Western Science

Department of Earth Sciences

Geophysics 9522b: Data Analysis and Signal Processing
Course Outline – Winter 2026

1. Course Information

GP9522b – Data Analysis and Signal Processing

List of Prerequisites: Permission of the instructor.

Unless you have either the requisites for this course or written special permission from your Dean's Designate (Department/Program Counsellors and Science Academic Advisors) to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

2. Instructor Information

Instructors	Email	Office	Phone	Office Hours
Dr. Robert Shcherbakov (Course Instructor)	rshcherb@uwo.ca	B&GS 1080	x84212	By appointment
TA: N/A				

3. Course Syllabus, Schedule, Delivery Mode

This course introduces the data analysis techniques in the Earth Sciences with emphasis on Geophysics, Environmental Sciences, and related fields. It introduces statistical methods to characterize univariate, bivariate and multi-variate data. It also introduces concepts required for digital signal processing and interpretation of geophysical and earth sciences time-series data. The overall goal of the course is to teach students the rigorous use of the statistical methods when analysing empirical data.

This is a lab-oriented course that will provide extensive hands-on computer experience in data analysis, particularly with the numerical software package Matlab.

Course Objectives and Learning Outcomes:

Upon successful completion of this course, students will be able to:

- describe and identify fundamental terms and concepts in data analysis;
- discuss which techniques and methods are suitable for the analysis of different geophysical data;
- identify the key aspects of a typical workflow of the processing of geophysical data;
- summarize observations, data, and methodological principles;
- interpret and make decisions based on results from numerical computations and data analysis.
- apply the skills required to work with the scientific computer software Matlab.

Summary of Lecture Topics (*approximate and subject to change*!)**:**

- Introduction and Outline.

- Data Analysis: data collection and preprocessing, types of data, and methods of data analysis.
- Introduction to Matlab: syntax, array manipulation, data structures, data storage/handling, control flow, scripts and functions, and data visualization.
- Univariate Statistics: empirical distributions, theoretical discrete and continuous distributions.
- Hypothesis Testing and Bivariate Statistics: trends and correlations.
- Bivariate and Multivariate Statistics: regression and residual analysis, multivariate regression.
- Time Series Analysis: autocorrelation and cross-correlation, power spectrum.
- Digital Signal Processing: signal analysis, Fourier analysis, convolution, deconvolution, filtering and filter design. Applications in seismology and geophysics.
- Basics of Machine Learning applications in Earth and Environmental sciences.
- Spatial Data analysis: gridding and contouring. Mapping projections.

Course Work

The lecture and laboratory components cover theory and "hands-on" components of the course, respectively. Lab/tutorials will be held in the ES computer labs. Lecture notes and assignments are going to be available through OWL (https://westernu.brightspace.com/).

The relevant Key Sessional Dates:

Classes begin:	January 5, 2026
Reading Week:	February 14-22, 2026
Classes end:	April 9, 2026
Exam period:	April 12-30, 2026

Contingency plan:

Although the intent is for this course to be delivered in person, should any university-declared emergency require some or all of the course to be delivered online, either synchronously or asynchronously, the course will adapt accordingly. The grading scheme will not change. Any assessments affected will be conducted online as determined by the course instructor.

4. Course Materials

Recommended Textbooks:

- DelSole T., Tippett M. ***Statistical Methods for Climate Scientists***, Cambridge, 2022.
- Menke, W., ***Environmental Data Analysis with Matlab***, Academic Press, 2016 (2nd edition) or 2022 (3rd edition).
- Wilson, C.R., ***Essential Geophysical Data Processing***, Cambridge, 2022.
- Trauth, M.H., ***Matlab Recipes for Earth Sciences***, Springer, 2015 (4th edition) or 2021 (5th edition). (the 4th edition is available for download through Springer when connected through Western: https://link.springer.com/book/10.1007/978-3-662-46244-7).
- Gubbins, D. ***Time Series Analysis and Inverse Theory for Geophysicists***, Cambridge, 2004.
- Chave A.D. ***Computational Statistics in the Earth Sciences. With Applications in Matlab***, Cambridge, 2017.
- Stein S., Wyssession M**.,** ***An Introduction to Seismology, Earthquakes, and Earth Structure***, Blackwell, 2003.

Matlab software package is going to be used for Labs. It can be installed on your personal computer using Western site license. It is also installed on all computers in BGS0184 or it can be accessed through MyVlab or online on Mathworks website. The instructions will be provided.

All course material will be posted to OWL: https://westernu.brightspace.com/

Students are responsible for checking the course OWL site (https://westernu.brightspace.com/) regularly for news and updates. This is the primary method by which information will be disseminated to all students in the class.

If students need assistance with the course OWL site, they can seek support on the OWL Brightspace Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

5. Methods of Evaluation

The overall course grade will be calculated as listed below:

Assignments	Participation	Project Presentation	Project report
35%	10%	15%	40%

Assignments will consist of examination-style short-answer questions and require no formal writeup. In many cases, assignments will require the use of Matlab. Unless indicated otherwise, assignments should be submitted by the due date. Late submissions will be accepted with a 5% per day penalty. Under exceptional circumstances, late submissions will be accepted with no penalty, provided that adequate documentation is given. With a few exceptions, only SI units should be used to report any physical quantities.

The project will involve a written report (~10 pages + figures). The topic will be chosen by the student and approved by the instructor. Research topics must be in any area of data analysis and modelling covered during the course. The project must include references to the scientific literature. Projects are due April 4, and oral presentations will be given during the last week of the term.

