

INFORMATION SHEET

Math 434: Advanced Linear Algebra, Spring 2021, Professor Rebecca Field
MWF 3:30–4:20pm, on zoom

Primary Text: A Second Course in Linear Algebra by Garcia and Horn	Contact information for Professor Field
Exam dates:	Office: Roop 114
Big Quiz 1: Friday, February 14	Phone: 540-746-1231
Midterm: Week of March 18, individually scheduled oral exam	Email: fieldre@jmu.edu
Big Quiz 2: Friday, April 17	Webpage: https://educ.jmu.edu/fieldre/434.html
Final Exam: Individually scheduled oral exam	Canvas: https://canvas.jmu.edu/courses/1777147

Office Hours: MW 11:30am–12:30pm and F 2:00–3:00pm (+evening problem session TBD) also by appointment.

You can always make an appointment to see me.

The goal of Math 434 is to solidify and expand your understanding of a fundamental topic in mathematics, Linear Algebra. This class will be significantly harder than your first course in linear algebra (Math 300/Math 238/Introduction to Linear Algebra somewhere other than JMU), so take that ‘Advanced’ from the title seriously. The idea with this class is that Linear Algebra is probably our most widely used topic, both inside and outside mathematics. It is both more interesting and more intricate than you’ve ever imagined and any introduction to the subject must prioritize computation due to its ubiquity. The main topics covered in a first course in linear algebra are Systems of Equations, Vector Spaces, Linear Transformations, and Diagonalization and each of them is absolutely necessary in a wide variety of fields (Math, Physics, Engineering, etc.) and super useful in a wider variety of fields (Chemistry, Biology, Computer Science, etc.). Because of that, none of them can be skipped, which leaves room no room for interesting digressions. Things you may have wondered about, like how the standard basis is more than just a nice basis, its vectors are also unit length and perpendicular, and the consequences of trying to measure things like angles between vectors are truly interesting aspects of the subject and will occupy the first part of the course.

This is not so much a secrets-of-the-universe class like Math 410 (Intro to Real Analysis), or an introduction to true abstraction like Math 430 (Intro to Algebra), but given our increasing dependence on technology, it is a secrets-of-our-universe class, and consequently, it can change the way you think about the world, but only if you give it the time it deserves!

Here is my most important piece of advise about this course: DO NOT FALL BEHIND!! This includes things like DO NOT MISS CLASS!! (If you must miss a class, get notes from one of your classmates *and read them/copy them into your notebook* before the next class.) It also includes things like DO YOUR HOMEWORK!! It is not possible to actually learn this material without doing problems. You might be able to convince yourself you understand, but if you can’t do problems, you aren’t at the level of understanding required to pass the class. In fact, if the class seems too easy at any point, do more problems!

There will be two big quizzes, an oral midterm and an oral final as well as weekly quizzes (usually on Fridays), weekly homework, and daily vocabulary checks. Your weekly quizzes will be self scheduled on Canvas, will take a half hour to an hour of your time and are all based on the ‘easy’ homework problems. Your Big Quizzes are timed cumulative weekly quizzes that may also include ‘medium’ homework problems. For your oral midterm and final exam, all homework problems are fair game. As far as the homework goes, I will give it a quick check for completeness, and depending on how the course is going, may grade it, but the best way to get feedback on the homework is to go over it with me, either in class (if it is a problem many people had trouble with) or in my office hours/by appointment. Your quizzes and daily vocabulary checks will be your main source of feedback.

TEXTBOOK: Our primary text (hopefully available from the bookstore) will be *A Second Course in Linear Algebra* by Stephan Ramon Garcia and Rodger Horn (1st edition, 2017, Cambridge University Press) ISBN-10: 9781107103818, ISBN-13: 978-1107103818. Chapters 0,1, and 2 are mostly review (with a few new things spattered here and there). As student’s previous linear algebra experience varies in both class (238/300/not at JMU) and in time (anywhere between three weeks and three years since it was last considered), I am asking students to conduct their own review of this material. Our first weekly quiz will cover chapters 0-4.

I also suggest that you have at least one supplemental text to help you review topics from Math 300/238 and as a second (or third) opinion about new material

SUPPLEMENTAL TEXTBOOKS:

Your Math 300/238 textbook: whether or not this book is the definitive tome of the material or not, that text book is *your* definitive tome of Introduction to Linear Algebra because that was the structure under which *you* first learned the material. The best would be if you kept a copy of this text. If not, buy, borrow, or steal one. This will be the first place you look when you’re trying to remember something that you know you covered in Math 300/238.

Strang Gilbert Strang is a professor at MIT and has several linear algebra textbooks that have both run through multiple editions so some edition of one of them should be available cheaply online. These are *Introduction to Linear Algebra* and *Linear Algebra and Its Applications*. Either of these texts would make an excellent reference.

