

Math 325-001, Mathematical Statistics I: Probability Theory, Fall 2017
Syllabus



Instructor: Dr. Thomas M. Fiore, Associate Professor

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Instructor Website: <http://www-personal.umd.umich.edu/~tmfiore>

WeBWorK Website for Our Section:

<https://instruct.math.lsa.umich.edu/webwork2/ma325-001-umd-f17>

Instructor Office Hours in 2071 CB:

Mondays and Wednesdays, both 12:00 – 12:30 and 2:00 – 2:50, and by appointment

Dearborn Discovery Core Category: Inquire in CASL Advising if needed

Course Meeting Times and Format:

Mondays, Wednesdays, Fridays 10:00 am – 10:50 am in 2070 CASL Building (3 credit hours)

Course Description: We are living in the age of Big Data, and there is no turning back. Small businesses, large corporations, internet companies, government agencies, and scientists are all collecting massive amounts of data. What can they do with it? In this new era of observation and recording, powerful computers make it possible to interpret untold amounts of information, if only one knows how to make sense of it all. Statistics provides the tools. Shrewd business decisions, successful social policies, and scientific breakthroughs often utilize statistical methods. No doubt, statisticians will be in high demand in the next decade. Knowledge of statistics is important for many lucrative career paths, just to name a few: actuarial science, financial engineering, biostatistics, biomathematics, bioinformatics, educational testing, numerous government agencies (Food and Drug Administration, Census Bureau, Bureau of Labor Statistics, NSA), pharmaceutical research, and risk management.

For us in this class, the main goal of statistics is to infer a conclusion about a population when you only know information about a sample, and to quantify the conclusion's reliability.

Statistics classes are among the most important and useful classes you can take at UM-Dearborn. In this class, we will learn the fundamentals of **probability theory**, which is the

foundation for statistics. We will also learn the basics of the open-source statistics language called R. The topics covered in this course are: three kinds of histograms, basic concepts of probability and enumeration, discrete random variables and their probability mass functions, continuous random variables and their probability density functions, expectation and variance of random variables, bivariate distributions, conditional distributions, the correlation coefficient, independent random variables, distributions of functions of random variables, transformations of random variables, moment generating functions, the Central Limit Theorem, and order statistics. The material of this course consists of most of Chapters 1 through 5 of the textbook, as well as Section 8.3 on order statistics. We skip Sections 3.2 on exploratory data analysis, 3.7 on other random variables, and 4.4 on the bivariate normal distribution, and 5.7 on approximations of discrete random variables. We cover Section 4.4 on the bivariate normal distribution next semester in Math 425: Mathematical Statistics. All of the material in Math 325 is relevant for Actuarial Exam P.

Program Learning Goals: This class improves your problem-solving abilities in written homework problems, automatically graded WeBWorK problems, in-class examples, in-class teamwork, quizzes, and exams. A few homework problems and WeBWorK problems deal with topics outside of mathematics so that you learn about applications of mathematics to other fields. Your ability to communicate and work cooperatively is honed in your in-class problem presentations, your discussions with classmates about WeBWorK outside of class, and during in-class teamwork. Your facility to use technology and draw conclusions from its output will be improved during online WeBWorK homework, in-class computer demonstrations, and R-labs. Occasional anecdotes will increase your knowledge of the history and nature of mathematics. Our problem discussions and feedback on your in-class problem presentations (especially WeBWorK) will improve your understanding of how mathematics is done and learned so that you become a self-reliant learner and effective user of mathematics.

Course Objectives: Learn the techniques and applications in the Course Description, and attain the Program Learning Goals.

Prerequisites: Calculus II, in the form of Math 114 or Math 116 or at another university.

Textbooks:

- Our main textbook is:
Probability and Statistical Inference by Robert V. Hogg and Elliot A Tanis. Prentice Hall, **8th** Edition. Notice that we are using the **8th** Edition, and not the new 9th

Edition.

- A supplementary free textbook is:

Introduction to Probability and Statistics Using R by G. Jay Kerns.

<http://cran.r-project.org/web/packages/IPSUR/vignettes/IPSUR.pdf>

Grading: WeBWorK and Homework: 20%, Labs: 2%, Participation: 5%, Quizzes: 8%, In-Class Exams: 17.5% each, Final: 30%. Letter grades will be assigned according to a scale no more challenging than the following.