Plagiarism: *Students must write their essays and assignments in their own words. Whenever students take an idea, or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar).*

Use of Generative AI Tools

The use of generative AI tools (e.g., ChatGPT, Microsoft Copilot, Google Gemini, or similar platforms) is **not permitted** in the completion of any course assessments, including but not limited to: assignments, lab reports, presentations, tests, and final examinations.

General information about missed coursework

Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs* posted on the Academic Calendar: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf,

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult Accessible Education.

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar's webpage:
https://registrar.uwo.ca/academics/academic_considerations/

All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

All Academic Consideration requests must include supporting documentation; however, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request **without supporting documentation** in this course. However, the following assessments are excluded from this, and therefore always require formal supporting documentation:

- Examinations scheduled during official examination periods (Defined by policy)
- Practical laboratory and performance tests (Defined by policy)
- Midterm/Presentation (Designated by the instructor as the one assessment that always requires documentation when requesting Academic Consideration)

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. **All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.**

When a student *mistakenly* submits their one allowed Academic Consideration request **without supporting documentation** for the assessments listed above or those in the **Coursework with Assessment Flexibility** section below, the request cannot be recalled and reapplied. This privilege is forfeited.

Evaluation Scheme for Missed Assessments

Unless indicated otherwise, assignments should be submitted by the due date. Late submissions will be accepted with a 5% per day penalty. Under exceptional circumstances, late submissions will be accepted with no penalty, provided that adequate documentation is given. With a few exceptions, only SI units should be used to report any physical quantities.

When a student misses the Final Exam and their Academic Consideration has been granted, they will be allowed to write the Special Examination (the name given by the University to a makeup Final Exam).

See the Academic Calendar for details (under Special Examinations), especially for those who miss multiple final exams within one examination period.

6. Additional Statements

6.1 Religious Accommodation

When a recognized religious holiday or observance conflicts with an examination, test, or other scheduled academic obligation, students must request accommodation via the University's Student Absence Portal (SAP). This request should identify the conflict and specify which course component(s) (e.g. test, midterm, exam) are affected.

Students are encouraged to submit the SAP request as early as possible, but no later than two weeks before any examination, or one week before any mid-term test or quiz, to allow sufficient time for adjustment.

The SAP request serves as official notification to both the course instructor and the Academic Advising Office, in accordance with University policy:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

The Faculty of Science considers religious accommodations as scheduling conflicts. Instructors should provide either a make-up exam or an earlier sitting of the same exam to accommodate the student.

For more information on recognized religious holidays, please visit the Diversity Calendar posted on the Equity, Diversity & Inclusion website - https://www.edi.uwo.ca

6.2 Academic Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf.

6.3 General Academic Policies

The website for Registrar Services is https://www.registrar.uwo.ca/.

Use of @uwo.ca email: In accordance with policy, https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf, the centrally administered e-mail account provided to students will be considered the individual's official university email address. It is the responsibility of the account holder to ensure that emails received from the University at their official university address are attended to in a timely manner.

Requests for Relief (formally known as "appeals")

Policy on Request for Relief from Academic Decision:
https://uwo.ca/univsec//pdf/academic_policies/appeals/requests_for_relief_from_academic_decisions.pdf

Procedures on Request for Relief from Academic Decision (Undergraduate):

https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_requests_for_relief_procedure.pdf

For both mid-term and final exams, a single-sided hand-written crib sheet and a non-programmable calculator may be used.

6.4 Scholastic Offences

Policy on Scholastic Offences:
https://uwo.ca/univsec//pdf/academic_policies/appeals/scholastic_offences.pdf

Procedures on Scholastic Offences (Undergraduate):
https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_scholastic_offence_procedure.pdf

Use of Electronic Devices During Assessments

In courses offered by the Faculty of Science, the possession of unauthorized electronic devices during any in-person assessment (such as tests, midterms, and final examinations) is strictly prohibited. This includes, but is not limited to: mobile phones, smart watches, smart glasses, and wireless earbuds or headphones.

Unless explicitly stated otherwise in advance by the instructor, the presence of any such device at your desk, on your person, or within reach during an assessment will be treated as a *scholastic offence*, even if the device is not in use.

Only devices expressly permitted by the instructor (e.g., non-programmable calculators) may be brought into the assessment room. It is your responsibility to review and comply with these expectations.

Use of Generative AI Tools

Unless otherwise stated, the use of generative AI tools (e.g., ChatGPT, Microsoft Copilot, Google Gemini, or similar platforms) is **not permitted** in the completion of any course assessments, including but not limited to: assignments, lab reports, presentations, tests, and final examinations.

Using such tools for content generation, code writing, problem solving, translation, or summarization—when not explicitly allowed—will be treated as a **scholastic offence**.

If the use of generative AI is permitted for a particular assessment, the conditions of use will be specified by the instructor in advance. If no such permission is granted, students must assume that use is prohibited. It is your responsibility to seek clarification before using any AI tools in academic work.

6.5 Support Services

Please visit the Science & Basic Medical Sciences Academic Advising webpage for information on adding/dropping courses, academic considerations for absences, requests for relief, exam conflicts, and many other academic-related matters: https://www.uwo.ca/sci/counselling/.

Students who are in emotional/mental distress should refer to Mental Health@Western (https://uwo.ca/health/) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence (GBSV) and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced GBSV (either recently or in the past), you will find information about support services for survivors, including emergency contacts, at:

https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. If you have any questions regarding accommodations, you may also wish to contact Accessible Education at

http://academicsupport.uwo.ca/accessible_education/index.html

Learning-skills counsellors at Learning Development and Success (https://learning.uwo.ca) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Additional student-run support services are offered by the USC, https://westernusc.ca/services/.