Biol 6000, Topics in Biology: "Spatial Analysis", Spring 2013

Instructor: Corey Devin Anderson, Ph.D. (Preferred salutation: "Dr. Anderson")

Lecture location: BSC 1025
Days and time: Monday and Wednesday, 2-3:15 PM.

Final Exam: TBA

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Office Hours: Monday 4:00 to 5:00 PM*
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*Policy on appointments and drop-ins: I do not schedule student appointments on Fridays. I always prefer that students come to office hours, use e-mail, or make an appointment; if these avenues are not feasible, unscheduled drop-ins are permitted.

Course description:

A survey of key concepts and statistical methods for the statistical analysis of spatio-temporal data, geared toward environmental and life sciences, but open to all relevant disciplines. The course is intended to complement existing courses in Geographic Information Systems (GIS) and biostatistics, which do not cover the statistical analysis of spatially dependent data.

Some overlap exists between the present course and GEOG 4710 (Statistics for Geoscientists); however, the purview of the present course extends beyond geostatistics. The present course emphasizes traditional univariate and bivariate spatial pattern analysis. However, recent developments in the analysis of the spatial data are also introduced (e.g., multivariate ordination, Bayesian Hierarchical Modeling, and Empirical Hierarchical Modeling).

The lecture part of the course emphasizes the basic theory underlying the various statistical methods/models, supplemented by outside readings from both a textbook and the scientific literature. Mastery of lecture concepts will be assessed via in-class examinations and take home problem sets.

Standards

Education outcomes for MS Degree in Biology: 2

Topics covered:

- History of spatial analysis.
- Spatial dependency and autocorrelation, stationarity/nonstationarity, and anisotropy.
- Data structures, coordinate systems, and map projections.
- Sampling design and scale; modifiable areal unit problem.
- Distance metrics.
- Point pattern analysis.
    - Dispersion indices; nearest-neighbor analysis; second-order analysis.
- Contiguous unit analysis.
    - Quadrat variance/covariance analysis; spectral and wavelet analysis, lacunarity.
- Scattered Data analysis.
    - Spatial autocorrelation functions and correlograms: Moran's I, Geary's C, join-count analysis.
    - Anisotropy analysis.
- Local spatial statistics.
    - LISAs, Getis-Ord statistics.
- Variography and interpolation.
- Boundary and cluster analysis.
    - Wombling, agglomerative clustering, Bayesian K-means clustering.
- Modeling and removing autocorrelation; spatial regression.
- Matrix correspondence and multivariate ordination.
- Bayesian Hierarchical Modeling (BHM) and Empirical Hierarchical Modeling

Book

Required text:

1) *Spatial Analysis A Guide for Ecologists* by Marie-Josee Fortin and Mark Dale; the publisher is Cambridge University Press.

Computing

Access to a PC with a Windows operating system is required for this course. Apple Macintosh computers may be used, but are limited to command line and batch modes for some of the software we will be using.

You will need to download the following freeware:

- PASSaGE 2
    - http://www.passagesoftware.net/download.php

Grading

For graduate students, I use a rank-based system: graduate students will be evaluated based on how well they perform *relative* to other graduate students in the class. Students that fall at or above the median grade will receive no lower than a "B"; the top 10 to 20% of the class will receive an "A". Students falling below the median will receive a "C" or lower; the bottom 10 to 20% of the class will receive a "D" or "F". If the number of graduate students in the course is limited, I usually loosen the constraints of the letter distribution.

There are a total of 700 points that can be earned in this course: 300 points from lecture exams 100 points from quizzes, and 300 points based on problem sets.

- There will be three unit exams, each worth 100 points. The third unit exam will be on the date of the final.
- There will be approximately ten 10-point quizzes, worth 100 points.
- There will be approx. five problem sets (worth 60 points each). Late problem sets will be docked 5 points/day.
    - Before calculating your final point total, I will drop the lowest score you received on a problem set and double the highest.

Most of the difficult calculations and computation will come in the form of problem sets. Exams are intended to assess general comprehension of the lecture material.

Behavioral factors: Your behavior in lecture may also affect your final grade. If you fall near the break between letter grades, excessive tardiness, absence, or simply a bad attitude may affect your grade negatively. Conversely, if you are usually on time, attend lecture consistently, and have a good attitude, I may bump-up your grade if you fall near the break.

For those students in danger of failing (< C), I also consider whether or not you took advantage of office hours or made appointments. In general, I will reward those students who make an overt effort to succeed in this course.

Cheating policy

Do not cheat on an exam. You will receive a zero on the exam and will be reported to the Office of Student Affairs.

Cell phone and computer policy

Please turn your cell phones off (or on silent) when you enter the classroom If you want to use your computer in class you will need special permission.

Students with disabilities

Students requiring classroom or testing accommodations because of documented disabilities should discuss their needs with the instructor at the beginning of the semester.