multinomial Probit Regression with Gaussian Process Priors". In: *Neural Computation* 18.8, pp. 1790–1817. DOI: 10.1162/neco.2006.18.8.1790.

Goia, Aldo and Philippe Vieu (2014). "Some Advances in Semiparametric Functional Data Modelling". In: *Contributions in Infinite-Dimensional Statistics and Related Topics*. Societa Editrice Esculapio, pp. 135–141. DOI: 10.15651/978-88-748-8763-7.

Gretton, Arthur, Olivier Bousquet, Alex Smola, and Bernhard Schölkopf (Oct. 2005). "Measuring Statistical Dependence with Hilbert-Schmidt Norms". In: *Proceedings of the 16th International Conference of Algorithmic Learning Theory (ALT 2005)*. Ed. by Sanjay Jain, Hans Ulrich Simon, and Etsuji Tomita. Singapore: Springer-Verlag, pp. 63–77. DOI: 10.1007/11564089_7.

Groves, Theodore and Thomas Rothenberg (1969). "A note on the expected value of an inverse matrix". In: *Biometrika* 56.3, pp. 690–691. DOI: 10.1093/biomet/56.3.690.

Gu, Chong (2013). *Smoothing Spline ANOVA Models*. New York: Springer-Verlag. ISBN: 978-1-4614-5368-0. DOI: 10.1007/978-1-4614-5369-7.

Guvenir, H. Altay, Burak Acar, Gulsen Demiroz, and Ayhan Cekin (1997). "A supervised machine learning algorithm for arrhythmia analysis". In: *Computers in Cardiology 1997*. Lund, Sweden, pp. 433–436. DOI: 10.1109/CIC.1997.647926.

Hajivassiliou, Vassilis and Daniel McFadden (1998). "The Method of Simulated Scores for the Estimation of LDV Models". In: *Econometrica* 66.4, pp. 863–896. DOI: 10.2307/2999576.

Hajivassiliou, Vassilis, Daniel McFadden, and Paul Ruud (1996). "Simulation of multivariate normal rectangle probabilities and their derivatives theoretical and computational results". In: *Journal of Econometrics* 72.1–2, pp. 85–134. DOI: 10.1016/0304-4076(94)01716-6.

Hall, Peter, Tung Pham, Matt P. Wand, and Shen S. J. Wang (2011). "Asymptotic normality and valid inference for Gaussian variational approximation". In: *The Annals of Statistics* 39.5, pp. 2502–2532. DOI: 10.1214/11-AOS908.

Hastie, Trevor and Robert Tibshirani (1986). "Generalized Additive Models". In: *Statistical Science* 1.3, pp. 297–310. DOI: 10.1214/ss/1177013604.

Hein, Matthias and Olivier Bousquet (2004). *Kernels, Associated Structures and Generalizations*. Tech. rep. Max Planck Institute for Biological Cybernetics, Tübingen, Germany.

Hensman, James, Nicolo Fusi, and Neil D. Lawrence (Aug. 2013). "Gaussian Processes for Big Data". In: *Proceedings of the Twenty-Ninth Conference on Uncertainty in Artificial Intelligence (UAI 2013)*. Ed. by Ann Nicholson and Padhraic Smyth. Bellevue, WA. ISBN: 978-0-9749039-9-6. arXiv: 1309.6835 [cs.LG].

Hoerl, Arthur E. and Robert W. Kennard (1970). "Ridge Regression: Biased Estimation for Nonorthogonal Problems". In: *Technometrics* 12.1, pp. 55–67. DOI: 10.2307/1267351.

Hoeting, Jennifer A., David Madigan, Adrian E. Raftery, and Chris T. Volinsky (1999). "Bayesian Model Averaging: A Tutorial". In: *Statistical science* 14.4, pp. 382–401. DOI: 10.1214/ss/1009212519.

Hofmann, Thomas, Bernhard Schölkopf, and Alexander J. Smola (2008). "Kernel Methods in Machine Learning". In: *The Annals of Statistics* 36.3, pp. 1171–1220. DOI: 10.1214/009053607000000677.

Itzykson, Claude and Jean-Michel Drouffe (1991). *Statistical Field Theory*. Vol. 2: Strong Coupling, Monte Carlo Methods, Conformal Field Theory and Random Systems. Cambridge University Press. ISBN: 978-0-511-62278-6. DOI: 10.1017/CBO9780511622786.

Jamil, Haziq (2017). *iprior: Regression Modelling using I-Priors*. R package version 0.7.1. URL: https://cran.r-project.org/web/packages/iprior.

— (2018a). *ipriorBVS: Bayesian Variable Selection using I-priors*. R package version 0.1.1. URL: https://github.com/haziqj/ipriorBVS.

— (2018b). *iprobit: Binary and Multinomial Probit Regression with I-priors*. R package version 0.1.1. URL: https://github.com/haziqj/iprobit.

Jamil, Haziq and Wicher Bergsma (2017). "**iprior**: An R Package for Regression Modelling using I-priors". R package vignette. URL: https://cran.r-project.org/web/packages/iprior/vignettes/iprior_paper.pdf.

Jaynes, Edwin Thompson (1957a). "Information Theory and Statistical Mechanics". In: *Physical Review* 106.4, p. 620. DOI: 10.1103/PhysRev.106.620.

— (1957b). "Information Theory and Statistical Mechanics II". In: *Physical Review* 108.2, p. 171. DOI: 10.1103/PhysRev.108.171.

— (2003). *Probability Theory: The Logic of Science.* Ed. by G. Larry Bretthorst. Cambridge University Press. ISBN: 978-0-521-59271-0.

Jeffreys, Harold (1946). "An invariant form for the prior probability in estimation problems". In: *Proceedings of the Royal Society A* 186.1007, pp. 453–461. DOI: 10.1098/rspa.1946.0056.

Jordan, Michael I., Zoubin Ghahramani, Tommi S. Jaakkola, and Lawrence K. Saul (1999). "An Introduction to Variational Methods for Graphical Models". In: *Machine Learning* 37.2, pp. 183–233. DOI: 10.1023/A:1007665907178.

Kadane, Joseph B. (2011). *Principles of Uncertainty.* Chapman & Hall/CRC. ISBN: 978-1-4398-6161-5.

Kahle, David and Hadley Wickham (2013). "**ggmap**: Spatial Visualization with **ggplot2**". In: *The R Journal* 5.1, pp. 144–161.

Kalaitzis, Alfredo, Antti Honkela, Pei Gao, and Neil D. Lawrence (2014). *gptk: Gaussian Processes Tool-Kit.* R package version 1.08. URL: https://CRAN.R-project.org/package=gptk.

Kalaitzis, Alfredo and Neil D. Lawrence (May 2011). "A Simple Approach to Ranking Differentially Expressed Gene Expression Time Courses through Gaussian Process Regression". In: *BMC Bioinformatics* 12.1, p. 180. DOI: 10.1186/1471-2105-12-180.

Kammar, Ohad (2016). *A note on Fréchet diffrentiation under Lebesgue integrals.* URL: https://www.cs.ox.ac.uk/people/ohad.kammar/notes/kammar-a-note-on-frechet-differentiation-under-lebesgue-integrals.pdf.

Karatzoglou, Alexandros, Alexander J. Smola, Kurt Hornik, and Achim Zeileis (2004). "**kernlab** - An S4 Package for Kernel Methods in R". In: *Journal of Statistical Software* 11.9, pp. 1–20. DOI: 10.18637/jss.v011.i09.

Kass, Robert E. and Adrian E. Raftery (1995). "Bayes Factors". In: *Journal of the American Statistical Association* 90.430, pp. 773–795. DOI: 10.2307/2291091.

Keane, Michael (1992). "A Note on Identification in the Multinomial Probit Model". In: *Journal of Business & Economic Statistics* 10.2, pp. 193–200. DOI: 10.2307/1391677.

— (1994). "A Computationally Practical Simulation Estimator for Panel Data". In: *Econometrica* 62.1, pp. 95–116. DOI: 10.2307/2951477.

