UNIVERSITY of GUELPH

ENVS*6440 - Field Sampling Strategies and Geostatistics

Winter 2026 Course Outline

Section: 01

Credits: 0.50

Land Acknowledgement: Guelph

The University of Guelph resides on the ancestral lands of the Attawandaron people and the treaty lands and territory of the Mississaugas of the Credit. We recognize the significance of the Dish with One Spoon Covenant to this land and offer respect to our Anishinaabe, Haudenosaunee and Métis neighbours. Today, this gathering place is home to many First Nations, Inuit, and Métis peoples and acknowledging them reminds us of our important connection to this land where we work and learn.

Calendar Description

Concepts and practical aspects of collecting, synthesizing and interpreting data from spatially and temporally variable and/or correlated fields. Handson experience in describing spatial structure of large data sets (supplied by student or instructor) using available software.

Department(s): School of Environmental Sciences

Course Description

Concepts and practical aspects of collecting, synthesizing, and interpreting data from spatially variable and/or correlated fields. Hands-on experience in describing spatial structure of large data sets (supplied by student or instructor) using available software.

Lecture Schedule

Wed 8:30am-11:20am in ALEX*165 (1/5 to 4/2)

Instructor Information

Asim Biswas
Professor
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Office: ALEX 135
Office Phone: 519 824 4120 Extn- 54249
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Textbooks

Group	Title	Author	ISBN
Recommended	Field Sampling for Environmental Science and Management	Richard Webster & Murray R. Lark	1849713677
Recommended	Spatial and Temporal Statistics: Sampling Field Soils and their Vegetation	Donald R. Nielsen & Ole Wendroth	3923381468

Learning Resources

Course Resources

Recommended Software-

- R, a free statistical programming language – download at http://cran.r-project.org/bin/windows/base/
- R-Studio, a free graphical interface to work with R, https://www.rstudio.com/products/rstudio/#Desktop
- ArcGIS software from Library (available free to students) https://www.uoguelph.ca/ccs/software/supported-products/esri-arcgis (https:// www.uoguelph.ca/ccs/software/supported-products/esri-arcgis/)

Campus Resources

If you are concerned about any aspect of your academic program: Make an appointment with a Program Counsellor (https://www.uoguelph.ca/uaic/ programcounsellors/) in your degree program. If you are struggling to succeed academically: There

are numerous academic resources offered by the Learning Commons (https://www.lib.uoguelph.ca/using-library/spaces/learning-commons/) including, Supported Learning Groups for a variety of courses, workshops related to time management, taking multiple choice exams, and general study skills.

Cost of Textbooks and Learning Resources

Textbook / Learning Resource	Required / Recommended	Cost
Field Sampling for Environmental Science and Management by Richard Webster & Murray R. Lark ISBN 1849713677	Recommended	USD 53.59
Spatial and Temporal Statistics: Sampling Field Soils and their Vegetation by Donald R. Nielsen & Ole Wendroth ISBN 3923381468	Recommended	$129.99

Students are advised that prices are often determined by the publisher or bookstore and may be subject to change.

Library Course Reserve (Ares)

For this course, you will be required to access course reserve materials through the University of Guelph McLaughlin Library. To access these items, select **Ares** on the navbar in CourseLink. Note that you will need your Central Login ID and password in order to access items on reserve. For further instructions on accessing reserve resources, visit How to Get Course Reserve Materials (https://www.lib.uoguelph.ca/find/coursereserves-ares/).

If at any point during the course you have difficulty accessing reserve materials, please contact the e-Learning Operations and Reserve Services staff at: Tel: 519-824-4120 ext. 53621 | Email: libres2@uoguelph.ca | Location: McLaughlin Library, First Floor, University of Guelph

Course Learning Outcomes

1. Critical review skills on spatial data analysis literature
2. Understand and apply spatial statistical analysis
3. Understand and apply basic geostatistical methods to spatial data.
4. Analyze spatial data using R and ArcGIS

Teaching and Learning Activities

Lecture topics:

- Introduction to ENVS 6440
- Self-Review on basic and explanatory statistics (materials provided)
- Self-Review on experimental design (materials provided)
- Self-Review on sampling design (materials provided)
- Introduction to spatial statistics
- Geostatistics
- Interpolation
- Areal and point data pattern

