Math 586: Spatial variability and geostatistics
Fall 2021

Instructor: Dr. Oleg Makhnin **Office:** Weir 238

Class: TR 1:50-3:05 Jones Annex 106

Office Hours: M 8:30-10:30am TR 3:30-5pm F 1:30-3:20pm
or whenever you can catch me!

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Catalog description:

"Introduction to spatial and temporal variability. Stationary and intrinsic random fields, variograms and estimation. Kriging, co-kriging and simulation of random fields. Conditioning and conditional simulation. Indicator kriging and simulation. Applications from hydrology, mining, petroleum engineering and other fields."

Mode of Instruction:

This class is in-person but I will also provide a Zoom meeting. Meeting link:
`https://zoom.us/j/91957839542?pwd=bVVLekRiM2RVb3JkYzF2elBUR3B2QT09`

The class participation is encouraged: in the form of asking questions, answering my questions, suggesting improvements etc. The class will also be recorded for later viewing. The list of videos is available from Canvas (under `Panopto Recordings`).

Your course grade will be determined on the basis of combined scores from Homework, Labs, Midterm and a Final Project.

In order to make up any assignment, a valid excuse should be documented. The instructor decides if an excuse is a valid one. You are encouraged to seek help from the instructor.

Homework: All homework is due on Canvas. One lowest score will be dropped.

Labs: will cover computation and data examples, primarily using Matlab or R.

Grading is based on the percentage of total points earned (the individual tests, homework etc. are not assigned a letter grade).

Distribution of points:
Homework 100 Labs 50 Midterm 100 Final project 100

Grading Scale (tentative): A: 90-100%; B: 80-89; C: 70-79; D: 60-69; F: 0-59

Course outline:

- review of probability/statistics
- methods for modeling independent observations (regression, ANOVA)
- random fields and variograms
- kriging (spatial prediction)
- stochastic simulation
- Bayesian methods (if time allows)

Academic Honesty

New Mexico Tech's Academic Honesty Policy for undergraduate and graduate students is found in the student handbook, which can be found at: `https://www.nmt.edu/studenthandbook/nmt-student-handbook.pdf`
You are responsible for knowing, understanding, and following this policy.

Homework: collaborating on homework is ok, but you have to write your own final solution. Carbon copy of someone else's solution is not acceptable!

COVID-19 Safety Issues for Face-to-Face Instruction:

As of the beginning of Fall semester, NMT classes are under the following constraints, which may change as COVID conditions and/or New Mexico Governor's orders change. Please check for daily updates of COVID constraints, posted on `www.nmt.edu/covid19/`.

1. All vaccinated and unvaccinated individuals are required to wear a face mask indoors anywhere on campus. It is anticipated based on prior Governor's orders that, when conditions improve individuals who have not been fully vaccinated will still be required to wear a face mask and to social distance indoors. Vaccinated individuals, in contrast, would not be required to wear a mask indoors but are welcome to still wear a mask if they choose to, so please do not assume that individuals wearing masks are unvaccinated.

2. Instructors and TAs will not ask for proof of vaccination. This, too, may change in response to changing conditions.

3. Please note provisions on masks, vaccines or other possible requirements are subject to change as the situation evolves, based on guidance from the Centers for Disease Control, the State of New Mexico, and university officials (i.e., the President and the Board of Regents).

4. Students should not come to class if they are feeling ill and to follow any quarantine guidelines that they are given in the event of exposure to COVID-19. If you do miss class, please contact the instructor for missed assignments, contact the Student Health Center, and consider getting tested for COVID-19.

For the most up-to-date guidelines, please consult NMT's COVID- 19 information page: `https://www.nmt.edu/covid19/`.

Course Learning Outcomes:

The students will learn the ways to conduct a variogram analysis, including the calculation of experimental variograms, directional analysis and variogram modeling. They will also learn the mathematical principles behind kriging, co-kriging and stochastic simulation and learn to apply these geostatistical methods in spatial interpolation. Through labs, exercises, and a final project, the students will gain familiarity with the practical application of the various components of geostatistical analysis.

Program Learning Outcomes:

Learning objectives for the math departments undergraduate and graduate degree programs can be found at

`http://infohost.nmt.edu/~math/about/learningoutcomes.html`

Cell phones:

To help make our emergency response as effective as possible, we require that cell phones be set on "vibrate." The reason: if all phones vibrate at the same time during your class, you know there is an emergency that must be responded to immediately. If there is such an emergency, you and your students need to know this without delay.

Reasonable Accommodations:

New Mexico Tech is committed to protecting the rights of individuals with disabilities. Qualified individuals who require reasonable accommodations are invited to make their needs known to the Office of Counseling and Disability Services (OCDS) as soon as possible. To schedule an appointment, please call 835-6619.

Counseling Services:

New Mexico Tech offers mental health and substance abuse counseling through the Office of Counseling and Disability Services. These confidential services are provided free of charge by licensed professionals. To schedule an appointment, please call 835-6619.

Respect Statement

New Mexico Tech supports freedom of expression within the parameters of a respectful learning environment. As stated in the New Mexico Tech Guide to Conduct and Citizenship: "New Mexico Tech's primary purpose is education, which includes teaching, research, discussion, learning, and service. An atmosphere of free and open inquiry is essential to the pursuit of education. Tech seeks to protect academic freedom and build on individual responsibility to create and maintain an academic atmosphere that is a purposeful, just, open, disciplined, and caring community."

Title IX Reporting:

Sexual misconduct, sexual violence and other forms of sexual misconduct and gender-based discrimination are contrary to the University's mission and core values, violate university policies, and may also violate state and federal law (Title IX). Faculty members are considered "Responsible Employees" and are required to report incidents of these prohibited behaviors. Any such reports should be directed to Tech's Title IX Coordinator (Dr. Peter Phaiah, 20D Brown Hall, 575-835-5187, titleixcoordinator@nmt.edu.) Please visit Tech's Title IX Website (`http://www.nmt.edu/titleix`) for additional information and resources.

The instructor reserves the right to change any part of this syllabus as he sees fit.