Keane, Michael and Kenneth Wolpin (1994). "The Solution and Estimation of Discrete Choice Dynamic Programming Models by Simulation and Interpolation: Monte Carlo Evidence". In: *The Review of Economics and Statistics* 76.4, pp. 648–672. DOI: 10.2307/2109768.

Kenward, Michael G. (1987). "A Method for Comparing Profiles of Repeated Measurements". In: *Journal of the Royal Statistical Society C (Applied Statistics)* 36.3, pp. 296–308. DOI: 10.2307/2347788.

Kimeldorf, George S and Grace Wahba (1970). "A Correspondence Between Bayesian Estimation on Stochastic Processes and Smoothing by Splines". In: *The Annals of Mathematical Statistics* 41.2, pp. 495–502. DOI: 10.1214/aoms/1177697089.

Kokoszka, Piotr and Matthew Reimherr (2017). *Introduction to Functional Data Analysis*. Chapman & Hall/CRC. ISBN: 978-1-4987-4634-2.

Krée, Paul (1974). "Produits tensoriels complétés d'espaces de Hilbert". In: *Séminaire Paul Krée* 1.7, pp. 1974–1975.

Kuhn, Max et al. (2017). **caret***: Classification and Regression Training*. R package version 6.0–77. URL: https://CRAN.R-project.org/package=caret.

Kuo, Frances Y., Ian H. Sloan, Grzegorz Wasilkowski, and Henryk Woźniakowski (2010). "On decompositions of multivariate functions". In: *Mathematics of Computation* 79.270, pp. 953–966. DOI: 10.1090/S0025-5718-09-02319-9.

Kuo, Lynn and Bani Mallick (1998). "Variable selection for regression models". In: *Sankhyā: The Indian Journal of Statistics, Series B* 60.1, pp. 65–81.

Kuss, Malte and Carl Edward Rasmussen (2005). "Assessing Approximate Inference for Binary Gaussian Process Classification". In: *Journal of Machine Learning Research* 6, pp. 1679–1704.

Kyung, Minjung, Jeff Gill, Malay Ghosh, and George Casella (2010). "Penalized regression, standard errors, and Bayesian lassos". In: *Bayesian Analysis* 5.2, pp. 369–411. DOI: 10.1214/10-BA607.

Lange, Kenneth (1995). "A quasi-Newton acceleration of the EM algorithm". In: *Statistica Sinica* 5.1, pp. 1–18.

Lee, Kyeong Eun, Naijun Sha, Edward R. Dougherty, Marina Vannucci, and Bani Mallick (2003). "Gene selection: a Bayesian variable selection approach". In: *Bioinformatics* 19.1, pp. 90–97. DOI: 10.1093/bioinformatics/19.1.90.

Leisch, Friedrich and Evgenia Dimitriadou (2010). **mlbench***: Machine Learning Benchmark Problems*. R package version 2.1-1.

Lian, Heng and Gaorong Li (2014). "Series Expansion for Functional Sufficient Dimension Reduction". In: *Journal of Multivariate Analysis* 124, pp. 150–165. DOI: 10.1016/j.jmva.2013.10.019.

Liang, Feng, Rui Paulo, German Molina, Merlise A. Clyde, and James O. Berger (2008). "Mixtures of g Priors for Bayesian Variable Selection". In: *Journal of the American Statistical Association* 103.481, pp. 410–423. DOI: 10.1198/016214507000001337.

Lifshits, Mikhail (2012). "Lectures on Gaussian processes". In: *Lectures on Gaussian Processes*. Springer-Verlag, pp. 1–117. DOI: 10.1007/978-3-642-24939-6.

Liu, Chuanhai, Donald B. Rubin, and Ying Nian Wu (1998). "Parameter expansion to accelerate EM: The PX-EM algorithm". In: *Biometrika* 85.4, pp. 755–770. DOI: 10.1093/biomet/85.4.755.

Lloyd, Chris, Tom Gunter, Michael Osborne, and Stephen Roberts (July 2015). "Variational Inference for Gaussian Process Modulated Poisson Processes". In: *Proceedings of the Thirty-Second International Conference on Machine Learning (ICML 2015)*. Ed. by Francis Bach and David Blei. Vol. 37. Lille, France, pp. 1814–1822. ARXIV: 1411.0254 [stat.ML].

Louppe, Gilles (Oct. 2014). "Understanding Random Forests: From Theory to Practice". PhD thesis. University of Liege, Belgium. arXiv: 1407.7502 [stat.ML].

Lunn, David J., Andrew Thomas, Nicky Best, and David Spiegelhalter (Oct. 2000). "WinBUGS - A Bayesian modelling framework: Concepts, structure, and extensibility". In: *Statistics and Computing* 10.4, pp. 325–337. DOI: 10.1023/A:1008929526011.

MacDonald, Blake, Pritam Ranjan, and Hugh Chipman (2015). "**GPfit**: An R Package for Fitting a Gaussian Process Model to Deterministic Simulator Outputs". In: *Journal of Statistical Software* 64.12, pp. 1–23. DOI: 10.18637/jss.v064.i12.

Madigan, David and Adrian E. Raftery (1994). "Model Selection and Accounting for Model Uncertainty in Graphical Models Using Occam's Window". In: *Journal of the American Statistical Association* 89.428, pp. 1535–1546. DOI: 10.2307/2291017.

Mallows, Colin L. (1973). "Some comments on C_p". In: *Technometrics* 15.4, pp. 661–675. DOI: 10.2307/1267380.

Mandelbrot, Benoit B. and John W. Van Ness (1968). "Fractional Brownian Motions, Fractional Noises and Applications". In: *SIAM Review* 10.4, pp. 422–437.

Marsaglia, George and Wai Wan Tsang (2000). "The Ziggurat Method for Generating Random Variables". In: *Journal of Statistical Software* 5.8, pp. 1–7. DOI: 10.18637/jss.v005.i08.

Mary, Xavier (2003). "Hilbertian subspaces, subdualities and applications". PhD thesis. INSA de Rouen.

McCullagh, Peter and John A. Nelder (1989). *Generalized Linear Models*. 2nd ed. Chapman & Hall/CRC. ISBN: 978-0-412-31760-6.

McCulloch, Robert E., Nicholas G. Polson, and Peter E. Rossi (2000). "A Bayesian analysis of the multinomial probit model with fully identified parameters". In: *Journal of Econometrics* 99.1, pp. 173–193. DOI: 10.1016/S0304-4076(00)00034-8.

McCulloch, Robert E. and Peter E. Rossi (1994). "An exact likelihood analysis of the multinomial probit model". In: *Journal of Econometrics* 64.1, pp. 207–240. DOI: 10.1016/0304-4076(94)90064-7.

McDonald, Gary C. and Richard C. Schwing (1973). "Instabilities of Regression Estimates Relating Air Pollution to Mortality". In: *Technometrics* 15.3, pp. 463–481. DOI: 10.2307/1266852.

McLachlan, Geoffrey and Thriyambakam Krishnan (2007). *The EM Algorithm and Extensions*. 2nd ed. John Wiley & Sons. ISBN: 978-0-471-20170-0. DOI: 10.1002/9780470191613.

Meila, Marina (2003). "Data centering in feature space." In: *Proceedings of the Ninth International Workshop on Artificial Intelligence and Statistics (AISTATS)*. Ed. by Christopher Bishop and Brendan Frey. Society for Artificial Intelligence and Statistics.

Meng, Xiao-Li and Donald B. Rubin (1993). "Maximum likelihood estimation via the ECM algorithm: A general framework". In: *Biometrika* 80.2, pp. 267–278. DOI: 10.1093/biomet/80.2.267.

Meng, Xiao-Li and David Van Dyk (1997). "The EM Algorithm—an Old Folk-song Sung to a Fast New Tune". In: *Journal of the Royal Statistical Society: Series B (Statistical Methodology)* 59.3, pp. 511–567. DOI: 10.1111/1467-9868.00082.

