

EPSY 583 Multivariate Analysis of Educational Data

Online Spring 2021 (Jan 11 – May 12)

Instructor:	Yue Yin, Ph.D.
Learning Material Release Time:	By 1:00 AM (Central US Time), Every Wednesday The course materials will be released by the scheduled day. After the course materials are released, you can work on the course materials at any time and any pace before the corresponding homework assignment is due.
Weekly Homework Due Time:	11:59 PM (End of the day, Central US Time), Every Wednesday , if any.
Office Hour:	By Appointment. You can email me to make an appointment for a talk on the phone or via zoom. When you schedule a call with me, you may provide several time slots that work for you.

Major Reference Textbook

Tabachnick, B. G., & Fidell, L. S. (2013). *Using Multivariate Statistics* (6th ed.). Boston: Allyn and Bacon

- You are highly encouraged to read a multivariate analysis textbook to get a deep and systematic understanding of the corresponding contents. Although the structure of the recommended textbook will be followed primarily and some examples in this book will be used, the homework assignment/exams are NOT directly from the textbook and you are NOT required to purchase this book. If you have an earlier version of this book or a standard multivariate analysis book that covers similar topics, it will work too.
- I notice multiple versions of these textbooks on Amazon, including international versions. Any version of 5 or later will work for class purposes.

Supplementary Books

Delwiche, L. D., & Slaughter, S. J. (2019). *The Little SAS Book: A Primer* (6th ed.). Cary, NC: SAS Institute.

- Sample chapters of the "Little SAS Book: A Primer" can be found on the Blackboard course site or at https://www.sas.com/storefront/aux/en/spls/65423_excerpt.pdf

Johnson, R and Wichern, D (2007). *Applied Multivariate Statistical Analysis, Sixth Edition*. Prentice-Hall. (More mathematical)

Course Description

As an introduction to multivariate statistics, this course is a continuation of the topics covered in introductory statistics and intermediate statistics courses; therefore, introductory statistics (e.g., EPSY 503) and ANOVA (e.g., EPSY 543)/Regression (e.g., EPSY 547) are prerequisites for this course.

This course will primarily cover the following topics related to multivariate analysis: data screening, multivariate analysis of variance (MANOVA), multivariate analysis of covariance

(MANCOVA), discriminant function analysis (DFA), profile analysis (PA), principal component analysis (PCA), exploratory factor analysis (EFA), and an introduction to structural equation modeling (SEM).

SAS will be the focus of class demonstration for data analyses for two major reasons: (a) Learning SAS programming can help you to get familiar with the programming language so that you can be more ready to learn other programming languages when needed. (b) SAS is one of the most widely used and powerful statistical software in the industry, so having SAS programming skills may help you to be more competitive in the job market.

However, some of you may prefer to use SPSS or want to learn how to use SPSS to run corresponding analysis in addition to SAS. To accommodate the need for learning SPSS, a brief demonstration of using SPSS to run the most analyses will be provided as well. You can use either SAS or SPSS to complete homework assignments and exams. However, only SAS codes are provided in the homework solutions, as it is the primary software used in this course.

Structure of the Course

Week	Main Content
1	We will first have an overview of multivariate analysis techniques so that you can get a conceptual understand of all the multivariate analysis techniques to be covered.
2	We will learn about SAS, which will be used as the major statistical tool in this course.
3	We will review introductory and intermediate statistics, which are the building blocks of multivariate analysis. While reviewing statistics, we will also learn how to use SAS to run the analyses for which we used SPSS in the earlier statistics courses. Because the corresponding SPSS functions weeks 2 and 3 are usually covered in the prerequisite courses, the SPSS demonstrations are NOT included in the first two-week course materials. If you choose to use SPSS for this course, you can finish the two weeks' homework assignment by using SPSS.
4	We will learn matrix algebra, which is the mathematics foundation of multivariate analysis.
5 +	We will learn the various multivariate analysis techniques specified in the syllabus.

Course Site

The course site will be on Blackboard (the university's course management system): <http://uic.blackboard.com/>. You will need to login to Blackboard to access the weekly class materials.

