Homework #7 – Time & Space

This homework will be like the last 2 – only hand in the code, output & results & answers to questions.

Time

Decomposing

Load the data nottem which contains temperatures in Nottingham over several decades (data(nottem) in library(MASS)).

Plot and print the nottem series.

Decompose it into trend/season/residual using:

```
t3=stl(…. # you should be able to figure this out
```

Plot the result. Print the result.

1) **What is the range in seasonal temperature effects (how many degrees between warmest and coldest month) and what is the warmest and coldest month.**
2) **Now look at the trend and remainder data. Adding trend and remainder, what is the most unuseasonably warm month across the whole time span? The most unseasonably cold month?**

Now extract the three series

```
nttrend=t3$time.series[,'trend']
ntseasonal=t3$time.series[,'seasonal']
nttresid=t3$time.series[,'remainder']
```

ACF analysis

Run an autocorrelation function (acf) on the nttrend

3) Excepting the first 2 years, what is the lag (time span) associated with the largest negative correlation? largest positive correlation? Are either significant? Any guess what might cause these?

Fractal analysis

Plot the periodogram (command spectrum, hint use the option span=5). Look in the Halley paper. Does the periodogram look most like white, pink, or brown noise? Let's find out. Recall that the slope of log(power) vs. log(frequency) gives β. Do:

```
sp=spectrum(nttrend,span=5)
(lm(log(sp$spec)~log(sp$freq)))
```

4) What is the slope. What color does this β indicate? You may need to refer to the Halley paper.

Space

Load the data: http://128.196.231.204/614/dicklla.csv. It has the Dickcissel log abundance and latitude and longitude. Normally, since latitude and longitude are coordinates on a sphere a projection (such as Mercator) is needed to convert these into x & y coordinates on a flat surface. Since the area we are examining is small (relative to the globe) we will ignore this and treat lat & lon as the y and x coordinates respectively.

5) Is this data lattice, geospatial or point process?

Plotting GIS data

Plot a 2-degree polynomial trend surface. Plot a 4-degree polynomial trend surface. You may find the "levels=seq(-1,2.5,0.5)" option on the contour command useful. Add the actual data points using the "points" command. The surface outside these points is not valid and should be ignored. Good thing you plotted the points! This is typical to have important looking features outside the actual data. Plot a krigged surface. 6**) Describe verbally what features the 4-degree surface picks up over the 2-degree surface. What does the krigged surface pick up over the 4-degree? How does this compare to the actual surface found in the class notes?**

“Grams” (analogs to ACF)

Plot a variogram and correlogram for the data with no trend removed. There are at least two ways to do this (hint: one uses variogram and formulas involving ~1 and ~lat+lon in library gstat; the other involves library(spatial) and the surf.ls – what degree polynomial leaves all trend in – and the commands variogramor correlogram). **7) Interpret verbally the two correlograms. What pattern do they show with distance? What does this suggest about the shape of the abundance surface?** Now run variogram/correlogram with 2nd degree polynomial trend removed. **8) How does the variogram/correlogram change?**

Exogenous factors/spatial regression/GLS

Load the dataset http://128.196.231.204/614/dickspatial.csv. This contains abundance and latitude and longitude of the dickcissel (like the last dataset) but also contains four climate variables that show up high in the regression tree for dickcissel abundance (remember HW #5?!). Note that again we will ignore projections and treat lat/lon like x/y coordinates.

In this exercise, show your stuff. Do analyses to identify appropriate transformations, interaction terms, quadratic terms, etc.

Run a linear model of abundance versus the four climate factors. Take the residuals. Analyze the residuals (several methods possible – visual or correlogram/variogram – pick one) to see if the residuals are autocorrelated. **9) What model did you decide is appropriate for abundance vs. climate? 10) Were the residuals spatially autocorrelated? How could you tell?**

Now run a GLS for the same model with a spherical variogram based on distance. **11) How do the results of the gls differ from the lm?**