Micchelli, Charles A., Yuesheng Xu, and Haizhang Zhang (2006). "Universal Kernels". In: *Journal of Machine Learning Research* 7, pp. 2651–2667.

Microsoft Corporation and Stephen Weston (2017). ***doSNOW**: Foreach Parallel Adaptor for the **snow** Package*. R package version 1.0.15. URL: https://CRAN.R-project.org/package=doSNOW.

Miller, Alan (2002). *Subset Selection in Regression*. Chapman & Hall/CRC. ISBN: 978-1-58488-171-1.

Minka, Thomas P. (Aug. 2001). "Expectation propagation for approximate Bayesian inference". In: *Proceedings of the Seventeenth Conference on Uncertainty in Artificial Intelligence (UAI 2001)*. Ed. by Daphne Koller John Breese. San Francisco, CA, pp. 362–369. ISBN: 1-55860-800-1. ARXIV: 1301.2294 [cs.AI].

Mitchell, Toby J. and John J. Beauchamp (1988). "Bayesian Variable Selection in Linear Regression". In: *Journal of the American Statistical Association* 83.404, pp. 1023–1032. DOI: 10.2307/2290129.

Neal, Radford M. (1999). "Regression and Classification using Gaussian Process Priors". In: *Bayesian Statistics 6*. Proceedings of the Sixth Valencia International Meeting. Ed. by José M. Bernardo, James O. Berger, A. Philip Dawid, and Adrian F. M. Smith. Oxford University Press, pp. 475–501. ISBN: 978-0-19-850485-6.

— (2011). "MCMC using Hamiltonian dynamics". In: *Handbook of Markov Chain Monte Carlo*. Ed. by Steve Brooks, Andrew Gelman, Galin Jones, and Xiao-Li Meng. Chapman & Hall/CRC. ISBN: 978-1-4200-7941-8. ARXIV: 1206.1901 [stat.CO].

Nobile, Agostino (1998). "A hybrid Markov chain for the Bayesian analysis of the multinomial probit model". In: *Statistics and Computing* 8.3, pp. 229–242. DOI: 10.1023/A:10089053.

Nocedal, Jorge and Stephen Wright (2006). *Numerical Optimization*. New York: Springer-Verlag. ISBN: 978-0-387-30303-1. DOI: 10.1007/978-0-387-40065-5.

Ntzoufras, Ioannis (2011). *Bayesian Modeling Using WinBUGS*. Wiley. ISBN: 978-0-470-14114-4. DOI: 10.1002/9780470434567.

O'Hara, Robert B. and Mikko J. Sillanpää (2009). "A Review of Bayesian Variable Selection Methods: What, How and Which". In: *Bayesian Analysis* 4.1, pp. 85–117. DOI: 10.1214/09-BA403.

Ong, Cheng Soon, Xavier Mary, Stéphane Canu, and Alexander J. Smola (July 2004). "Learning with non-positive kernels". In: *Proceedings of the Twenty-First International Conference on Machine Learning (ICML 2004)*. Ed. by Russ Greiner and Dale Schuurmans. Banff, Alberta, Canada.

Ormerod, John T., Chong You, and Samuel Müller (2017). "A variational Bayes approach to variable selection". In: *Electronic Journal of Statistics* 11.2, pp. 3549–3594. DOI: 10.1214/17-EJS1332.

Pan, Jianxin and Yi Pan (2017). "**jmcm**: An R Package for Joint Mean-Covariance Modeling of Longitudinal Data". In: *Journal of Statistical Software* 82.1, pp. 1–29. DOI: 10.18637/jss.v082.i09.

Park, Trevor and George Casella (2008). "The Bayesian Lasso". In: *Journal of the American Statistical Association* 103.482, pp. 681–686. DOI: 10.1198/016214508000000337.

Pawitan, Yudi (2001). *In All Likelihood*. Statistical Modelling and Inference Using Likelihood. Oxford University Press. ISBN: 978-0-19-850765-9.

Petersen, Kaare Brandt and Michael Syskind Pedersen (2012). *The Matrix Cookbook*. Technical University of Denmark. URL: http://www2.imm.dtu.dk/pubdb/p.php?3274.

Pinheiro, José C. and Douglas M. Bates (2000). *Mixed-Effects Models in S and S-plus*. Springer-Verlag. ISBN: 978-0-387-98957-0. DOI: 10.1007/b98882.

Pinheiro, José C., Douglas M. Bates, Saikat DebRoy, Deepayan Sarkar, and R Core Team (2017). **nlme**: *Linear and Nonlinear Mixed Effects Models*. R package version 3.1-131. URL: https://CRAN.R-project.org/package=nlme.

Plummer, Martyn (Mar. 2003). "JAGS: A Program for Analysis of Bayesian Graphical Models Using Gibbs Sampling". In: *Proceedings of the 3rd International Workshop on Distributed Statistical Computing (DSC 2003)*. Ed. by Kurt Hornik, Friedrich Leisch, and Achim Zeileis. Vienna, Austria.

Quiñonero-Candela, Joaquin and Carl Edward Rasmussen (Dec. 2005). "A Unifying View of Sparse Approximate Gaussian Process Regression". In: *Journal of Machine Learning Research* 6, pp. 1939–1959.

R Core Team (2018). *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. URL: https://www.R-project.org/.

Rabe-Hesketh, Sophia and Anders Skrondal (2012). *Multilevel and Longitudinal Modeling Using Stata*. 3rd ed. Stata Press. ISBN: 978-1-59718-108-2.

Raftery, Adrian E., David Madigan, and Jennifer A Hoeting (1997). "Bayesian Model Averaging for Linear Regression Models". In: *Journal of the American Statistical Association* 92.437, pp. 179–191. DOI: 10.1080/01621459.1997.10473615.

Ramsay, J. O., Hadley Wickham, Spencer Graves, and Giles Hooker (2017). **fda**: *Functional Data Analysis*. R package version 2.4.7. URL: https://CRAN.R-project.org/package=fda.

Ramsay, James and Bernard W. Silverman (2005). *Functional Data Analysis*. New York: Springer-Verlag. ISBN: 978-1-4757-7107-7. DOI: 10.1007/978-1-4757-7107-7.

Rasmussen, Carl Edward and Christopher K. I. Williams (2006). *Gaussian Processes for Machine Learning*. The MIT Press. ISBN: 0-262-18253-X. URL: http://www.gaussianprocess.org/gpml/.

Raykar, Vikas C and Ramani Duraiswami (Mar. 2007). "Fast large scale Gaussian process regression using approximate matrix-vector products". In: *Learning Workshop 2007*. San Juan, Peurto Rico.

Reed, Michael (1972). *Methods of Modern Mathematical Physics*. Functional Analysis. 1st ed. Academic Press. ISBN: 978-0-323-15500-7.

Revolution Analytics and Steve Weston (2015). **foreach**: *Provides Foreach Looping Construct for R*. R package version 1.4.3. URL: https://CRAN.R-project.org/package=foreach.

Robbins, Herbert (1956). "An Empirical Bayes Approach to Statistics". In: *Proceedings of the Third Berkeley Symposium on Mathematical Statistics and Probability*. Ed. by Jerzy Neyman. Vol. 1: Contributions to the Theory of Statistics. Berkeley, CA: University of California Press, pp. 157–163.

Robbins, Herbert (1983). "Some Thoughts on Empirical Bayes Estimation". In: *The Annals of Statistics* 11.3, pp. 713–723.

Robert, Christian (1995). "Simulation of truncated normal variables". In: *Statistics and Computing* 5.2, pp. 121–125. DOI: `10.1007/BF00143942`.

— (2007). *The Bayesian Choice*. From Decision-Theoretic Foundations to Computational Implementation. New York: Springer-Verlag. ISBN: 978-0-387-95231-4. DOI: `10.1007/0-387-71599-1`.

Robinson, Anthony John (1989). "Dynamic error propagation networks". PhD thesis. University of Cambridge.

