Mathematical Modeling (STAT 420/620) Fall 2014
Ansari Business Building (AB), Room 635
MW 1:00-2:15PM
3 credits

Instructor: Ilya Zaliapin  Office: Davidson Math & Science (DMS), Room 221
Office hours:  MW 10:00AM–noon + 4:00-5:00PM + by appointment
Phone: (775) 784-6077  E-mail: zal@unr.edu
Course web page: http://www.unr.edu/~zal/STAT620_Fall14.html

Catalog Description:  Formulation, analysis and critique of methods of mathematical and statistical modeling; selected applications in physics, biology, economics, political science and other fields.

Prerequisites:  MATH 283 and MATH/STAT 352 or MATH 461 with C- or better; completion of CO 1 – 8, junior or senior standing

Course Intro:  “Mathematical modeling is the link between mathematics and the rest of the world. Some people are fluent in English, and some are fluent in calculus. We need more people who are fluent in both languages and are willing and able to translate. These are the people who will be influential in solving the problems of future.”  (Mark Meerschaert, Mathematical Modeling, 2013). The course integrates and synthesizes the quantitative knowledge and skills earned in previous mathematical, statistical, and computing classes. The class participants build proficiency in formulating and solving quantitative models that address real-world problems using mathematical and statistical modeling roughly classified into three groups: optimization, dynamic models, and probability/statistics models. Serious attention is paid to the interpretation of the quantitative findings in the language of the applied problem and professional reporting of the results. Selected applications in physics, biology, economics, and other fields are discussed.

Required textbook:

Course Objectives:
•  Core Objective 13 (Integration & Synthesis):  Students will be able to integrate and synthesize Core knowledge, enabling them to analyze open-ended problems or complex issues.
•  Core Objective 14 (Application):  Students will be able to demonstrate their knowledge and skills developed in previous Core and major classes by completing a project or structured experience of practical significance.

Student Learning Outcomes:  Upon completion of this course, students will be able to
•  Choose and apply key mathematical and statistical techniques for solving problems in a diverse collection of scientific disciplines (CO 2, CO 13)
•  Organize and clean data; critically assess the origin of the data and method of data analysis (CO 3, CO 13).
• Interpret the results of the modeling process to reach sound scientific conclusions within the problem’s economic, scientific, and social context (CO 9).

• Propose a project (individually or in a group) and devise strategies and practices to do the research work that will lead, with the support of computational software (e.g., Maple, Mathematica, R, Matlab), to the writing of a technical report using professional typesetting software (e.g., LaTeX) (CO 14).

Tentative list of topics and Schedule:
- Weeks 1 – 5: Optimization Models
  - One-variable/multivariable optimization
  - Constrained Optimization
  - Computational Methods
- Weeks 6 – 10: Dynamic Models
  - Phase portrait
  - Spectral analysis
  - Euler method
  - Chaos and Fractals
- Weeks 11 – 15: Probability and Statistics Models
  - Random walks and diffusion
  - Markov chains
  - Time series models
  - Monte Carlo methods
  - Particle tracking

Technology: MAPLE software (http://www.maplesoft.com/) is used for class discussions and homework problems. The program can be accessed through the library’s Citrix server at https://citrix.unr.edu/.

Final exam: Final exam will be given on [Exam Date]

Exam policy: Open notes, open books. There will be no make-ups for exams, except legitimate medical reasons. In case of participating in University-related activities or in any other special circumstances, contact instructor in advance.

Homework projects are given and graded weekly; they require a printed illustrated report. The project report consists of (i) problem formulation and solution (including method description and a software code) and (ii) interpretation/discussion. Both parts are graded. You are encouraged to discuss HW assignments with each other and with instructor during office hours. However, the homework reports must be written individually; grades for homework report will be used to assess your individual performance.

Semester project is an integral part of the course. Students will form research groups and select a particular applied problem to work on during the semester. The project will require (but is not limited to) application of the mathematical and statistical techniques discussed in class to real-world problems and data using professional mathematical software. The project will result in a professional illustrated project report and project presentation. The project will include: critical approach to choosing and justifying the data and quantitative methods, technical solution part, discussion and interpretation of results in the language of the selected applied problem. Project progress will be assessed via a set of deadlines, each requiring a specific tangible outcome (problem and data description, literature review, method description, technical solution, interpretation of results, discussion, etc.). Each project group will consist of 4-6 members. Each group member will be responsible for meeting a particular project.
deadline and turning in the related materials. The division of responsibilities among the group members will be clearly defined in consultation with the instructor. The project assessment will include individual and group’s contribution and outcome. The details of project preparation and presentation will be discussed in class.

**Effort distribution:** The approximate division of the course load (in terms of efforts spent) among its different components is the following: Class attendance and participation (20%), Homework projects (40%), Semester Project (30%), Midterm and Final (10%).

**Grading policy:** A letter grade for the course is based on home works (40%), project (30%), and final exam (30%).

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**Graduate/Undergraduate levels:** Graduate students will achieve deeper understanding of the material and will be offered sufficient opportunities for work at a higher academic level. This will be done by adding quality and quantity to homework, the final exam, and the project.

**Academic dishonesty** will not be tolerated and will result in an F grade. See [http://www.unr.edu/stsv/acdispol.html](http://www.unr.edu/stsv/acdispol.html) for more information.

**Class recording policy:** Surreptitious or covert video-taping of class or unauthorized audio recording of class is prohibited by law and by Board of Regents policy. This class may be videotaped or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may have been given permission to record class lectures and discussions. Therefore, students should understand that their comments during class may be recorded.

**Special needs:** The Department of Mathematics and Statistics supports providing equal access for students with disabilities. Any student needing accommodations for a specific disability is encouraged to meet with instructor or any Department representative at your earliest convenience to ensure timely and appropriate accommodations.

**Academic Success Services:** Your student fees cover usage of the Math Center (775) 784-4422, Tutoring Center (775) 784-6801, and University Writing Center (775) 784-6030. These centers support your classroom learning; it is your responsibility to take advantage of their services. Keep in mind that seeking help outside of class is the sign of a responsible and successful student.