Earth Sciences 2222B Data Analytics for Earth Science
January - April 2020

(Course material courtesy Prof. Gail Atkinson, Dr. Hadi Ghofrani, and Dr. Sheri Molnar)

INSTRUCTOR:
Lecturer: Dr. Katsu Goda
Office: B&GS-1076; 519-661-2111 x 83189
E-mail: kgoda2@uwo.ca
If you are contacting your instructor or TA, please use your Western email address.

DESCRIPTION:
An introduction to data analysis techniques, including data types and analysis tools, statistical methods to characterize univariate, bivariate and multi-variate data, Monte Carlo simulation, time series, signal processing, and spatial data. A variety of applications from various fields will be used to illustrate these techniques, with emphasis on applications in Earth Sciences. This course involves computer programming with MATLAB. Hands-on start-up instruction for the use of MATLAB will be given.

PREREQUISITES:
0.5 course from Calculus 1000A/B, 1100A/B, 1500A/B or Mathematics 1225A/B; or Applied Mathematics 1413.
Unless you have either the requisites for this course or written special permission from your Dean 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.

LECTURE AND LAB SCHEDULE:
Lecture - Mondays & Wednesdays 11:30 am – 12:30 pm, MC-17
Computer lab - Tuesdays 6:00 pm – 9:00 pm, B&GS-0184
3 lecture hours, 3 laboratory hours, 0.5 course.

TUTORIAL HELP:
Ample time is available during each three-hour lab. Labs are focused on answering questions and working on assignments. The lab period is the course tutorial. Office hours are not provided outside of lab time.

METHOD OF ASSIGNING FINAL GRADE:
There will be 4 assignments, 2 term tests, and an individual project (oral presentation and written report). All assignments are due ~2-3 weeks after the assignment is given at the beginning of a Wednesday lecture. The ability to express ideas in a coherent and logical manner is an important factor in evaluation of assignments and tests.
Term Test I: Mid-Feb
Term Test II: End of March
Project: Early April
Final Grade: Assignments - 40%, Term tests - 30%, Individual project - 30% (15% presentation and 15% written report)

TEXTBOOK:
MATLAB Recipes for Earth Sciences – M. Trauth, Springer, 2015.
Available for download through Springer when connected to Western internet:
4th Edition http://link.springer.com/book/10.1007%2F978-3-662-46244-7

ADDITIONAL REFERENCES:
The following texts are recommended for additional reading and supplement to the lectures, but not required.

- *MATLAB Design Recipes* – M.H. Trauth and E. Sillmann, Springer, 2013.
  http://www.springer.com/us/book/9783642325434
- *Random Data: Analysis and Measurement Procedures* – J.S. Bendat and A.G. Piersol, Wiley, 2010*.*
  A good reference for time-series analyses, both introductory and advanced.
- *Environmental Data Analysis with Matlab* – W. Menke and J. Menke, Academic Press, 2016.

LONG DESCRIPTIONS OF COURSE CONTENT:

Week 1 – Course Briefing and Data Analysis (Jan. 6, 8)
    Course briefing: purpose, scope, expectations, and evaluation
    Data collection, types of data, and methods of data analysis
    MATLAB demonstration

Week 2 – Introduction to MATLAB (Jan. 13, 15)
    MATLAB basic: syntax, array manipulation, data structures, data storage/handling, control flow, scripts and functions, and data visualization

Week 3 – Univariate Statistics (Jan. 20, 22)
    Empirical distributions
    Theoretical distributions
    Hypothesis tests

Week 4 – Bivariate Statistics (Jan. 27, 29)
    Trends and correlations
    Regression analysis
    Residual analysis

Week 5 – Probabilistic Fitting and Monte Carlo Simulation (Feb. 3, 5)
    Fitting of probabilistic models to random data
    Monte Carlo simulations

Week 6 – Review (Feb. 10) and Term Test 1 (Feb. 12)

Week 7 – Time Series Analysis (Feb. 24, 26)
    Auto-spectral and cross-spectral analysis
    Individual project briefing on Feb. 26

Week 8 – Time Series Analysis (March 3, 5)
    No lecture on March 3
    Power spectrum

Week 9 – Signal Processing (March 10, March 12)
    Signal data analysis
    Convolution, deconvolution and filtering
    Filter design

Week 10 – Spatial Data (March 17, March 19)
    Spatial data
    Gridding and contouring

Week 11 – Review (March 24) and Term Test 2 (March 26)

Week 12 – Individual Project Presentation (March 31, April 2)
    Oral presentations

Week 13 – Individual Project Report (April 7)
    Project written report (Q&A)

EVALUATION AND DUE DATES (Subject to change):
- Assignment 1 (10%) – Jan. 22
- Assignment 2 (10%) – Feb. 5
- Term test 1 (10%) – Feb. 12 (lecture time)
- Assignment 3 (10%) – Feb. 26
- Assignment 4 (10%) – March 19
- Term test 2 (20%) – March 26 (lecture time)
- Project oral presentation (15%) – March 31 and April 1, 2 (lecture and lab times)
- Project written report (15%) – April 9

POLICY STATEMENTS:
No electronic devices may be in your possession during in-class term tests.

It is Faculty of Science policy that a student who chooses to write a test or exam deems themselves fit enough to do so, and the student must accept the mark obtained. Claims of medical, physical, or emotional distress after the fact will not be considered.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:
http://www.uwo.ca/univsec/handbook/appeals/scholoff.pdf

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Dean's office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Dean's Office immediately. For further information please see:
http://www.uwo.ca/univsec/handbook/appeals/medical.pdf

A student requiring academic accommodation due to illness, should use the Student Medical Certificate when visiting an off-campus medical facility or request a Records Release Form (located in the Dean's Office) for visits to Student Health Services. The form can be found here:
https://studentservices.uwo.ca/secure/medical_document.pdf

ACCESSIBILITY STATEMENT:
Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

SUPPORT SERVICES:
Learning-skills counsellors at the Student Development Centre are ready to help you improve your learning skills (http://www.sdc.uwo.ca). 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.

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

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

The website for Registrarial Services is http://www.registrar.uwo.ca.