Rudin, Walter (1987). *Real and Complex Analysis*. 3rd ed. McGraw-Hill Education. ISBN: 978-0-07-100276-9.

SAS Institute Inc. (2008). *SAS/STAT(R) 9.2 User's Guide*. 2nd ed. Cary, NC: SAS Institute Inc. ISBN: 978-1-60764-566-5.

Schoenberg, Isaac J. (1937). "On Certain Metric Spaces Arising From Euclidean Spaces by a Change of Metric and Their Imbedding in Hilbert Space". In: *Annals of Mathematics* 38.4, pp. 787–793. DOI: `10.2307/1968835`.

Schölkopf, Bernhard and Alexander J. Smola (2002). *Learning with Kernels*. Support Vector Machines, Regularization, Optimization, and Beyond. The MIT Press. ISBN: 978-0-262-19475-4.

Schwarz, Gideon (1978). "Estimating the Dimension of a Model". In: *The Annals of Statistics* 6.2, pp. 461–464. DOI: `10.1214/aos/1176344136`.

Scott, Steven L. and Hal R. Varian (2014). "Predicting the present with Bayesian structural time series". In: *International Journal of Mathematical Modelling and Numerical Optimisation* 5.1-2, pp. 4–23. DOI: `10.1504/IJMMNO.2014.059942`.

Sejdinovic, Dino and Arthur Gretton (2012). *What is an RKHS?* COMPGI13 Advanced Topics in Machine Learning: Lectures conducted at University College London. URL: `http://www.gatsby.ucl.ac.uk/%7B~%7Dgretton/coursefiles/RKHS%7B%5C_%7DNotes1.pdf`.

Shi, Jian Qing and Yafeng Cheng (2014). **GPFDA**: *Apply Gaussian Process in Functional Data Analysis*. R package version 2.2. URL: `https://CRAN.R-project.org/package=GPFDA`.

Skorohod, Anatolij Vladimirovič (1974). *Integration in Hilbert Space*. Springer-Verlag. ISBN: 978-3-642-65634-7. DOI: `10.1007/978-3-642-65632-3`.

Skrondal, Anders and Sophia Rabe-Hesketh (2004). *Generalized Latent Variable Modeling*. Multilevel, Longitudinal, and Structural Equation Models. Chapman & Hall/CRC. ISBN: 978-1-58488-000-4.

Sobol, Ilya M (2001). "Global sensitivity indices for nonlinear mathematical models and their Monte Carlo estimates". In: *Mathematics and Computers in Simulation* 55.1–3, pp. 271–280. DOI: `10.1016/S0378-4754(00)00270-6`.

Sriperumbudur, Bharath, Kenji Fukumizu, Arthur Gretton, Aapo Hyvärinen, and Revant Kumar (2017). "Density Estimation in Infinite Dimensional Exponential Families". In: *Journal of Machine Learning Research* 18.57, pp. 1–59. ARXIV: `1312.3516 [math.ST]`.

Stan Development Team (2016a). ***RStan****: The* R *Interface to* Stan. R package version 2.14.1. URL: http://mc-stan.org/.

— (2016b). ***rstanarm****: Bayesian Applied Regression Modeling via* Stan. R package version 2.13.1. URL: http://mc-stan.org/.

Steinwart, Ingo and Andreas Christmann (2008). *Support Vector Machines*. New York: Springer-Verlag. ISBN: 978-0-387-77241-7. DOI: 10.1007/978-0-387-77242-4.

Steinwart, Ingo, Don Hush, and Clint Scovel (2006). "An Explicit Description of the Reproducing Kernel Hilbert Spaces of Gaussian RBF Kernels". In: *IEEE Transactions on Information Theory* 52.10, pp. 4635–4643. DOI: 10.1109/TIT.2006.881713.

Sturtz, Sibylle, Uwe Ligges, and Andrew Gelman (2005). "**R2WinBUGS**: A Package for Running WinBUGS from R". In: *Journal of Statistical Software* 12.3, pp. 1–16. DOI: 10.18637/jss.v012.i03.

Tapia, Richard A. (1971). *The Differentiation and Integration of Nonlinear Operators*. Ed. by Louis B. Rall. DOI: 10.1016/C2013-0-11348-7.

Taylor, Benjamin, Tilman Davies, Barry Rowlingson, and Peter Diggle (2013). "**lgcp**: An R Package for Inference with Spatial and Spatio-Temporal Log-Gaussian Cox Processes". In: *Journal of Statistical Software* 52.4, pp. 1–40. DOI: 10.18637/jss.v052.i04.

Teh, Yee Whye, David Newman, and Max Welling (2008). "A Collapsed Variational Bayesian Inference Algorithm for Latent Dirichlet Allocation". In: *Advances in Neural Information Processing Systems 20 (NIPS 2007)*. Ed. by John C. Platt, Daphne Koller, Yoram Singer, and Sam T. Roweis, pp. 1353–1360.

Thodberg, Hans Henrik (1996). "A review of Bayesian neural networks with an application to near infrared spectroscopy". In: *IEEE Transactions on Neural Networks* 7.1, pp. 56–72. DOI: 10.1109/72.478392.

Tibshirani, Robert (1996). "Regression Shrinkage and Selection via the Lasso". In: *Journal of the Royal Statistical Society: Series B (Statistical Methodology)* 58.1, pp. 267–288. DOI: 10.1111/j.1467-9868.2011.00771.x.

Tibshirani, Robert, Trevor Hastie, Balasubramanian Narasimhan, and Gilbert Chu (May 2002). "Diagnosis of Multiple Cancer Types by Shrunken Centroids of Gene Expression". In: *Proceedings of the National Academy of Sciences of the United States of America (PNAS 2002)*. Vol. 99. 10, pp. 6567–6572. DOI: 10.1073/pnas.082099299.

Titsias, Michalis (Apr. 2009). "Variational Learning of Inducing Variables in Sparse Gaussian Processes". In: *Proceedings of the Twelfth International Conference on Artificial Intelligence and Statistics (AISTATS 2009)*. Ed. by David van Dyk and Max Welling. Clearwater Beach, FL, pp. 567–574.

Train, Kenneth (2009). *Discrete Choice Methods with Simulation*. Cambridge University Press. ISBN: 978-0-511-80527-1. DOI: 10.1017/CBO9780511805271.

van der Vaart, Aad W. and J. Harry van Zanten (2008). "Reproducing kernel Hilbert spaces of Gaussian priors". In: *Pushing the Limits of Contemporary Statistics: Contributions in Honor of Jayanta K. Ghosh*. Ed. by Bertrand Clarke and Subhashis Ghosal. Beachwood, OH: Institute of Mathematical Statistics, pp. 200–222. DOI: 10.1214/074921708000000156.

Vila, J. P., V. Wagner, and P. Neveu (2000). "Bayesian Nonlinear Model Selection and Neural Networks: A Conjugate Prior Approach". In: *IEEE Transactions on Neural Networks* 11.2, pp. 265–278. DOI: 10.1109/72.838999.

Wahba, Grace (1990). *Spline Models for Observational Data*. SIAM. ISBN: 978-0-89871-244-5. DOI: 10.1137/1.9781611970128.

Wasserman, Larry (2004). *All of Statistics. A Concise Course in Statistical Inference*. New York: Springer-Verlag. ISBN: 978-0-387-40272-7. DOI: 10.1007/978-0-387-21736-9.

Wassermann, Larry (2006). *All of Nonparametric Statistics*. New York: Springer-Verlag. ISBN: 978-0-387-25145-5. DOI: 10.1007/0-387-30623-4.

Wei, Greg C. G. and Martin A. Tanner (1990). "A Monte Carlo Implementation of the EM Algorithm and the Poor Man's Data Augmentation Algorithms". In: *Journal of the American statistical Association* 85.411, pp. 699–704. DOI: 10.2307/2290005.

