STATS 470 001: Introduction to the Design of Experiments
FALL 2019

Lectures: STATS 470-001 WF, 10.00-11.30am, 1120 WEIL
Labs: STATS 470-002 Th, 4.00-5.30pm, B760 EH
STATS 470-003 Th, 2.30-4.00pm, B254 EH

Instructor: **Dr. Shyamala Nagaraj**, shyamnk, 258 West Hall

GSI: Subha Maity, smaity, Lab 470-003 Thursdays, 2.30pm - 4pm

In your emails, it will be helpful to track the email if you include "Stats 470" in the subject line when emailing us

Office hours: Monday, 2.00pm – 4.00pm, 258WH (Shyamala Nagaraj)
Tuesday, 5.45pm – 7.30pm, SLC@USB (Subha Maity)

Course Description:

This course introduces students to basic principles in classical experimental design, including randomization, replication, blocking, confounding and interaction, and their analysis in the general linear model. Students will be introduced to the following designs: one way anova designs, block designs, factorial designs, fractional factorial designs and, time permitting, random effects models.

Prerequisites: (STATS 401 or STATS 412 or STATS 425) or MATH 425.

Calendar Commitments

- Lectures: WF, 10-11.30 pm, 1120 WEIL
- Lab, either STATS 470-002: Thursdays, 4 – 5.30 pm, B760 EH
  Or STATS 470-003: Thursdays, 2.30 – 4 pm, B254 EH
- First day of class: September 4, 2019
- First day of lab: September 5, 2019
- Last day to complete student survey and to let me know if you have read this document: September 9, 2019, 8am.
- Office Hours: Begin week of September 10, 2019.
- No lab, November 28, 2019
- Last day of classes: Wednesday, December 11, 2019.
- **Exam I: WEDNESDAY, October 9, 2019, 10-11.30 am, 1120 WEIL**
- **Project group selection: Friday, October 18, 2019, during lecture**
- Project proposal submission: Friday, October 25, 2019, 8am, online
- **Project discussion: Thursday, October 31, 2019, during lab**
- **Project presentations: November 13/15, 10-11.30 am during lecture. Attendance is compulsory on both days**

- **Project report submission:** November 27, 2019, 8am, online
- **Final Exam: Friday, December 13, 2019, 10am-12pm, room to be determined**

Textbook: Montgomery, D.C. (2019), Design and Analysis of Experiments, 10th Edition, Enhanced eText, Wiley. ISBN 978-1-119-32093-7.
https://www.vitalsource.com/products/design-and-analysis-of-experiments-enhanced-etext-douglas-c-montgomery-v9781119492443

You also have a choice of an ebook plus an abridged print companion. The Print companion does not offer the graphics and images, only text. The Montgomery set with the enhanced ebook and print companion has ISBN 978-1-119-59340-9.

If you wish to use another edition of the text, you are responsible for ensuring that you are doing the correct questions with the correct information in them for homework.

I have requested a copy to be placed in Course reserves.

iClicker Cloud : We will be using the cloud based response system iClicker REEF. iClicker will enable us to engage interactively in the classroom. We will be using it in lecture and lab to capture *participation*. You must be in class to participate and provide your own polite and respectful answers.

- You will be able to use your laptop, phone, or tablet to respond to questions.
- The service is free to LSA students, so you will need to ensure you have set up your student account for this course correctly
- Details for setting up your student account and registering for the correct classes will be provided on Canvas. You will need to set up an iClicker Cloud account as a student (not instructor) with your umich ID (not a personal id). The institution is University of Michigan Ann Arbor – LSA.
- It is important that you first read the documentation provided here carefully, and then follow all steps to setting up your account, so that your participation is synced to the gradebook. Go to the Canvas site for the course, look for the iClicker sync button. Click on it to set up your account. The course id on iClicker Cloud is STATS470F19-001. The link to the documentation is here https://docs.google.com/document/d/1Raqxgu0krIoe0OOViz7IvjATvwxwd6gvTW_OVTLZXVc/edit
- If you do not have a mobile device, you may check out a laptop (MacBook or Surface Pro) from Instructional Support Services Loan Centers in Mason Hall (G340) and the Modern Languages Building (2001 MLB).
- If you have any issues with getting registered, contact BlueCorps for support. They are available M-F, 10am-4pm in the ISS Media Center, on the Second floor of the Modern Languages Building. You can email them at bluecorps@umich.edu or call them at 734-763-2985. *Please do not send email about issues to me or your GSIs until you have already worked with BlueCorps!*

SSD students:

Please inform the instructor of your special needs (by email would do) no later than **September 16, 2019.** Provide a copy of the documentation.

