

Quantitative Methods in Archaeology (116.569)  
Syllabus—Spring 2013

Room 14-119  
Thursdays 10:00-13:00

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Appointments welcome

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This course will offer you an in depth review of spatial analysis tools in Geographic Information Systems (GIS) using ArcGIS software. Like last semester, we will have a brief discussion on GIS theory and general principles each week, which will be followed by a lab practicum. Although the labs in this class are not specifically geared toward archaeologists, we will use the class periods to discuss how we can apply each week's principles to our discipline. The labs are very self-directed, but I will be available throughout the class period to help you finish your lab.

In order to get you to be more "active" in your readings, you are going to take turns researching topics in the class and leading the class in a discussion of the materials. You will also have a final project in the class in which you will use spatial analysis tools in GIS to develop a research protocol from the project you started last semester.

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There are three textbooks for the class, all of which are available in the SNU library, but I **strongly** advise you to purchase your own copy of the following book from an online retailer:

Allen, David W.  
2011 *GIS Tutorial 2: Spatial Analysis Workbook*. For ArcGIS 10 (2<sup>nd</sup> edition). Redlands, California: ESRI Press. (ISBN 978-1-58948-258-6)

There is a companion DVD that comes with the textbook that is essential for you to complete your weekly assignments. There is another DVD that is a 180-day trial edition of ArcGIS, so if you want to install the program on your own laptop, you can do that for the duration of the class. When you order your book, be sure to get the DVDs.

The other two companion books for this class are available in the SNU library. They are not mandatory readings, but they may help you understand certain concepts:

Mitchell, Andy  
1999 *The ESRI Guide to GIS Analysis, Volume 1*. Redlands, California: ESRI Press. (ISBN 978-1-879-10206-4)  
2005 *The ESRI Guide to GIS Analysis, Volume 2*. Redlands, California: ESRI Press. (ISBN 978-1-589-48116-9)

These are referred to in each week's exercises, so if there are things you don't understand about the assignments, it is a good idea to find the sections of these books that correspond to the confusing section.

*Weekly assignments.* Each week, you will need to complete two or three lab assignments that are in the back of each chapter of the textbook. There are nine chapters, but some of the chapters will take two or three weeks for us to get through. There are four computers in the GIS classroom, and you will use the same computer every week so that

I can grade your assignments from those locations. Each assignment will be stored in a separate folder, and organized by the week and assignment. GIS requires that you be very organized with storing files, and I will not hunt through your computer every week to try to find where you buried your assignment. It needs to be in the same set of folders every week. Each assignment is due on the Tuesday following class at 9:00 am. **NOTE: You must also answer the study questions located in the review section of each tutorial.** They are generally pretty easy to answer, but be sure to give clear and concise responses that have enough detail to be thorough.

*Discussion topics.* In light of this class's reticence to complete the readings from last semester, you are going to take turns leading the class in specific topics that pertain to the materials we are covering each week. I will distribute the assignments equitably based on the number of students in the class, but you should plan on covering a topic at least once every two weeks. The objective in these discussion topics is very straightforward and you will be graded on your ability to stay focused on the following outline: (1) present a brief (<5 minute) review of the topic, (2) discuss an assigned reading that shows how archaeologists have used the topic to advance the discipline (I will assign this reading), and (3) review one more peer-reviewed, academic article that you have found that covers your topic for that week. I anticipate that you should spend no more than 10 or 15 minutes talking about the articles. *I will tell you when you have talked for 10 minutes. I will stop you at 15 minutes.*

*Final project.* Your final project should build on the project you began last semester. You can choose to start a new project, but you will need to digitize a new dataset, which, as you know, takes a lot of time. It makes more sense to add to your existing dataset and perform spatial analyses from an augmented database.

Your final project must have the following elements:

- (1) Mapped quantities of something. They can be artifacts, features (graves, dolmen, houses, etc.), or settlements (Neolithic, Bronze Age, Three Kingdoms, etc.). However, you must be able to count them and perform some kind of spatial analysis on them.
- (2) Analysis of some kind of relationship between the quantities within or between polygons. Examples of these relationships include a network analysis, % of change, cost-path, or geographic distributions.
- (3) Perform an analysis of patterns (Ch. 8) in order to identify clusters, outliers and hotspots in your datasets (Ch. 9).

