

# Statistics 514(Q): Design of Experiments – Fall 2007

## Course Information and Policies

### Divisions 1 – TTh 9:00am-10:15am (POTR 262)

**Instructor:** Dr. Kristofer Jennings

**Office:** 538 Mathematical Sciences Building (5th floor, turn right from the elevator)

**Office Hours:** T 10:30am-noon, W 2:30-4pm

**Appointments:** If you cannot come to scheduled office hours, you may arrange an appointment for another time. Please be courteous and make an appointment instead of just “dropping by,” since I am likely to be busy. You can arrange an appointment by phone or by e-mail.

**Phone:** (765-49)4-6052

**E-mail:** [jennings@stat.purdue.edu](mailto:jennings@stat.purdue.edu)

**Mailbox:** in room 533 MATH, open during business hours. Please use the mailbox, and DO NOT put anything under my door! If you absolutely must hand in your homework outside these hours, you may send it as an e-mail attachment.

**Prerequisite:** This course is effectively a continuation of (and not a substitute for) STAT 512. Much of the preliminary information will be considered a quick review of the material covered in that class. While it is not recommended that you take this course without taking STAT 512, you should absolutely not take this course without having taken a good introductory course in statistics covering probability distributions, sampling distribution, sample mean, variance, hypothesis testing,  $Z$ -test,  $t$ -test, two-sample paired  $t$ -test, two-sample independent  $t$ -test, one-way ANOVA, and simple regression.

**Course Objectives:** To be able to plan an experiment in such a way that the statistical analysis results in valid and objective conclusions. To learn a variety of experimental designs and be able to choose an appropriate design for a specific experiment. To be able to perform the proper statistical analysis and draw valid conclusions from a specific experiment.

### Course Schedule:

Chapter(s)	Description	Approx. Time (weeks)
2	Overview and Hypothesis Testing	1
3, 2, 14	Completely Randomized Design	2
4	Randomized Block Designs	3
5, 14	Factorial Designs	1
12	Mixed Models/Random Effects	2
13	Nested Designs, Split Plot, Repeated Measures	4
6, 7, 8	Fractional Factorial Designs	1
11	Response Surface	1

**Grader:** All homework will be graded by a student grader, who will also help grade the exams. He or she will not hold office hours.

**Textbook:** *Design and Analysis of Experiments, 6th edition*, by D. C. Montgomery (*Required*). This book will be used to describe most of the technical details of the course material. After the first few chapters, we will skip around. By the end of the semester, we will have covered most sections.

*A First Course in Design and Analysis of Experiments* by G. W. Oehlert (*Recommended*). This book is a nice counterpoint to Montgomery's book, providing a somewhat more readable discussion of more difficult topics as well as covering some material that the required text doesn't get to. It is, however, not as comprehensive as Montgomery's book, nor does it provide as many examples.

**Webpage:** <http://www.stat.purdue.edu/~jennings/stat514/>

This page will be used to provide information relevant to the course. Such information includes this document, announcements, lecture notes, homework assignments and solutions, reading assignments, data sets, dates of exams, review sheets, and changes to office hours. Please check this page regularly for updates.

**Mailing List:** A mailing list will be arranged for this course. I will send (very occasionally) e-mail to this list with any special announcements or reminders.

**WebCT Vista:** A Vista site has been created for this course. Students enrolled in the course will be automatically given access to the site ("auto-populated"). The Vista site is limited to enrolled students and thus will be used to provide restricted information such as grades and homework solutions.

In addition, discussion groups are available for homework questions (although questions in class are encouraged) and general suggestions. Note that this discussion option is an experiment and may be discontinued if the instructor deems it necessary.

**Class Time:** I will try to begin and end every class promptly. I have no objection to students' eating during class, as long as it is done discreetly and quietly. I would rather you drink coffee in class than sleep. Before class is usually *not* a good time to ask lengthy questions or make appointments, since I will be busy setting up the computer, arranging handouts, etc. Please email, call, or come to office hours instead. Questions during class are welcomed and encouraged.

**Lectures:** Lecture notes will usually be displayed on the computer projection screen during class, occasionally supplemented by sketches and/or handouts. The computer-displayed notes will be made available to you on the class web page as MS-Word and Portable Document Format (.pdf) documents. Usually they will be available in advance of class. We will cover roughly 1 chapter per week, so lectures will go pretty quickly. The provided notes are

not necessarily comprehensive, so come prepared to take handwritten notes (particularly at the beginning of each lecture). You are always welcome to ask questions if I need to slow down.

