Department of Chemical & Materials Engineering

CHE 358: Process Data Analysis

2014 Winter Term

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Classroom: NRE 1-003
Lectures: Tuesdays, Thursdays, 12:30–13:50
Office hours: Tuesdays, 14:00 - 15:00 or emails or stop by

Teaching Assistant: Su Liu (su7@ualberta.ca)
Grader: TBD

Course webpage

All handouts, assignments and other pertinent information will be posted on UofA's eclass portal for this course: https://eclass.srv.ualberta.ca/portal/ Other important announcements and information will also appear on this webpage.

Course Objectives

This course will focus on the analysis of engineering problems and process data using statistical tools. You will be exposed to a number of practical problems selected from subject areas related to fluid mechanics, heat transfer, mass transfer, reactor analysis, and process control. Throughout the course, you will work with a number of practical engineering problems, including two physical experiments, two data mining case studies and several homework assignments.

The course consists of four teaching modules which are outlined below. The modules will be motivated by case studies based on relevant engineering problems. The problems will be analyzed and the solution strategy will be developed. All statistical tools relevant to the analysis of the case study will be identified. Data analysis, experimental design, and problem solving skills will be reinforced through physical experiments, example problems and homework exercises.

Upon completion of this course, you will be able to:

- Correctly formulate an engineering problem in a statistical framework
- Build linear, non-linear or multiple regression models from process data and validate such models
- Develop efficiency in planned experimentation (or tests) to collect data
- Apply appropriate statistical tools analyze data and interpret the results
- Develop models based on statistical analysis, and make prudent predictions using the developed models

Pre-requisites: CHE 351, STAT 235 **Co-requisites**: CHE 314, CHE 345

Course Contents

Topics to be covered will include some or all the following.

Module #1: Fundamental Statistical Analysis and Multivariate Linear Regression Analysis

- Fundamental statistical analysis
- Simple regression analysis
- Multiple regression analysis
- Statistical properties of linear regression
- Analysis of variance
- Determine model adequacy
- Statistical inferences based on multivariate linear regression models
- Weighted least squares

Module #2: Nonlinear Regression Analysis

- Linearization through data transformation
- Nonlinear regression
- Statistical analysis of nonlinear regression
- Determine model adequacy
- Statistical inferences based on nonlinear regression models
- Linear versus nonlinear regression

Module #3: Design of Experiments

- Strategies for experimentation
- Single factor experiments
- Two-level factorial experiments
- Fractional factorial design
- Multiple level factorial design
- Analysis of variance
- Interpretation of results from experiments

Module #4: Selected Advanced Topics

- Robustness
- Optimal design
- Response surface method

Physical Labs: Pilot-Scale Experiments

- Lab 1: Regression analysis
- Lab 2: Experimental design

Computer Labs: Process Data Analysis
Assignments

There will be five (more or less) assignments in this course.

Examinations and Grading

Assignments	20%	
Labs	20%	
Midterm exam	20%	(27 February, 2014 during regular class time)
Final exam	40%	(24 April 2013 at 2 PM)

The conversion of the percentage grade into a final grade will be performed using a combination of relative and absolute measures taking into account the quality of work submitted and University policy on the distribution of grades. Grades are unofficial until confirmed by Faculty Council or its representative. Re-examination requests for a missed midterm examination will not be entertained. The weight for any deferred midterm exam will be carried onto the final exam. All examinations are closed book and closed notes; calculators are required. Policy regarding the use of calculators will be declared. Formulae sheets, if required, will be provided with each examination.

Unless you have an acceptable excuse, there will be a penalty on late assignments (including lab reports) according to the following rules:

- Late by 24 hours or less, the grade will be reduced by 25%
- Late by more than 24 hours, a zero grade will be assigned

References

- CHE 358 lecture notes (available on the course homepage; need CCID to access)
- D.C. Montgomery, Design and Analysis of Experiments, 8th edition, Wiley, 2012.
- D.C. Montgomery and G.C. Runger, Applied Statistics and Probability for Engineers.
- G.E.P. Box, W.G. Hunter and J.S. Hunter, Statistics for Experimenters, John Wiley & Sons, 1978
- An electronic textbook on Statistics is available at the following website. This site is an excellent source of information and learning aids in basic statistics: http://www.statsoft.com/textbook/stathome.html

Software

The software platform for this course is MATLAB and the associated toolboxes. MATLAB is a popular scientific computation and visualization software package that closely incorporates the theory taught in this course. The Signal Processing Toolbox along with the MATLAB contains the necessary tools for the analysis and design of control systems. It is highly recommended that students familiarize themselves with the basic functionalities of MATLAB as the text and the course frequently refer to MATLAB codes for implementation purposes.

The best way to learn MATLAB is by going through some of the popular tutorials first and then trying it out for oneself. A good site that contains links to a few educational web sites is: http://www.mathworks.com/academia/student_center/tutorials/launchpad.html

MATLAB is available on all departmental Unix workstations as well as several PC labs. You may want to consider buying the Student Edition of MATLAB, available in the U of A Bookstore, for your own PC; this software will be useful later for several other courses.

MATLAB is a registered trademark of the Mathworks Inc.

Policy Regarding Calculators:

Only non-programmable calculators will be permitted during exams for this course. To see the list of approved non-programmable calculators, check the following website:
http://www.engineering.ualberta.ca/calculator.cfm

Plagiarism, Cheating, Misrepresentation of Facts and Participation in an Offence:

The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behaviour (online at http://www.governance.ualberta.ca/en/CodesofConductandResidenceCommunityStandards/CodeofStudentBehaviour.aspx) and avoid any behaviour which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

The following behaviours constitute academic misconduct in this course (in addition to those specified on the Code):

1. Looking at another student's exam during a midterm or final.
2. Copying any part of an assignment or lab report from another student, or from an assignment or lab report from previous offerings for CHE358.
3. Permitting any other class member to copy any part of your assignment or project report.
4. Presenting laboratory data from any other student or former student of CHE358 as your own.
5. Using a programmable calculator in the exams.
6. Accessing the eclass during exams.