Williams, Christopher K. I. and Matthias Seeger (2001). "Using the Nyström Method to Speed Up Kernel Machines". In: *Advances in Neural Information Processing Systems 13 (NIPS 2000)*. Ed. by Todd K. Leen, Thomas G. Dietterich, and Volker Tresp, pp. 682–688.

Wood, Simon N. (2017). *Generalized Additive Models. An Introduction with R*. 2nd ed. Chapman & Hall/CRC. ISBN: 978-1-4987-2833-1.

Wu, C. F. Jeff (1983). "On the Convergence Properties of the EM Algorithm". In: *The Annals of Statistics* 11.1, pp. 95–103. DOI: 10.1214/aos/1176346060.

Yamamoto, Yutaka (2012). *From Vector Spaces to Function Spaces: Introduction to Functional Analysis with Applications*. SIAM. ISBN: 978-1-61197-230-6. DOI: 10.1137/9781611972313.

Yu, Yaming (2012). "Monotonically overrelaxed EM algorithms". In: *Journal of Computational and Graphical Statistics* 21.2, pp. 518–537.

Zafeiriou, Stefanos (Oct. 2012). "Subspace Learning in Krein Spaces: Complete Kernel Fisher Discriminant Analysis with Indefinite Kernels". In: *Proceedings of the Twelfth European Conference on Computer Vision (ECCV 2012)*. Ed. by Andrew Fitzgibbon, Svetlana Lazebnik, Pietro Perona, Yoichi Sato, and Cordelia Schmid. Springer. Florence, Italy, pp. 488–501. ISBN: 978-3-642-33764-2. DOI: 10.1007/978-3-642-33765-9_35.

Zellner, Arnold (1986). "On Assessing Prior Distributions and Bayesian Regression Analysis with *g*-Prior Distributions". In: *Bayesian Inference and Decision Techniques: Essays in Honor of Bruno de Finetti*. New York: Elsevier, pp. 233–243.

Zhang, Haizhang, Yuesheng Xu, and Jun Zhang (2009). "Reproducing Kernel Banach Spaces for Machine Learning". In: *Journal of Machine Learning Research* 10, pp. 2741–2775.

Zhang, Haizhang and Jun Zhang (2012). "Regularized learning in Banach spaces as an optimization problem: representer theorems". In: *Journal of Global Optimization* 54.2, pp. 235–250. DOI: 10.1007/s10898-010-9575-z.

Zhang, Huamin and Feng Ding (2013). "On the Kronecker Products and Their Applications". In: *Journal of Applied Mathematics* 296185. DOI: 10.1155/2013/296185.

Zhu, Hongxiao, Fang Yao, and Hao Helen Zhang (2014). "Structured functional additive regression in reproducing kernel Hilbert spaces". In: *Journal of the Royal Statistical*

Society: Series B (Statistical Methodology) 76.3, pp. 581–603. DOI: `10.1111/rssb.12036`.

Zou, Hui and Trevor Hastie (2005). "Regularization and variable selection via the elastic net". In: *Journal of the Royal Statistical Society: Series B (Statistical Methodology)* 67.2, pp. 301–320. DOI: `10.1111/j.1467-9868.2005.00503.x`.