E	D-	D	D+	C-	C	C+
0 – 60	60 – $63\frac{1}{3}$	$63\frac{1}{3}$ – $66\frac{2}{3}$	$66\frac{2}{3}$ – 70	70 – $73\frac{1}{3}$	$73\frac{1}{3}$ – $76\frac{2}{3}$	$76\frac{2}{3}$ – 80

B-	B	B+	A-	A	A+
80 – $83\frac{1}{3}$	$83\frac{1}{3}$ – $86\frac{2}{3}$	$86\frac{2}{3}$ – 90	90 – $93\frac{1}{3}$	$93\frac{1}{3}$ – $96\frac{2}{3}$	$96\frac{2}{3}$ – 100

Homework: There are five kinds of homework for this class, outlined below. This class requires ten hours of practice/study/work per week, outside of class.

1. **Daily reading and reviewing.** Using the schedule below, determine the next section and read it ahead of class. Review your notes daily, before and after class.
2. **WeBWorK. WeBWorK counts for approximately 20% of your grade, and is required.** This is online homework at the website below, and is automatically graded. Your FIRST login must occur through the Canvas website in the left Modules tab, NOT the login below.

<https://instruct.math.lsa.umich.edu/webwork2/ma325-001-umd-f17>

(Note the s in the link!) Due dates are on the WeBWorK site and Canvas site. Each student has individualized problems, that means no two students have the exact same problems, though they are similar. My suggestion is to print out your assignment, work on it by hand, and then return to the computer, type in your answer to a problem, **preview it, and then submit that problem.** Whenever you have a wrong answer, the computer will tell you, and you get several more chances to correct your mistake,

and submit the correct answer before the due date. After you submit a problem correctly, that problem is finished and you have its credit; there is no overall final submit button for the whole assignment. The purpose of the WeBWorK is to give you immediate feedback so that you can learn from your mistakes. WeBWorK problems will often be more challenging than ordinary practice problems, so I encourage you to discuss the problems with your classmates, in person or in the Canvas chatroom. New WeBWorK assignments will be announced on email or in class. Only the final overall total WeBWorK grade will be recorded on Canvas, not individual assignment grades. The individual assignments on Canvas will say zero points, but that is not correct, WeBWorK counts for approximately 20% of your grade.

3. **Practice problems.** Written practice problems will be assigned. The problems for sections covered Monday, Wednesday, and Friday of a given week are “due” on the Wednesday of the following week. Written practice problems will rarely, if ever, be collected. Your progress on the practice problems is evaluated by the quizzes, the exams, your presentations before class, and the WeBWorK. Quiz problems and exam problems may come from the practice problems or be very similar to them.
4. **Monthly Board Problems.** Everyone in the class must write up *at least* 3 of the ODD practice problems or WeBWorK problems throughout the semester on the chalk board *before* class, any day of class except exam days. Your presentation does not have to be 100% correct, but it must show a very good effort. I will correct the problem in class so everybody can learn from your presentation. Corrections are not embarrassing, we are all learning Math, and I will make the class atmosphere very comfortable. These 3 presentations count towards your participation grade: each of the 3 presentations is 1% of your entire course grade. Each student is required to do one board presentation (practice problem or WeBWorK) in each month: September, October, November. Any extra problems you do in a given month will go towards extra credit, you can do at most 3 extra credit problems the entire semester. Please avoid repeating problems other students have done by checking my list and checking what other people are currently writing. Whoever starts writing a board problem first, claims it. You will not get credit for repeating a problem someone else has done. Do not wait until the end of the month.
5. **R Labs.** These will be assigned occasionally. I encourage you to hand in *one copy, together with your lab partner*, for which you will both receive the same grade. Lab problems are often challenging, and are meant to be solved by a team. *Teamwork is an important skill, and is highly valued in industry. Now is the time to hone your teamwork skills by working with a lab partner.* However, if you cannot work with your

lab partner, you may hand in separate assignments for separate grades. Sometimes it is just too difficult to find a time to meet outside of class. R and its interface RStudio are available for *free download*

<http://cran.at.r-project.org>
<http://www.rstudio.com>

online. On campus, R and RStudio are installed on the University computers in the Calculus Lab 2046 CASL Building and the Calculus Lab 2048 CASL Building. Unfortunately, R is not available in the Math Learning Center 2076 CASL, nor in the ITS computer lab in the 1140 Computing Wing. Next to the doors for 2046 CASL and 2048 CASL you can find a bin with lab hour printouts for you to take, or you can find the lab hours online.

Quizzes: We will have two quizzes. The lowest quiz score will be dropped. The reasons we drop the lowest quiz is: 1) you may be absent some day because of outside circumstances, 2) you just made mistakes and are dissatisfied with your score. There are no make-up quizzes; if you miss a quiz, it will simply count as the dropped quiz. If you are seriously ill or injured, and have documentation from a doctor, then you can have a make up quiz. Quiz problems will come directly from in-class examples and the practice problem sheet, or be very similar to them or WeBWorK problems. So the best way to prepare is to do and redo the practice problems (check answers in the back of the book), review your class notes, and redo the class examples without looking at your notes.

