


Syllabus for GTECH 70500
Spatial Data Analysis
Spring 2017
Wednesdays 5:35 – 8:15 PM

Instructor: Jochen Albrecht
Office: Hunter N1030
E-Mail: jochen.albrecht@gmail.com

Class room: HN 1090B
Office hours: Mo/Th 3-5 PM
Phone: (212) 772-5221


Course Overview:

This course provides an overview to a number of techniques aimed at the analysis of spatial data. We will study local and neighborhood level methods, regionalized variables, and the modifiable area unit problem. While most techniques have a geographic origin, we will address all geo-spatially relevant methods, including geophysical, landscape ecological, econometric, epidemiological, and regional science approaches. As this is a graduate course, the bulk of the content will come from *you*, the student. The role of the instructor is mostly to provide structure and guidance. On the practical side, students will be introduced to five different software packages. Each student conducts an individual software project that relates to spatial analysis. The choice of software package is up to the respective student. The application area (field) is to be chosen by the student, who in turn is responsible for gathering the necessary data.

Textbook: Bivand *et al.*, 2013 *Applied Spatial Data Analysis with* , ISBN 0387781706, \$55 or free as [digital book from the Hunter library](#)

A small list of books relevant to this course will be discussed during our first session. Reading material for each session will be made available in advance through the course web site. Recommended books are:

- Banerjee et al 2015. Hierarchical modeling and analysis for spatial data. 2^o, Boca Raton: CRC Press.
- Brunsdon and Comber 2015. An introduction to R for spatial analysis and mapping. London: Sage.
- Dorman 2014. Learning R for Geospatial Analysis. Birmingham: Packt.
- Fischer and Getis 2010. Handbook of Applied Spatial Analysis.
- Fotheringham et al., 2000 Quantitative Geography
- Gaetan, Carlo and Xavier Guyon. 2010. Spatial statistics and modeling, New York, Springer.
- Gelfand et al., 2010 Handbook of Spatial Statistics
- O'Sullivan, D. and Unwin, D.J. 2010. Geographic Information Analysis. Hoboken, NJ: Wiley.
- Schabenberger and Gotway, 2005. Statistical Methods for Spatial Data Analysis

Pre- and co-requisites: GTECH 702, or a good knowledge of regression statistics, experience with  (if in doubt check out [this course sub page](#)), and permission of the instructor.

Policies:

Attendance is crucial. Given that the class-learning environment is active learning, meaning that most of the student performance is practical assignments rather than tests, adherence to protocols and the course timetable is very important. I will be on time. So you will also be on time. It's just common courtesy. Lateness in arriving at class, both lectures and laboratory/discussion sections, will not be tolerated. Active involvement in the course is evidenced in part by undertaking the mechanics of the practical assignments systematically, and learning the tools by hours of practice. In so doing the tools soon come to be seen as a means to an end, rather than the end itself. For example, you will make many maps, and may get caught up in this creative activity, but remember that the maps are being made for particular scientific purposes. Class participation includes timely attendance at laboratory sessions, participation in

organized class discussions, accomplishments of in-class tasks, accomplishment of the preliminary assignment on time, and participation in the map poster display (if this is a part of the course this semester). Remember that a good part of your grade depends on class participation. Of course, you are expected to behave respectfully towards the instructor and the other students, by not imposing a dominating or threatening presence in conversations and discussions, and by allowing others to speak and be heard, especially if they are shy and their voice weaker than yours.

Electronic recording devices are allowed during class. All other personal electronics should be turned off before coming into the classroom. This includes cell and smart phones.

Web-enhancement in the context of this course means that everything pertaining to this course will be communicated through [BlackBoard](#). You are required to check the BlackBoard course site on a daily basis. All changes to the syllabus will be announced on the course home page. All lecture and lab materials are accessible through [BlackBoard](#), and this is also the place where you upload your assignments. Your exams and lab assignments will be graded based on what you have uploaded to BlackBoard and this is where you will find your grades and may access course statistics that help you to assess your standing at any given time.

All [email messages](#) about this course should include [GTECH 705](#) in the subject line, and be signed with your full name. You are addressing me professionally and I will not answer messages coming from "fun" addresses such as "sweetheart4u" or "slamdunk23".....

Academic dishonesty (e.g., plagiarism, cheating on examinations, obtaining unfair advantage, and falsification of records and official documents) is simply not acceptable. Hunter College regards such acts of academic dishonesty as serious offenses against the values of intellectual honesty. The College is committed to enforcing the CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Hunter College Academic Integrity Procedures. The College is committed to enforcing the CUNY Policy on Academic Integrity and will pursue cases of academic dishonesty according to the Hunter College Academic Integrity Procedures. Helping other students on use of the software is encouraged – if you are in doubt what is permissible and what is not, please talk to your instructor.

