IE 6309-001/002/003 / Fall 2015
Response Surface Methodology and Computer Experiments

Professor: Victoria (Tory) Chen, 420J Woolf Hall.
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Classes: MWF 3:00–3:50PM in 109 Nedderman Hall.
Office Hours: MW 4:00–5:00PM, F 2:00–3:00PM, and by appointment.

Prerequisite: IE 6308.

Description: Empirical model building and process optimization using experimental design and statistical modeling. First half of course covers first and second order models and designs, multiresponse experiments and mixture experiments. Second half of course introduces designs based on Latin hypercubes, orthogonal arrays, and number-theoretic methods; and models using kriging, multivariate adaptive regression splines, and neural networks.

Student Learning Objectives: At the end of this course, students should be able to: (1) execute response surface methodology, (2) design and conduct a computer experiment for a software code, and (3) conduct a computer experiment analysis.

Course References:
1. Dean, A. and D. Voss (1999). *Design and Analysis of Experiments*. New York: Springer-Verlag. http://www.wright.edu/ dvoss/book/DeanVoss.html
2. Mason, R. L., R. F. Gunst, and J. L. Hess (1989). *Statistical Design and Analysis of Experiments*. New York: Wiley.
3. Shah, H. K., D. C. Montgomery, and W. M. Carlyle (2004). "Response Surface Modeling and Optimization in Multiresponse Experiments Using Seemingly Unrelated Regression." *Quality Engineering*. **16(3)**, pp. 387–397.
4. Chen, V. C. P., K.-L. Tsui, R. R. Barton, and J. K. Allen (2003). "A Review of Design and Modeling in Computer Experiments." In *Handbook of Statistics: Statistics in Industry* (R. Khattree and C. R. Rao, eds.), **22**, Amsterdam: Elsevier Science, pp. 231–261.
5. Kutner, M., C. Nachtsheim, J. Neter, and W. Li (2005). *Applied Linear Statistical Models, Fifth Edition*. New York: McGraw-Hill Irwin.
6. Garth, A. D. N., D. K. Rollins, V. C. P. Chen, and J. Zhu (1996). "Evaluation of Model Discrimination Techniques in Artificial Neural Networks with Application to Grain Drying." *ANNIE 96 Proceedings: Intelligent Engineering Systems Through Artificial Neural Networks*, **6**, pp. 939–950.

Supplemental References:
1. Hastie, T., J. H. Friedman, and R. Tibshirani (2001). *Elements of Statistical Learning: Data Mining, Inference, and Prediction*. New York: Springer-Verlag.
2. Box, G. E. P. and N. R. Draper (1990). *Empirical Model-Building and Response Surfaces*. New York: Wiley.
3. Box, G. E. P., W. G. Hunter, and J. S. Hunter (1978). *Statistics for Experimenters: An Introduction to Design, Data Analysis, and Model Building*. New York: Wiley.

Projects: There will be two projects, each consisting of two parts: the proposal and the full report. Project 1 will require a study using classical response surface methodology. Project 2 will require development of a (simple) computer experiment followed by appropriate design and analysis. For the proposals, you must clearly state the problem of interest, describe the variables to be studied, and explain details on data collection. Actual data is not required in the proposal. For Project 2, choices of experimental design and statistical model must be specified. The full report should include data and analysis with good discussion and should be typewritten.

Oral Presentation: Each student will be required to prepare and present a presentation. The presentation can be on any topic related to the course or on the student's research. Time length for the presentation will depend on the number of students in the class, but will not exceed 30 minutes.

Attendance: At The University of Texas at Arlington, taking attendance is not required. Rather, each faculty member is free to develop his or her own methods of evaluating students academic performance, which includes establishing course-specific policies on attendance. As the instructor of this section, attendance will be required at the student presentations in order to receive full credit for the oral presentation component.

Regrading Policy: If you would like an assignment regraded, you must submit a written statement which clearly explains the reason you would like a regrade. If an assignment is submitted for regrading, I reserve the right to regrade the *entire* assignment.

Expectations for Out-of-Class Study: Beyond the time required to attend each class meeting, students enrolled in this course should expect to spend at least an additional 9 hours per week of their own time in course-related activities, including reviewing lecture content, reading required materials, completing assignments, etc.

Grade Grievances: Any appeal of a grade in this course must follow the procedures and deadlines for grade-related grievances as published in the current graduate catalog.

Academic Integrity: All students enrolled in this course are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence. I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

Instructors may employ the Honor Code as they see fit in their courses, including (but not limited to) having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents' Rule* 50101, Section 2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University.

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance**. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (http://wweb.uta.edu/ses/fao).

Americans with Disabilities Act: The University of Texas at Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including the Americans with Disabilities Act (ADA). All instructors at UT Arlington are required by law to provide "reasonable accommodation" to students with disabilities, so as not to discriminate on the basis of that disability. Any student requiring an accommodation for this course must provide the instructor with official documentation in the form of a letter certified by the staff in the Office for Students with Disabilities, University Hall 102. Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at (817) 272-3364.

Title IX: The University of Texas at Arlington is committed to upholding U.S. Federal Law "Title IX" such that no member of the UT Arlington community shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity. For more information, visit www.uta.edu/titleIX.

Electronic Communication: UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at http://www.uta.edu/oit/cs/email/mavmail.php.

Student Feedback Survey: At the end of each term, students enrolled in classes categorized as "lecture," "seminar," or "laboratory shall be directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each students feedback enters the SFS database anonymously and is aggregated with that of other students enrolled in the course. UT Arlingtons effort to solicit, gather, tabulate, and publish student feedback is required by state law; students are strongly urged to participate. For more information, visit http://www.uta.edu/sfs.

Final Review Week: A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities, such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week, *unless specified in the class syllabus.* During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Emergency Exit Procedures: Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit, which is located across the atrium from the classroom. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist handicapped individuals.

Grading (tentative):

40% RSM Project: proposal due Friday, September 18th, report due Wednesday, October 21st.
40% DACE Project: discussion Wednesday, October 28th, report due Wednesday, December 16th.
20% Presentations: special lectures and during finals period, if necessary,

Course Schedule: Approximate number of lectures is given in parentheses.

1. Response Surface Methodology (RSM)
   - 1.1 Introduction: Dean and Voss (1999), 16.1 (1 lecture)
   - 1.2 First-Order Models: Dean and Voss (1999), 16.2 (4 lectures)
   - 1.3 Second Order Models: Dean and Voss (1999), 16.3–16.7 (6 lectures)
   - 1.4 Multiresponse Experiments: Shah et al. (2004) (1 lecture)
   - 1.5 Mixture Experiments: Mason et al. (1989), 11.4 (1 lecture)
2. Design and Analysis of Computer Experiments (DACE): Chen, Tsui et al. (2003)
   - 2.1 Overview (2 lectures)
   - 2.2 DACE Designs (9 lectures)
   - 2.3 DACE Models
     - 2.3.1 Kriging (4 lectures)
     - 2.3.2 Regression Trees (3 lectures)
     - 2.3.3 Multivariate Adaptive Regression Splines (3 lectures)
     - 2.3.4 Artificial Neural Networks (3 lectures)
     - 2.3.5 Other Methods and Applications (3 lectures)