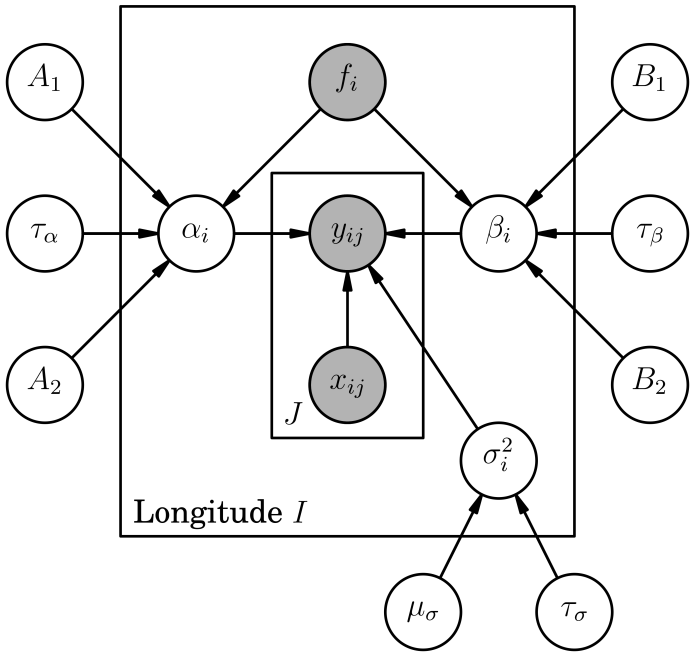
1 General Model Framework

We wish to split the sky map into longitudinal bins, regressing FUV (y_{ij}) on i100 (x_{ij}) within each bin i. As such, this problem lends itself to a hierarchical framework in which each longitudinal bin has its own slope β_i and intercept α_i, which are both linear functions of the light intensity (f_i) of the bin. This can be represented graphically as:



1.1 Linear Model

We model y_{ij} as a square root function of the strictly positive parameters with the following setup:

$$y_{ij} \sim N\Big(\alpha_i + \beta_i x_{ij}, \sigma_i^2\Big) \qquad \alpha_i \sim N(A_1 + A_2 f_i, \tau_\alpha) \qquad \beta_i \sim N(B_1 + B_2 f_i, \tau_\beta) \qquad \log \sigma_i \sim N(\mu_\sigma, \tau_\sigma^2)$$

1.2 Square Root Model

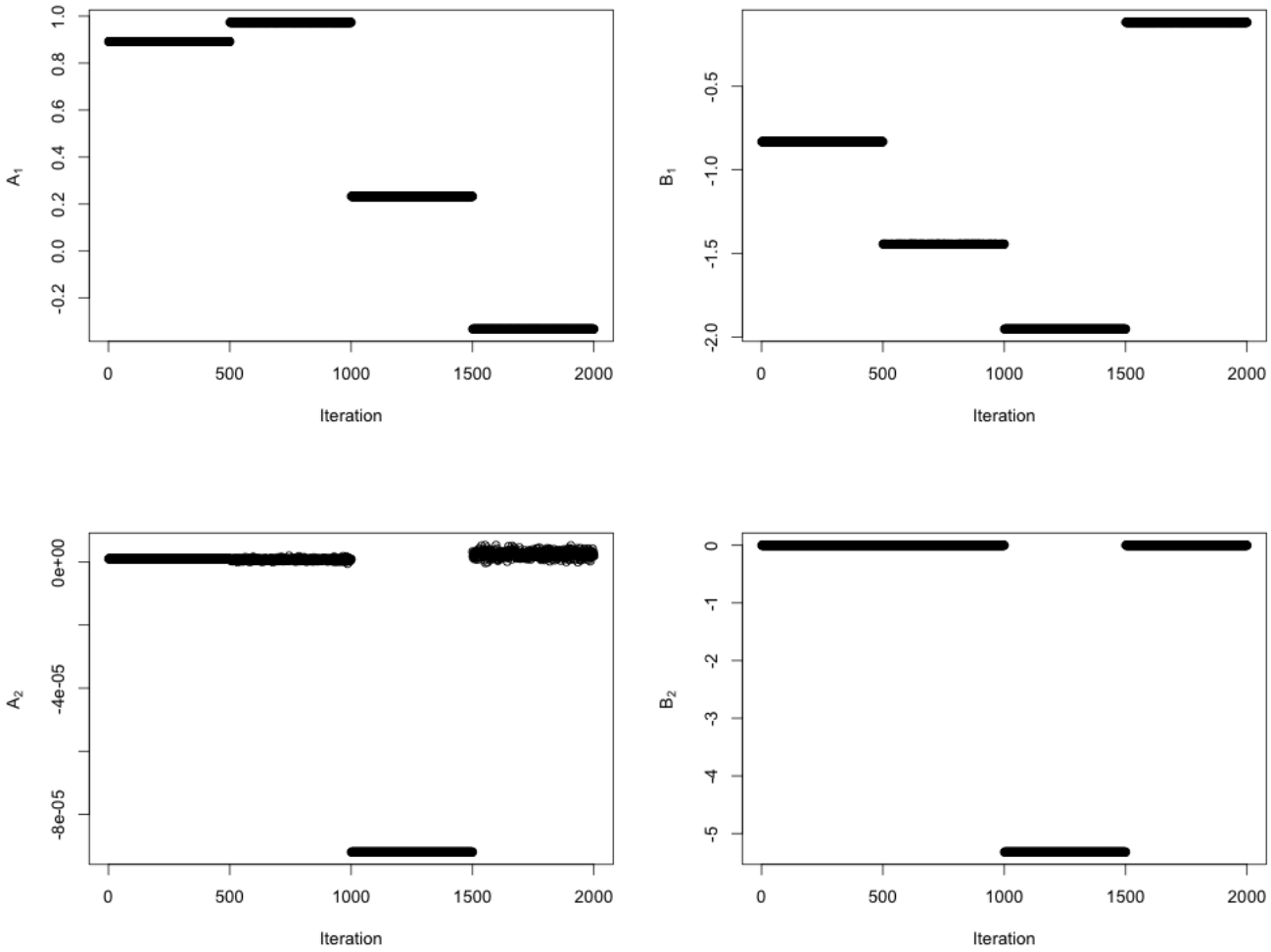
We model y_{ij} as a square root function of the strictly positive parameters with the following setup:

$$y_{ij} \sim N\Big(\sqrt{\alpha_i^2 + \beta_i^2 x_{ij}^2}, \sigma_i^2\Big) \qquad \alpha_i \sim N(A_1 + A_2 f_i, \tau_\alpha) \qquad \beta_i \sim N(B_1 + B_2 f_i, \tau_\beta) \qquad \log \sigma_i \sim N(\mu_\sigma, \tau_\sigma^2)$$

2 Linear Model Fitting

We fit the model with 360 bins (100 data points sampled from each bin, with i100 bounded above by 4) and four chains of 1000 iterations (4.29 minutes).

Strangely, the four chains for the hyper parameters A_1, A_2, B_1, and B_2 are not mixing.



3 Square Root Model Fitting

The same issue is present when we fit the square root model.