STA 4211 Design and Analysis of Experiments Fall 2019

Class No. 21250, MWF 4th period, 10:40am–11:30am, FLO 100

Class No. 21251, MWF 6th period, 12:50pm – 1:40pm, FLO 100

Instructor Deborah Burr, 116C Griffin-Floyd Hall (FLO);
Office Hours: MWF 11:35am–12:25pm, or by appointment; Email: `burr@stat.ufl.edu` (put "4211" in the subject line); Phone: 273-2973 (do not leave a message).

Teaching Assistants Lei Yang, FLO 218; Office Hours: Mon 1:50pm – 3:50pm;
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Required Materials

Textbook Kutner, Nachtsheim, Neter, and Li, *Applied Linear Statistical Models*, 5^{th} ed., Vol. II (Chapters 15–30, Appendix A).

Scientific Calculator You need one which will compute the mean and standard deviation automatically. You will use it for tests. A graphing calculator is allowed.

Statistical Software We will use the free statistical computing language R; download it in the first week of the semester from `http://www.r-project.org`. Also download Rstudio from `http://www.rstudio.com` (Desktop free license).

Prerequisite STA 4210, Regression Analysis.

Course Description This course is on the basic principles of experimental design (control, randomization, and blocking), and the analysis of data gathered via a number of typical designs. The course begins with the completely randomized design for experiments with a single factor, then moves on to randomized blocks and two-way factorial experiments. Model equations, index notation for ANOVA models, decomposition of the sum of squares, estimation of effects, F tests, and graphical methods for displaying the data and for checking assumptions are common themes for all designs. Several methods of multiple comparisons will be covered. More complicated cases will include multi-factor designs, covariance models, and models with nested random factors. Further topics such as Latin squares, incomplete block designs, and response surface methodology, will be covered as time permits. Together with linear regression models, the models for analysis of variance are cases of the general linear model, for which matrix notation and linear algebra are commonly used. This connection with regression models, and other connections, will be brought out throughout the course.

Main Course Objectives

1. Know the basic elements of experiments (control, randomization, blocking), how these are combined to construct several simple and complex designs, and how such designs are carried out in practice. Know the advantages and disadvantages of the one-way and two-way designs, as well as several more complex designs.
2. For one-way analysis of variance (ANOVA), be able to state the model in both the cell-means and factor-effects forms, for either a single observation at a time or in matrix notation.
3. Be able to carry out and interpret the analysis of a one-way ANOVA using least-squares methods, both descriptive and inferential (F and t) methods.
4. Learn several methods of simultaneous inference in one-way ANOVA, how to carry them out, and when each is appropriate.
5. Know how residual methods are applied in one-way ANOVA to check the model, and nonparametric alternative methods of analysis to use when assumptions are not satisfied.
6. For crossed designs with equal number $n > 1$ of observations in each cell, know the different ways to represent the model with interaction. Be familiar with different types of interaction. Know the representation of the additive model. Be able to explain the difference between the additive and interaction model.
7. Be able to carry out the analysis of the two-way layout by hand and in R, to check assumptions using residuals, and to suggest alternative approaches if assumptions are not satisfied.
8. For two-way layouts with one observation per cell, know that the additive model must be used; know how to fit, check assumptions, and interpret the fit of the usual model.
9. Be familiar with examples of the randomized blocks design, and how to analyze data arising from this design, as a special case of the two-way layout with one observation per cell.
10. For the two-way layout with unequal numbers of observations in the cells, know how to analyze the data using the regression approach.

Grading Your final course grade will depend on your course score based on the following components with their respective weights:

Homework:		15%
Project	Paper due Friday November 22	10%
	Presentations 22 Nov - 4 Dec	
Exam 1:	Wednesday September 25 (8:20 –10:10pm, location TBA)	25%
Exam 2:	Wednesday October 30 (8:20 – 10:10pm, location TBA)	25%
Exam 3:	Wednesday December 11 (during final exam period, FLO 100)	25%

Note: The final exam period for 4th period class is Wed 11 Dec 7:30am–9:30am, and for 6th period is Wed 11 Dec 12:30pm – 2:30pm.

The assignment of letter grades will be determined as follows (cutoffs will be no stricter than indicated, and may be relaxed): A 93–100; A^- 90–92; B^+ 87–89; B 80–86; B^- 77–79; C^+ 74–76; C 67–73; D 50–66; E < 50.

Homework/Quizzes There will be about eight homeworks to be submitted on Canvas. Some but not all of the problems on each homework will be graded. A crucial part of homework assignments is to show your work and explain your reasoning. It is not sufficient to simply give a numerical or short answer. Some homeworks will require you to use R and to produce a written report of a data analysis. You need to earn a total of 220 points for a perfect homework score (not including the project); there will be at least 250 points possible. (If you earn a total score over 220, this will not count extra.) There will be some announced in-class multiple-choice quizzes; quiz scores will be added to your homework score. Quizzes will be closed book and closed notes. One of the quizzes is the academic learning compact (ALC) instrument. The ALC exam is a 20-item, multiple-choice test on statistical concepts mostly from Statistics 1, which is a requirement of the Florida Board of Governors for statistics majors. All students in 4211 will take this test, both majors and non-majors. Topics on this exam are listed in `AppliedTopics.pdf` under Files/Homework on Canvas.

Project If you are a statistics major, the project requires you to collect and analyze data, and to present your design and analysis in a written and an oral report. If you are not a statistics major, you have two choices for your project—you may do exactly what the majors are doing, or you may do an analysis and written report on a dataset which will be provided for you. Information on the project is on Canvas under Files/Project. The project fulfills the requirement for majors in any field to acquire and demonstrate proficiency in communication, both written and oral, in their major area.

Exams There will be three exams. On all exams, there will be several questions which describe an experiment, give R output from the analysis, and ask you to interpret the output. In analysis of designed experiments, quite a few calculations can be done "by hand." You will be asked to do some of these on the tests; bring a calculator to the exams.

Course Policies

Homework You are allowed to get help with homework problems, but your final write-up must be your own. Homework must be submitted on Canvas by the posted due date and time. Late homework will not be accepted.

Exams Makeup exams must be approved before the time of the exam and will generally be given only in case of medical or family emergencies, which must be appropriately documented. More details regarding policy for granting a makeup exam may be found in the undergraduate catalog under Attendance Policies (`https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx`). For cases of illness, a doctor's signed note will be required.

Email Use email only for administrative matters. Email me at `burr@stat.ufl.edu`, and put the course number in the subject line. See me or a TA in person for content questions. The ideal time to ask questions is right after class.

Honor Code All work on quizzes and exams must be entirely your own. Refer to `http://www.dso.ufl.edu/sccr/process/student-conduct-honorcode/` for the UF Honor Code.

Disabilities Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, `www.dso.ufl.edu/drc/`) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.