Figures
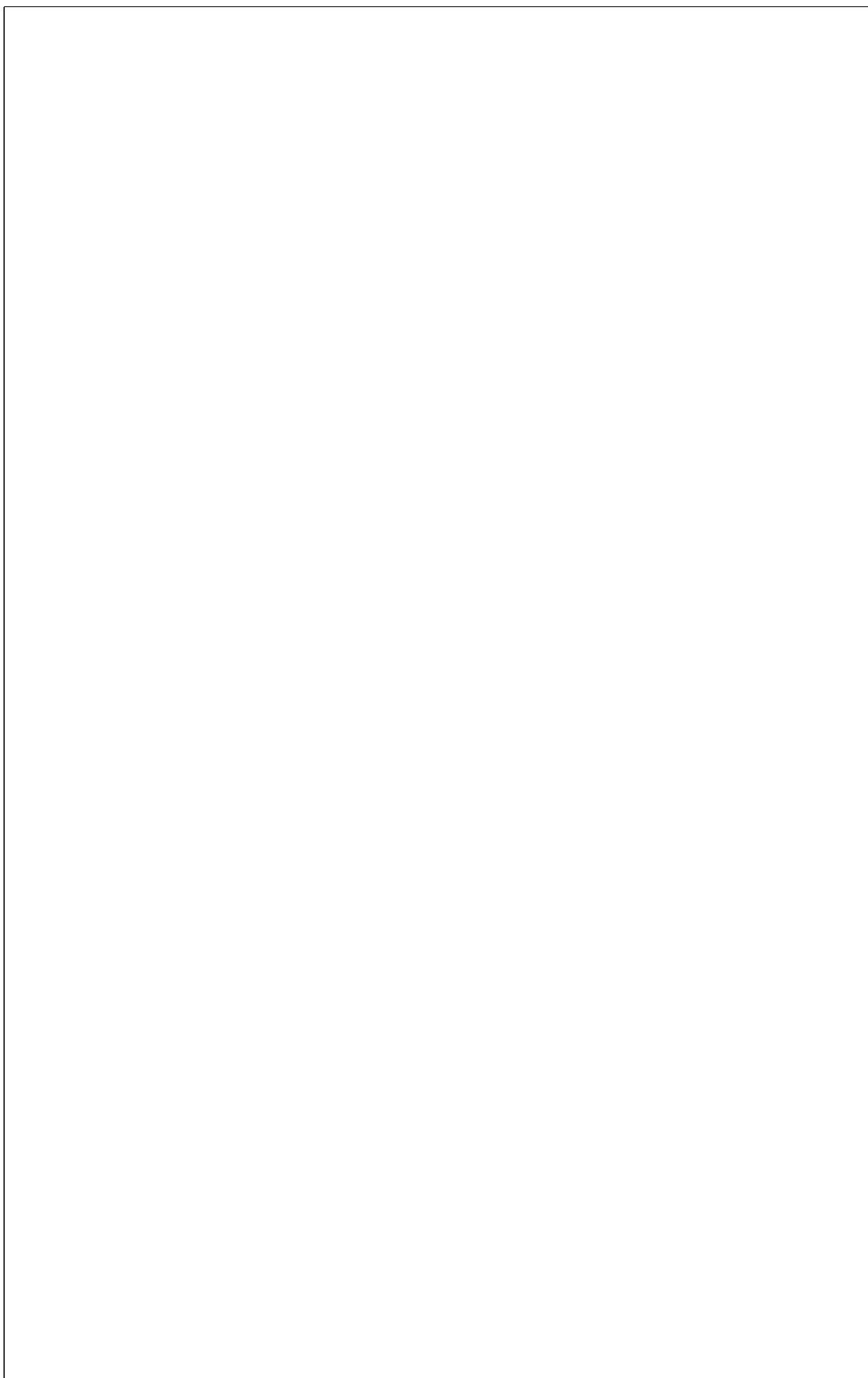
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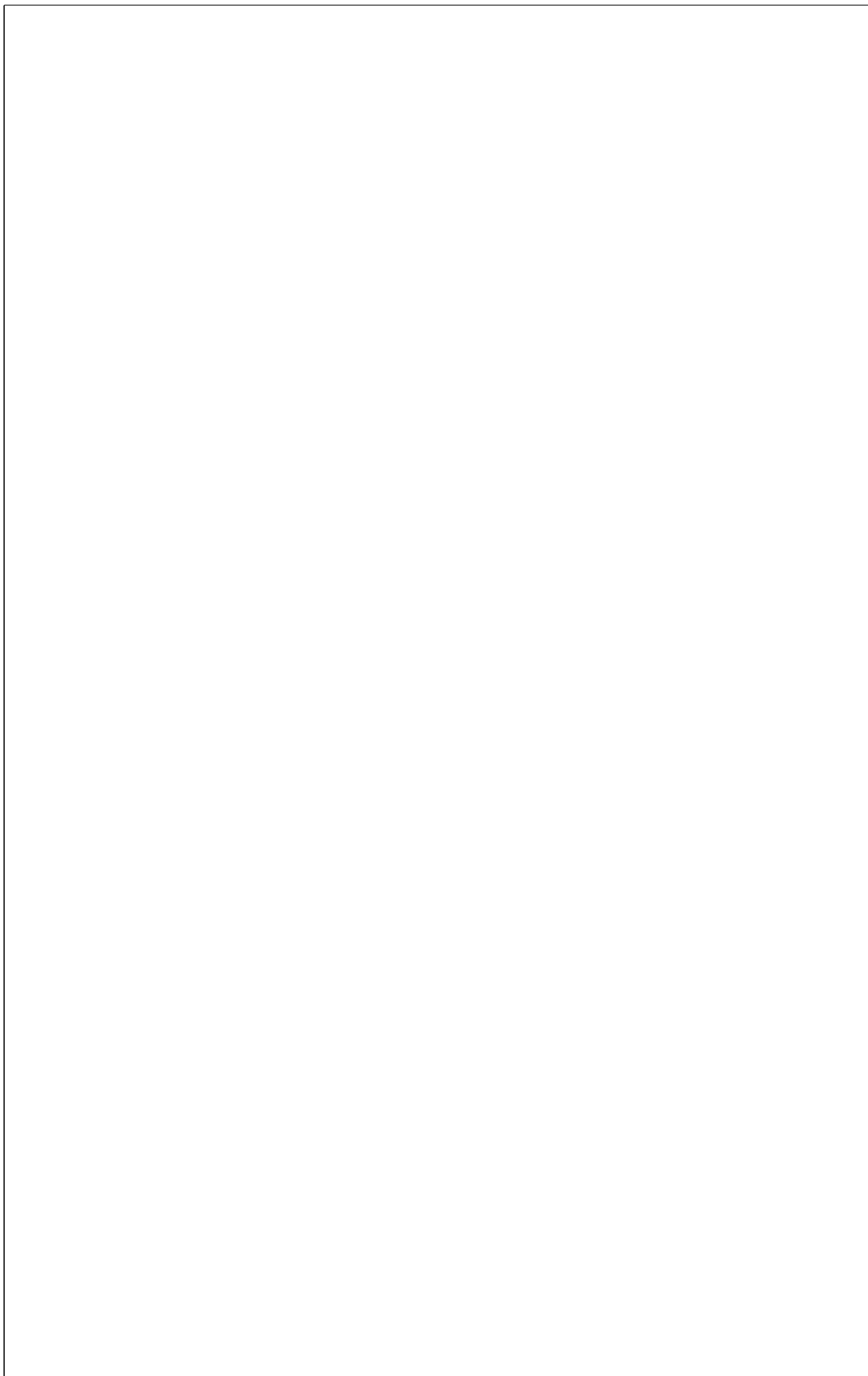
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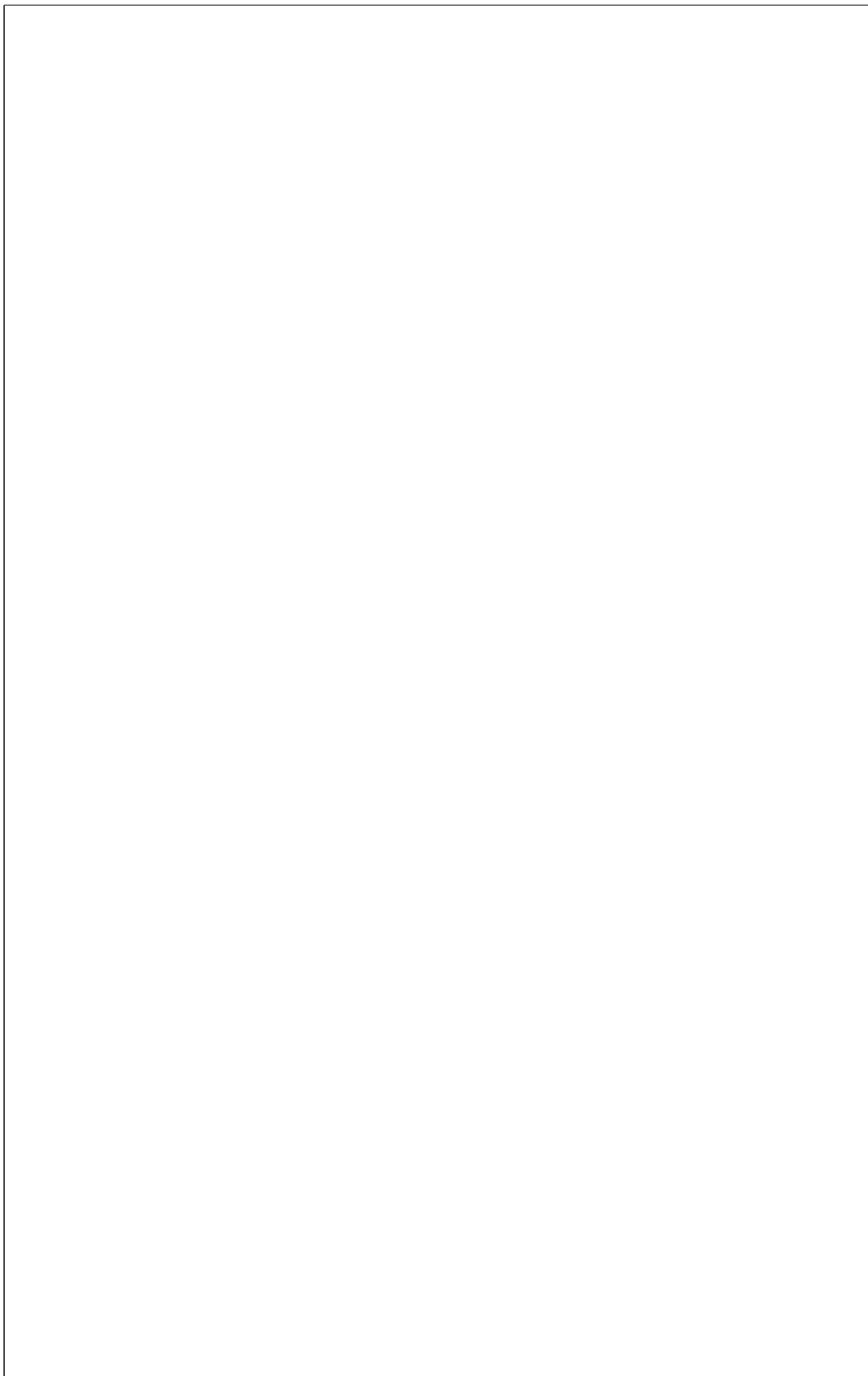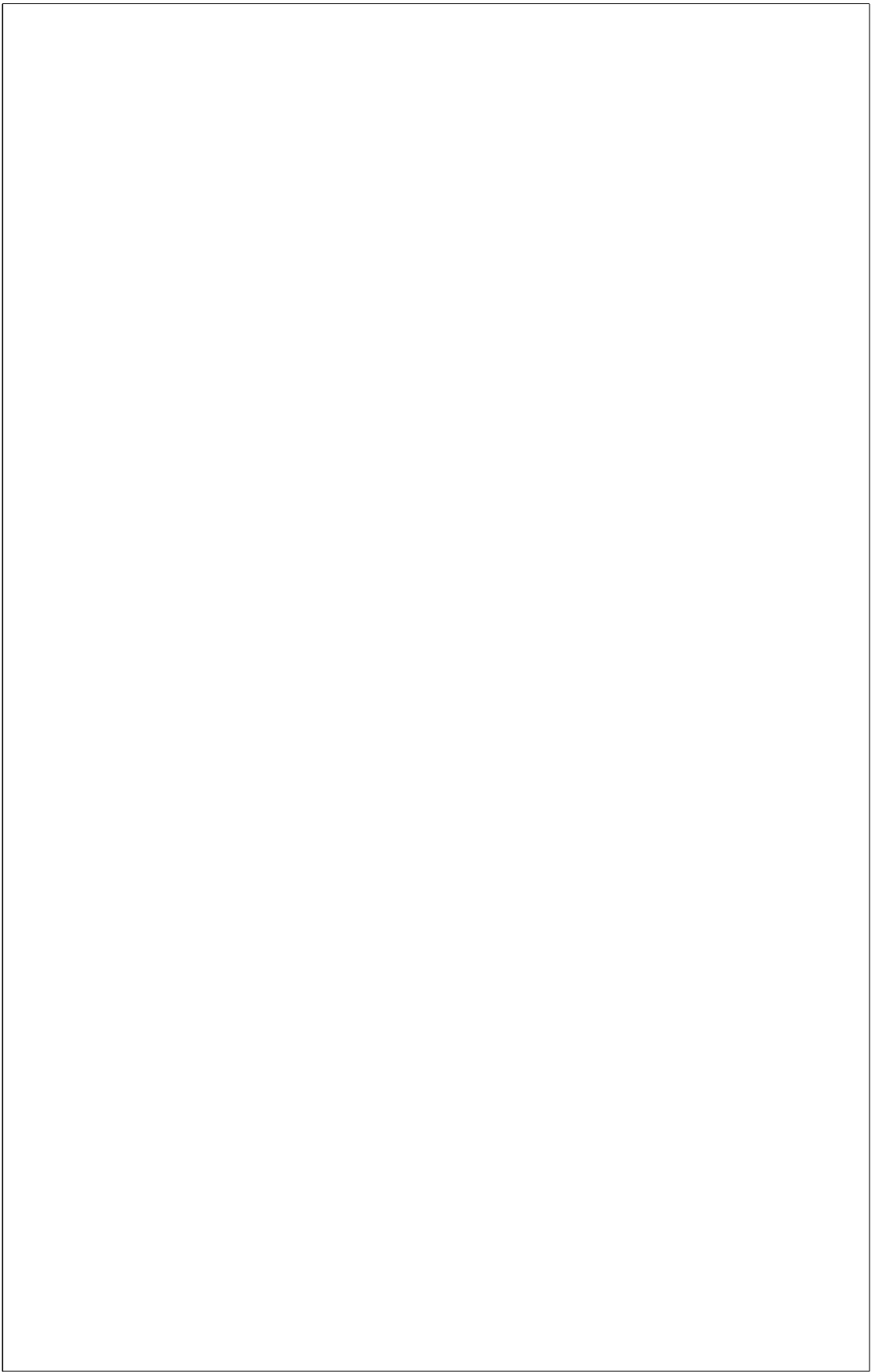
Definitions

