COA 616 Geostatistics in Environmental Science
Homework 1
Assigned: September 13, 2016
Due: September 20, 2016

1. Giesler et al. (1998) studied the variation in soil properties and plant communities structure along a 90-m transect in a boreal forest near Betsele, Sweden.
   The data in the table below are the average soil solution pH, soil nitrogen content, and cation exchange capacity (CEC) in O horizons, at 10-m intervals along the transect. (Courtesy of R. Giesler, Swedish Univ. of Agric. Sci. Umeå, Sweden)

Distance Along Transect m	Soil Solution pH	Total Nitrogen (% of OM)	Cation Exchange Capacity (cmol/Kg)
0	3.72	1.23	40.8
10	3.80	1.14	30.4
20	3.83	1.18	40.7
30	3.94	1.36	48.0
40	3.95	1.74	45.2
50	4.75	2.19	62.9
60	4.60	2.01	68.6
70	4.90	2.23	70.9
80	5.30	2.33	82.9
90	6.36	3.14	91.3

1) Using a spreadsheet (NOT R), compute the spatial correlation, semivariance, and medogram values of the total nitrogen data for separation distances of 10, 20, 30, …, 70-m along the transect.
2) Plot the results. The resulting graphs are the “correlogram”, “semivariogram”, and “medogram”, respectively.
3) Compute and plot the semivariograms for soil solution pH and CEC.
4) Fit a second-order polynomial to the total nitrogen data (the “Trendline” function in Excel can do this). Report the equation and the R^2 value. Compute the residuals. (Note: for the regression, express the distance along the transect in km rather than m. If you use meters, the coefficient for the quadratic term reported by Excel will only contain one significant digit.)
5) Using a spreadsheet to prepare a semivariogram of the residuals computed above.
6) Comment on the results. Is there spatial structure in the data? Are the patterns described by the semivariogram so the raw nitrogen data and the residuals different? If so, what does this mean?

2. You will explore the concentrations of Ca and Mg in Oa horizons in watershed 6 at the Hubbard Brook Experimental Forest, NH. Use R to perform the following analyses:

1) Perform logarithm transformations on Ca and Mg to see if the transformed data follow normal distribution.
2) Use the transformed Calcium data to create a posting of the sampling points.
3) Create omnidirectional semivariograms for transformed Calcium and Magnesium. Use 2 as lag and up to a maximum of 30. The default lag tolerance is ± 1.
4) Discuss the results. Is the spatial structure evident in either data set? At what lag distance, if any, do the variograms become stable?

References

Giesler, R., Högberg, M., and Högberg, P., 1988. Soil chemistry and plants in Fennoscandian boreal forest as exemplified by a local gradient. *Ecology* 79, 119-137.