1. boral Model

site i
species j
latent factor k

Φ: CDF of standard normal
observed data: Y_{ij} true occurrence, assuming perfect detection
parameters: λ_{jk}
random effects: η_{ik}

$$
\begin{aligned}
Y_{ij} &\sim Bern(\Phi(v_{ij})) \\
v_{ij} &= \eta_{i.}\lambda'_{j.} \\
\eta_{i.} &\sim MVN(0, I_K) \\
\lambda_{jk} &\sim N(0, 10)
\end{aligned}
$$

Think of λ_{kj} as species-specific coefficients for unobserved covariates $\eta_{i.}$ at the site level. They introduce correlation between species: $v_{i.} \sim MVN(0, \Lambda\Lambda')$.

Note: ignoring fixed effects of observable covariates for now