Assessment: The final grade is based on scores derived from:

- Homework (10%)
- Lab(15%)
- Midterm exam (15%)
- Project (15%)
- Final exam (40%)
- Class participation (5%)

Course Outline: This course covers three broad areas: aspects of doe (hypothesis testing, power, sample size); analysis of doe data (expected mean squares, multi-factorial anova, multiple comparisons, interaction, response surface); designs for experiments (fixed effects, random effects, factorial designs, block designs, 2^k designs). Specifically, we will cover

- Designing an experiment (Chapter 1, articles, notes)
- Review of two treatment comparisons (Chapter 2)
- One way ANOVA (Chapter 3)
- Randomized blocks (Chapter 4)
- Factorial Designs (Chapters 5)
- 2^k designs (Chapter 6, some 7, some 8)
- Response surface methods (Chapter 11)
- Selected topics from Chapter 10 (regression) and Chapter 13 (random effects) will be incorporated as needed when discussing content in the chapters above
- Planning and carrying out an experiment (notes)

Note on content and software: We will be using R. Most of you are familiar with R, but perhaps not with its use in analyzing results from design of experiments. You are expected to **learn from and use code** that will be provided in lectures and during lab to obtain computational results. For this, you should review ***by practicing every week*** the code that you learn in weekly labs.

Exam Policy: Apart from health reasons, requests for alternate exam times will not be considered unless there are extremely extenuating circumstances. Any such requests must be accompanied by proper supporting evidence and must be sent via e-mail **by September 16, 2019.**

Attendance:

- You are expected to attend ALL lectures and labs
- While no points are given for attendance, lecture participation points require your attendance

- You must be in class on when Project groups will be formed. You must also be present when your project proposal is discussed. You must also be in class during presentations.
- Attendance is required for labs. Points are given for attendance and participation in labs

Office hours: Office hours are for you to meet with your GSI and Instructor. You can attend any of the office hours listed. They have been timed to assist you with homework prior to submission. If you are unable to come to these office hours on a particular week, it may be possible to arrange an appointment. It is usually not easy to answer homework queries by email, so it is best not to rely on that method to do homework just prior to the deadline. If you have any questions at any time, I will be happy to meet with you to review your progress and to discuss specific learning strategies that may be useful. Just e-mail to make a special appointment.

Class participation: Participation points come from completion of quizzes, surveys and iClicker participation during lecture (participation in lab is captured in your lab score).

- Some participation points can be obtained only if you attend lecture. For example, to get iClicker points for responding during a lecture, you will need to participate at least once during a lecture where iClicker is used. We understand that you may have many reasons (health, project deadlines, etc) for not being able to attend all lectures. So complete lecture participation for the semester is defined as at least 80% of the lectures where iClicker is used. Complete lecture participation will get you 2% class participation points (a lower than 80% participation will get you 0% for this component).
- Other participation activities are usually provided through Canvas. Generally, you will get 0.5 percentage points for answering a survey. Your first two online participation activities are due September 9, 2019 (see page 5 for details).

Lab Score

- Each lab is worth 5 points
- ***Lab attendance is compulsory unless we have informed you otherwise***.
- ***Lab score comprises attendance, participation and a ticket***
- You will need to attend lab to get 1 attendance point per lab. You will need to participate at least once on iClicker during lab to get 2 points per lab. So that is 3 points, and this will appear in gradebook.
- An assignment will be given during the lab that must be completed during the lab session (uploaded to Canvas). These lab tickets will be graded cursorily to receive 2 points per lab ticket. Tickets must be submitted in a timely manner to get credit.
- The lowest lab score will be dropped in computing the percentage for lab at the end of the semester.
- If for any reason you are unable to attend your lab, you may attend another lab. However, you will need to ask the other GSI for permission politely and inform your GSI prior to the lab. Copy all emails to both GSIs, and check after lab that your scores are in. If you are unable to attend any lab on a Thursday, email your GSI for a make-up. You can make up a lab at most two times.