Finally, you must write a 4-5 page paper (**single space, text**) that discusses the purpose of your project, the types of spatial analyses you performed (methods), potential sources of errors, and what the spatial analyses told you about your data (what you learned about patterns of human behavior).

**Grading:** Weekly assignments (37 assignments, 50%); Discussion topics (~5 assignments, 20%); Final project (30%)

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### **Class outline:**

Week 1 (March 7): Class introduction.

- DISCUSSION: We will review the syllabus and ensure that everyone has access to the reading material for the class.
- Review on working with categories and displaying categories in GIS
- Assignment: Allen (2011) Tutorials 1-1, 1-2, & 1-3 (DUE March 12, 9am)

- Read: Bevan & Conolly (2004) GIS, archaeological survey, and landscape archaeology on the island of Kythera, Greece. *Journal of Field Archaeology* 29(1-2):123-138.
  - What role can quantitative analysis have in interpreting archaeological information?

#### Week 2 (March 14): Mapping the most and the least

- DISCUSSION: How is spatial quantitative data used in archaeology?
- Assignment: Allen (2011) Tutorials 2-1, 2-2, 2-3 & 2-4
- Read: Alexakis, et al. (2011) Integrated GIS, remote sensing and geomorphologic approaches for the reconstruction of the landscape habitation of Thessaly during the Neolithic period. *Journal of Archaeological Science* 38(1):89-100.
  - What are the variables involved with creating an accurate density map? What factors can reduce the accuracy of these maps?

#### Week 3 (March 21): Mapping density

- DISCUSSION: Creating density maps in archaeology
- Assignment: Allen (2011) Tutorials 3-1, 3-2 & 3-3
- Read: Campana and Francovich (2006) Landscape Archaeology in Tuscany: Cultural resource management, remotely sensed techniques, GIS based data integration and interpretation. *BAR INTERNATIONAL SERIES* (1151):15-28. ([http://internt.ht.lu.se/media/utbildning/dokument/kurser/ARKN06/20102/Landscape\\_Archaeology\\_in\\_Tuscany.pdf](http://internt.ht.lu.se/media/utbildning/dokument/kurser/ARKN06/20102/Landscape_Archaeology_in_Tuscany.pdf))
  - How can relational databases be used to manage cultural resources?

#### Week 4 (March 28): What's inside?

- DISCUSSION: What are the tools archaeologists use to construct a detailed landscape analysis?
- Assignment: Allen (2011) Tutorials 4-1 & 4-2
- Read: Espa, et al. (2006) GIS based models and estimation methods for the probability of archaeological site location. *Journal of Cultural Heritage* 7(3):147-155
  - How can archaeologists use buffers to identify areas of high archaeological site probability?

#### Week 5 (April 4): Buffering

- No discussion this week, just work on the tutorials (we will make up the discussion next week)
- Assignment: Allen (2011) Tutorials 5-1, 5-2 & 5-3
- Read: Cahen, et al. (1979) Stone tools, toolkits, and human behavior in prehistory. *Current Anthropology* 20(4):661-683
  - How can spider diagrams be used to reconstruct patterns of human behavior?

#### Week 6 (April 11): Nearness

- DISCUSSION: How do we quantify the nearness of things to each other?
- Assignment: Allen (2011) Tutorials 5-4, 5-5 & 5-6
- Read: Whitley and Hicks (2003) A Geographic Information Systems approach to understanding potential prehistoric and historic travel corridors. *Southeastern Archaeology* 22(1):77-91.
  - How do archaeologists calculate "friction" in travel for prehistoric populations?

- Read: Brughmans (2010) Connecting the dots: Towards archaeological network analysis. *Oxford Journal of Archaeology* 29(3):277-302
  - What are the advantages of using a network analysis in modeling archaeological settlements?

