Chemical, Biological, and Environmental Engineering 213 (4)
Process Data Analysis
Spring 2009
http://classes.engr.oregonstate.edu/cbee/spring2009/che213-001/

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Laboratory Assistants: Adrian Crevier W 1-3; R 1-3
Katherine McAuliffe W 3-5; R 10-12

Class Times:
Lecture/ Recitation: TR 4:00 - 5:50 200 Gleeson
Lab: W 1:00 - 2:50, 3:00 – 4:50 210 Graf
R 10:00 - 11:50, 1:00 - 2:50

Prerequisites: ChE, BioE, or EnvE 212
This prerequisite will be enforced

Office Hours: MK: M 4-5, T 1-2, W 12-1 201 Gleeson
You can also schedule an appointment with either the instructor or TA via email; please list at least three available times in your email.

Learning Resources:
Textbook:
   http://www.statsoft.com/textbook/stathome.html

Wireless Laptop Computer:
You need to bring a wireless laptop to class every Thursday and to your laboratory section.
All students are required to have a laptop as part of the College of Engineering’s wireless laptop initiative:
http://engr.oregonstate.edu/students/wireless/

We will make extensive use of the following software:
Excel – make sure to have both “Solver…” and “Data Analysis… Add-ins in the Tools menu
StatGraphics - StatGraphics is available to OSU Faculty, staff & students for institutional purposes and may be installed on home workstations. StatGraphics is available on the OSUware CD.
Matlab (limited)
You will need Excel and StatGraphics in Lab this week.
**Course Description:**
Statistics provides a powerful set of tools for improving the quality of designs, processes, and products. This course provides a brief introduction to the use of applied statistics in the chemical process industry. Application of statistics will be integrated to ChE problem solving through case studies.

**Course Goals:**
1. Develop an awareness of the utility of statistics in assessing experimental data and operating industrial chemical processes.
2. Describe the basic concepts and nomenclature associated with applied statistics, regression, Statistical Process Control, and Design of Experiments.
3. Work through real industrial examples (case studies) in the fields of chemical, biological and environmental engineering to gain experience with these tools.
4. Utilize computer software (Microsoft Excel, StatGraphics) to aid in statistical analysis.

**Course Learning Objectives:**
*By the end of the course, you will be able to:*
1. Define major terms used in applied statistics including those on the assessment matrix.
2. By hand and using software, perform the following: (1) statistically summarize data including measures of central tendency and dispersion, and (2) use the appropriate graphical form to summarize data for analysis including box plots, scatter plots and histograms. Match given graphical output to the corresponding summary statistics. Explain trends in data based on these methods.
3. List the key characteristics of probability distributions, in particular the normal distribution. Given a histogram, explain how it relates to the normal distribution. Given a mean, standard deviation and observed value, calculate the z-score and find the corresponding percentile. Identify populations that follow a binomial distribution and a Poisson distribution.
4. Describe the sampling distribution of a statistic, in particular the $t$ distribution and the $\chi^2$ distribution. Given a study, describe what role statistical inference plays in terms of the population and sample. Calculate confidence intervals. Statistically analyze data for significance and compare sets of data. Define the standard error of a statistic.
5. Fit experimental data to an empirical model equation using least squares analysis. For linear regression, both by hand and using software, calculate the slope intercept and correlation coefficient. Explain the relation between the slope of the regression line and the correlation coefficient.
6. Given data from a process, calculate control limits and capability ($C_p$ and $C_{pk}$). Distinguish between specification limits and control limits. Make SPC control charts, including $x$, $x$-bar R, and $x$-bar S charts.
7. Quantify the effect of (i) a single factor and (ii) two factors on a process by applying Analysis of Variance (ANOVA).
8. In the context of Design of Experiments (DOE), (i) set up a balanced design array, (ii) create a marginal means plots and/or an interaction plot from the experimental response, and (iii) develop an empirical model equation.
9. Define the important elements of a measurement system. Calculate the repeatability and reproducibility of a gauge based on measured data.
10. Prepare and peer review a formal laboratory report.
**Course Grades:**
The grades will be based upon examination of course work. An approximate breakdown is as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Laptop – WISE</td>
<td>5% + 5% bonus</td>
</tr>
<tr>
<td>Homework</td>
<td>15%</td>
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<tr>
<td>Midterm Exam</td>
<td>20%</td>
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<tr>
<td>Final Exam</td>
<td>25%</td>
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<tr>
<td>Laboratory</td>
<td>15%</td>
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<tr>
<td>Lab Report</td>
<td>15%</td>
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<tr>
<td>Attendance</td>
<td>5%</td>
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**Laptop – WISE (10%)**
We will be doing graded interactive activities in class using the WISE Learning Tool:
https://secure.engr.oregonstate.edu/che/WISE/

**Homework (15%):**
*Unless otherwise stated by the instructor, you are not allowed to look at to previously worked solutions of the assigned problems (e.g., from the Web, solutions manual etc.), before the homework due date - even to check your work. Using worked solutions will be considered as a case of academic dishonesty and may result in an F grade in the class.*

Homework is instrumental in helping you grasp fundamental concepts and in exposing you to techniques and skills for applying these principles to real-life situations. Homework should be done in several sittings; you cannot expect to be successful doing homework quickly the night before it is due. Homework will be available on the web by Tues. and due at the beginning of class the following Tues. Any late homework will receive a grade of 0 unless arrangements are made with the instructor before it is due. Failure to turn in more than 2 homework assignments will result in a grade of F in the class.