Free Online *Linear Algebra Done Wrong* by Sergei Treil (licensed under Creative Commons, 2017) available at [http://www.math.brown.edu/~treil/papers/LADW/LADW\\$_2017-09-04.pdf](http://www.math.brown.edu/~treil/papers/LADW/LADW$_2017-09-04.pdf) (there will be a link on the course website). This text started as lecture notes for Honors Linear Algebra at Brown. It is considerably more sophisticated than the previous two options and should be thought of as a second resource equivalent to our textbook.

Many Other Options

Note about written sources There are many linear algebra texts in existence, as well as many on-line resources and if you search hard enough, it is probably possible to find the answer for just about anything eventually. However, the time you spend looking for an answer online would be much better spent *trying to figure it out* yourself, and then working in groups/coming to see me if you have trouble. The ability to find solutions to problems using the internet will not help you at all on tests and quizzes! If you do end up doing the bad-idea (looking up solutions on the internet), as a minimum to get anything educational out of the process (and to avoid an HONOR CODE VIOLATION) you must 1. reference your source, 2. change the wording of the solution (choose different English words) and 3. change the names of all of the variables. If I catch anyone copying from any source (including each other or me or your textbooks) without doing those three things, I WILL bring you up on honors charges.

GRADES: Your grade for this course will be determined by the big quizzes and your midterm (40% total), the final exam (30%), and by your written work (30%). This written work includes weekly quizzes, daily vocabulary checks (if you are in class and participate you will get full credit for it), and homework. Class participation, whether in class, in problem session, or on the class Piazza page is very important and will be counted with your written work.

If you have any special needs, please see me in the first two weeks of the term.

HOMEWORK: may be worked on in groups, but must be written up independently in your own words. Cooperation is encouraged and we may sometimes spend the last 20 minutes of the class discussing the more difficult homework problems. Typically, I will assign homework weekly, and I will let you know at the time I assign written work when it is due.

NOTE TAKING: By this point in your college career, you are self aware enough to know if you find taking notes during lecture/discussion helpful for your understanding or actively detrimental to your understanding (I personally find note taking essential for my concentration during a talk as my mind wanders easily and losing track of the narrative makes it impossible to follow the later part of a talk). I will be posting our in class discussions/lectures/problem solving sessions on canvas, so unlike an ordinary class, which only happens once, you do not *need* to take notes in order to keep track of the course. That being said, I would strongly encourage those of you who have found note taking helpful in the past to continue doing. It is very easy to have the best of intentions to re-watch a video, but if you come to class (*highly recommended* if for no other reason than to get points for the daily vocabulary checks), you will have seen everything at least once, and concepts are much easier to locate in a written record than somewhere in a 50 minute recording! If you are one of the people who find note taking actively detrimental to your concentration, I would strongly encourage you to either rewatch the videos and take notes the second time through or to copy a friend's notes *and go over them together, pooling your knowledge*. Having a written record other than the textbook can be crucial when concepts pile on other concepts later in the semester.

DIFFICULTY OF THIS CLASS: This class is *supposed to be difficult*. It is a 'real' 400 level math class along the lines of 435, 411, and 431 (that is, it's not required for anyone and covers advanced material quickly). I strongly advise my advisees to take Math 434 their Junior year if they are considering math grad school (it's a great preparation for both grad school and the Math Subject GRE). You should expect to spend at least one hour outside class for every hour in class *just working on what we are doing/have done in class* (doing the pre-class reading and going over your class notes). This is *in addition* to your time spent studying vocabulary for daily quizzes, working on homework and reviewing for quizzes/tests. At the same time, it's still Linear Algebra, so proofs and explanations are often more or less the same thing and all the material slots together in a truly satisfying way once you understand it. The homework problems can be difficult, so we will have a weekly problem session in the evening to talk about them.

TOPICS: I am planning on covering
Inner Product Spaces/Orthogonality/Graham Schmidt
Eigenvalues/Eigenvectors/Caley-Hamilton/Jordan Canonical Form
Connections between these two topics (Normal Matrices/Matrix Factorizations/Positive Definiteness)

PIAZZA: once the class starts, please direct all questions that arent of a personal nature to the class Piazza site (you should have already received an invitation). You may post to Piazza either under your own name, anonymously for the rest of the class, or completely anonymously, even to me.

ATTENDANCE and participation will be an important requirement of this course. If you must miss a class, be sure to get notes.

HONOR CODE: I take the honor code very seriously, and so should you. Any instances of suspected cheating or academic dishonesty will be referred to the JMU Honor Board for investigation. Please see the note at the end of the textbook section for specific requirements about academic honesty and homework.