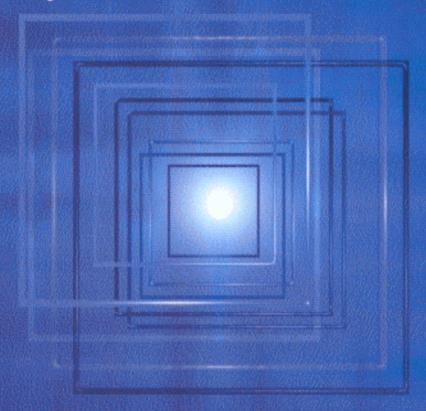


Applied Bayesian Modelling



Peter Congdon

WILEY SERIES IN PROBABILITY AND STATISTICS

Contents

Preface			xi	
Chapter 1	The Basis for, and Advantages of, Bayesian Model			
	Estimation via Repeated Sampling			
	1.1		1	
		Gibbs sampling	5	
		Simulating random variables from standard densities	12 18	
		Monitoring MCMC chains and assessing convergence		
		Model assessment and sensitivity	20	
		Review	27	
	Ref	erences	28	
Chapter 2	Hierarchical Mixture Models			
	2.1		31	
	2.2	General issues of model assessment: marginal likelihood		
		and other approaches	32	
		2.2.1 Bayes model selection using marginal likelihoods	33	
		2.2.2 Obtaining marginal likelihoods in practice	35	
		2.2.3 Approximating the posterior	37	
		2.2.4 Predictive criteria for model checking and selection	39	
		2.2.5 Replicate sampling	40	
	2.3	Ensemble estimates: pooling over similar units	41	
		2.3.1 Mixtures for Poisson and binomial data	43	
		2.3.2 Smoothing methods for continuous data	51	
	2.4	Discrete mixtures and Dirichlet processes	58	
		2.4.1 Discrete parametric mixtures	58	
		2.4.2 DPP priors	60	
	2.5	General additive and histogram smoothing priors	67	
		2.5.1 Smoothness priors	68	
	•	2.5.2 Histogram smoothing	69	
	2.6	Review	74	
	Ref	erences	75	
	Eve	rcises	78	

Chapter 3	Keg	ression .	Models	79		
	3.1	Introd	luction: Bayesian regression	79		
		3.1.1	Specifying priors: constraints on parameters	80		
		3.1.2	Prior specification: adopting robust			
			or informative priors	81		
		3.1.3	Regression models for overdispersed discrete outcomes	82		
	3.2		e between regression models and sets of predictors			
	٥.2	in regression				
			Predictor selection	84 85		
			Cross-validation regression model assessment	86		
	3.3		omous and ordinal regression	98		
	3.3	-	_	99		
		3.3.1	<u> </u>	100		
			Nested logit specification	101		
			Ordinal outcomes			
			Link functions	102		
-	3.4		ssions with latent mixtures	110		
			ral additive models for nonlinear regression effects	115		
	3.6		st Regression Methods	118		
			Binary selection models for robustness	119		
			Diagnostics for discordant observations	120		
	3.7	Revie	w	126		
	Refe	erences		129		
	Exe	rcises		132		
Chapter 4	Ana	lysis of	Multi-Level Data	135		
	4.1	Introd	luction	135		
	4.2	Multi-	-level models: univariate continuous			
		and di	iscrete outcomes	137		
		4.2.1	Discrete outcomes	139		
			lling heteroscedasticity	145		
	4.4 Robustness in multi-level modelling					
			-level data on multivariate indices	151 156		
			domain estimation	163		
		Review		167		
	References					
	Exercises					
	LAU.	CISCS		169		
•						
Chanter 5	Models for Time Series					
Спарист 5		Introd		171 171		
	5.2			171		
	ع.د		regressive and moving average models under narity and non-stationarity	172		
			* ·			
			Specifying priors	174		
		5.2.2	*1 · · · · · · · · · · · · · · · · · · ·	179		
			Formal tests of stationarity in the AR(1) model	180		
			Model assessment	182		
	5.3		ete Outcomes	191		
		5.3.1	Auto regression on transformed outcome	193		