In-Class Exams: We will have two midterm exams during the semester in class. Each will last 50 minutes. Exam problems will be similar to the lecture problems, practice problems, quizzes, WeBWorK, and sample exams. See the tentative schedule below for approximate dates.

Final Exam: Friday, December 15, 2017, 9 am – 11 am in 2070 CASL Building. The final exam must occur at the time and place designated on the Final Exam Schedule. Final exam problems will be similar to the lecture problems, practice problems, quizzes, WeBWorK, in-class exams, and sample exams.

Tentative Course Schedule: Most of Chapters 1 – 5 and Section 8.3, as follows.

Tentative Course Schedule			
Week Starting	Monday	Wednesday	Friday
Sept 4	Labor Day	Intro	1.1
Sept 11	1.2	1.3	1.4, Quiz #1
Sept 18	1.5	1.6	Catch Up
Sept 25	2.1	2.2	2.3
Oct 2	2.4	2.5	Review
Oct 9	Exam #1	2.6	Catch Up
Oct 16	Study Break	3.1	3.3
Oct 23	3.4	3.5	3.6
Oct 30	Catch Up	Catch Up	4.1
Nov 6	4.2, Quiz #2	4.3	Catch Up
Nov 13	5.1	5.2	Review
Nov 20	Exam #2	5.3	Thanksgiving
Nov 28	5.4	5.5	5.6
Dec 4	8.3	Catch Up	Review
Dec 11	Review (Last Class)	no class	Final Exam, 9 am

University Attendance Policy: A student is expected to attend every class and laboratory for which he or she has registered. Each instructor may make known to the student his or her policy with respect to absences in the course. It is the students responsibility to be aware of these policies. The instructor makes the final decision to excuse or not to excuse an absence. An instructor is entitled to give a failing grade (E) for excessive absences or an Unofficial Drop (UE) for a student who stops attending class at some point during the semester.

Professor Fiore's Attendance Policy: In this class, you may be absent only on rare occasions, this means up to 3 times.

Academic Integrity Policy: The University of Michigan-Dearborn values academic honesty and integrity. Each student has a responsibility to understand, accept, and comply with the University's standards of academic conduct as set forth by the Code of Academic Conduct <http://umdearborn.edu/697817>, as well as policies established by each college. Cheating, collusion, misconduct, fabrication, and plagiarism are considered serious offenses and violations can result in penalties up to and including expulsion from the University. Academic dishonesty is not acceptable. Plagiarism, cheating, fabrication or any other form of academic misconduct will be subject to disciplinary action as described in the Code of Aca-

demic Conduct. All students must adhere to the Code of Academic Conduct. I recommend that you explore the Tutorial on Academic Integrity and Plagiarism.

<http://webapps.umd.umich.edu/aim>

Disability Resource Services: The University will make reasonable accommodations for persons with documented disabilities. Students need to register with Counseling & Disability Services (DS) every semester they are enrolled. DS is located in 2157 UC, see the website <https://umdearborn.edu/students/disability-services> for more information. To be assured of having services when they are needed, students should register no later than the end of the add/drop deadline of each term. If you have a disability that necessitates an accommodation or adjustment to the academic requirements stated in this syllabus, you must register with DS as described above and notify your professor.

Technology Policy: Your attendance and full participation in class is important for you and your career. For this reason, and out of respect of others, we would like to eliminate distractions to you and others in the classroom. Think ahead and *silence and put away* your phones at the beginning of class. Also put away any other electronic devices such as ipods, mp3 players, or laptops. Do not plan to use the calculator on your phone or ipod. These devices should be stored and not used in class. A laptop should be used only for instructor-requested, course-related activities. Text messaging is *never* appropriate during class.

When emailing your instructor remember that this is a professional context and you should present yourself as a future professional. Your message should be well composed with proper salutation, grammar, punctuation, capitalization, and spelling. Proof-read, then sign your name.

We appreciate that you show respect to your classmates and instructor by following these technology guidelines. (This Technology Policy was adapted from that of the Math Education Team). **If you do not follow these rules or any others, you will lose points, without warning.**

Calculators: This course does *not* require you to buy any special calculator, so there is no need to buy a powerful calculator. Calculators are not allowed on quizzes, nor on exams.

About R and RStudio: *For free*, download and install first R and then its interface RStudio from the links below.