Special accommodations for persons with disabilities are provided upon request. Please see the instructor if you feel the need for them. In compliance with the American Disability Act of 1990 (ADA) and with Section 504 of the Rehabilitation Act of 1973, Hunter College is committed to ensuring educational parity and accommodations for all students with documented disabilities and/or medical conditions. It is recommended that all students with documented disabilities (Emotional, Medical, Physical, and/or Learning) consult the [Office of AccessABILITY](#), located in Room E1214B, to secure necessary academic accommodations. For further information and assistance, please call: (212) 772- 4857 or (212) 650-3230

Lab policies are described in detail in <http://www.geo.hunter.cuny.edu/techsupport/rules.html>.

Assignments are due one week after they are given in class. It is in your best interests to keep up with the work and meet deadlines for assignments. Incomplete grades and time extensions are not an option for this course. There are no "extra-credit" assignments. Unless otherwise instructed, you will submit assignments in electronic form.

Syllabus change policy: Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice. All changes will/would be announced on [BlackBoard](#), which you are expected to check on a daily basis.

Criteria for evaluation:

Evaluation of academic performance is based on your lab exercises, your software project and your participation according to the following breakdown:

I do not grade on a curve. If many students get good grades, great! If many have mediocre grades, so be it, it will be disappointing and an incentive to do better. I will not try to trick you with impossible exams. Ideally, all can have 100 points! Final evaluation will be based on the following breakdown:

Lab exercises	40%
Software project	50% (with 5% proposal, 5% update report, 5% presentation)
Participation	10%


Numeric scores will be used throughout the semester. The course letter grade will be determined only at the end of the semester, although guidance as to letter grade standing will be given along the way.

All labs exercises are designed for a 4-hour period. You are free to work with them at your own leisure either in our computer labs, in your home department, or at your private home. As you are graduate students, you can use our computer labs at any time outside of the posted instruction times for other courses. It is your responsibility to manage your time to conduct both the labs as well as project work during the hours that the lab room is accessible. Of course, you are free to work at home as much you want – if you can arrange for access to the software that you need.

Each student conducts an individual semester-long software project that involves the quantitative analysis of a substantial geographical problem. There are no requirements with respect to what software the student uses. In a similar vein, the application area (field) is to be chosen by the student, who is also responsible for gathering the necessary data. Basically, you can choose whatever topic you want, provided it has to do with *geographical analysis*; the stress is on both words! It is your responsibility to find a suitable project, which will have to be accepted by the instructor. A few ready-made projects are available but experience shows that motivation increases when students take pride in their own project.

I will not accommodate students who are late in their work or do not show up for the final exam. And, unless you produce a medical certificate or letter from the [Office of AccessABILITY](#), I will not give the final grade of IN (incomplete).

Schedule (*subject to change*):

Session #	Date	Topic	Reading(s)
1	Feb 1	Introduction, syllabus, rules; What is special about spatial; Local vs. global; Terminology	Syllabus Anselin
2	Feb 8	 spatial	Bivand Ch 1 and 2 and the SF package in R
	Feb 15	No GTECH 705 (this is a CUNY Monday) but project proposal due date	
3	Feb 22	Visual data exploration theory; Lab 1: Visual data exploration	Bailey&Gatrell Ch 3 Fischer&Getis Ch B2
4	Mar 1	Descriptive spatial statistics including networks	McGrew Ch 4
5	Mar 8	Point pattern analysis; Lab 2: NNA and k-hat	Baddeley 2005
6	Mar 15	Landscape ecological measures and spatial crime analysis; Lab 3: CrimeStat / FragStats	McGarigal; Keitt; Levine
7	Mar 22	Review of vector spaces and matrix algebra; Regression review; Autocorrelation	Spivey; O'Sullivan & Unwin
8	Mar 29	Residuals and GWR; Lab 4: Autocorrelation lab and GWR	Fotheringham; Charlton 2005; Mennis 2006
9	Apr 5	Spatial regression; Project update report due	Anselin; Petrucci 2003
	Apr 12	Spring break	

10	Apr 19	Geostatistics; Lab 5: Kriging	Clark 1979; Goovaerts 2004
11	Apr 26	Bayes, Markov and Monte Carlo	Lee; Yudkowsky 2003
12	May 3	Spatial interaction modeling; linear programming	Fischer&Getis Part 3; Roy & Thill 2004; Spivey
13	May 10	GeoComputational methods	Couclelis 1998 Banchuen 2007
14	May 17	Comparison of software packages	Bivand 2008
15	May 24	Presentation of projects	you

It is the student's responsibility to regularly check the course website to become aware of changes to the schedule or other announcements.

Instructor expectations

Hunter College...

This is a place where students come to learn. It's a place where knowledge is developed and hopefully it's a place where students can see and participate in its development. Unlike previous schooling you don't have to be here, so we'll assume that you want to be here and that you are here to actively seek knowledge and skills.

With assumptions that you are (a) here of your own free will and (b) are actively seeking to gain knowledge and skills, there is only one fuzzy area (for some) - how to succeed. It's really quite simple: have fun. If you are enjoying what you are doing, you will succeed; if you are taking subjects or studying in a particular program and not enjoying it, you are unlikely to be successful.

