R Short Course for GIS and Spatial Econometrics:

This is a brief outline for a proposed short course in using R to introduce Geographic Information Systems (GIS) and Spatial Econometrics. The course is targeted for graduate students that have a research interest in spatial data. Currently, this is intended to have 6 one-hour long lectures and any highlighted sections are areas to focus on for improving this course in the future.

1. **Basics for Using R:**
    a. An introduction to the statistical software used for this course. Those familiar with R already may skip this lecture. Topics include:
        i. Installing R software, as well as RStudio
        ii. Understanding the user interface and the R environment
        iii. Defining variable classes, objects, functions, and packages
        iv. Loading/saving data
        v. Simple commands
2. **Basics for Geographic Information Systems (GIS) and Spatial Data:**
    a. A geographic information system (GIS) lets us visualize, question, analyze, interpret, and understand data to reveal relationships, patterns, and trends.
    b. Gives a better understanding of what GIS is and why one would be concerned with GIS. Topics will include:
        i. General Geography knowledge on coordinate systems
        ii. Geospatial versus Areal versus Spatial Point Patter Data
        iii. Map projects
        iv. Different distance calculations in a GIS framework
3. **R and GIS I – Displaying Data:**
    a. Introduces how R can be an environment to GIS techniques to display data. R is a low cost (free as in beer) alternative to other GIS software such as ArcGIS. R is only a statistical program and language, so GIS packages need to be installed for this to work functionally.
    b. Topics include:
        i. Loading shape files
        ii. Merging shape files with data
        iii. Plotting maps with different projections
        iv. Choropleths (maps with regions shaded in so as to define a variables value at a given region)
        v. Locational plots
        vi. Mapping changes of a variable over time
    c. Packages used:
        i. animation
        ii. ggplot2
        iii. gpclib

iv. rgdal
v. sp

4. **R and GIS II – Extracting Spatial Information:**
    a. Spatial Data can have important features that are needed for a model used in research. This may need to be calculated through shape files or other spatial data.
    b. Topics include:
        i. Calculating the centroid for a region
        ii. Crow's distance calculation
        iii. Calculating distance to a fixed location
        iv. Integrating Google Maps for calculating distance/time for driving, biking, walking
    c. Packages used:
        i. ggmap
        ii. rgdal
        iii. sp
        iv. spdep
5. **Spatial Statistics I – Introduction:**
    a. Gives a brief introduction to Spatial Statistics, further interest in this topic should be explored in ST 730 (Applied Spatial Statistics) and ST 810 (Advanced Spatial Statistics).
    b. Introduce the concept of spatial correlation and the implications of modeling a spatial process with simple OLS.
    c. Topics include:
        i. Moran's I Test
        ii. Spatial Model Simulations
        iii. Kriging (predicting unknown spatial locations given known spatial data)
        iv. Estimating
6. **Spatial Econometrics I – Introduction:**
    a. Introduction to the field of Spatial Econometrics and application of models to data. The purpose is to give a rough introduction to the 3 main spatial econometric models, how they are used and the interpretation of the model estimates.
    b. The WVU Spatial Econometrics Course could potentially help my personal understanding of Spatial Econometrics that could expand upon this section.
    c. Topics include:
        i. Spatial Weighting Matrix interpretation and calculation
        ii. Spatial Data Generating Process for:
            1. Spatial Autoregressive (SAR) Model
            2. Spatial Error Model (SEM)
            3. Spatial Durbin Model
        iii. Global versus Local Spillovers
        iv. Model Selection using LaGrange Multiplier Test
        v. Interpretation of spatial coefficients

vi. Direct, Indirect, and Total Impacts of coefficients in spatial models

7. Spatial Econometrics II – Additional Topics:

a. Additional topics may include:

i. Further descriptions of the SAR, SEM, and Spatial Durbin Models

ii. Geographically Weighted Regressions, a modeling technique that implies coefficients vary across space

iii. Bayesian Spatial Econometrics