



THE OHIO STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

# **SYLLABUS: STAT 6410**

## **DESIGN AND ANALYSIS OF EXPERIMENTS**

**SPRING 2021**

### **Course overview**

#### **Instructor**

Instructor: Omer Ozturk

Email address: Ozturk.4@osu.edu

Phone number: 740 725 6204

Office hours: Virtual office hours via Carmen Zoom, TR 1:00pm-2:00pm or by appointment

Office Location: CH419

#### **Grader or Teaching Assistant**

Grader: Poulami Chakraborty

Email address: chakraborty.121@osu.edu

#### **Course description**

Principles of designing experiments; analysis of variance techniques for hypothesis testing, simultaneous confidence intervals; block designs, factorial experiments, random effects and mixed models, split plot designs. Prereq: 6201, 6302, or 6802, and 6450 or 6950; or permission of instructor. Not open to students with credit for 6910.

#### **Course learning outcomes**

By the end of this course, students should successfully be able to:

- Understand basic principles of good design (randomization, replication, blocking).
- Understand and correctly interpret models for factorial experiments (main effects, interactions).
- Be able to analyze data from factorial experiments, including diagnostics, methods to address model inadequacy, and multiple comparisons.[Learning outcome]
- Understand the issues involved in determining the sample size for factorial experiments and be able to compute the needed sample size for balanced factorial experiments.
- Understand the difference between fixed and random effects, and be able to analyze mixed models.
- Be able to recognize and analyze data from experiments with some special types of randomization (blocking, split plots)
- Understand the concept of aliasing.
- Be able to design and analyze some basic two-level fractional factorial experiments.
- Be able to use software to design and analyze experimental data.

## Course materials

### Required

Design and Analysis of Experiments, 2nd Ed. by Angela Dean, Daniel Voss, and Danel Draguljic.

Download the eBook from

<https://link-springer-com.proxy.lib.ohio-state.edu/book/10.1007%2F978-3-319-52250-0>

Errata and datasets available from <http://www.wright.edu/~dan.voss/DeanVossDraguljic.html>

Rdata sets can be downloaded from:

<http://deanvosdraguljic.ietsandbox.net/DeanVossDraguljic/R-data>

## Course technology

For help with your password, university e-mail, Carmen, or any other technology issues, questions, or requests, contact the OSU IT Service Desk. Standard support hours are available at <https://ocio.osu.edu/help/hours>, and support for urgent issues is available 24x7.

- **Self-Service and Chat support:** <http://ocio.osu.edu/selfservice>
- **Phone:** 614-688-HELP (4357)
- **Email:** [8help@osu.edu](mailto:8help@osu.edu)
- **TDD:** 614-688-8743

## Baseline technical skills necessary for online courses

- Basic computer and web-browsing skills
- Navigating Carmen

## Technology skills necessary for this specific course

- CarmenZoom
- Collaborating in CarmenWiki
- Recording a slide presentation with audio narration
- Recording, editing, and uploading video

## Necessary equipment

- Computer: current Mac (OS X) or PC (Windows 10+) with high-speed internet connection
- Webcam: built-in or external webcam, fully installed
- Microphone: built-in laptop or tablet mic or external microphone

## Necessary software

- This class requires you to use the statistical software package called R (The R Project for Statistical Computing; <http://www.r-project.org/>). This software package is available as Free Software.
  - You can download R for Windows, Mac, and Linux, from the CRAN archive at <https://cran.r-project.org>.
  - An in-depth introduction to R is available at <http://cran.r-project.org/doc/manuals/R-intro.pdf>
  - Hands-on tutorials are available in the Swirl system, which you can learn about at <http://swirlstats.com/>. In particular, “R Programming: The basics of programming in R” is an appropriate first tutorial for students who have never used R.
- An easier to use interface to R is available in the software package RStudio. This package is available for Windows, Mac, and Linux and can be downloaded for free from <http://rstudio.org>. **Note that RStudio requires R to be installed.**
- [Microsoft Office 365 ProPlus](#) All Ohio State students are now eligible for free Microsoft Office 365 ProPlus through Microsoft’s Student Advantage program. Each student can install Office on five PCs or Macs, five tablets (Windows, iPad® and Android™) and five phones.
  - Students are able to access Word, Excel, PowerPoint, Outlook and other programs, depending on platform. Users will also receive 1 TB of OneDrive for Business storage.

- Office 365 is installed within your BuckeyeMail account. Full instructions for downloading and installation can be found <https://ocio.osu.edu/kb04733>.

