Chemical Engineering: 4C3/6C3
Statistics for Engineering

2009 to 2010: Term 2

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Class time and location: Burke Science Building, room B136. Mondays: 14:30 to 17:20.

Prerequisites: A basic course in statistics that covers probability, means, variances, confidence intervals and linear regression. However, all these topics are covered again in this course, focusing on their practical application.

Course materials: All course materials will be permanently available from the course website:

http://stats4.eng.mcmaster.ca

All course announcements, discussion boards, assignments and solutions will be available from there. Course handouts will be posted to the site at least 3 days prior to the next class. It is your responsibility to print out the class notes and bring them to the class.

Reference texts: The course draws from a variety of sources, but the following books cover the course material and are available, on reserve, in Thode Library:

1. Box, G.E.P., Hunter, J.S and Hunter, W.G, *Statistics for experimenters - design, innovation and discovery*, 2nd edition, Wiley. ISBN: 978-0471718130.
2. Draper, N.R. and Smith, H. *Applied regression analysis*, Wiley.
3. Montgomery, D.C. and Runger, G.C, *Applied statistics and probability for engineers.*

If you want to buy a book that you intend to keep after the course, please buy the first one, Box Hunter and Hunter. Also see the course website for other readings and references.

What you must be able to demonstrate by the end of the course:

These are the key objectives of the course:

- Understand that all data has variability: we want to separate that variability into information (knowledge) and error (unknown structure, noise, randomness).
- Understand and use control charts, confidence limits and be able to formulate a hypothesis test.
- Least-squares models: how to fit and interpret it, understand the confidence limits, understand the model's limitations.
- Be able to design your own experimental program and then also interpret the experimental data.
- Understand the principles of multivariate data methods, and be able to interpret and use these models.

Course outline

The course is divided into 6 main sections, taught over 12 classes of 3 hours each.

A. Visualization: creating high-density, efficient graphics that highlight the data without distortion.

B. Probability distributions, confidence intervals, and hypothesis tests.

C. Control charts for statistical control of processes.

D. Correlation, covariance, bivariate least squares and multiple least squares.

E. Design and analysis of experimental data; response surface methods.

F. Introduction to latent variable methods: principal components analysis and principal components regression. Overview of other latent variable tools.

Several enrichment topics are covered throughout the course: robust methods, cross-validation for model assessment, nonparametric methods, real-time application of the above methods, correlation and causality, and missing data handling.

Grading

To assess your understanding of the course materials, the grading for the course is broken down as:

Component	All students	Notes
Assignments	20%	Expect around 8 assignments; can be completed individually, or in groups of 4 or less (4C3), or in groups of 2 or less (6C3)
Mini-project	10%	A small project, no more than 5 written pages.
In-class quizzes	5%	Will not be counted towards your grade if the quiz grade is below your exam grades.
Midterm exam	15%: take-home portion 15%: in-class portion	The take-home portion requires use of the course software
Final exam	15%: take-home portion 25%: written portion	The take-home portion requires use of the course software

6C3 students will have extra readings, and extra questions on all assignments and exams.

Policies regarding grading

We encourage you to complete the assignments in groups of no more than 4 participants. The 6C3 students may also work in groups of at most 2 participants. The course forum provides a discussion board for you to collaborate with your classmates. However, please do not post direct solutions to the forum, and ensure that you read the University's academic integrity policy (reproduced below).

There is a large class of over 90 students, so late hand-ins interfere with the TA's ability to efficiently grade your assignments. Late assignments will be penalized by deducting 20% per day for every late day after the first day. Emergencies and such arise, so each person has 2 "late day" credits.

We do *not* recommend that you assign group members to different questions in the assignment, but if you do this, you must hand in one assignment for the group. The TA will not grade loose sheets handed in after the first submission, and there will be a corresponding reduction in marks.

The take-home portions of the exams will examine course content that requires a computer to complete the questions. The 4th year chemical engineering lab has the course software installed in the event that you do not have access to a computer. You may collaborate with your classmates, but individual hand-ins are required. You must add the names of any collaborators on your exam.

The written component of the midterm and final exam will be open-notes: you may be bring any notes, books, and calculators into the exam. Cellular phones, or any other form of communication will not permitted.

There is a heavy focus on group work (60% of the course grade). Please use this opportunity to your advantage to learn from and with each other. All group submissions must clearly show the names of the group participants.

No make-ups will be given for assignments or quizzes. Only the best N-2 assignments (N is expected to be 8) will be used for the assignment grade, and the quiz grades are only bonus marks.

The maximum grade achievable is 105%. Any students scoring above 100% will be assigned a grade of A+ on the university's standard grading scale.

Class participation

Please bring a calculator to every class, and additional paper for completing group exercises.

Course software

Use of a computer is required in the course. The R-language (http://www.r-project.org/) will be used, and is a freely available software package that runs on Linux, Mac and Windows computers. The software is available in the 4th year Chemical Engineering computer labs. Please see the course website for detailed installation instructions for your own computer.

Out-of-class access: Office hours will be arranged in the first class, based on times that suit students' schedules. However, any questions you have should be:

1. first posted to the course forum, so your classmates can learn with you and help you (and so we can see where the problem areas are - we will not participate in the course forums).
2. emailed to the TA, with a CC to the instructor. Please, only send email from your McMaster email address - we cannot respond to personal email addresses.

Disclaimer

The above outline may be modified slightly, as circumstances change, with agreement from the class.

Academic Integrity

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at http://www.mcmaster.ca/academicintegrity

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.