Required Technology

Internet Access

The class will be delivered online. Communication with the instructor will be conducted online as well. Students are responsible to maintain access to the internet throughout the semester to ensure a smooth and complete delivery of course materials and timely communication with the instructor.

Software

1. Internet browser capable of running Blackboard
2. The Microsoft (MS) Office suite of software (including Word, PowerPoint, and Excel)
3. SPSS
 - Free SPSS download: It is provided by the College of Education at UIC for you to use. Please see the course blackboard for detailed instructions.
 - Purchase SPSS software: You can purchase SPSS from the UIC webstore at <https://webstore.illinois.edu/shop/product.aspx?zpid=4022> If you have specific questions, please contact them using the form on their website.
4. SAS
 - Connect to the server in the College of Education to use the software remotely: The procedures are on blackboard. Many former students preferred this way.
 - Purchase software
 - **If you are in the US**, you can purchase SAS at a discounted price from UIC webstore at <https://webstore.illinois.edu/shop/search.aspx?keyword=SAS>
 - SAS may have compatibility problems with your computer system. If you need more information about the software or have trouble installing it, you need to contact SAS Technical Support <support@sas.com> and/or contact UIC IT support <https://webstore.illinois.edu/shop/contact.aspx>
 - As some of the former students have experienced problems in SAS installation, you may want to start early to make sure that your SAS program runs well before the class starts.
 - **If you are not in the US, the SAS purchased at UIC may not work on your computer.** You need to contact the webstore before you make the purchase. Or you can use the remote connection provided by the College of Education above.

WARNING: if you use SAS on the remote server, make sure that you close your SAS/SPSS program every time before you log off. Otherwise, other users may have trouble using the program, because the license only allows a certain number of users to use the software concurrently.

Hardware

You must have a computer that has audio capabilities (i.e., a working sound card and speakers or headphones) so that you can listen to the audio lectures.

Learning Materials

By each Wednesday, the following learning materials will be available for you to view and/or download from the Course Document Section on Blackboard. You are responsible for reviewing all of these materials thoroughly and completing the assigned activities. The table below lists the specific accessibility features and times when course materials will be made available to you. All the documents are in the section of "Course Documents."

Materials	Access	Latest Time
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Slide handout	PowerPoint Slides: can be downloaded and printed and also have scripts of the lecture in the notes	1:00 AM
Audio lecture	Audio PowerPoint Presentation: can only be played online	1:00 AM
Data sets (as needed)	Can be downloaded	1:00 AM
Homework assignment (hw) ^a	Can be downloaded	1:00 AM
Answer key to previous week's homework assignment (hw solution) ^b	Can be downloaded	Varying ^c , as early as 1:00 AM
Other course materials, such as required or supplementary readings	Can be downloaded	1:00 AM

Note:

- a. The homework assignment is in the folder of the Course Document that contains the corresponding learning materials. E.g., hw1 is in the folder of Week 1.
- b. The answer key to the homework assignment is in the folder of Course Document that contains the next topic. E.g., the solution to hw1 is in the folder of Week 2. You are expected to review the solution to the previous homework assignment before you start a new topic.
- c. The answer key to the homework assignment is only available to you after you submitted your corresponding homework assignment.

Suggested Learning Sequence and Tips

You are responsible for reviewing ALL of the course materials and completing the homework assignments and exams as assigned. To assist you with managing your time effectively, the following list of actions is a suggested sequence for using the course materials.

1. Read the assigned textbook chapter(s) and journal article(s) for the current week.
2. Print the lecture handout for the current week.
3. View and listen to the lecture for the current week, and carefully complete the exercises given during the lecture. **Important:** Each lecture presentation contains exercises and answer keys to help you apply the content of the lecture. When I suggest that you pause the presentation and complete an exercise, you should DO so to gain the maximum benefit from the exercise. Do NOT skip the exercise or check the key beforehand. Otherwise, you will lose an opportunity to practice what you are learning.
4. If a demonstration of data analysis is available, practice it on your computer.
5. Complete the homework assignment, and submit it on time.
6. When the answer key is provided for the homework: Correct your homework assignment using the answer key (as needed), and review the course materials of the items that you answered incorrectly or with uncertainty.
7. Please contact me or discuss it with your classmates promptly if you have any questions. DO NOT skip over content that you do not understand, and DO NOT allow confusion to build over time.