## Course delivery

The content of this course will be delivered in 100% synchronous mode. The content will be presented live over CarmenZoom. The recorded lectures will be posted on the class website. **Details of the weekly schedule will be announced at the start of each week.**

Each week we will cover approximately 220 minutes of content in total. You will be responsible for watching any live content or recorded videos and studying the material that is assigned. In addition to the lecture videos, assignments will be posted on the class website. You will be given ample time to complete the assignments.

The instructor will hold weekly office hours via CarmenZoom. The times are given above.

## Grading and faculty response

### Grades

Assignment or category	Percentage
Homework	30
Midterm	30
Final	40
<b>Total</b>	<b>100</b>

*See course schedule, below, for due dates*

*Grad*

### Assignment information

Grades will be recorded on the class website.

**Homework:** There are several homework assignments, which are due at various times during the semester. The homework should be submitted at the specified time on the day it is due. No late homework will be accepted since the solution will be released immediately after the due date. You are allowed to work together on the homework, but do not copy any part of a homework. Each student must produce his/her own homework to be handed in. All homework

must be submitted online as a PDF file through the class website. Homework solutions will be posted in the course webpage.

**Homework preparation rules:** Put your name and the homework assignment number on the top right-hand corner of every page. Submit the problems in order, making sure that the computer output and discussion is placed together (do not put the computer output at the end of homework). Raw computer output is not acceptable. Make it clear what parts of the output are relevant and show how they answer the questions posed in the homework.

**Exams:** There will be one midterm and one final exam:

Midterm exam Tuesday, March 4, 9.05–11.55 am

Final exam, Wednesday, April 29, 8.00am– 9.45 am.

All exams are **closed book/closed notes** and will be **proctored online** – there are no make-up exams. Further details will be given in advance of each exam. A basic calculator is allowed-- tablets, laptops, cellphones, and other communication devices are not.

## Late assignments

No late homework will be accepted unless you have a real legitimate reason.

## Grading scale

93–100: A

90–92.9: A-

87–89.9: B+

83–86.9: B

80–82.9: B-

77–79.9: C+

73–76.9: C

70 –72.9: C-

67 –69.9: D+

60 –66.9: D

Below 60: E

## Faculty feedback and response time

I am providing the following list to give you an idea of my intended availability throughout the course. (Remember that you can call **614-688-HELP** at any time if you have a technical problem.)

### Grading and feedback

For large weekly assignments, you can generally expect feedback within **7 days**.

## E-mail

I will reply to e-mails within **24 hours on school days**.

## Discussion board

I will check and reply to messages in the discussion boards every **24 hours on school days**.

# Attendance, participation, and discussions

Because this course is run in synchronous mode your attendance is based on your online activity and participation. The following is a summary of everyone's expected participation:

- **In live lectures:**

Students will be expected to participate, discuss, and answer questions in online live lectures. If you miss a lecture for some reason, you must view the recorded lecture in course webpage

- **Logging in: AT LEAST THREE TIMES PER WEEK**

Be sure you are logging in to the course in Carmen each week, including weeks with holidays. (During most weeks you will probably log in many times.) If you have a situation that might cause you to miss an entire week of class, discuss it with me *as soon as possible*.

- **Office hours: OPTIONAL OR FLEXIBLE**

All office hours, are optional. If you are required to discuss an assignment with me, please contact me at the beginning of the week if you need a time outside my scheduled office hours.

## Discussion and communication guidelines

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Writing style:** While there is no need to participate in class discussions as if you were writing a research paper, you should remember to write using good grammar, spelling, and punctuation. Informality (including an occasional emoticon) is fine for non-academic topics.
- **Tone and civility:** Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across online.
- **Citing your sources:** When we have academic discussions, please cite your sources to back up what you say. (For the textbook or other course materials, list at least the title and page numbers. For online sources, include a link.)

- **Backing up your work:** Consider composing your academic posts in a word processor, where you can save your work, and then copying into the Carmen discussion.

## Other course policies

### Health and safety

The Ohio State University Wexner Medical Center's Coronavirus Outbreak site (<https://wexnermedical.osu.edu/features/coronavirus>) includes the latest information about COVID-19 as well as guidance for students, faculty and staff. Guidelines and requirements for campus safety from the University's COVID-19 Transition Task Force were published on July 1 on the Safe and Healthy website (<https://safeandhealthy.osu.edu>).

### Potential disruptions to instruction

- As much as is possible, students will have access to material online if they are unable to attend class because of positive diagnosis, symptoms, or quarantine required following contact tracing.
- If the instructor is unable to be present in person because of positive diagnosis, symptoms, or quarantine following contact tracing a new instructor will be assigned to the course. Details will be given on the course website.