#### Week 7 (April 18): Routes and Networks

- DISCUSSION: How can we quantify movement in prehistory?
- Assignment: Allen (2011) Tutorials 5-7, 5-8 & 5-9
- Read: Ayala & French (2005) Erosion modeling of past land-use practices in the Fiume di Sotto di Troina River Valley, North-Central Sicily. *Geoarchaeology* 20(2):149-167
  - How can archaeologists model landscape change? What is the purpose of such analyses?

#### Week 8 (April 25): Mapping change

- DISCUSSION: What are the types of landscape changes that archaeologists are concerned with mapping?
- Assignment: Allen (2011) Tutorials 6-1, 6-2 & 6-3
- Read: Ayhan & Cubukcu (2010) Explaining historical urban development using the locations of mosques: A GIS/spatial statistics-based approach. *Applied Geography* 30(2): 229-238
  - What is the value of determining centroids in archaeology?

#### Week 9 (May 2): Mean Centers

- DISCUSSION: How do we determine the center of things?
- Assignment: Allen (2011) Tutorials 7-1 & 7-2
- Read: Crema, et al. (2010) A probabilistic framework for assessing spatio-temporal point patterns in the archaeological record. *Journal of Archaeological Science* 37(5):1118-1130
  - How can we model moving distributions of features through time? What other applications can archaeologists use to determine change through time?

#### Week 10 (May 9): Standard distances, multiple means, moving means

- DISCUSSION: What do we need to know and what can we model statistically to determine change through time?
- Assignment: Allen (2011) Tutorials 7-3, 7-4 & 7-5
- Read: Morgan (2009) Climate change, uncertainty and prehistoric hunter-gatherer mobility. *Journal of Anthropological Archaeology* 28(4):382-396
  - How can nearest neighbor analyses be used to understand patterns of human mobility? What other kinds of behavior can be modeled?
- Read: Winter-Livneh, et al. (2010) Settlement patterns, social complexity and agricultural strategies during the Chalcolithic period in the Northern Negev, Israel. *Journal of Archaeological Science* 37(2):284-294
  - How can the randomness of archaeological settlements be determined? (z-score)

#### Week 11 (May 16): Random or patterned?

- DISCUSSION: What are the bases for determining randomness?
- Assignment: Allen (2011) Tutorials 8-1 & 8-2
- Read: Sayer and Wienhold (2012) A GIS-investigation of four early Anglo-Saxon cemeteries: Ripley's K-function analysis of spatial groupings amongst graves. *Social Science Computer Review* DOI: 10.1177/0894439312453276.

- What is a Ripley's K function and how can it help archaeologists determine if data is random, dispersed or clustered?
- Read: Fletcher (2008) Some spatial analyses of Chalcolithic settlement in Southern Israel. *Journal of Archaeological Science* 35(7):2048-2058
  - How is Moran's I used to measure clustering of value densities in archaeology?
  - How do the results compare to Winter-Livneh (2010) that you read last week?

Week 12 (May 23): Multidistance clustering and spatial autocorrelation

- DISCUSSION: More tools for identifying random, clustered or dispersed sets of data.
- Assignment: Allen (2011) Tutorials 8-3 & 8-4
- Read: Ciminale, et al. (2009) A multiscale approach for reconstructing archaeological landscapes: Applications in Northern Apulia (Italy). *Archaeological Prospection* 16(3):143-153
  - How can various layers of analysis be used to determine "hotspots" of archaeological settlement?
  - Focus on the use of the Getis-Ord ( $G_i^*$ ) statistic, but also incorporate the other analyses we have been discussing in this class.

Week 13 (May 30): Hotspots

- DISCUSSION: How do we determine the location of archaeological hotspots? What is the value of this to heritage preservation and archaeological prospection?
- Assignment: Allen (2011) Tutorials 9-1 & 9-2
- No reading. Work on your final project!

Week 14 (June 6): NO CLASS (Memorial Day)

- Assignment: Continue working on your final project.

Week 15 (June 13): FINAL PROJECT DUE (paper + maps submitted to me as a pdf **and** .doc/.docx file and leave the digital versions on your computer).