8. Some previous students found that talking to me on phone or via zoom is an efficient way to help them understand the contents that they have trouble with. Therefore, I encourage you to do so when needed.

Course Requirements

Homework Assignment (HW) -- 96 points

Purpose: Almost every week, you will be given a homework assignment to complete. The homework assignments serve three purposes: (1) to reinforce your learning, as the best way of learning is by doing; (2) to self-evaluate your ongoing learning, so that you can get timely feedback on how well you meet the instructional objectives and how you can improve learning; and (3) to give me feedback to improve my teaching. When you find anything confusing, please let me know as soon as possible, so that I can help you and/or modify the teaching materials timely. Doing and reviewing your homework assignments are critical for you to learn the course materials and prepare for the exams. **Based on my previous experience, those who completed their homework assignments carefully and timely tend to learn well, do very well on the exams, and gain good grades in the course. Plus, homework assignments are worth a lot of points. If you miss one homework assignment, it means that you need to get 8 more points on your exam to make it up, which is NOT easy.**

Due date/time: Unless specified otherwise, a homework assignment is due on the day when the following week's materials are available, e.g., hw for week 2 is due when week 3's materials are available. Homework assignments are due at 11:59 PM (central US time) on the due day (Wednesday). You must upload your completed assignment on Blackboard *before* the due date/time.

Homework Submission: You are required to submit your completed homework assignments electronically on the Blackboard site by using the corresponding homework assignment link in the "Content" folder so that I can track everybody's work. Please do not send me your homework assignment via email. Even if it is a late submission, please still submit it via the homework submission link on Blackboard, so that your homework assignment will be recorded appropriately and you will be able to see the corresponding answer key.

Discussion and Group Work: While working on the homework assignments, you are welcome to discuss the assignment using the Blackboard discussion boards or through personal emails. However, you are not allowed to copy each other's work. If evidence of copying is detected, all parties involved will receive a 0 for the particular homework assignment.

Scoring: I will check your homework assignment for completion rather than correctness. (Each of you is responsible for reviewing the correctness of your homework assignment using the solution provided.) A homework assignment completed and submitted on time will earn full credit (8 points each) regardless of whether all of the problems are solved perfectly. If you don't know how to solve a problem, try your best and complete it as much as you can.

An assignment that is submitted on time but incomplete without trying will lose points proportionally. An assignment that is submitted late (i.e., after 11:59 PM central US time on the due day) will earn 0 points. I understand that everybody may have some emergency to deal with sometimes. Therefore, each of you will be allowed TWO opportunities to submit homework assignments up to one week late and still gain full credit for the homework assignment. When you need to use your late submission opportunities, please inform me as

soon as you can. Again, when you submit your homework after the due time, please still submit your completed homework assignment on Blackboard.

You will be able to check your homework grade in "Tool→ My Grades" after the points have been awarded by the following week.

Answer Key (Feedback) and Self-Evaluation: I will provide a detailed solution file as a type of feedback for each homework assignment soon after you submit your completed homework assignment on the due day. As it is a graduate-level course and we have frequent homework assignments, it is your responsibility to carefully compare your completed homework assignment with the answer key and correct any mistakes. However, if you have any questions about the homework assignments or you have trouble understanding the solution, please let me know or share your thoughts on the discussion board as soon as possible.

Discussion Board Contribution -- 4 points

Students are encouraged to discuss course contents and share course-related resources on the discussion board of blackboard, so that students can build a learning community and learn from each other, just like what you do in a regular classroom! You are also encouraged to read the discussion board regularly in case any of the information is helpful for you.

To promote online discussion, besides self-introduction at the beginning of the class, each student is required to post on the discussion board at least once. Your post could be asking a question, answering a question, sharing your research design, or sharing a research article. Details about sharing research design and articles will be given on the homework assignments. When you fulfill the requirements, you will gain 4 points.