**Final Grade:** Your final grade will depend on the following components with these proportions: homework (40%), exam 1 (25%), exam 2 (25%), exam (10%). These proportions may be adjusted by up to 5% in either direction at the instructor's discretion but will be the same for every student in the class. (I expect – but won't guarantee – that the median grade in this class will be an A.) It is your responsibility to check that your grades have been recorded correctly in Vista

**Computer Software:** This class will be based on using SAS 8 (and 9) to perform data analysis. The intent of using software is to allow the computer to perform routine calculations and graphing, while we focus on choosing the appropriate analysis tools and interpreting the results. Computer software is NOT a substitute for understanding the statistical methods, and you will not have access to a computer during exams. SAS is available in the Purdue computing labs. You may also obtain a copy of SAS for your own PC for class purposes free of charge by showing your student ID at ITaP in South Campus Courts Building C at the corner of Sheetz and Harrison streets.

There are several sources of SAS help available. Make use of the SAS help system within the program to look up specific details. Another tool that should not be overlooked is the Web for finding SAS help. If you need help in person, the Statistics Department provides a software consultant in MATH G-175, M-F, 10am-4pm; also they provide a document with a nice introduction to SAS (see the link on the class website). You can also get help from the instructor in office hours or by email. SAS manuals are available in the bookstore and the library.

It is not required that SAS is used for data analysis. Programs such as R, S-plus, Matlab, and Mathematica are all perfectly acceptable alternatives and might occasionally be preferable for methods that require programming. In addition, for much of the work in this class, statistical packages such as SPSS and Minitab (and occasionally JMP and Statistica) are also acceptable.

**Reading:** I expect you to read the text as we cover the material, as announced in class. It can help to read about a topic (especially example) *before* it is covered in class. This does not mean that I expect you to learn it all on your own. Rather, your reading before the class should be a “first pass” at the subject. The first time through, I just want you to read through it quickly, in order to get a general idea of the material – the “big picture”. Don't get bogged down in formulas or details; just try to get a rough idea of the material and get familiar with the vocabulary. This will prepare you for what is to come in the class, and will make the class easier to follow. If, as you are reading, you find something hard to understand, don't be alarmed or discouraged. Just make a note of any parts you found confusing, or any questions that occur to you as you read. Often, you will find that those

questions are cleared up in the following class. If not, please ask during class! Later, as you are working on problem sets and studying for tests, you will find it helpful to read the material again. This time, read at a much more detailed level. It will be a lot easier to follow then, since you have already covered the material in class. Repetition and practice are important learning tools.

**Examinations:** There will be two midterm examinations. The first will take place on October 4 in class; the second will take place on November 20. These will contribute the majority of your final grade. *Please let me know as soon as possible if the exam times don't work for you.* Each examination will have both mathematical and conceptual (written) components. The date and time of the final exam will be announced later in the semester.

**Homework:** Homework will be due every other week (or so), on Thursdays, in class. My hope is that it will be returned by the grader within one week. The homework assignment will be posted on the web approximately one week before its due date and will also be posted on the class web page. Late homework will not be accepted under any circumstances (late = after 5:00pm on due date). If you cannot hand in your homework in class you should put it in my mailbox (see above). Homework solutions will be posted on the class Vista page (accessible only to registered students). To allow for illness, family emergencies, conference travel, etc., your lowest homework grade will be dropped.

Homework performs three vital functions in this course:

1. it gives you an opportunity to practice what you have learned and to understand concepts by actually using them;
2. it gives you feedback on what you understand and on what areas need more work;
3. it contributes to your final grade.

You are encouraged to use homework as a learning tool. It is important to start work on it early, so as to have an opportunity to ask for help from the instructor if necessary during office hours. You may also wish to discuss homework with your classmates. **Group discussions and study sessions are a very useful tool for learning.** However, outright copying is unacceptable, as well as pointless, and will be penalized. A good rule of thumb is that it is fine to talk together about how to do a problem, but then go do it and write it up yourself, possibly comparing answers afterwards. Do not copy another person's SAS code, but it is okay to ask someone to help you find your mistake. Remember that if you copy from a classmate without understanding it, only your classmate will pass the exam. If blatant copying is detected, all parties involved (copier and copied) will receive a score of zero for that assignment.

*When turning in your homework, each problem must be presented in order.* This includes all relevant graphs and tables, which must be easily readable and appropriately labeled. Any graph or figure that is turned in without comments or spans across more than one page will be ignored.

