ratio of two probability densities. Instead of using the log-likelihood ratio, one may use a power function or some convex function of the likelihood ratio, a generalization due to A. Renyi and I. Csiszár in the 1960s. The exploitation of this generalized divergence measure to solve various statistical estimations and hypothesis testing problems is the subject of this beautifully produced book, which fills the gap of many recent developments since Kullback's 1959 landmark *Information Theory and Statistics*.

Chapter 1 gives a nice summary of various divergence measures, including those of J. Burbea and C. R. Rao. Chapter 2 discusses the issues in estimating entropies from data whereas Chapters 3, 4 and 6 discuss applications in hypothesis testing. Chapter 5 covers minimum Φ-divergence estimators. A nice application of divergence measure is for compositional and contingency data, which is discussed in Chapters 7 and 8. The issue of testing general populations is discussed in the final chapter. Fairly complete references are provided for readers who may want to explore the original sources. Readership of the book should be statistical researchers who want to explore the boundaries of statistical inference paradigms and practitioners who are frequently faced with the needs to analyse categorical and discrete data.

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Gaussian Markov Random Fields: Theory and Applications

H. Rue and L. Held, 2005
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ISBN 1-584-88432-0

This book unifies and formalizes various strands in the emerging Bayesian literature on space–time smoothing. It considers inferential techniques and sampling methods that take advantage of the sparseness of the precision matrix Q (the inverse covariance matrix) in a class of Bayesian hierarchical models known as Gaussian graphical models, especially Gaussian Markov random fields (GMRFs). Whereas the covariance matrix is often of complicated form, for such models the precision matrix typically includes model information in simple form: for autoregressive AR1 error models in time and conditional autoregressive CAR1 models in space, 0s in precision matrices corresponding to conditional independences in such models.

In Chapter 2 the authors consider more generally the precision matrices for autoregressive models in time, spatial conditional autoregressions and space–time GMRF models. In spatial applications, there is benefit in Markov chain Monte Carlo sampling terms to focus on simplifying even further the structure of Q, for instance by reordering of the nodes (areas). This leads to a minimal diagonal band structure in Q followed by Cholesky decomposition to take advantage of the band diagonalization. An example on pages 45–48 considers band Cholesky factorization for a map of Germany.

Chapter 3 considers deficient rank precision matrices in improper or intrinsic GMRFs. It includes random-walk priors for equally and unequally spaced points ('locations') in time, and first- and higher order improper GMRFs on regular and irregular spatial lattices. Chapter 4 considers Markov chain Monte Carlo techniques in general, leading on to a consideration of block updating schemes that are of particular relevance in sampling for GMRF models (Knorr-Held and Rue, 2002). Applications in time series models (e.g. dynamic linear models type), semiparametric regression and binary regression with auxiliary variables are considered. Univariate and multivariate count disease models are also discussed.

Chapter 5 considers recent developments in GMRF methods, e.g. GMRF approximations instead of Gaussian fields in geostatistics. Appendix B contains more specific details for GMRF computing using the C routines in GMRFlib. This is a useful and up-to-date reference work in the area of space–time modelling and will complement related recent works such as those of Banerjee *et al.* (2004) and Waller and Gotway (2004).

References

Banerjee, S., Carlin, B. and Gelfand, A. (2004) *Hierarchical Modelling and Analysis for Spatial Data*. Boca Raton: Chapman Hall–CRC.
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Data Analysis of Asymmetric Structures

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What is asymmetry? The authors give no rigorous definition, and Chapter 1 presents it as one aspect of paired comparison data