	CONTENTS	vii
	5.3.2 INAR models for counts	193
	5.3.3 Continuity parameter models	195
	5.3.4 Multiple discrete outcomes	195
	5.4 Error correction models	200
	5.5 Dynamic linear models and time varying coefficients	203
	5.5.1 State space smoothing	205
	5.6 Stochastic variances and stochastic volatility	210
	5.6.1 ARCH and GARCH models	210
	5.6.2 Stochastic volatility models	211
	5.7 Modelling structural shifts	215
	5.7.1 Binary indicators for mean and variance shifts	215
	5.7.2 Markov mixtures	216
	5.7.3 Switching regressions	216
	5.8 Review	221
	References	222
	Exercises	225
Chanton 6	Analysis of Banal Data	227
Chapter 6	Analysis of Panel Data 6.1 Introduction	227
	6.1.1 Two stage models	228
	6.1.2 Fixed vs. random effects	230
	6.1.3 Time dependent effects	230
	6.2 Normal linear panel models and growth curves	231
	for metric outcomes	231
	6.2.1 Growth Curve Variability	232
	6.2.2 The linear mixed model	234
	6.2.3 Variable autoregressive parameters	235
•	6.3 Longitudinal discrete data: binary, ordinal and	255
	multinomial and Poisson panel data	243
	6.3.1 Beta-binomial mixture for panel data	244
	6.4 Panels for forecasting	257
	6.4.1 Demographic data by age and time period	261
	6.5 Missing data in longitudinal studies	264
	6.6 Review	268
	References	269
	Exercises	271
Ob 4 5	No. 1.1. See Co. 45-1 Ontoning and Communities Association	272
Chapter 7	Models for Spatial Outcomes and Geographical Association 7.1 Introduction	273
		273
	· · ·	275
	interaction schemes 7.2.1 Joint vs. conditional priors	275 276
		2/0
	• · · · · · · · · · · · · · · · · · · ·	278
	analysis involving count data 7.3.1 Alternative spatial priors in disease models	278 279
	7.3.1 Afternative spatial priors in disease models 7.3.2 Models recognising discontinuities	2/9
	7.3.3 Binary Outcomes	281
	1.3.3 Diliary Outcomes	202

viii CONTENTS

	7.4 Direct modelling of spatial covariation in regression				
	and interpolation applications	289			
	7.4.1 Covariance modelling in regression	290			
	7.4.2 Spatial interpolation	291			
	7.4.3 Variogram methods	292			
	7.4.4 Conditional specification of spatial error	293			
	7.5 Spatial heterogeneity: spatial expansion, geographically				
	weighted regression, and multivariate errors	298			
	7.5.1 Spatial expansion model	298			
	7.5.2 Geographically weighted regression	299			
	7.5.3 Varying regressions effects via multivariate priors	300			
	7.6 Clustering in relation to known centres	303			
	7.6.1 Areas vs. case events as data	306			
	7.6.2 Multiple sources	306			
	7.7 Spatio-temporal models	310			
	7.7.1 Space-time interaction effects	312			
	7.7.2 Area Level Trends	312			
	7.7.3 Predictor effects in spatio-temporal models	313			
	7.7.4 Diffusion processes	314			
	7.8 Review	316			
	References	317			
	Exercises	320			
		323			
Chapter 8	Structural Equation and Latent Variable Models				
	8.1 Introduction	323			
	8.1.1 Extensions to other applications	325			
	8.1.2 Benefits of Bayesian approach	326			
	8.2 Confirmatory factor analysis with a single group	327			
	8.3 Latent trait and latent class analysis for discrete outcomes	334			
	8.3.1 Latent class models	335			
	8.4 Latent variables in panel and clustered data analysis	340			
	8.4.1 Latent trait models for continuous data	341			
	8.4.2 Latent class models through time	341			
	8.4.3 Latent trait models for time varying discrete outcomes	343			
	8.4.4 Latent trait models for clustered metric data	343			
	8.4.5 Latent trait models for mixed outcomes	344			
	8.5 Latent structure analysis for missing data	352			
	8.6 Review	357 358			
	References				
	Exercises	360			
		361			
Chapter 9	Survival and Event History Models				
=	9.1 Introduction	361			
	9.2 Continuous time functions for survival	363			
	9.3 Accelerated hazards	370			
	9.4 Discrete time approximations	372			
	9.4.1 Discrete time hazards regression	375			

			CONTENTS	ix	
		9.4.2	Gamma process priors	381	
	9.5	Accour	nting for frailty in event history and survival models	384	
	9.6	Counti	ng process models	388	
	9.7 Review				
	Refe	rences		394	
	Exer	cises		396	
Chapter 10	Mod	lelling ar	nd Establishing Causal Relations: Epidemiological		
•	Methods and Models				
	10.1	Causal	processes and establishing causality	397	
		10.1.1	Specific methodological issues	398	
	10.2	Confou	inding between disease risk factors	399	
			Stratification vs. multivariate methods	400	
	10.3 Dose-response relations				
		10.3.1	Clustering effects and other methodological issues	416	
		10.3.2	Background mortality	427	
	10.4	Meta-a	nalysis: establishing consistent associations	429	
		10.4.1	Priors for study variability	430	
			Heterogeneity in patient risk	436	
		10.4.3	Multiple treatments	439	
		10.4.4	Publication bias	441	
	10.5	Review	7	443	
	Refe	erences		444	
		cises		447	

Index

449