You may discuss homework problems with your classmates (NOT COPY THEIR SOLUTIONS), but please try them on your own first. Additionally solutions must be written up independently.

**Format:** see
http://classes.engr.oregonstate.edu/cbee/spring2009/che213-001/HWFormat.pdf

**Exams:**
If you MUST miss an exam for an emergency situation, please let me know as soon as possible. If you skip an exam, you will not have an opportunity to make it up. If you have a valid (according to me) time conflict and you let me know in advance, there is the possibility of taking an exam at an alternate time.

**Midterm Exam (20%):**
There will be a midterm exam, tentatively scheduled for 05/05/09. You will be asked, in part, to apply the fundamental principles that have been covered in the course to entirely new problems.
Final Exam (25%):  
The Final Exam is scheduled for Monday, June 8, 2:00 – 3:50 PM. Please make sure to schedule summer activities so that you are available to take the Final. Requests to take the exam early for this reason will not be granted.

Laboratory (20%):  
The laboratory sections will contain both computer and hands-on data collection and analysis.

Class Attendance (5%):  
Attendance is MANDATORY? You are expected to attend every class and participate in discussion. Lectures are designed to supplement, not replace, the reading material, and to develop problem-solving skills. If you are not able to make class, notify the instructor before class. Unexcused absences may lower your final course grade. If you do miss class, it is your responsibility to find out what was covered and any administrative information that was discussed.

Summer Research Experiences and other Extracurricular Professional Activities:  
This class is scheduled for 10 weeks ending June 12; there is lab every week. If you will miss any of the required activities, you need to let me know, in writing, before the activity takes place. It is your responsibility to make up any assignments and class activities that you will miss and to get the information covered during class. Students leaving early for a summer research experience must have a B or better in the class, and will be given the Final in the week before Fall term starts.

Disruptive Behavior  
While the University is a place where the free exchange of ideas and concepts allows for debate and disagreement, all classroom behavior and discourse should reflect the values of respect and civility. Behaviors which are disruptive to the learning environment will not be tolerated. As your instructors, we are dedicated to establishing a learning environment that promotes diversity of race, culture, gender, sexual orientation, and physical disability. Anyone noticing discriminatory behavior in this class, or feeling discriminated against should bring it to the attention of the instructors or other University personnel as appropriate.

The following specific behavior is not allowed:

- No cell phones or pagers in class.
- No use of Laptops or other electronic devices for activity outside of its use in THIS class (i.e., surf the web, email, pictures)
- No reading the Barometer during class

Cheating and Student Conduct:  
The instructors of this class take the issue of academic honesty very seriously. You are expected to be honest and ethical in your academic work. There is a “zero tolerance” policy in effect for cheating in this class. Any instance in which a student is caught
cheating will be handled in strict accordance with the policies outlined at http://www.orst.edu/admin/stucon/achon.htm. In order to provide students with a positive learning environment, OSU has adopted a pledge of civility, which can be found at http://osu.orst.edu/admin/stucon/index.htm.

Academic dishonesty is defined as an intentional act of deception in one of the following areas:

- **Cheating**- use or attempted use of unauthorized materials, information or study aids
- **Fabrication**- falsification or invention of any information
- **Assisting**- helping another commit an act of academic dishonesty
- **Tampering**- altering or interfering with evaluation instruments and documents
- **Plagiarism**- representing the words or ideas of another person as one's own

When evidence of academic dishonesty comes to the instructor's attention, the instructor will document the incident, permit the accused student to provide an explanation, advise the student of possible penalties, and take action. The instructor may impose any academic penalty up to and including an "F" grade in the course after consulting with his or her department chair and informing the student of the action taken.

**Disability:**

Students with documented disabilities who may need accommodations, who have any emergency medical information the instructor should know of, or who need special arrangements in the event of evacuation, should make an appointment with the instructor as early as possible, no later than the first week of the term. Students with disabilities are encouraged to contact the Services for Students with Disabilities Department (SSD) and obtain professional opinion and recommendation. SSD website: http://ssd.oregonstate.edu/. These documents are needed for specific accommodation and should be presented to the instructor as early as possible.