Homework

- Generally, homework will be posted on Friday and is due the following Thursday. Homework must be submitted in a timely manner as specified. Once solutions are posted, no homework will be accepted.

- Electronic submissions (that is, by email) of homework will be accepted only under very extenuating circumstances and then only with prior permission. Send an email to Professor Nagaraj (shyamnk) and your GSI. Final decision for acceptance of any electronic submission is at the discretion of the Instructor. Homework can then be sent via email to your GSI with a copy to Professor Nagaraj (shyamnk) by the agreed upon date and time.
- You may be required to submit online or by hand. Follow the instructions stated in each homework.
- Homework solutions submitted online should use RMarkdown and submitted in *html* format. Homework solutions submitted by hand must be written out neatly and stapled.
- Collaboration on homework is encouraged. However, each student must hand in their own assignment. Assignments that have been clearly copied from another student or from previous homework solutions, whether modified or not, will result in a score of 0 for all parties involved.
- One homework, the one with the lowest score, will be dropped in computing the final homework score

Project:

- You will work in groups on the project
- The project requires the group to design and carry out a statistical experiment.
- A proposal must be first approved. Your group then carries out the experiment and does the analysis the weekend before your presentation.
- **Attendance is compulsory when we decide on groups, decide on your proposal and for all days of presentation.**
- The final exam will include a question based on your project.
- More details will be provided as the semester progresses.

Grades and gradebook:

Final letter grades for the course will be based on total weighted scores and will be curved (**Professor's curve**, not Bell's or Gauss; generally skewed to the left). Note that in this regard,

- It is your responsibility to be aware of course policies, to check announcements and email messages *sent to your UM email*, and to communicate with your instructor and GSI in a *timely manner* regarding any conflicts or issues.
- It is your responsibility to collect your graded homework and exams, and checking that your score matches that in the Canvas site *in a timely manner*. If the score is missing, please inform us immediately. Searching for exams or homework at the end of the semester is not an accepted shared responsibility.
- It is your responsibility to check your graded homework against solutions. Homework will be graded by your GSI and questions about grading should be directed to him or her, first. You're welcome to ask the GSI to reconsider a grade. Regrade requests for exams must be in writing after comparing your answer against the solution, and justifying why you are correct. *In either case, your request should be polite and well-reasoned to ensure a consideration of the request.*
- It is your responsibility to check your graded exam against solutions. All exam regrade requests must follow the procedure that provided when exams are returned.

Canvas site: Notes, homework questions, surveys, etc will be posted on Canvas. Additional materials will be distributed in class. Weekly announcements in class/ Canvas will alert you to current and future events and activities. Use the site to keep track of your submissions and scores. Your final score will be based on the assessment rubric provided above, not on any totals you may find in Canvas

Communication: Aside from lectures, Canvas will the most frequently used form of communication. Weekly announcements in class/ Canvas will alert you to current and future events and activities. **Please read them!** Notes, homework questions, surveys, etc will be posted on Canvas. Additional materials will be distributed in class. Use Gradebook to keep track of your submissions and scores. However, note that your final (total) score will be based on the assessment rubric provided above, not on any totals you may find in Canvas.

Lecture Notes Notes and problems to be discussed in class will be available under Resources in Canvas. These will be posted online as early as possible prior to class, usually by Friday the week before. It is advisable to print out the lectures prior to class so that you can make notes on it. Some pages will have blank spaces to be filled in during class. **Bring pencil and paper, and be prepared to take written notes**. *If you are unable to come to these office hours on a particular week, it may be possible to arrange an appointment. Email us!*

Absences from Class Due to Illness or Unanticipated Circumstances:
You are expected to meet all requirements of the course in a timely manner. If you have to miss a class or assignment because of an illness or unanticipated event, it is your responsibility to notify me and provide an explanation. I will try to accommodate your needs in a way that maintains the integrity of the class. Remember also that LSA provides a website for students to self-report an illness as a centralized means of initial contact with *all* of your instructors.

