

**STAT 406, Spring 2008**  
**Assignment 4 (turn in by Thursday, March 27)**

The Buell-Small Succession Study (<http://www.ecostudies.org/bss/>) is a long-term ecological field experiment designed to document succession on released agricultural fields. The study began in 1958 at the Hutcheson Memorial Forest in New Jersey and continues to the present. The data set you have to work with for this assignment (plants.txt) is a portion of this much larger data base. I have selected here data collected on two adjacent fields (E1 and E2) and the time span between 1968 and 1978. The data consists of presence or absence of two species, one a so-called resident species (Red Sorrel, denoted as S) and an exotic invasive species (Honeysuckle, denoted as H). Presence or absence of these species at each of the 96 locations is recorded as 1 or 0. The coordinates are given in meters from an arbitrarily defined origin.

- First task for this assignment is to use exploratory tools to identify whether the two species display spatial dependence. Do so for each year, for each species. You can consider either Moran's I to do this, and I would suggest an Monte Carlo test, or, more appropriately for binary data, a Join Count test. For each of the two species, plot a graph with the time on the x-axis and the test statistics which you used to test for spatial dependence on the y-axis (this is a little bit trickier for the join count statistics, since R reports two statistics, just keep in mind the discussion we had about their meaningfulness in terms of the overall proportion of 1s and 0s in the data set, and report the appropriate value). To make the graph easier to read, use different symbols for statistics that turned out to be significant versus the ones that did not (to change the point type in a plot, use the option pch). Write a short paragraph describing what you have uncovered through these explorations.

- Secondly, using the functions provided by me, fit a CAR model with constant mean to each of the years, each of the species. Report, in a table, the values of the estimated parameters for each of these cases, and their standard errors. Comment on these findings and how they compare to the exploratory analysis you performed in the first part.
- Thirdly, select a subset of three years, one in the beginning, one in the middle, and one towards the end, and fit a CAR model for Sorrel using Honeysuckle as a covariate. Report the estimated parameter values and comment on the effect of Honeysuckle on Sorrel.
- Finally, for one single year, your choice which one, compute MSPE (mean square predicted errors) for the constant mean model, for the model with covariate and for the model under independence (in this case, the prediction is simply the average over the entire domain). Comment on these findings (i.e. does it look like fitting a spatial model improved your predictions, does it look like adding a covariate to the spatial model with constant mean improved predictions?)