Exams -- 200 points

There will be two exams during the course and each exam is worth 100 points. The midterm exam will focus on all the content up to and include "Multivariate Analysis of Variance and Covariance -2". The final exam will focus on the content from "Profile Analysis", but will not exclude the basic information covered before the midterm.

You will take the midterm and final exams online. On the exam week, the exam will be available on Blackboard from 12:00 AM (early morning) Wednesday morning to 11:59 PM (midnight) Sunday on the dates listed on the course schedule. You can start to take the exam anytime during this 96 hour time window, but you will have to complete and submit your exam within 4 hours once you start the test. If you submit the exam late or fail to submit the exam at all, your score on the exam will be a 0. During the exam, you can log off and log in to the test if only you have not submitted the test. However, the 4-hour timer keeps running from the moment that you first log in to the test, even when you log off the test temporarily. Therefore, you may schedule 4 uninterrupted hours for the exam to fully use the time when needed. Please make sure that your computer, internet, software, and everything related to the test-taking are all working well before you start the test.

Both exams are open-book and open-notes, so you can use any course materials or even search online for information when taking the exams. However, you must take the exams independently and should NOT consult any other people inside or outside the class. Also, for test security, you should NOT release the exam information to anybody. Otherwise, it is unfair to any honest students, including yourself. If any cheating behavior or exam releasing behavior is detected, anybody involved will be scored a 0 on the exam.

After all the students have finished the exam, I will double-check computer scoring and send each student a feedback file with all the items you have missed. However, if your total score is lower than 70, such a file will not be sent because too many items and keys will be released. However, if you are interested in knowing what items you have missed, you are welcome to schedule a phone call with the instructor, so that the instructor can go over the items you missed with you.

To help students prepare for the online exam format, a sample exam will be available for students to practice before the midterm exam. However, students' scores on the sample exam will NOT be counted as part of your course score.

Grading

The final letter grade received for the course will be based on homework assignments and two exams. The relative contribution of each element is as follows: homework assignment (96 points), discussion board contribution (4 points), midterm (100 points), and final (100 points). Your total course score = (homework assignment + discussion board contribution + midterm score + final score)/3.

The letter grade will be assigned according to the following scale:

90 – 100%	A
80 – 89%	B
70 – 79%	C
60 – 69%	D
59% or below	F

For example, you turn in 10 homework assignments in time ($8 * 10 = 80$ points), use the one late submission opportunity and turn in one homework assignment one week late (8 points), and miss one homework assignment (0 points). You contributed to the discussion board at least once (4 points). Finally, you score 90 on the midterm exam and 95 on the final exam. Your total score = $(80 + 8 + 0 + 4 + 90 + 95)/3 = 92.33$. You will obtain an A for the course.

Communication with Instructor

If you ask clarification questions about the course contents (such as lectures, homework assignments, and solutions), please post your questions on the discussion board so that other students can participate in the discussion and benefit from your questions as well, just like in a regular classroom! I will also check the discussion board regularly and respond when needed. Even if you do not have questions about a topic, you are highly encouraged to read the discussion board regularly in case that you would like to share your ideas, contribute to the discussion, and learn from the discussions. If you have to email me your question and I find that your questions might be common or helpful for other students' learning, I will share your question anonymously and my answers on the discussion board, unless you ask me not to.

When you ask a personal question that is irrelevant to others, e.g., asking for a deadline extension for a homework assignment, you may email me at yueyin@uic.edu. When emailing me, please include "583" in the subject line, so that your email would be less likely to be missed.

When you post your question on the discussion board or email me, I will try my best to respond in 24 hours on weekdays. When you send me an email or post questions on the

blackboard after 5:00 PM Chicago time on Friday, most likely I will respond on the following Wednesday. If you have not received my reply within this planned time, please repost/resend your question, as I may have missed your earlier message somehow. I would appreciate your reminder.

When you post your research design, which is required in some homework assignments, I will provide feedback on your research design within a week after the assignment is due.

When you share a research article, which is required in some homework assignments, I will NOT provide comments unless you raise specific questions about the article on the discussion board.

If you ask a question that needs a detailed and/or interactive answer, you may request a zoom meeting or phone call with me for efficiency.

