

CH EN 5207/6207 – Statistics for Chemical Engineers

Department of Chemical Engineering

University of Utah

Last Revised 2019 August 9

Semester	Fall 2019
Instructor	Geoff Silcox (geoff@chemeng.utah.edu) Room MEB 4542 (801)581-8820 (office)
Meetings	Lecture: M W F 09:40 – 10:30, Union Theater
Office hours	TBA in my office or just stop by or make appointment for other times.
Teaching assistant	Jebin Elias, jebin.elias@utah.edu Office hours: TBA
Prerequisites	C or better in (MATH 2250 AND CH EN 2300 AND CH EN 2450) AND Full Major status in CH EN.
Required software and computing notebook	<p>The simplest approach to working with Jupyter Notebook is to login to the Jupyter Hub with your U of U credentials at https://juno.chpc.utah.edu/hub/login. If you choose that approach, you do not need to download anything and once you login you will be in a Jupyter Notebook window.</p> <p>If you want to download Python and its supporting libraries, use the Anaconda download: https://www.anaconda.com/download/. Unless your laptop is old, download the 64-bit version. The computing notebook, Jupyter Notebook, is included in the download. To run Jupyter Notebook, launch the Anaconda Prompt, navigate to the folder you are interested in, type jupyter notebook, and press Enter. Jupyter Notebook files have the extension ipynb.</p>
Suggested text	<i>Miller & Freund's Probability and Statistics for Engineers</i> , 9th ed, Richard A. Johnson, Pearson, 2017.
Suggested references	LaTeX/Mathematics, https://en.wikibooks.org/wiki/LaTeX/Mathematics . We will use LaTeX to write equations in Jupyter Notebook.

OpenIntro Statistics, David M Diez, Christopher D Barr, Mine Cetinkaya-Rundel, 3rd and 4th ed, openintro.org, 2015 and

2019. Available online at
<https://www.openintro.org/stat/textbook.php>.

Engineering Statistics Handbook, NIST, 2013. Available online at <http://www.itl.nist.gov/div898/handbook/index.htm>.

Consider a Cylindrical Cow: More Adventures in Environmental Problem Solving, John Harte, University Science Books, 2001.

Elements of Chemical Reaction Engineering, 5th ed, H. Scott Fogler, Prentice Hall, 2016. See Chapters 16-18 at the author's website: <http://umich.edu/~elements/5e/index.html>.

Course description	Basic statistics presented using the Python programming language with applications to chemical engineering including environmental problem solving and process optimization.
Learning objectives	<p>By the end of this course you will be able to use Python to</p> <ol style="list-style-type: none">1. Solve and present solutions to statistics problems using Jupyter Notebook.2. Visualize and clean data.3. Work with probability mass functions and cumulative distribution functions.4. Calculate confidence intervals and perform hypothesis testing.5. Calculate confidence intervals on variance.6. Propagate uncertainty.7. Compare two means and two proportions. Compare many means.8. Perform linear, curvilinear, nonlinear, and multivariable regression.9. Perform two-factor and multiple-factor ANOVA.10. Design experiments and graphically present the results of 2^2 and 2^3 experiments.11. Apply response surface analysis to optimize a process.

12. Create and analyze control charts for process location, variation, and attributes.
13. Apply Weibull and Rayleigh statistics to determine wind turbine performance.
14. Use pulse tracer data to determine the residence time distribution in a packed-bed.
15. Graduate students: create and deliver an interesting, content-rich lecture that applies statistical analysis to a problem of your choosing.

Special dates

First day of semester: Monday, August 19
 Last day to add or drop: Friday, August 30
 Labor Day: Monday, September 3
 Last day to withdraw: Friday, October 18
 Fall break: October 7 - 11
 Thanksgiving break: November 28-29
 Classes end: Thursday, December 5
 Reading Day: Friday, December 6
 Final exam: Thursday, December 12, 08:00 – 10:00

Grading

Undergraduate: 10 % homework, 20 % first exam, 25 % second exam, 10 % project, 35 % final exam.

Graduate: 10 % homework, 20 % first exam, 20 % second exam, 10 % project, 10 % lecture, 30 % final exam.

I will grade graduate students separately from undergraduates. Graduate students will be required to create and deliver a 30-min long, content-rich lecture that applies statistical analysis to a problem of their choosing.

Final grades will be based on the following table. The table represents grade guarantees. The high score in the class will be used to scale all other scores. For example, if the high score is 95%, all scores will be divided by 0.95. I reserve the right to reevaluate the grades of students who show exceptional performance on the final, the project, or the homework. I may lower the grading scale and may choose a lower scaling factor than that based on the highest score.