A few words on success and enjoyment. Success is not just measured by your grade (but passing does help), it is also measured by how you feel about what you are doing. You are the only person who can really judge whether you are successful - have you met your own expectations? Enjoyment does not necessarily mean stress free living (although maybe it is for some). Taking only subjects that you were told were "easy" doesn't guarantee enjoyment; some of us require a challenge in life. Again, only you are in a position to determine what you find enjoyable.

A final thought on what a university is: this is also a place where faculty comes to learn...

GTECH 705 Spatial Data Analysis

Students: to be successful you should be taking this subject because you want to take it, not because someone told you that you need to take it and you must be actively seeking knowledge and skills. This subject is a good participation "sport", but it's not a really good spectator event. You need to be proactive, be able to try something new, look at things from a new (spatial) perspective, ask questions, read, read, read. You need to know when to take a break, get some fresh air, rest your eyes (a Buddhist philosophy is quite useful...). Attend the lectures and practical sessions. When your absence is unavoidable, make sure you catch up on what was missed. Plan your week as best as possible and make the commitment to spend the amount of time needed for you to be successful. Get a study partner or three, if this works for you.

Faculty: to be successful, I need to know that I've "made a difference" to at least some of my students, i.e., they feel successful. I'll provide a coherent subject structure, I'll deliver the best lecture possible on the day, and pointers to resources where possible and I will provide sound practical instruction and practice our listening skills so that we can understand what difficulties you may be having, so that we can resolve them. Furthermore, we are available and approachable; ask questions in lectures, labs and at other times; use our office hours or make appointments to see us. Faculty have shown disappointing prowess at extra-sensory perception, please help us out!

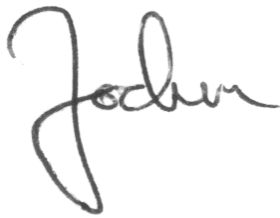
We often lecture in subjects we are considered to have some expertise in; we are therefore fairly interested in the subject matter. We too are students in that we are continuing to learn new things in our areas of expertise and sometimes we are the ones who develop new knowledge in our areas of expertise!

Theory vs. practice: In lectures I try to provide an overview of the most important knowledge, but this never replaces the reading material. Sometimes lectures and readings will cover the same ground, but often, the best that can be done in some fourteen sessions is to provide just a "flavor" of the subject matter, something to whet your appetite, something to set the context for your readings.

Finally...

The reason for this page of amateur pop psychology is twofold: (a) first I hope that prospective students take this subject for the right reasons (i.e. they believe that they will enjoy it) and are in the right frame of mind to be successful and (b) second, I hope that with a little mutual empathy the learning experience can be made better for both student and teacher. If we are not having fun, we are both doing something wrong!

I wish us a lot of fun in this course,



Preliminary reading list (to be augmented by plenty of BlackBoard readings):

Albert 2007, *Bayesian Computation with R*. New York: Springer.

Baddeley 2008, *Analysing spatial point patterns in R*

Banerjee, Sudipto, Bradley Carlin and Alan Gelfand. 2004. *Hierarchical Modeling and Analysis for Spatial Data*. Boca Raton: CRC.

Borcard, Daniel, François Gillet and Pierre Legendre. 2011. *Numerical Ecology with R*. Springer, New York.

Burt *et al.*, 2009 *Elementary Statistics for Geographers*, 3^o

Crawley, 2007 *The R Book*

Dalgaard, Peter. 2008. *Introductory Statistics with R*, New York, Springer.

Fischer and Getis, 2010 *Handbook of Applied Spatial Analysis*

Fortin, Marie-Josée and Mark Dale. 2005. *Spatial Analysis, a Guide for Ecologists*. Cambridge University Press.

Fotheringham *et al.*, 2000 *Quantitative Geography*

Gelfand *et al.*, 2010 *Handbook of Spatial Statistics*

Gaetan and Guyon 2009. *Spatial Statistics and Modeling*. New York: Springer.

Hengl 2009, *A Practical Guide to Geostatistical Mapping*

Lawson, 2008 *Bayesian Disease Mapping*

Lee, 2004 *Bayesian Statistics, an introduction*

Levine 2008, *CrimeStat III Workbook*

Longley and Batty, 1996 *Spatial Analysis: modeling in a GIS environment*

McGarigal 2000, *FragStats documentation*

Mitchell, 2005 *The ESRI Guide to GIS Analysis Volume 2: Spatial Measurements and Statistics*

Peng and Dominici, 2008 *Statistical Methods for Environmental Epidemiology with R*

Qian, 2010 *Environmental and Ecological Statistics with R*

Ripley, 1988 *Statistical Inference for Spatial Processes*

Schabenberger and Gotway, 2005 *Statistical Methods for Spatial Data Analysis*

Waller, Lance and Carol Gotway, 2004. *Applied Spatial Statistics for Public Health Data*, Hoboken, NJ: Wiley.