Cornell University
CSS/NTRES 6200
Spatial Modelling and Analysis for agronomic, resources and environmental applications

Spring semester 2015

Course information

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November 15, 2014
Orientation to course

1. for whom?

2. objectives

3. instructor

4. method

5. assignments & grading

6. project

7. schedule

8. some key references
For whom?

- **Graduate** and **senior undergraduate** students who want to advance their understanding of geographic information science and technology;
  - Including introduction to the **R environment** for (spatial) statistical computing and visualization, and the **QGIS** open-source GIS
  - Student should have followed an undergraduate-level course in GIS theory and practice
  - Helpful but not necessary: remote sensing, statistical modelling, computer programming

- Especially useful for students starting a **graduate research project** that uses spatial information in agronomy, soil science, natural resource management, hydrology, ecology and similar
  - “spatial”: information is from **known locations** in some coördinate reference system (global, national, state, local, arbitrary . . .)
Objectives

• **Core competency**: student is able to analyze *complex spatial problems* with appropriate theory and tools
  * especially their “own” problems

• Enhance student skills in processing, analyzing, and visualizing spatial data; with emphasis on *open-source computer programs* and *publically-available data*

• Provide opportunities to analyze *students’ own geospatial data* under instructor supervision
Introduction to course

**Instructor**

David G. Rossiter

- Adjunct Associate Professor, CSS
  - [http://www.css.cornell.edu/faculty/dgr2/](http://www.css.cornell.edu/faculty/dgr2/)
- Guest Researcher (*Gastmedewerker*), ISRIC–World Soil Information, Wageningen (NL)
- Visiting Professor (客座教授), Chinese Academy of Sciences, Soil Science Institute Nanjing (中国科学院南京土壤研究所)
- Retired from University of Twente (NL), Faculty of Geoinformation Science & Earth Observation
Instruction method

• Graduate-level course, emphasis is on **guided self-instruction**;
  * including critical reading of primary literature, lab. self-paced tutorials

• Lectures are **overviews / orientations** to introduce **fundamental spatial analysis concepts and methods**, widely applicable methods;
  * Emphasizes **theory and practice** of using **geospatial data** for resource inventory and analysis, biophysical process modeling, and land surveys

• Emphasise ability to read, understand and apply **methods in journal papers**, advanced **textbooks** and **reference** books; necessary in graduate career

• Student **project** is about half the course (and lab. periods);

• First six (of 14) labs. are tutorial exercises to process, visualize, and analyze geospatial data; other lab. periods for project work.
  * Emphasis on **methods** and **computation**; example applications to illustrate these
Assignments

• Weeks 2–4, 6–8: six (6) set **lab. exercises**, small hand-in assignment; due before Tues. of following week

• Week 9: **Prelim** = literature review & **project** flow chart

• Weeks 10, 12–15 five (5) short **question sets** based on reading; due before Thursday lecture (to be discussed in class)

• (Week 11: spring break)

• Week 16: **Project** presentations
Grading

- Six lab. exercise assignments: graded 0–3; 20% of final
- Five question sets: graded 0–3; 20% of final
- Prelim: 10% of final
- Project: 50% of final (breakdown: 60% project, 30% reporting, 10% oral presentation/discussion)
  * So, project, including prelim, 60% of final
- Grading on absolute scale, not curve.
Project

- An independent project in which the student applies spatial analysis methods to a problem of interest relevant to student’s field of study;
  * May work in pairs provided that independent contributions of team members can be evaluated.

- **Spatial analysis** must be prominent;

- Prefer use of **own** data, **similar** obtained from colleague/advisor, or **publically-available** data; little credit for extensive data manipulation (not the main purpose of this course);

- Should be able to complete during allocated lab. time and related self-study time; graded as such;

- Milestones: (1) **brief proposal**: 10-March (week 8 Tuesday); (2) **prelim** (literature review / detailed project plan): 23-March (week 10 Monday, after hearing comments on proposal presentation week 9); (3) **report**: ≈14-May (on scheduled exam date, TBD)
Project proposal structure

Title
Your Name; CSS/NTRES 6200

Background
Area of interest
Brief literature review
Problem statement
Objectives

Approach
General description of study area
General description of spatial data needed
Proposed analytical methods
Spatial analysis flow diagram

Anticipated Outcomes
Graphics
Maps

References
Project report structure

Title
Your Name; CSS/NTRES 6200 Lab Section

Background
- Area of interest
- Problem statement
- Brief literature review
- Objectives

Approach
- General description of study area
- General description of spatial data needed
- Proposed analytical methods
- Spatial analysis flow diagram

Results and discussion
- Graphics
- Maps

Summary and conclusions; recommendations for future work

References
Week schedule

Lectures: Tuesday, Thursday 0905–0955 Bradfield 110

Computer laboratory: Tuesday or Wednesday 1325–1625 Bradfield 108

- you can come to one or both labs
- brief orientation but most time is self-paced with instructor available
- Bradfield 108 always available (card access for enrolled students)
Schedule – lectures

Week 1  Course Intro, expectations, naïve analysis (Th only)

Week 2  Typology of spatial analysis

Week 3  The R environment; non-spatial regression

Week 4  Spatial correlation; spatial interpolation

Week 5  Model-free interpolation (Th only)

Week 6  Spatial regression

Week 7  Area-Based spatial analysis

Week 8  Point Pattern analysis

...
Week 9  Review

Week 10  Time series; Spatio-temporal analysis

Week 11  (spring break)

Week 12  Spatial sampling theory

Week 13  Data sources

Week 14  Tools: remote sensing

Week 15  Tools: terrain analysis

Week 16  Summary: the typology revisited
Schedule – labs

Week 1  (no lab)

Week 2  open-source GIS

Week 3  The R environment; non-spatial regression

Week 4  geostatistics with R/gstat

Week 5  (no lab)

Week 6  R: Generalized least squares, REML

Week 7  R/spdep and GeoDa

Week 8  R/spatstat

...
Week 9  prelim presentations

Weeks 10, 12–15  individual project work (staff available for consultation)

Week 16  student project presentations/discussion
Key texts/references

Spatial modelling in general


Ecological modelling


Spatial analysis in R


- abbreviated as ASDAR; full text downloadable from CU library via catalog and then Springer Link;

- https://catalog.library.cornell.edu/cgi-bin/Pwebrecon.cgi?BBID=6995229&DB=local

**General GIS**


**Geostatistics**


Statistics review


Statistical modelling


Land surface modelling

Spatial sampling


- full text downloadable from CU library via catalog and then Springer Link

- https://catalog.library.cornell.edu/cgi-bin/Pwebrecon.cgi?BBID=7000603&DB=local