

GEOG 606: Quantitative Spatial Analysis Spring 2014 SYLLABUS¹

Course Information

Lecture: Monday 2pm - 4:30pm

Instructor Information

Instructor: Chengquan Huang

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Office Hours:

Monday 4:30 – 5:15 pm, or by appointment

GEOG 606 Course Schedule

01/27	1. Introduction to quantitative spatial analyses in geography and related fields
02/03	2. Review of basic statistics and linear algebra: Both groups present
02/10	3. Hypothesis testing I
02/17	4. Hypothesis testing II. R presentation: Stats group
02/24	5. Exploration of data structure through PCA and factor analysis <i>Project topic and initial proposal due</i>
03/03	No class, UMD closed due to snow
03/10	6. Correlation and linear regression analysis. R presentation: Matrix group
03/17	2013 Spring Break -- No Class, (GLP OSM 3/19-21)
03/24	7. Advanced regression methods. R presentation: Stats group
03/31	8. Spatial predictions: continuous variable estimation. R presentation: Matrix group <i>Final project proposal</i>
04/07	9. Spatial predictions: classification. R presentation: Stats group (AAG week).
04/14	10. Spatial pattern analysis: randomness, clustering and autocorrelation R presentation: Matrix group
04/21	11. Spatial prediction through kriging. (NASA LCLUC meeting 4/23-25). R presentation: Stats group (Progress report on project (identify journal, develop an outline based on that journal's format. Email a template.)
04/28	12. Uncertainty estimation in spatial prediction R presentation: Matrix group.
05/05	13. Validity of spatial/statistical inferences: sampling design, data quality, and other considerations. (presentation by Andrew and Steve)
05/12	14. Final project presentation (final report due on 5/15)
05/19	

Course Description

¹ Version 2.2, April 22, 2014.

This course introduces many advanced quantitative methods for studies in geographical sciences and other related fields, including (1) multivariate methods, (2) spatial pattern analysis methods, and (3) spatial prediction and uncertainty estimation methods. Through this course, students will develop their technical foundations for geographical analysis. They are expected to understand the **mathematical and statistical principle** of the methods covered, **types of science problems** that can be addressed using these methods, and their **strength and weaknesses**, and to demonstrate their ability to use these methods to address their own research questions **using R and related tools**. Students should gain a thorough understanding of the impacts on spatial/statistical inferences of many issues associated with these methods, including data sampling methods, sample size, data distribution, etc.

Students are expected to play major roles in the teaching of this course. For each method covered in this course, the instructor will give a lecture on the mathematical/statistical theory. The students will demonstrate its usage using R and lead discussions on the science questions that can be or have been addressed using that method. To make this task more manageable for the students, they will be divided into two groups, which will take turns in leading class discussion.

Other assignments include homework and a final project. Homework reports are due one week after the homework is assigned unless specified differently. Submission should be made via the ELMS/CANVAS.

For the final project, students will conduct a research using methods covered in this course and report the outcome of the research. The final project report should be 10-12 pages (double space) of text plus additional pages for bibliography and figures. At the end of the semester, each student will have 20 minutes to present his/her project, including 10 minutes for the presentation and 10 minutes for question/discussion. Students are to provide an initial project topic, a short proposal (1-page), a progress report (1-page), and a final report following course schedule.

The short proposal should include the following:

- Significance of the science question to be address
- Hypothesis to be tested, if any
- Data and methods to be used
- Expected outcome of the project

The final report should be prepared following conference or journal paper standards (in terms of both format and scientific contents). A typical paper structure should include the following:

- Introduction (Background/context, objective, and significance)
- Data and methods (study area, data sets, methods)
- Results
- Discussions and conclusion
- References

In addition to fulfilling the requirements of this course, students are encouraged to have a plan to develop their final project into a **conference proceeding or journal paper**.

Course Prerequisite

A basic class in statistics (GEOG 306 or equivalent) is required. Knowledge of linear algebra is a must. A basis proficiency in computers is assumed as assignments are computer-based.

Grading

Final grades will be based on the following: Homework reports (30%), Class discussion (30%) and the Final project (40%).

Course Resources

Readings

The required textbooks for this class are:

1. *Using Multivariate Statistics*, by Barbara G. Tabachnick and Linda S. Fidell, 2006
2. *An Introduction to Applied Multivariate Analysis with R*, by Brian Everitt and Torsten Hothorn, 2011. E-book available via UMD library.
3. *Applied Spatial Data Analysis with R*, by Bivand, Pebesma, and Gómez-Rubio, 2008. E-book available via UMD library.

Additional reading materials:

4. *Sheskin, David J., Handbook of parametric and nonparametric statistical procedures. CRC Press, 2004. ISBN 1584884401, 9781584884408.*
5. *Fischer, M. M., Getis, A. 2010. Handbook of Applied Spatial Analysis. Springer*
6. *Montgomery, DC, Peck, EA, Vining, GG. 2001. Introduction to Linear Regression Analysis. 3rd Ed. Wiley*
7. *Plant, RE., 2012. Spatial Data Analysis in Ecology and Agriculture Using R. CRC.*
8. *Schabenberger, O. and Gotway CA., Statistical Methods for Spatial Data Analysis. Chapman & Hall/CRC.*

Other reading materials will be added as necessary throughout this semester:

Software

The software for our statistics analyses is R. An online tutorial of basic functions and syntax: <http://www.ats.ucla.edu/stat/r/>

All students are REQUIRED to have a UMD GLUE account and a UMD email address. We will frequently use email for communication of class related matters. In addition all students must get access to the Geography Open Lab PC. If your current email address is not the one listed by the UMD Registrar, please update that address immediately. The instructors will ONLY mail to a UMD email address.

Late Assignment Policies

No late assignments will be accepted without prior arrangement. However, each student can apply in advance for two penalty-free extensions of any homework anytime in the semester. Each student only has 2 such chances and each time you have 4 extra days. They can help you when you have too many midterms/projects from other courses. Please use them wisely.

No late project report will be accepted without a very strong reason.

Academic Misconduct

The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. All students are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit <http://www.shc.umd.edu>.

Within our class, students may discuss together. Exchanging questions and suggestions on ELMS discussion board are highly encouraged. However, once the discussion is close to the solution, students should not exchange written code or solution steps with each other.

In short, discussion among students should be in the form of “why don’t you try ...”, but not in the form of “the solution is ...”

The final project cannot include inputs from outside the study group.

Disability Statement

Any student who feels he or she may need an accommodation based on the impact of a disability should contact the instructor privately to discuss his or her specific needs. Please contact the Office of Disability Support Services (<http://www.counseling.umd.edu/DSS/>) at 301.314.7682 in Counseling Center, 0126 Shoemaker Building to coordinate reasonable accommodations in case of documented disabilities.