Assessment Breakdown

Description	Weighting (%)	Due Date
Assignment 1 (Critical Review and Presentation)	25%	Feb 25
Project (Part 1: Presentation 1)	25%	Mar 25 and Apr 1
Project (Part 2: Review paper)	40%	Apr 8
Attendance and participation	10%	Throughout the course

Grading Schemes

Instruction for Assignment #1- Critical Review and Presentation:

For this assignment, you will be reading a published paper that used spatial analysis and Geostatistics as tools to quantify variations in the topic of interest, analyze and critique the paper, and present your understanding and findings of the paper. While the assigned paper will provide a starting point, you will be required to read relevant literature to develop a firsthand understanding of spatial analysis and Geostatistics. While you critique the published paper, connected and cross-referenced literature will help you explore the

tools more. Finally, you will present your synthesis of the paper and comments critiquing the study in a short and coherent presentation.

Recommended best practices-

- Read the assigned paper (remember, Geostatistics as a tool is more important than the subject matter of the paper)
- Find out related literature on Geostatistics including some fundamental theories- What is it? How does it work? What information can this provide?
- What do we learn from using this technique? What sort of questions can we answer with the information that can be derived?
- Reassess the paper and examine the feasibility of the tools to examine relevant topics.
- Critique the paper (e.g., study topic, experimental design, data analysis, information derivation, etc.)
- Prepare a 10-minute presentation (8 + 2). You may prepare a PowerPoint presentation covering 1) the title of the paper with the study background, 2) the rationale and study objectives, 3) the methods used and their justification (may use two slides), 4) the main findings, and 5) your critique.

** Remember, you are presenting the paper to a graduate-level audience with some background in Geostatistics but with different environmental sciences knowledge. Thus, the tools used to derive certain information are more important than the topic itself. Think critically about the visual impact of your slides—colors, layout, use of space. Photos, graphs, charts, and/or diagrams are encouraged and can be copied from the paper itself; be sure that all text is large enough to be easily read. For information you want your audience to be able to see, the minimum font size is 24. Present within the allotted time.

Some websites that you may find helpful as you prepare your oral presentation are:

- Delivering an effective presentation, Learning Development, Univ. of Leicester: http://www2.le.ac.uk/offices/ld/resources/presentation/deliveringpresentation (http://www2.le.ac.uk/offices/ld/resources/presentation/delivering-presentation/)
- How to Deliver Effective Presentations (WikiHow): http://www.wikihow.com/Deliver-Effective-Presentations (http://www.wikihow.com/DeliverEffective-Presentations/)
- 10 Tips for More Effective PowerPoint Presentations: https://www.lifehack.org/articles/featured/10-tips-for-more-effective-powerpointpresentations.html
- Tips for Giving and Creating Effective PowerPoint Presentations (Stats Canada): http://www.statcan.gc.ca/conferences/it-ti2009/tips-conseilseng.htm
- 5 Rules for more effective presentations-Michael Hyatt: http://michaelhyatt.com/5-rules-for-more-effective-presentations.html
- Really Bad PowerPoint- and How to Avoid It—Seth Godin: http://www.sethgodin.com/freeprize/reallybad-1.pdf

Evaluation sheet for Oral Presentation

Presentation Criteria

- Clarity of speech; pace and timing (/10)
- Body language (engaged with audience, calm presence) (/10)
- Level of enthusiasm (/10)
- Quantity of information provided; appropriate detail (/10)
- Ability to explain research clearly (/15)
- Flow and logical development of the given topic/paper- (/15)
- Critical analysis of the topic. (/10)
- Slide design (amount of text, structure, etc.) (/10)
- Ability to answer questions (/10)
- Grade (/100)

Information on the project

Write a review paper after a critical synthesis of the literature on the topic provided. The assessment will be carried out in two parts: a presentation on the topic and a written review paper.

Part 1: Presentation

The oral presentation will be on the topic of your review paper and may be structured similarly. The presentation is intended to be a conceptual representation of your topic.

Your presentation should be 12 minutes in length, followed by up to 3 minutes of questions (Important to maintain timing). It should be geared towards a graduate-level audience within the School of Environmental Sciences, but general enough for people in different disciplines to understand. Think critically about the visual impact of your slides—colors, layout, use of space. Photos, graphs, charts,

and/or diagrams are encouraged (can be copied from literature or prepared based on your understanding; be sure that all text is large enough to be easily read. For information you want your audience to be able to see, the minimum font size is 24.