Percentage	Grade
95-100	A
90-95	A-
85-90	B+

80-85	B
75-80	B-
70-75	C+
65-70	C
60-65	C-
50-60	D
< 50	E

Homework

Homework is due on Thursdays by 11:59 pm and should be submitted as a Jupyter Notebook (ipynb) file in Canvas with all coding in Python. Supplemental files for figures or data are perfectly acceptable. The solutions will be posted in Canvas. Late homework will not be accepted after the solutions have been posted. The neatness, organization, and completeness of your homework solutions will be evaluated in grading.

To receive full credit for your written solutions, you must write out all equations that you use and you must state all values substituted in those equations. You must show all of your work to receive credit. Complete sentences must be using in answering homework questions.

I encourage you to work with other students on the homework. You are required, however, to turn in individual, original assignments for grading. You should be able to solve all problems on your own. Copying the assignments of others will constitute plagiarism.

If you don't have anyone with whom to study, please contact me and I'll see if I can arrange something.

Quizzes and Examinations

The examinations will be closed book, closed note, closed homework. I will provide an equation sheet with each exam.

The final, comprehensive exam will be from 08:00 – 10:00 on Thursday, December 12, in our regular classroom.

To receive credit for solutions to exam questions you must show all of your work: write out the equations in symbolic form and provide all numerical values that you use.

Requests for regrading of an exam must be made in writing and must be submitted within one week from when the exam or quiz is returned.

Students with Disabilities	<p>The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability & Access (https://disability.utah.edu/), 162 Olpin Union Building, 801-581-5020. CDS will work with you and Prof. Silcox to make arrangements for accommodations.</p> <p>All written information in this course can be made available in alternative format with prior notification to the Center for Disability & Access.</p>
Addressing Sexual Misconduct	<p>Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran’s status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, Eccles Student Life Center, Suite 2100, 801-581-7776. To report to the police, contact the Department of Public Safety, 911 or 801-585-2677(COPS).</p>
University Counseling Center	<p>The University Counseling Center (https://counselingcenter.utah.edu/) helps students resolve existing problems, prevent potential problems, and develop new skills that will enrich their lives. Their services address personal, career, and academic learning issues in formats include individual and group counseling, classes, and mindfulness-based workshops. Phone: 801-581-6826. For after-hours emergencies, 801-587-3000.</p>
Campus Safety	<p>To report suspicious activity or to request a courtesy escort, call campus police at 801.585.COPS (801.585.2677). If you choose, you will receive emergency alerts and safety messages via text messaging and email. For more information, see safeu.utah.edu.</p>

Draft Schedule and Outline

Week	Monday	Wednesday	Friday	Deadlines
8/19, 21, 23	L01 Intro Probability and Stats	L01 Intro Probability and Stats	L02 Intro to stats and Python	
8/26, 28, 30	L03 DataFrames and data cleaning	L04 Linear regression	L04 Linear regression	HW 1 due Aug 26 by 11:59 pm
9/2, 4, 6	Labor Day	L05 Probability mass functions (PMF)	L06 Distributions	HW 2 due Sept 2 by 11:59 pm
9/9, 11, 13	L07 Sampling	L08 Confidence intervals	TBA	HW 3 due Sept 9 by 11:59 pm
9/16, 18, 20	Review for Exam 1	Exam 1	L09 Hypothesis testing	HW 4 due Sept 16 by 11:59 pm
9/23, 25, 27	L10 Uncertainty and its propagation	L11 Comparing two means	TBA	
9/30, 10/2, 4	L12 Comparing many means (ANOVA)	Reactor residence time distributions	Reactor residence time distributions	HW 5 and lecture abstract due Sept 30 by 11:59 pm
10/7, 9, 11	Fall Break	Fall Break	Fall Break	
10/14, 16, 18	TBA	L13 Nonlinear regression	L13 Nonlinear regression	HW 6 due Oct 14 by 11:59 pm
10/21, 23, 25	L14 Comparing two proportions	L15 Curvilinear and multiple regression	L15 Curvilinear and multiple regression	HW 7 due Oct 21 by 11:59 pm.
10/28, 30, 11/1	Review for Exam 2	Exam 2	TBA	HW 8 and lecture outline due Oct 28 by 11:59 pm
11/4, 6, 8	L16 Two-factor ANOVA	L17 Confidence intervals on variance	L18 Three or more-factor ANOVA	
11/11, 13, 15	L19 Graphic of 2^2 and 2^3 experiments	L20 Response surface analysis	L20 Response surface analysis	HW 9 due Nov 4 by 11:59 pm

11/18, 20, 22	L21 Control charts for process location	L22 Control charts for process variation	L23 Control charts and attributes	HW 10 and lecture due Nov 18 by 11:59 pm
11/25, 27, 29	L24 Wind turbines and Weibull and Rayleigh statistics	TBA	Thanksgiving Break	HW 11 due Nov 25 by 11:59 pm
12/2, 4, 6	TBA	Review for Final Exam 2	Reading Day	HW 12 due Dec 2 by 11:59 pm
Thursday, December 12, 08:00 – 10:00, Final Exam				