

**GEOG 6000**  
**Advanced Geographical Data Analysis**

Professor: Simon Brewer  
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Gardner Commons, 4845  
Office hours 10:00am-1:00pm Wednesday

Class time and location: Online (Fall 2023)  
Meeting times: 10:45am-12:05pm Tuesday/Thursday  
In-person lab: 12:25pm-1:45pm Thursday

Prerequisite: GEOG 3020 Geographical Analysis (or equivalent introduction to statistical analysis)

Grading:

Exercises	50pts
Project Proposal	5pts
Final Project	45pts
<b>Total</b>	<b>100pts</b>

Course description: Geographical research increasingly generates large and complex datasets. The course is designed to introduce students to:

- A suite of techniques for the analysis of such datasets
- The interpretation of results generated
- The appropriate (and inappropriate) use of these methods.

Topics will include advanced regression analysis, the analysis of multivariate datasets, spatial analysis and modeling. Theory will be taught during lectures, but emphasis will be placed on the practical application of these techniques and best-use practices in the analysis of research datasets. The majority of topics will be accompanied by lab exercises using the statistical software R, as well as take-home exercises. Students will undertake a short research project using one or more of the techniques covered in the course.

Teaching & learning methods: **For the Fall 2023 semester, the class is divided into an online lecture component and an in-person lab component.**

**Lectures will generally consist of two parts:**

- **Pre-recorded videos covering theoretical background. Videos will be made available in the week before they are scheduled.**
- **Group meetings for discussion of material in the videos and demonstration of the methods. These will be held during the scheduled class meeting times, and students will be assigned to either the Tuesday or Thursday meeting time. Group membership will be organized during the first week of class. Attendance at these group meetings is not**

obligatory, however, the class covers a significant amount of material, and you are encouraged to attend to ask questions and review concepts.

Labs will be held in GC 1855 (Thursdays 12:25pm-1:45pm)

- Lab time is designed as time for you to work through the lab material, and to help solve problems or issues with using R or for questions related to the lab material and exercises
- Lab material will be made available at the start of the week through Canvas

Note that all material will be made available through the class Canvas page, as well as submission links for all exercises. An introduction to the Canvas system can be found [here](#).

Course goals: Students completing the course will have

- A toolbox of statistical techniques for use with geographical data
- Experience in planning the analysis based on the type of datasets commonly generated in geographical research
- The ability to interpret the results of such analyses with their own data and in other studies
- Experience in presenting the results of analysis
- Experience with one of the most commonly used and generally applicable software packages for statistical analysis

Class policies:

- Individual extra credit will not be assigned
- **Any assignment, including the project report, turned in after the due date will only be worth half the earned points**
- Materials (exercises, project report) must be turned in electronically
- Collaboration between students is encouraged, but **final products must show evidence of individual effort**. If not, no credit will be given.
- The course will cover a broad range of material and many classes will depend on information from the previous class: full attendance is encouraged

GEOG 6000 Preliminary Class Schedule<sup>1</sup>

Date	Module	Class	Lab
22-Aug	1	<i>Intro to class</i>	
24-Aug		Probability	Intro to R
29-Aug	2	Inference	
31-Aug		Linear models	Inference lab* <sup>2</sup>
5-Sep	3	Multivariate models	

<sup>1</sup> Every effort will be made to keep to the scheduled class order, however, some adjustments may be made as the semester progresses.

<sup>2</sup> Indicates lab with accompanying exercise.

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7-Sep		Effects and model selection	Modeling lab 1
12-Sep	4	Generalized models I	
14-Sep		Generalized models II	Modeling lab 2*
19-Sep	5	Mixed effects models I	
21-Sep		Mixed effects models II	Modeling lab 3*
26-Sep	6	Additive models	
28-Sep		Model review	Modeling lab 4*
3-Oct	7	Cluster analysis	
5-Oct		Ordination	MVA lab*
10-Oct		<i>Fall break</i>	
12-Oct		<i>Fall break</i>	
17-Oct	8	Intro to spatial data	
19-Oct		Point processes I	Spatial data in R
24-Oct	9	Point processes II	
26-Oct		Point processes III	Point process lab*
31-Oct	10	Geostatistics I	
2-Nov		Geostatistics II	Geostats lab 1*
7-Nov	11	Geostatistics III	
9-Nov		Geostatistics IV	Geostats lab 2*
14-Nov	12	Spatial regression I	
16-Nov		Spatial regression II	Spatial regression lab 1*
21-Nov	13	Spatial regression III	
23-Nov		<i>Thanksgiving</i>	
28-Nov	14	Spatial regression IV	
30-Nov		Bayesian methods for spatial data	Spatial regression lab 2*
5-Dec		Spatiotemporal models	
7-Dec		Class review	Spatiotemporal models

**Course materials**

**As this course covers a wide range of subjects, there is no single required text. PDFs will be made available from the following books:**

1. Kuhnert, P. and W. Venables, 2005, *An Introduction to R: Software for Statistical Modelling & Computing*. CSIRO Australia (PDF)<sup>3</sup>
2. Owen, W.J., 2007, *The R Guide*. Dept. of Mathematics and Computer Science, University of Richmond. (PDF)
3. Maindonald, J.H., 2004, *Using R for Data Analysis and Graphics, an Introduction* (PDF)

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<sup>3</sup> Readings marked (PDF) will be made available through Canvas.

