
CONTENTS

| | | |
|----------|---|-----------|
| 1 | Introduction | 5 |
| 1.1 | Discrete longitudinal data | 5 |
| 1.2 | Hierarchical modelling of discrete longitudinal data | 11 |
| 1.3 | Scope of thesis | 13 |
| 2 | Markov chain Monte Carlo | 15 |
| 2.1 | Full conditionals and the Hastings algorithm | 17 |
| 2.1.1 | Full conditional distributions | 17 |
| 2.1.2 | The Hastings algorithm | 18 |
| 2.1.3 | Some special types of Hastings algorithms | 22 |
| 2.1.4 | Visiting schedules, choice between samplers and blocking strategies | 23 |
| 2.2 | MCMC diagnostics | 24 |
| 2.2.1 | How much burn-in? | 25 |
| 2.2.2 | How many samples? | 25 |
| 2.3 | Parameter estimation based on posterior samples | 26 |
| 3 | Mixed models | 27 |
| 3.1 | Model definition | 29 |
| 3.2 | MCMC in mixed models | 30 |
| 3.2.1 | Derivative-free updating | 32 |
| 3.2.2 | Weighted least squares proposals | 33 |
| 3.3 | Incorporating model uncertainty | 33 |
| 3.4 | An application to longitudinal count data | 35 |

| | | |
|----------|---|-----------|
| 4 | Dynamic models | 39 |
| 4.1 | Autoregressive priors | 40 |
| 4.1.1 | Definition and some examples | 41 |
| 4.1.2 | Conditional distributions in autoregressive priors | 46 |
| 4.2 | Model definition | 48 |
| 4.3 | MCMC in dynamic models | 50 |
| 4.3.1 | Single move | 50 |
| 4.3.2 | Block move | 52 |
| 4.3.3 | Blocking strategies | 53 |
| 4.3.4 | Blocking strategies for products of autoregressive priors | 53 |
| 4.3.5 | An example | 54 |
| 4.3.6 | Other MCMC strategies | 57 |
| 4.4 | Incorporating model uncertainty | 60 |
| 5 | Further topics | 65 |
| 5.1 | Categorical covariates and dynamic models | 65 |
| 5.1.1 | Constrained random walk priors | 68 |
| 5.1.2 | MCMC implementation | 72 |
| 5.2 | Non-equally spaced data | 74 |
| 5.2.1 | Generalized first order random walks | 74 |
| 5.2.2 | Generalized second order random walks | 75 |
| 5.3 | Priors for spatial correlation | 77 |
| 5.4 | Combinations of dynamic and mixed models | 79 |
| 6 | Case studies | 83 |
| 6.1 | IFO business test data | 83 |
| 6.1.1 | Data description | 83 |
| 6.1.2 | The model | 84 |
| 6.1.3 | MCMC implementation | 86 |
| 6.1.4 | Results | 86 |
| 6.2 | Modelling longitudinal paired comparison data | 92 |

| | | |
|----------|---|------------|
| 6.2.1 | Data description | 94 |
| 6.2.2 | The model | 95 |
| 6.2.3 | MCMC implementation | 96 |
| 6.2.4 | Results | 96 |
| 6.3 | Time-space modelling of disease risk data | 101 |
| 6.3.1 | Data description | 102 |
| 6.3.2 | Time-space modelling | 104 |
| 6.3.3 | MCMC implementation | 105 |
| 6.3.4 | Results | 106 |
| A | Parametrization of some distributions | 117 |
| B | Computation of some full conditional distributions | 119 |
| C | Computation for Section 5.1.1 | 121 |
| | Bibliography | 127 |