Some websites that you may find helpful as you prepare your oral presentation are:

- Delivering an effective presentation, Learning Development, Univ. of Leicester: http://www2.le.ac.uk/offices/ld/resources/presentation/deliveringpresentation (http://www2.le.ac.uk/offices/ld/resources/presentation/delivering-presentation/)
- How to Deliver Effective Presentations (WikiHow): http://www.wikihow.com/Deliver-Effective-Presentations (http://www.wikihow.com/DeliverEffective-Presentations/)
- 10 Tips for More Effective PowerPoint Presentations: http://money.howstuffworks.com/business-communications/effective-powerpoint- (http:// money.howstuffworks.com/business-communications/effective-powerpoint-/) presentations.htm#page=0
- Tips for Giving and Creating Effective PowerPoint Presentations (Stats Canada): http://www.statcan.gc.ca/conferences/it-ti2009/tips-conseilseng.htm
- 5 Rules for more effective presentations-Michael Hyatt: http://michaelhyatt.com/5-rules-for-more-effective-presentations.html
- Really Bad PowerPoint- and How to Avoid It—Seth Godin: http://www.sethgodin.com/freeprize/reallybad-1.pdf

Part 2: Review paper

The purpose of a review paper is to succinctly review **recent progress** in a particular topic (the topic is provided to you). Overall, the paper will **summarize the current state of knowledge of the topic**. It will create an understanding of the topic for the reader by **discussing the findings presented in recent research papers**.

A review paper is not a "term paper" or book report. It is not merely a report on some references you found. Instead, a review paper **synthesizes the results** from several primary literature papers **to produce a coherent argument** about a topic or focused description of a field.

A **key aspect** of a review paper is that it **provides evidence for a particular point of view in a field**. Thus, a large focus of **your paper should be a description of the data that support or refute that point of view**. In addition, you should inform the reader of the experimental techniques that were used to generate the data.

The **emphasis** of a review paper is **interpreting the primary literature** on the subject. You need to **read several original research articles** on the same topic and **make your own conclusions** about the meanings of those papers.

GOOD TO KNOW ABOUT REVIEW PAPERS

What is a review paper?

- A critical, constructive analysis of the literature in a specific field through summary, classification, analysis, and comparison.
- A scientific text relying on previously published literature or data. New data from the author's experiments are not presented (with exceptions: some reviews contain new data).
- A stand-alone publication. Literature reviews as integral parts of master theses, doctoral theses, or grant proposals are considered review papers.

What is the function of a review paper?

- to organize literature
- to evaluate literature
- to identify patterns and trends in the literature
  to synthesize literature
  to identify research gaps and recommend new research areas

Who is the audience of review articles?

- experts in specific research areas
- students or novice researchers
- decision-makers

HOW TO WRITE THE PAPER

Elements of the review paper:

Your paper should consist of the following sections:

- Title
- Introduction
- The body of the paper/ Main part of the review paper

- Conclusion and Future Directions
- Literature Cited/ References
- Illustrations/Concept map (if any)

Review articles contain neither a materials and methods section nor an abstract.

Organizing the Paper:

Use topic headings. Do not use a topic heading that reads, "Body of the paper." Instead, the topic headings should refer to the actual concepts or ideas covered in that section.

Section of a paper- What it should contain?

Title

Function: Helping readers to decide whether they should read the text or not.

- The title must be informative:
- The title has to include important terms.
- It has to indicate that the text is a review paper.
- It may include the message of the article, not just its coverage
- The title must be short:
- Keep the title concise.
- A longer subtitle may be an option in case a specification is necessary
- Length is between 8 to 14 words or reasonable
- The title should only be a question if this question remains unanswered at the time of writing.

Introduction & Background

Function: Provides information about the context, indicates the motivation for the review, defines the focus, the research question and explains the text structure.

- Make it brief (~1/5 of the paper's total length).
- Grab the reader's interest while introducing the topic.
- Explain the "big picture" relevance.
- Provide the necessary background information.
- Often three paragraph introduction is followed and the elements are 1) subject background- The general topic, issue, or area of concern is given to illustrate the context, 2) "Problem"- Trends, new perspectives, gaps, conflicts, or a single problem is indicated, and 3) Motivation/justification. The author's reason for reviewing the literature, the approach and the organization of the text are described.
- Note: Make sure to have a narrow focus and an explicit research question. Indicate these two points clearly in the introduction. Give theoretical or practical justifications for the need for the review.