4. Okansen, J. *Multivariate Analysis of Ecological Communities in R: vegan tutorial* (PDF)
5. Bivand, R.S., E.J. Pebesma, and V. Gomez-Rubio (2008). *Applied Spatial Data Analysis with R*. Springer, 374 pp. (PDF)

\*\*\*Additional readings may be assigned as appropriate for the discussion topic\*\*\*

### Grading

Students' point totals will be converted to percentages and then used to assign letter grades following the scheme provided below, using .5 as the break point:

A	95+	C+	70~74
A-	90~94	C	65~69
B+	85~89	C-	60~64
B	80~84	D	50~59
B-	75~79	E	~49

### Assessment

#### 1. Exercises

There will be 10 graded exercises throughout the course, each worth 5pts. These will generally consist of 1-2 questions that will follow-up on the preceding computer lab, and require analysis of a new dataset and some brief interpretation of the results. Exercises are due *two weeks* after they are made available. Questions and data files will be made available through Canvas.

#### 2. Final project

##### Guidelines for final project:

Students are required to undertake a short research project based on one or more of the techniques covered in the class and are encouraged to use their own data for this analysis. Students who have not yet generated datasets are should contact the course instructor to discuss suitable alternatives. Students may use the same data that they have used/will use in their other projects. **However, the final products to be presented or submitted for this course must be independent of any other projects or classes.**

The project will be evaluated on two parts:

- A one-page proposal (5pts, due September 24<sup>th</sup>). This must be approved by the instructor before continuing
- A project report (45pts, due December 15<sup>th</sup>)

The **one-page proposal** should describe the following:

- Topic of your final project,
- Why you are interested in the topic and/or why it is important for your research field, community, society, ...

- Tentative list of datasets to be used (include both datasets you already have and those you need to find)

The **project report** should take the form of a short (ca. 8-10 pages) scientific research article with a title page and elements listed below. The final paper must be typed (double space, 10-12 fonts); no hand-written submission will be accepted. Figures are encouraged!

- Abstract (10-15 lines)
- Introduction, explaining objectives of your project and the background of the topic
- Literature review, which may be combined with Introduction. A minimum of 5 references (journal articles, book chapters, etc.) is required. The references should cover both methodological aspects and applications of the project.
- Methods including
  - Description of data, study region, etc.,
  - Summary of statistical methods used (and their implementation),
- Results
- Discussions
- Conclusions
- Bibliography, listing all the references cited in the paper.

Class policies:

- Evaluation-related policies
  - Individual extra credit will not be assigned.
  - There will be no “make-up” exams, quizzes, or assignments.
  - An “incomplete” grade will be given only in extreme cases when conditions beyond the student’s control require an extended period of absence.
  - Any assignments, including the final project report, submitted to the instructor after its due date will be worth only half of the earned points.
  - Materials to be turned into the instructor must be typed.
  - Students are encouraged to help each other in their work. However, final products turned into the instructor must display evidence of individual initiative and creativity. If not, no credits will be given to the particular work.
- Attendance
  - Full attendance is strongly recommended. The content of the course is often progressive, meaning you must know the material from previous class meetings in order to understand subsequent material. When missing classes, students are responsible for seeking for help to catch up with the class progress in a timely manner, if they need to.
- Email correspondence
  - Students must copy themselves on any email to the instructor to ensure documentation of submission date and time. Doing so will

- assist the student when system outages occur.
- Senders must also validate that all files are in readable format. Corrupted files are the responsibility of the sender and corrupted-file assignments will be marked as late
- Cell phones
  - Please turn off your cell phones or use vibrate/silence mode during class meetings.
- Student responsibilities
  - All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook of the University of Utah (<http://www.acs.utah.edu/sched/handbook/toc.htm>). Students have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know they are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee.
- Liability warning
  - Students are responsible for all activities on their computer accounts. Keep your user name and password confidential.

AI / LLM statement:

Large language models (LLMs, e.g. ChatGPT) may be used in the preparation of your final project reports. However, if you choose to use an LLM, you must submit an accompanying document that details which sections were generated by the LLM, the prompt used to generate the text and which LLM was used. You should also include a brief discussion and criticism of the text produced including, but not limited to, a statement about the accuracy of the text, the level of detail obtained and any adjustments or edits you subsequently made. All project reports will be submitted to an online service to detect AI-generated text. Any project that was detected as using AI, but does not have the accompanying text will not be graded.

