Let denote if cases were observed in county i at time t (0 and 1 represent the absence and presence of cases, respectively).

where is the detection probability and is the true infection status of county i at time t. We assume that the detection probability depends on several covariates through the following relationship:

where is the design vector containing covariates and is a vector of regression coefficients.

In relation to the partially latent true infection statuses, we assume that

In other words, once a location has been invaded, if remains invaded. We use a probit regression framework to model the invasion process:

where is another design vector containing covariates and is a vector of regression coefficients.

An important covariate contained in this design vector is the invasion pressure variable, given by:

where is the distance between county i and county j. This invasion pressure variable captures spatial and temporal correlation in these data by acknowledging the stronger influence of neighboring counties relative to more distant counties.

To finish specifying this model, we assume that:

#-------------------------------------------------------------------

Full model

The full model is given by:

#-------------------------------------------------------------------

Full conditional distributions

To implement the probit regression, we assume that:

iff

otherwise

Therefore, if and , then:

Therefore, if and , then:

We sample these parameters using an MH algorithm

where A is the set for which or .

I will only sample this when