Academic Honesty

There are many forms of academic integrity as well as plagiarism. Please familiarize yourself with the forms of academic dishonesty as recognized by the University by reviewing the university's policies, which can be found at <http://www.uic.edu/depts/sja/integrit.htm> (see #3 & #7, specifically). If you have any questions about whether a particular activity constitutes academic dishonesty, you can ask me, or contact UIC administrator Belia Gonzalez McDonald, beliag@uic.edu or 312-996-4857.

Technical Support

If you are having technical problems with the course, please send an e-mail with your name, the course rubric (i.e. EPSY583), and the nature of your problem to exedtech@uic.edu or call (312) 996-5948. A staff member will respond to inquiries Wednesday - Friday, 8 a.m. - 8 p.m. CST and Saturday - Saturday, 11 a.m. - 3 p.m. CST.

Special Needs

UIC is committed to the full inclusion and participation of people with disabilities in all aspects of university life. If you face or anticipate disability-related barriers while at UIC, such as documented learning disabilities, vision, or hearing impairments, and emotional or physical disabilities, please connect with the Disability Resource Center (DRC) at drc.uic.edu, via email at drc@uic.edu, or call (312) 413-2183 to create a plan for reasonable accommodations. To receive accommodations, you will need to disclose the disability to the DRC, complete an interactive registration process with the DRC, and provide me with a Letter of Accommodation (LOA). Upon receipt of an LOA, I will gladly work with you and the DRC to implement approved accommodations.

Diversity and Inclusion

UIC values diversity and inclusion. Regardless of age, disability, ethnicity, race, gender, gender identity, sexual orientation, socioeconomic status, geographic background, religion, political ideology, language, or culture, we expect all members of this class to contribute to a respectful, welcoming, and inclusive environment for every other member of our class. If there are aspects of the instruction or design of this course that result in barriers to your inclusion, engagement, accurate assessment, or achievement, please notify me.

Resources

Many links to campus resources will be auto-populated for students on Blackboard and are also described in the UIC Student Handbook (<https://dos.uic.edu/wp-content/uploads/sites/262/2019/01/FINAL-VERSION-2019.pdf>). A comprehensive list of student resources is available on the Current Student Resources (<https://today.uic.edu/resources/current-student-resources>).

Course Schedule and Topics

Week	Date	Topic	Reading	HW Due
1	01/13 (W)	Introduction to Multivariate Analysis	Ch. 1 & 2	
2	01/20 (W)	Introduction to SAS	Little SAS ^a	#1
3	01/27 (W)	Review of Introductory and Intermediate Statistics	Ch. 3	#2
4	02/03 (W)	Data screening	Ch. 4	#3
5	02/10 (W)	Introduction to Matrix Algebra	Appendix A	#4
6	02/17 (W)	Multivariate Analysis of Variance and Covariance -1	Ch. 7	#5
7	02/24 (W)	Multivariate Analysis of Variance and Covariance -2	Ch. 7	#6
8	03/03 (W)	Profile Analysis (PA) ^b	Ch. 8	#7
9	03/10 (W) ~ 03/13 (Sa)	Midterm Exam		
10	03/17 (W)	Discriminant Analysis (DFA)	Ch. 9	#8
11	03/24 (W)	Spring Break, no class		
12	03/31 (W)	Principal Component Analysis (PCA)	Ch. 13	#9
13	04/07 (W)	Exploratory Factor Analysis (EFA)	Ch. 13	#10
14	04/14 (W)	Introduction to Structural Equation Model (SEM) and Confirmatory Factor Analysis (CFA)	Ch. 14	#11
15	04/21 (W)	Review		#12
16	04/28 (W) ~ 05/01 (Sat)	Final		
17	05/05 (W)	Other Multivariate Topics (optional)		

- a. Delwiche, L. D., & Slaughter, S. J. (2019).
- b. Contents up to week 8 will be covered in the midterm exam. Content related to profile analysis will be covered in the final exam, not in the midterm exam.

*I sincerely welcome everyone's input, suggestions, and feedback anytime during the course.
Let's work together to have a fun and rewarding semester!*