# Laboratory 10 – Advanced Analysis, Spatial Regression

Objectives:

This week will be similar to last week in that I will provide you with the outline for a relatively advanced analysis, introducing you to the concepts and a workflow for spatial regression.

### Introduction:

Building on last week, we will continue building a library of techniques utilizing the Spatial\* objects. You will learn how to apply some basic techniques for detecting spatial autocorrelation in your data and model residuals. Then you will learn a couple of basic techniques for incorporating that spatial structure into the model estimation process to account for that autocorrelation.

There are multiple approaches to incorporating spatial structure into regression. They range from simply removing a trend surface and modeling the residuals, to much more sophisticated approaches such as spatial Durbin models and simultaneous or conditional autoregressive regression (SAR/CAR). We will explore two intermediate techniques called spatial error models (SEM) and spatial lag models (SLM) which are two types of spatial simultaneous autoregressive models. We will fit these using R on a sample data set of median house values in Boston townships.

### More Background:

When we have spatial autocorrelation in our **residuals**, or in the error structure of the model we are constructing, we can incorporate spatial effects directly into the error term of the model during estimation:



Where:



If there is no spatial correlation between the errors, then λ = 0

Alternatively, instead of assuming that the spatial process involved is inducing correlation into prediction errors, it may be modeled as part of the process underlying the correlation structure of the **observed response**. This is called a spatial lag model and works by including a spatially lagged dependent variable as an additional predictor:



Where:



If there is no spatial dependence in our observed response data, and a particular observation *y* does not depend on neighboring *y* values then the estimate for rho, will be *ρ =* 0.

## Questions

**All of the questions for this week’s lab appear in the “/src/Lab 10 – Advanced Analysis, Spatial Regression.r” file that you will be following. Please just answer the questions with comments and the code you used to generate the answers.**

**[Total Points: 100]**