Body of the Paper

- Experimental Evidence: Describe important results from recent primary literature articles and
- Explain how those results shape our current understanding of the topic.
- Mention the types of experiments done and their corresponding data, but do not repeat the experimental procedure step for step.
- Point out and address any controversies in the field.
- Use figures and/or tables to present your own synthesis of the original data or to show key data taken directly from the original papers.

Section structure: A coherent structuring of the topic is necessary to develop the section structure Subheadings reflect the organization of the topic and indicate the content of the various sections. Possible criteria for structuring the topic are:

- methodological approaches
- models or theories
- extent of support for a given thesis
- studies that agree with another versus studies that disagree
- chronological order
- geographical location
- Paragraph structure: Cover one idea, aspect, or topic per paragraph. Avoid referring to only one study per paragraph; consider several studies per paragraph instead.

Conclusions and Future Directions

Function: Answer the research questions set in the introduction and provide future needs of work

- Succinctly summarize your major points.
- Point out the significance of these results.

- Discuss the questions that remain in the area.
- Keep it brief.
- Note: Make sure to have a clear take-home message that integrates the points discussed in the review.

Literature Cited

- The number of citations will depend on the topic. Typically, at least of about 20 to 30 good references are required.
- You can find the citation style for the Soil Science Society of America Journal at https://dl.sciencesocieties.org/publications/style/

LENGTH OF THE PAPER

Review articles vary considerably in length. For this review article for this class, you are required to write between 6000 to 8000 words (may not exceed 10000 words) including everything. The assessment will be carried out based on the publishable quality of the paper in a journal.

Last Day to Drop Course

The final day to drop Winter 2026 courses without academic penalty is the last day of classes: April 06
After this date, a mark will be recorded, whether course work is completed or not (a zero is assigned for missed tests/assignments). This mark will show on the student's transcript and will be calculated into their average.

Course Grading Policies

Submission of Assignments

Submission should be made through Dropbox in CourseLink. The reports should be in Microsoft Word Format.

Late Assignment

5% of the allocated mark will be deducted per day of late submission. Make sure to communicate well ahead in time for any potential delay (not in the last moment).

Standard Statements for Graduate Courses

Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.
Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy (https://calendar.uoguelph.ca/graduate-calendar/general-regulations/academic-misconduct/) is outlined in the Graduate Calendar.

Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.
When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.
Use of the SAS Exam Centre requires students to make a booking at least 10 business days in advance, and no later than the first business day in November, March or July as appropriate for the semester. Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time. For students at the Guelph campus, information can be found on the SAS website. (https://www.uoguelph.ca/ sas/)

Accommodation of Religious Obligations

If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements.

See the Academic calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations (https:// calendar.uoguelph.ca/graduate-calendar/general-regulations/academic-accommodation-religious-obligations/)

Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

Drop Date

Courses that are one semester long must be dropped by the end of the last day of classes; two-semester courses must be dropped by the last day of classes in the second semester. The regulations and procedures for Dropping Courses (https://calendar.uoguelph.ca/graduate-calendar/ general-regulations/registration/) dropping courses are available in the Graduate Calendar (https://calendar.uoguelph.ca/graduate-calendar/generalregulations/registration/).

Email Communication

As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

Health and Wellbeing

The University of Guelph provides a wide range of health and wellbeing services at the Vaccarino Centre for Student Wellness (https:// wellness.uoguelph.ca/). If you are concerned about your mental health and not sure where to start, connect with a Student Wellness Navigator (https://wellness.uoguelph.ca/navigators/) who can help develop a plan to manage and support your mental health or check out our mental wellbeing resources. (https://wellness.uoguelph.ca/shine-this-year/) The Student Wellness team are here to help and welcome the opportunity to connect with you.

Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g., final exam or major assignment).

Recording of Materials

Presentations that are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

Resources

The Academic Calendars (http://www.uoguelph.ca/registrar/calendars/?index) are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.

When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the Graduate Calendar for information on regulations and procedures for Academic Consideration (https://calendar.uoguelph.ca/graduate-calendar/general-regulations/grounds-academicconsideration/).