Overall model

$[\text{counts} \mid \mu, \pi] = I_{[n=0]}(1 - \pi + \pi e^{-\mu}) + I_{[n>0]}\pi\frac{\mu^n e^{-\mu}}{n!}$

Parameters

$\log(\boldsymbol{\mu}) = \boldsymbol{\alpha}^{(\mu)} + \boldsymbol{X}\boldsymbol{\beta}^{(\mu)} + \boldsymbol{\Phi}^{(\mu)} + \log(\boldsymbol{a})$

$\text{logit}(\boldsymbol{\pi}) = \boldsymbol{\alpha}^{(\pi)} + \boldsymbol{X}\boldsymbol{\beta}^{(\pi)} + \boldsymbol{\Phi}^{(\pi)}$

Priors

$\boldsymbol{\beta} \sim N(\mathbf{0}, \boldsymbol{V} \otimes \boldsymbol{U})$
$\boldsymbol{V}$ is spatial correlation matrix
$\boldsymbol{U}$ is covariance matrix for spline covariates; has AR(1) structure

t^{th} column of $\boldsymbol{\Phi}$:
$\boldsymbol{\phi}_{t=1} \sim N(\mathbf{0}, (\tau(\boldsymbol{D} - \boldsymbol{W}))^{-1})$
$\boldsymbol{\phi}_t \sim N(\eta\boldsymbol{\phi}_{t-1}, (\tau(\boldsymbol{D} - \boldsymbol{W}))^{-1})$
$\boldsymbol{D} = 84 \times 84$ diagonal matrix, entries correspond to number of spatial neighbors for each spatial unit
$\boldsymbol{W} = 84 \times 84$ spatial adjacency matrix with nonzero elements only when unit i is a neighbor of unit j