

---

# Contents

<b>1</b>	<b>User's Manual</b> .....	1
1.1	Expectations .....	2
1.2	Prerequisites and Further Reading .....	3
1.3	Styles and Fonts .....	4
1.4	An Introduction to R .....	5
1.4.1	Getting Started .....	6
1.4.2	R Objects .....	8
1.4.3	Probability Distributions in R .....	15
1.4.4	Graphical Facilities .....	16
1.4.5	Writing New R Functions .....	19
1.4.6	Input and Output in R .....	21
1.4.7	Administration of R Objects .....	21
1.5	The bayess Package .....	22
<b>2</b>	<b>Normal Models</b> .....	25
2.1	Normal Modeling .....	26
2.2	The Bayesian Toolkit .....	28
2.2.1	Posterior Distribution .....	28
2.2.2	Bayesian Estimates .....	33
2.2.3	Conjugate Prior Distributions .....	34
2.2.4	Noninformative Priors .....	35
2.2.5	Bayesian Credible Intervals .....	37
2.3	Bayesian Model Choice .....	38
2.3.1	The Model Index as a Parameter .....	39
2.3.2	The Bayes Factor .....	41
2.3.3	The Ban on Improper Priors .....	43
2.4	Monte Carlo Methods .....	46
2.4.1	An Approximation Based on Simulations .....	47
2.4.2	Importance Sampling .....	49
2.4.3	Approximation of Bayes Factors .....	52

2.5	Outlier Detection	58
2.6	Exercises	61
<b>3</b>	<b>Regression and Variable Selection</b>	<b>65</b>
3.1	Linear Models	66
3.2	Classical Least Squares Estimator	69
3.3	The Jeffreys Prior Analysis	73
3.4	Zellner's $G$ -Prior Analysis	74
3.4.1	A Semi-noninformative Solution	75
3.4.2	The BayesReg R Function	80
3.4.3	Bayes Factors and Model Comparison	81
3.4.4	Prediction	84
3.5	Markov Chain Monte Carlo Methods	85
3.5.1	Conditionals	86
3.5.2	Two-Stage Gibbs Sampler	87
3.5.3	The General Gibbs Sampler	90
3.6	Variable Selection	91
3.6.1	Deciding on Explanatory Variables	91
3.6.2	$G$ -Prior Distributions for Model Choice	93
3.6.3	A Stochastic Search for the Most Likely Model	96
3.7	Exercises	98
<b>4</b>	<b>Generalized Linear Models</b>	<b>103</b>
4.1	A Generalization of the Linear Model	104
4.1.1	Motivation	104
4.1.2	Link Functions	106
4.2	Metropolis–Hastings Algorithms	108
4.2.1	Definition	109
4.2.2	The Independence Sampler	110
4.2.3	The Random Walk Sampler	111
4.2.4	Output Analysis and Proposal Design	111
4.3	The Probit Model	115
4.3.1	Flat Prior	115
4.3.2	Noninformative $G$ -Priors	117
4.3.3	About Informative Prior Analyses	122
4.4	The Logit Model	124
4.5	Log-Linear Models	127
4.5.1	Contingency Tables	127
4.5.2	Inference Under a Flat Prior	131
4.5.3	Model Choice and Significance of the Parameters	133
4.6	Exercises	137

<b>5</b>	<b>Capture–Recapture Experiments</b> .....	139
5.1	Inference in a Finite Population .....	140
5.2	Sampling Models .....	142
5.2.1	The Binomial Capture Model .....	142
5.2.2	The Two-Stage Capture–Recapture Model .....	143
5.2.3	The $T$ -Stage Capture–Recapture Model .....	148
5.3	Open Populations .....	152
5.4	Accept–Reject Algorithms .....	156
5.5	The Arnason–Schwarz Capture–Recapture Model .....	160
5.5.1	Modeling .....	161
5.5.2	Gibbs Sampler .....	165
5.6	Exercises .....	168
<b>6</b>	<b>Mixture Models</b> .....	173
6.1	Missing Variable Models .....	174
6.2	Finite Mixture Models .....	176
6.3	Mixture Likelihoods and Posteriors .....	177
6.4	MCMC Solutions .....	182
6.5	Label Switching Difficulty .....	192
6.6	Prior Selection .....	198
6.7	Tempering .....	199
6.8	Mixtures with an Unknown Number of Components .....	201
6.9	Exercises .....	206
<b>7</b>	<b>Time Series</b> .....	209
7.1	Time-Indexed Data .....	210
7.1.1	Setting .....	210
7.1.2	Stability of Time Series .....	212
7.2	Autoregressive (AR) Models .....	214
7.2.1	The Models .....	215
7.2.2	Exploring the Parameter Space by MCMC Algorithms .....	219
7.3	Moving Average (MA) Models .....	226
7.4	ARMA Models and Other Extensions .....	232
7.5	Hidden Markov Models .....	236
7.5.1	Basics .....	237
7.5.2	Forward–Backward Representation .....	241
7.6	Exercises .....	248
<b>8</b>	<b>Image Analysis</b> .....	251
8.1	Image Analysis as a Statistical Problem .....	252
8.2	Spatial Dependence .....	252
8.2.1	Grids and Lattices .....	252
8.2.2	Markov Random Fields .....	254
8.2.3	The Ising Model .....	256
8.2.4	The Potts Model .....	260

- 8.3 Handling the Normalizing Constant ..... 262
  - 8.3.1 Path Sampling ..... 264
  - 8.3.2 The ABC Method ..... 267
  - 8.3.3 Inference on Potts Models ..... 270
- 8.4 Image Segmentation ..... 273
- 8.5 Exercises ..... 281
  
- About the Authors** ..... 285
  
- References** ..... 287
  
- Index** ..... 291



<http://www.springer.com/978-1-4614-8686-2>

Bayesian Essentials with R

Marin, J.-M.; Robert, C.

2014, XIV, 296 p. 75 illus., 38 illus. in color., Hardcover

ISBN: 978-1-4614-8686-2