### Student academic services

Student academic services offered on the OSU main campus  
<http://advising.osu.edu/welcome.shtml>.

### Student support services

Student support services offered on the OSU main campus <http://ssc.osu.edu>.

### Academic integrity policy

#### Policies for this online course

- **Quizzes and exams:** You must complete the midterm and final exams yourself, without any external help or communication.

- **Written assignments:** Your written assignments, including discussion posts, should be your own original work
- **Reusing past work:** In general, you are prohibited in university courses from turning in work from a past class to your current class, even if you modify it. If you want to build on past research or revisit a topic you've explored in previous courses, please discuss the situation with me.
- **Falsifying research or results:** All research you will conduct in this course is intended to be a learning experience; you should never feel tempted to make your results or your library research look more successful than it was.
- **Collaboration and informal peer-review:** The course includes many opportunities for formal collaboration with your classmates. While study groups and peer-review of major written projects is encouraged, remember that comparing answers on a quiz or assignment is not permitted. If you're unsure about a particular situation, please feel free just to ask ahead of time.

## Ohio State's academic integrity policy

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct <http://studentlife.osu.edu/csc/>.

## Copyright disclaimer

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

## Statement on title IX (Recommended)

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at <http://titleix.osu.edu> or by contacting the Ohio State Title IX Coordinator, Kellie Brennan, at [titleix@osu.edu](mailto:titleix@osu.edu)



## Accessibility accommodations for students with disabilities

The university strives to make all learning experiences as accessible as possible. In light of the current pandemic, students seeking to request COVID-related accommodations may do so through the university's request process, managed by Student Life Disability Services. If you anticipate or experience academic barriers based on your disability (including mental health, chronic, or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: [slds@osu.edu](mailto:slds@osu.edu); 614-292-3307; <http://slds.osu.edu>; 098 Baker Hall, 113 W. 12th Avenue.

### Accessibility of course technology

This online course requires use of Carmen (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

- [Carmen \(Canvas\) accessibility](#)
- Streaming audio and video
- Synchronous course tools

## Your mental health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting [ccs.osu.edu](http://ccs.osu.edu) or calling 614- 292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273- TALK or at [suicidepreventionlifeline.org](http://suicidepreventionlifeline.org)

## Disclaimer

This syllabus should be taken as a fairly reliable guide for the course content. However, you cannot claim any rights from it and in particular we reserve the right to change due dates or the methods of grading and/or assessment if necessary. Any changes will be communicated to you through official course announcements.

## Course schedule (tentative)

Week	Dates	Topics, Readings, Assignments, Deadlines
1	Jan 12,14	Review (testing, confidence interval, general principals), Chapters 1,2
		<b>ONE-WAY ANALYSIS OF VARIANCE</b>
2	Jan 19, 21	Completely Randomized design, One Way Analysis of Variance, Chapters 3.1-3.5
3	Jan 26, 28	Choosing sample size and power, Chapters 3.6
4	Feb 2, 4	Tests and confidence intervals for contrast, Chapters 4.1-4.3
5	Feb 9, 11	Multiple comparisons, Chapter 4.4
6	Feb 16, 18	Checking model assumptions, Chapter 5
		<b>MULTIFACTOR ANALYSIS OF VARIANCE</b>
7	Feb 23, 25	Model, Chapters, 6.1-6.3,7.1-7.2
8	March 2, March 4	Analysis of complete model, chapter 6.4 Midterm exam, March 4
9	March 9,11	Analysis of Complete model, Chapters 7.3-7.4 Using software Chapters, 6.8,6.9,7.6,7.7
10	March 16, 18	Choosing sample sizes, Chapter 6.6 Multiple comparison, Chapters 6.3-6.5, 7.3-7.4,
11	March 23,25	Diagnostics, Chapters 6.2.3 Single replicate experiment, Chapters 6.7, 7.5
12	March 30,	Nested and Mixed models, Chapters 17,18

	<b>April 1</b>	
		<b>BLOCK DESIGNS and SPLIT PLOTS</b>
<b>13</b>	<b>Apr 6, 8</b>	<b>Randomized block design and analysis Chapter 10</b>
		<b>FACTORIAL EXPERIMENTS</b>
<b>14</b>	<b>Apr 13, 15</b>	<b>Confounding in single replicate experiment, Chapters 13.1-13.6,13.8</b>
<b>15</b>	<b>Apr 20,22</b>	<b>Fractional factorials, Chapter 15.2</b>
	<b>Apr 29</b>	<b>Final exam, 8:00am-9:45am</b>