Algorithms

Nomenclature

As much as possible, and unless otherwise stated, the following conventions are used throughout this thesis.

Conventions

$\mathbf{a}, \mathbf{b}, \mathbf{c}, \ldots$	Boldface lower case letters denote real vectors
$\mathbf{A}, \mathbf{B}, \mathbf{C}, \ldots$	Boldface upper case letters denote real matrices
$\mathcal{A}, \mathcal{B}, \mathcal{C}, \ldots$	Calligraphic upper case letters denote sets
x'	Primes are used to distinguish elements (not indicate derivatives)
$\hat{\theta}$	Hats are used to denote estimators of parameters

Indexing

$\mathbf{A}_{ij}, A_{ij}, a_{ij}$	The (i, j)'th element of the matrix $\mathbf{A}$
$\mathbf{A}_{i\cdot}$	The i'th row of the matrix $\mathbf{A}$ as a tall vector (transposed row vector)
$\mathbf{A}_{\cdot j}$	The j'th column vector of the matrix $\mathbf{A}$

Symbols

$\mathbb{N}$	The set of natural numbers (excluding zero)
$\mathbb{Z}$	The set of integers
$\mathbb{R}$	The set of real numbers
$\mathbb{R}_{>0}$	The set of positive real numbers, $\{x \in \mathbb{R} \mid x > 0\}$
$\mathbb{R}_{\geq 0}$	The set of non-negative real numbers, $\{x \in \mathbb{R} \mid x \geq 0\}$
$\mathbb{R}^d$	The d-dimensional Euclidean space
$\mathcal{A}^c$	The complement of a set $\mathcal{A}$
$\mathcal{P}(\mathcal{A})$	The power set of the set $\mathcal{A}$
$\{\}, \emptyset$	The empty set
$\mathbf{0}$	A vector of zeroes
$\mathbf{1}_n$	A length n vector of ones
$\mathbf{I}_n$	The $n \times n$ identity matrix
$\exists$	(short hand) There exists
$\forall$	(short hand) For all
$\lim_{n \to \infty}$	The limit as n tends to infinity
$\xrightarrow{\text{dist.}}$	Convergence in distribution
$O(n)$	Computational complexity (time or storage)
Δx	A quantity representing a change in x

Relations

$a \approx b$	a is approximately or almost equal to b
$a \propto b$	a is equivalent to b up to a constant of proportionality
$a \equiv b$	a is identical to b
$A \Rightarrow B$	The statement B being true is predicated on A being true
$A \Leftrightarrow B$	The statement A is true if and only if B is true
$a \in \mathcal{A}$	a is an element of the set $\mathcal{A}$
$\mathcal{A} \subseteq \mathcal{B}$	$\mathcal{A}$ is a subset of $\mathcal{B}$ which may include itself
$\mathcal{A} \subset \mathcal{B}$	$\mathcal{A}$ is a subset of $\mathcal{B}$ which does not include itself
$\mathcal{A} \cong \mathcal{B}$	The space $\mathcal{A}$ is isometrically isomorphic to the space $\mathcal{B}$
$a := b,\ a \leftarrow b$	a is assigned the value b
$X \sim p(X)$	The random variable X is distributed according to the pdf $p(X)$
$X \sim D$	The random variable X is distributed according to the pdf specified by the distribution D, e.g. $D \equiv \mathrm{N}(0,1)$
$X_1,...,X_n \overset{\text{iid}}{\sim} D$	Each random variable X_i, $i = 1, \ldots, n$ is independently and identically distributed according to the pdf specified by the distribution D
$X\|Y$	The (random) variable X given/conditional on Y

Functions

$\inf \mathcal{A}$	The infimum of a set $\mathcal{A}$
$\sup \mathcal{A}$	The supremum of a set $\mathcal{A}$
$\min \mathcal{A}$	The minimum value of a set $\mathcal{A}$
$\max \mathcal{A}$	The maximum value of a set $\mathcal{A}$
$\arg\min_x f(x)$	The value of x which minimises the function $f(x)$
$\arg\max_x f(x)$	The value of x which maximises the function $f(x)$
$\|a\|$ with $a \in \mathbb{R}$	The absolute value of a; $\|a\| = a$ if a is positive, and $-a$ if a is negative, and $\|0\| = 0$
$\delta_{xx'}$	The Kronecker delta; $\delta_{xx'} = 1$ if $x = x'$, and 0 otherwise
$[A]$	The Iverson bracket; $[A] = 1$ if the logical proposition A is true, and 0 otherwise
$\mathbb{1}_{\mathcal{A}}(x)$	The indicator function; $\mathbb{1}_{\mathcal{A}}(x) = 1$ if $x \in \mathcal{A}$, and 0 otherwise
$e^x,\ \exp(x)$	The natural exponential function
$\log(x)$	The natural logarithmic function
$\frac{\mathrm{d}}{\mathrm{d}x} f(x),\ \dot{f}(x)$	The derivative of f with respect to x
$\frac{\mathrm{d}^2}{\mathrm{d}x^2} f(x),\ \ddot{f}(x)$	The second derivative of f with respect to x
$f \circ g$	Composition of functions, i.e. g following f