*Please do not pad your homework with endless printouts of SAS output.* Only hand in those parts of the output that are directly relevant to your solution. You should edit any SAS output you plan to hand in by pasting it into an editor such as MS-Word, and getting rid of extra space or unnecessary output. *Use complete sentences and proper grammar.* It is helpful to circle or highlight the portions of the output to which you refer in your solution. *As a rule of thumb, only hand in what you actually expect the grader to read.* SAS output should be pasted into your solution as you are answering the questions. Your SAS input file may be attached at the end of the homework. The input is not given a grade *per se*, but it can be helpful to the grader in trying to figure out what you did wrong and in assigning partial credit. Remember, you are at a major university, so your work should demonstrate a level of professionalism. This class is about being able to understand and *communicate* understanding about statistics.

Homework must always be stapled if it is longer than one page. If it is not stapled, only the first page will be graded. The first page of each homework set handed in must contain the following information:

- your name
- my name (Dr. Jennings)
- the number of the homework set (e.g., Homework #2)
- STAT 514

This information is necessary to ensure that your grades are recorded correctly and that your homework is returned to you promptly. The grader may also grade other courses, including another section of 514, and we don't want to get them mixed up. Please make it easy for us not to lose your homework or grades!

**Finally, homework turned in late, under my door,  
or in the wrong mailbox will not be graded.**

**Re-grades:** Since the professor and grader are fallible human beings, occasionally errors will occur in grading. For this reason, students are able to request that such an error be corrected. Two types of error can occur. A *type I error* occurs if points are deducted for a correct solution. A *type II error* occurs if sufficient points are not deducted for an incorrect solution. Any request for a re-grade *must* be made *in writing* and *must* abide by the following procedure, or it will be ignored.

1. Attach a new piece of paper to the *front* of the work to be re-graded. This piece of paper should contain the following information:
  - (a) the word "re-grade" displayed prominently
  - (b) your name and section
  - (c) which homework set or midterm is involved (e.g., Homework #6)

- (d) the relevant problem number(s) (e.g., Problem 7.23)
  - (e) a detailed explanation of the suspected error (“Please look at problem 4” is not considered a detailed explanation).
  - (f) the date of resubmission
2. Print out the appropriate pages of the solutions from the web page, and circle the relevant piece of the solution. Attach this *behind* the work to be re-graded.
  3. Give this packet to me, or put it in my mailbox. A verbal explanation is neither necessary nor appropriate since a) I won’t remember it, and b) the grader will do the regrading anyway.

No exceptions will be made to this policy. The grader will be responsible for the re-grading and you will receive a written note from the grader explaining the outcome. I will review the grader’s response before returning it to you, to make sure the problem was resolved. Re-grade requests may be submitted until the last week of classes, but you are encouraged to be prompt. If the above procedure is not followed, the re-grade request will be denied. Any rudeness accompanying a re-grade request will result in the assessment of a “technical foul” penalty equal to the total number of points for the disputed question. Please also note that a re-grade request is different from the questions “Can you help me figure out what I did wrong here?”, or “I don’t understand the posted solutions”, which are entirely appropriate for office hours.

**General Comments:** This is not a math course. However, as in many other science courses, we will make use of mathematics quite extensively, and most questions will have some quantitative component. The use of SAS software will simplify many of the more computational tasks. However, the primary focus of this course is on learning how to do good science. Doing science well requires, among other things, a good experimental design as well as a correct and appropriate statistical analysis of the scientific data. Therefore, knowing when and when not to use a certain statistical method, and why, and how to interpret the results, are all at least as important as knowing how to actually carry out the calculations. In order to do well in this course, you must be prepared to master all of these areas.

**My Expectations:** I expect that you will work hard in this course. I expect you to come to each class prepared to listen and understand. I expect that you will ask questions if things are not clear. I expect that you will use the textbook and other resources, and will read material as assigned. I expect you to attend class regularly, and that you will promptly catch up on any classes you miss. I expect you to make an honest attempt at assigned homework, and to ask for help when you need it. I expect you to behave appropriately and politely towards me and your fellow classmates at all times. This includes remaining quiet when others are speaking and being patient with the questions of others. I expect you not to misrepresent the work of others as your own, and to neither give nor receive unauthorized aid in examinations or homework.

Finally, this is your time – ASK QUESTIONS while you're here. If by chance your question is beyond the scope of this course, I would be happy to discuss it with you outside class.