How to succeed in the course (no different from any other course, really):

- Ask questions inside and outside the classroom
- Come to class ready to be engaged fully in classroom activities
- The most important prerequisite is not formally stated. It is simply that you be organized and keep up with the class material, homework and other requirements for the course regularly.
- If I take the time to write and explain something, it must be important. I encourage you to take notes and refer to them when dong assignments or reviewing for an exam.
- When grading your written work, we look for solutions that are technically correct and reasoning that is clearly explained. Numerically correct answers, alone, are not sufficient on homework, tests or quizzes. Neatness and organization are valued, with brief, clear answers that explain your thinking. If we cannot read or follow your work, we cannot give you full credit for it.
- Reviewing solutions, especially learning from both mistakes and correct answers, will enable you to identify areas for improvement.
- If you have any questions at any time, I will be happy to meet with you to review your progress and to discuss specific learning strategies that may be useful. Just e-mail to make a special appointment.

Classroom etiquette:

The basic idea is respect for your classmates and your Instructor to ensure a harmonious learning environment.

- As soon as lecture has begun(usually 10 minutes after the posted start of the lecture), please "silence" your **cell phone** and refrain from disruptive or unrelated conversations with classmates
- Please try to be punctual. Late arrivals, early departures or leaving in the midst of a lecture does not require an excuse or special permission, but whenever you come or go, please make every effort to minimize disruption for your fellow students and the Instructor.
- You may use your **laptop** to access class materials or to take notes
- Do not use laptops or phones or tablets or any such media for entertainment during class and do not display any material that may be distracting or offensive to your fellow students. Email, instant messaging, surfing the internet, reading the news or playing games are not considered legitimate classroom purposes
- If you are not engaged, and cannot bring yourself to be engaged, please feel free to leave the room quietly. Any action that interferes with a harmonious and cooperative learning atmosphere in the classroom can disrupt and even negatively affect the overall learning environment for everyone
- IF YOU MUST WATCH A VIDEO OR CHECK A SOCIAL MEDIA SITE OR READ NEWS OR DO YOUR HOMEWORK, PLEASE DO SO OUTSIDE THE CLASSROOM.

Integrity:

A reminder about expectations (both yours and ours): The class will be a good experience for everyone only if we treat each other with honesty, fairness, and respect. You might think that a statistics course may not present many opportunities for discussion. However, data is sourced from different fields and the course includes discussion of findings. I like to reference current findings whenever possible.

- In this time we share together over the semester, please honor the uniqueness of your fellow classmates and appreciate the opportunity we have to learn from one another.
- Each student is encouraged to take an active part in class discussions and activities. Honest and respectful dialogue is expected.
- Sometimes we will make mistakes in our speaking and our listening. Always we will need respect for others.
- Just as we expect others to listen attentively to our own views, we must reciprocate and listen to others when they speak.

Student Mental Health and Wellbeing:

- University of Michigan is committed to advancing the mental health and wellbeing of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available.
- For help, contact Counseling and Psychological Services (CAPS) at (734)764-8312 and https://caps.umich.edu/ during and after hours, on weekends and holidays, or through its counselors physically located in schools on both North and Central Campus. You may also consult University Health Service (UHS) at (734) 764-8320

and https://www.uhs.umich.edu/mentalhealthsvcs, or for alcohol or drug concerns, see www.uhs.umich.edu/aodresources.

Student Sexual Misconduct Policy

Our school is committed to fostering a safe, productive learning environment. Title IX and our school policy prohibit discrimination on the basis of sex, which regards sexual misconduct — including harassment, domestic and dating violence, sexual assault, and stalking. We understand that sexual violence can undermine students' academic success and we encourage students who have experienced some form of sexual misconduct to talk to someone about their experience, so they can get the support they need.

Confidential support and academic advocacy can be found with the Sexual Assault Prevention and Awareness Center (SAPAC) on their 24-hour crisis line, 734-936-3333 and at http://sapac.umich.edu/. Alleged violations can be non-confidentially reported to the Office for Institutional Equity (OIE) at institutional.equity@umich.edu. Reports to law enforcement can be made to University of Michigan Police Department at 734-763-3434.

Shyamala Nagaraj
[Note this document will be updated as needed. If you have any questions on the content, please send them to shyamnk@umich.edu]