

Bayesian Model

Brian D. Gerber

October 4, 2024

1 Bayesian Generalized Linear Model

1.1 Hierarchical Statistical Model with extra Variance Term for Unexplained Site Specific Variation

We want to fit a model to our data, where the occurrence of the species ($y_{i,j}$) for site i in projected area j is modeled as,

$$\begin{aligned} y_{i,j} &\sim \text{Bernoulli}(p_{i,j}) \\ \text{logit}(p_{i,j}) &= \beta_0 + \beta_1 \times \text{dist.human}_{i,j} + \epsilon_{i,j} \\ \epsilon_{i,j} &\sim \text{Normal}(0, \sigma) \end{aligned}$$

1.1.1 Priors

$$\begin{aligned} \beta_0 &\sim \text{Logistic}(0, 1) \\ \beta_1 &\sim \text{Logistic}(0, 1) \\ \sigma &\sim \text{Uniform}(0, 5) \end{aligned}$$

1.2 JAGS syntax for this model

```
model {  
  
# Priors  
  b0 ~ dlogis(0,1)  
  b1 ~ dlogis(0,1)  
  sigma ~ dunif(0,5)  
  tau <- 1/sigma^2  
  
# Likelihood  
  for (i in 1:N) {  
    y[i] ~ dbern(p[i])  
    logit(p[i]) <- b0 + b1*dist.human[i]+epsilon[i]  
    epsilon[i] ~ dnorm(0,tau)  
  } #End loop  
  
} #End Model
```

1.3 Hierarchical Statistical Model with Extra Variance Term for Unexplained Variation by Protected Area

We want to fit a model to our data, where the occurrence of the species ($y_{i,j}$) for site i in projected area j is modeled as,

$$\begin{aligned}y_{i,j} &\sim \text{Bernoulli}(p_{i,j}) \\ \text{logit}(p_{i,j}) &= \beta_0 + \beta_1 \times \text{dist.human}_{i,j} + \epsilon_j \\ \epsilon_j &\sim \text{Normal}(0, \sigma)\end{aligned}$$

1.3.1 Priors

$$\beta_0 \sim \text{Logistic}(0, 1)$$

$$\beta_1 \sim \text{Logistic}(0, 1)$$

$$\sigma \sim \text{Uniform}(0, 5)$$

1.4 JAGS syntax for this model

Note that the variable PA should be an index labled as 1,1,1,1....50 times for the first PA and then 2,2,2,2...50 times for the second PA and so on....

```
model {  
  
  # Priors  
  b0 ~ dlogis(0,1)  
  b1 ~ dlogis(0,1)  
  sigma ~ dunif(0,5)  
  tau <- 1/sigma^2  
  
  # Likelihood  
  for (i in 1:N) {  
    y[i] ~ dbern(p[i])  
    logit(p[i]) <- b0 + b1*dist.human[i]+epsilon[PA[i]]  
  } #End loop  
  
  #Random variation by PA  
  for(i in 1:N.PA){  
    epsilon[j] ~ dnorm(0,tau)  
  }  
  
} #End Model
```