COVID19 statement:

University leadership has urged all faculty, students, and staff to model the vaccination, testing, and masking behaviors we want to see in our campus community. These include:

- Vaccination
- Masking indoors
- If unvaccinated, getting weekly asymptomatic coronavirus testing

Vaccination:

- Get a COVID-19 vaccination if you have not already done so. Vaccination is proving highly effective in preventing severe COVID-19 symptoms, hospitalization and death from coronavirus. Vaccination is the single best way to stop this COVID resurgence in its tracks.
- Many in the campus community already have gotten vaccinated:
  - o More than 80% of U. employees
  - o Over 70% of U. students
- Visit <http://mychart.med.utah.edu/>, <http://alert.utah.edu/covid/vaccine>, or <http://vaccines.gov/> to schedule your vaccination

Masking:

- While masks are no longer required outside of Health Sciences facilities, UTA buses and campus shuttles, CDC guidelines now call for everyone to wear face masks indoors.
  - o Check the CDC website periodically for masking updates: <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/fully-vaccinated-guidance.html>
  - o Treat masks like seasonal clothing (i.e. during community surges in COVID transmission, masks are strongly encouraged indoors and in close groups outside).

Testing:

- If you are not yet vaccinated, get weekly asymptomatic coronavirus tests. This is a helpful way to protect yourself and those around you because asymptomatic individuals can unknowingly spread the coronavirus to others.
  - o Asymptomatic testing centers are open and convenient:
    - Online scheduling
    - Saliva test (no nasal swabs)
    - Free to all students returning to campus (required for students in University housing)
    - Results often within 24 hours
    - Visit [alert.utah.edu/covid/testing](http://alert.utah.edu/covid/testing)
- Remember: Students must self-report if they test positive for COVID-19 via this website: <https://coronavirus.utah.edu/>.

Student Mental Health Resources

- Rates of burnout, anxiety, depression, isolation, and loneliness have noticeably increased during and following the pandemic. If you need help, reach out for [campus mental health resources](#), including counseling, trainings and other support.
- Consider participating in a [Mental Health First Aid](#) or other [wellness-themed](#) training provided by our Center for Student Wellness and sharing these opportunities with your peers, teaching assistants and department colleagues.

- Academic misconduct will not be tolerated. Penalties may include failure of an assignment, the entire course, and/or the filing of formal charges with appropriate university authorities. Academic misconduct includes, but is not limited to, cheating, misrepresenting one's work, and plagiarism:
- Cheating involves the unauthorized possession or use of information in an academic exercise, including unauthorized communication with another person during an exercise such as an examination.
- Misrepresenting one's work includes, but is not limited to, representing material prepared by another as one's own work or submitting the same work in more than one course without prior permission of all instructors.
- Plagiarism means the intentional unacknowledged use or incorporation of any other person's work in one's own work offered for academic consideration or public presentation.

*As the only institution in the state classified in the highest research category (R1), at the University of Utah you will have access to state-of-the-art research facilities and be able to be part of the knowledge creation process. You will have the opportunity to do research of your own with faculty who are leading experts in their field, engaging in programs that match your research interests. Further, you will interact with and often take classes with graduate students that provide an advanced understanding of the knowledge in your field.*

*The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the instructor and to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD) to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.*

**Undocumented Student Support.** *Immigration is a complex phenomenon with broad impact—those who are directly affected by it, as well as those who are indirectly affected by their relationships with family members, friends, and loved ones. If your immigration status presents obstacles to engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center. **Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence.** The Dream Center offers a wide range of resources to support undocumented students (with and without DACA) as well as students from mixed-status families. **To learn more, please contact the Dream Center at 801.213.3697 or visit dream.utah.edu.***

**Safety & Wellness.** *Your safety is our top priority. In an emergency, dial 911 or seek a nearby emergency phone (throughout campus). Report any crimes or suspicious people to **801-585-COPS (801-585-2677)**; this number will get you to a dispatch officer at the University of Utah Department of Public Safety (DPS; dps.utah.edu). If at*



*any time, you would like to be escorted by a security officer to or from areas on campus, DPS will help — just give a call.*

*The University of Utah seeks to provide a safe and healthy experience for students, employees, and others who make use of campus facilities. In support of this goal, the University has established confidential resources and support services to assist students who may have been affected by harassment, abusive relationships, or sexual misconduct. A detailed listing of University Resources for campus safety can be found at <https://registrar.utah.edu/handbook/campussafety.php>*

*Your well-being is key to your personal safety. If you are in crisis, call **801-587-3000**; help is close. The university has additional excellent resources to promote emotional and physical wellness, including the Counseling Center (<https://counselingcenter.utah.edu>), the Wellness Center (<https://wellness.utah.edu>), and the Women's Resource Center (<https://womenscenter.utah.edu>). Counselors and advocates in these centers can help guide you to other resources to address a range of issues, including substance abuse and addiction.*

*To report suspicious activity or to request a courtesy escort, call campus police at **801-585-COPS (801-585-2677)**. You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit [safeu.utah.edu](http://safeu.utah.edu).*