Abstract vector space operations and notations

$\mathcal{V}^{\perp}$	The orthogonal complement of the space $\mathcal{V}$
$\mathcal{V}^{\vee}$	The algebraic dual space of $\mathcal{V}$
$\mathcal{V}^*$	The continuous dual space of $\mathcal{V}$
$\overline{\mathcal{V}}$	The closure of the space $\mathcal{V}$
$\mathcal{B}(\mathcal{V})$	The Borel σ-algebra of $\mathcal{V}$
$\mathrm{L}^p(\mathcal{X}, \nu)$	The set of p-integrable functions over the space $\mathcal{X}$ with measure ν
$\mathrm{L}(\mathcal{V}; \mathcal{W})$	The set of bounded, linear operators from $\mathcal{V}$ to $\mathcal{W}$

$\dim(\mathcal{V})$	The dimensions of the vector space $\mathcal{V}$
$\langle x, y \rangle_{\mathcal{V}}$	The inner product between x and y in the vector space $\mathcal{V}$
$\|x\|_{\mathcal{V}}$	The norm of x in the vector space $\mathcal{V}$
$D(x, y)$	The distance between x and y
$x \otimes y$	The tensor product of x and y which are elements of a vector space
$\mathcal{F} \otimes \mathcal{G}$	The tensor product space of two vector spaces
$\mathcal{F} \oplus \mathcal{G}$	The direct sum (or tensor sum) of two vector spaces
$\mathrm{d}f(x)$	The first Fréchet differential of f at x
$\mathrm{d}^2 f(x)$	The second Fréchet differential of f at x
$\partial_v f(x)$	The first Gâteaux differential of f at x in the direction v
$\partial_v^2 f(x)$	The second Gâteaux differential of f at x in the direction v
$\nabla f(x)$	The gradient of f at x (f is a mapping between Hilbert spaces)
$\nabla^2 f(x)$	The Hessian of f at x (f is a mapping between Hilbert spaces)

Matrix and vector operations

$\mathbf{a}^\top, \mathbf{A}^\top$	The transpose of a vector $\mathbf{a}$ or a matrix $\mathbf{A}$
$\mathbf{A}^{-1}$	The inverse of a square matrix $\mathbf{A}$
$\|\mathbf{a}\|^2$	The squared 2-norm the vector $\mathbf{a}$, equivalent to $\mathbf{a}^\top \mathbf{a}$
$|\mathbf{A}|$	The determinant of a matrix $\mathbf{A}$
$\mathrm{tr}(\mathbf{A})$	The trace of a square matrix $\mathbf{A}$
$\mathrm{diag}(\mathbf{A})$	The diagonal elements of a square matrix $\mathbf{A}$
$\mathrm{rank}(\mathbf{A})$	The rank of a matrix $\mathbf{A}$
$\mathrm{vec}(\mathbf{A})$	The column-wise vectorisation of a matrix $\mathbf{A}$
$\mathbf{a} \otimes \mathbf{b}$	The outer product of two vectors $\mathbf{a}$ and $\mathbf{b}$
$\mathbf{A} \otimes \mathbf{B}$	The Kronecker product of matrix $\mathbf{A}$ with matrix $\mathbf{B}$
$\mathbf{A} \circ \mathbf{B}$	The Hadamard product two matrices $\mathbf{A}$ and $\mathbf{B}$

Statistical functions

$\mathrm{P}(A)$	The probability of event A occurring
$p(X|\theta)$	The probability density function of X given parameters θ
$L(\theta|X)$	The log-likelihood of θ given data X, sometimes simply $L(\theta)$
$\mathrm{BF}(M, M')$	Bayes factor for comparing two models M and M'
$\mathcal{I}(\theta)$	The Fisher information for θ
$\mathrm{E}(X), \mathrm{E}\,X$	The expectation[1] of the random element X
$\mathrm{Var}(X), \mathrm{Var}\,X$	The variance[1] of the random element X
$\mathrm{Cov}(X, Y)$	The covariance[1] between two random elements X and Y
$H(p)$	The entropy of the distribution $p(X)$
$\mathrm{D}_{\mathrm{KL}}\big(q(x)\|p(x)\big)$	The Kullback-Leibler divergence from $p(x)$ to $q(x)$, denoted also by $\mathrm{D}_{\mathrm{KL}}(q\|p)$ for short

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[1]When there is ambiguity as to which random element the expectation or variance is taken under or what its distribution is, this is explicated by means of subscripting, e.g. $\mathrm{E}_{X \sim \mathrm{N}(0,1)}\,X$ to denote the expectation of a standard normal random variable.

Statistical distributions

$N(\mu, \sigma^2)$	Univariate normal distribution with mean μ and variance σ^2
$N_d(\boldsymbol{\mu}, \boldsymbol{\Sigma})$	d-dimensional multivariate normal distribution with mean vector $\boldsymbol{\mu}$ and covariance matrix $\boldsymbol{\Sigma}$
$\phi(z)$	The standard normal pdf
$\Phi(z)$	The standard normal cdf
$\phi(x\|\mu, \sigma^2)$	The pdf of $N(\mu, \sigma^2)$
$\phi(\mathbf{x}\|\boldsymbol{\mu}, \boldsymbol{\Sigma})$	The pdf of $N_d(\boldsymbol{\mu}, \boldsymbol{\Sigma})$
$MN_{n,m}(\boldsymbol{\mu}, \boldsymbol{\Sigma}, \boldsymbol{\Psi})$	Matrix normal distribution with mean $\boldsymbol{\mu}$ and row variances $\boldsymbol{\Sigma} \in \mathbb{R}^{n \times n}$ and column variances $\boldsymbol{\Psi} \in \mathbb{R}^{m \times m}$
${}^tN(\mu, \sigma^2, a, b)$	Truncated univariate normal distribution with mean μ and variance σ^2 restricted to the interval (a, b)
$N_+(0, 1)$	The half-normal distribution
$N_+(0, \sigma^2)$	The folded-normal distribution with variance σ^2
${}^tN_d(\boldsymbol{\mu}, \boldsymbol{\Sigma}, \mathcal{A})$	Truncated d-dimensional multivariate normal distribution with mean vector $\boldsymbol{\mu}$ and covariance matrix $\boldsymbol{\Sigma}$ restricted to the set $\mathcal{A}$
$\Gamma(s, r)$	Gamma distribution with shape s and rate r parameters
$\Gamma^{-1}(s, \sigma)$	Inverse gamma distribution with shape s and scale σ parameters
χ_d^2	Chi-squared distribution with d degrees of freedom
$Bern(p)$	Bernoulli distribution with probability of success p
$Cat(p_1, \ldots, p_m)$	Categorical distribution with m categories, and each category has probability of success p_j

Abbreviations

ANOVA   analysis of variance
CAVI   coordinate ascent variational inference
cdf   cumulative distribution function
CRAN   Comprehensive R Archive Network
DAG   directed acyclic graph
ECM   expectation conditional maximisation
ELBO   evidence lower bound
EM   expectation-maximisation
fBm   Fractional Brownian motion
GPR   Gaussian process regression
HMC   Hamiltonian Monte Carlo
HPM   highest probability model
IIA   independent of irrelevant alternatives
iid   Identical and independently distributed
Lasso   Least absolute shrinkage and selection operator
MCMC   Markov chain Monte Carlo
ML   maximum likelihood
MMSE   minimum mean squared error
MSE   Mean squared error
OLS   ordinary least squares
pd/p.d. positive definite
pdf   probability density function
PIP   posterior inclusion probability
pmf   probability mass function
PMP   posterior model probability
RBF   radial basis function
RKHS   reproducing kernel Hilbert space
RKKS   reproducing kernel Kreǐn space
RMSE   root mean squared error
RSS   residual sum of squares
SE   Squared exponential (kernel)
SNR   signal-to-noise ratio

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evidence lower bound, *see* ELBO

fractional Brownian motion, *see* fBm

Hamiltonian Monte Carlo, *see* HMC

Markov chain Monte Carlo, *see* MCMC

signal-to-noise ratio, *see* SNR

squared exponential, *see* SE