SIE 596 – Special Topics in SIE

Design and Analysis of Simulation Experiments

Spring 2019

Course Description: Methods for designing and analyzing experiments that are conducted using computer simulation models, rather than physical experiments. The course covers sampling strategies for simulation experiments, metamodels, simulation-based optimization, sensitivity analysis, model validation, uncertainty quantification. This course focuses mainly on deterministic computer simulations commonly used in engineering design, analysis and optimization, but stochastic simulations (e.g., for queueing and inventory systems) will also be discussed.

Time and Location: MWF 14:00-14:50pm   ENGR 301

Instructor: Qiang Zhou   zhouq@email.arizona.edu

Office hour: By appointment

Recommended reference books
(1) The Design and Analysis of Computer Experiments, Santner, Thomas J., Williams, Brian J., Notz, William I, Springer Verlag, New York, 2003.

(2) Design and Analysis of Simulation Experiments. 2nd Ed. Kleijnen, Jack P. C., Springer, 2015.

(3) Design and Modeling for Computer Experiments. Kai-Tai Fang, Runze Li, Agus Sudjianto, Chapmen & Hall / CRC, 2005.

Prerequisites: SIE 530 or equivalent

Required, Elective, or Selected Elective: Elective

Course Objectives:	The students will be able to understand and apply the following concepts and methods: understand the fundamental differences between physical and simulation experiments and select the appropriate methods; design and analyze simulation experiments to characterize and improve systems, products and processes through their computer models; build, analyze and apply metamodels of expensive computer simulations in real applications for predictions, uncertainty quantification, and optimization.

Topics covered:

- Differences between physical and simulation experiments
- Design of simulation experiments, including Latin hypercube designs, space filling designs, uniform designs, sequential design strategies
- Metamodels: Kriging (Gaussian process models), Radial Basis Functions, Multivariate Adaptive Regression Splines (MARS), etc.
- Simulation-based optimization via metamodels
- Sensitivity analysis; Verification and Validation; Calibrating computer models
- Advanced topics: multivariate output / multi-fidelity / spatial temporal computer simulation models

Grading Policy:	20 % Homework; 40% Project; 40% Exam
Exam:	There are two in-class midterm exams (20% each, no final), each with 50 min. Online students will take exams using Examity **on the same dates** (a 24 hour window will be given).
Course Materials:	All course materials (HWs and solutions, lecture slides, etc.) and grades will be uploaded to the course D2L site. Students must check D2L site regularly.

Homework Policy:

HW will be assigned throughout the semester, usually following the completion of course chapters. All HWs should be submitted **on D2L by 11:59 PM on the due date**. Except for medical reason (doctor's proof needed), penalty for late submission is:
1) Submission on the 1st day after due date: 15%
2) Submission on the 2nd day after due date: 30%
3) Submission on the 3rd day or later: 100%

Project Policy:

The individual project will be comprehensive and a significant part of this course. For project details, refer to the separate **Project Description** document. The penalty for late submission is the same as Homework above.

Code of Academic Integrity:

Graded work must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity.
There is zero tolerance towards plagiarism and any act of intellectual dishonesty.

Attendance Policy:

Students are required to attend class. If you miss class you are responsible for obtaining the class notes, assignments, and announcements. Phone usage is not allowed during the class; please put your phone into "quiet", or "vibrate" mode prior to start of the class.

Accommodation for Students with Special Needs:

Students with disabilities or special needs for accommodations (including in class meetings and exams) are required to contact both the instructor and the S.A.L.T. Center (www.salt.arizona.edu) or the Disability Resource Center (http://drc.arizona.edu) as early as possible in the semester. They are also required to submit appropriate documentations to the instructor before accommodations could be offered.

Subject to Change Statement:

Information contained in the course syllabus, may be subject to change with advance notice, as deemed appropriate by the instructor. If any change is to be made to the exam date, it will be announced at least two weeks before the scheduled date.