<http://cran.at.r-project.org>
<http://www.rstudio.com>

What is R? R is a computer language for statistics, for statistical visualizations of data, and for statistical programming. It is powerful, it is open source, it is free, and it is used by tens of thousands of people every day in diverse applications of statistics. Its only drawback is that it does not have a graphical user interface like the expensive competitors SAS or SPSS, so the learning curve is steep. Nevertheless, the integrated development environment called RStudio does make R easier to use (RStudio is also open source and free!). If you are taking this course just as a first introduction to statistics and have no programming experience and no interest in programming, don't panic! We are not going to substantially use R in this course, everything will be guided, and you can do it. If you are taking this course because you want to pursue some lucrative career involving statistics, you really should spend your time and learn R. In my opinion the best introduction to R is the short book

- *A Beginner's Guide to R* by Alain Zuur, Elena Ieno, and Erik Meesters, Springer-Verlag, 2009. Available online for approximately \$40.

The wonderful thing about this Beginner's Guide is that it does not assume knowledge of statistics, so you do not have to learn statistics and R at the same time. Another useful book, perhaps even a companion to the Beginner's Guide, is

- *R Cookbook* by Paul Teetor, O'Reilly Media, 2011. Available online for approximately \$30.

This Cookbook contains recipes to quickly get you going with common statistical tasks in R.

Three really terrific, free online resources for learning R are the following.

- simpleR – *Using R for Introductory Statistics* by John Verzani.
<http://www.math.csi.cuny.edu/Statistics/R/simpleR>
- The College of the Redwoods (California) has fantastic introductory tutorials.
<http://mse.redwoods.edu/darnold/math15/RActivities.php>
<http://mse.redwoods.edu/darnold/math15/UsingRInStatistics.php>

- Code School teaches you to use R interactively, directly in your browser!
<https://www.codeschool.com/courses/try-r>

Online Resources for Statistics: There are a number of truly excellent (and free!) websites that help you learn statistics, though they are not required for the class.

- The Statistics Online Computational Resource at UCLA.
<http://www.socr.ucla.edu>
- Kyle Siegrist (Alabama) and collaborators made the Virtual Laboratories in Probability and Statistics.
<http://www.math.uah.edu/stat/index.html>
- Collaborators at OpenIntro have created a wonderful free and open-source textbook with labs and software.
<http://www.openintro.org/stat>
- Bruce Simmons (Oregon) has created great videos on how to use Excel for statistics. You really should learn this!
<http://www.brucesimmons.com/excel243.html>
<http://www.brucesimmons.com/excel244.html>

Math Learning Center (2076 CB): The Math Learning Center offers free, walk-in tutoring as well as many other services. Please use it! For more information, see <https://umdearborn.edu/cas1/685053>.

Tips for Success:

- Always attend class and take copious notes, even when you're sure you completely understand.
- Preview and review. That means read the book before class, and review your notes after class.
- Practice, practice, practice. That means do the homework, check your answers, find your mistakes, and correct them. Also, write down your answers in a systematic, clear way, and use complete sentences. Whenever you have trouble with a particular kind of problem, do more of that type.

- Study with others. When explaining things to a peer, you might find there is something you didn't understand. Also, talking about math with someone else helps you to remember it and understand it better.
- Understand things from various points of view: algebraically, graphically, numerically.
- Use the Math Learning Center (2076 CB) and ask me questions during office hours.
- At the end of each chapter, read the Chapter Summary and do some Review Problems.
- As one step in your preparation for an exam, write down in one place all the main theorems, definitions, and formulas, and two examples of each. This will give you a very good overview of the material. More importantly, in your process of creating your study sheet, you organize and internalize the material in your own mind.
- George Washington Carver: "...a very large proportion of every true student's work must be outside the classroom."

Safety: All students are encouraged to program 911 and UM-Dearborns University Police phone number (313) 593-5333 into personal cell phones. In case of emergency, first dial 911 and then if the situation allows call University Police.

The Emergency Alert Notification (EAN) system is the official process for notifying the campus community for emergency events. All students are strongly encouraged to register in the campus EAN, for communications during an emergency. The following link includes information on registering as well as safety and emergency procedures information: <http://umdearborn.edu/emergencyalert>.

If you hear a fire alarm, class will be immediately suspended, and you must evacuate the building by using the nearest exit. Please proceed outdoors to the assembly area and away from the building. Do not use elevators. It is highly recommended that you do not head to your vehicle or leave campus since it is necessary to account for all persons and to ensure that first responders can access the campus.

If the class is notified of a shelter-in-place requirement for a tornado warning or severe weather warning, your instructor will suspend class and shelter the class in the lowest level of this building away from windows and doors.

If notified of an active threat (shooter) you will Run (get out), Hide (find a safe place to stay) or Fight (with anything available). Your response will be dictated by the specific circumstances of the encounter.

Incident and Complaint Reporting: Title IX of the Civil Rights Act recognizes that students should be able to study in a safe atmosphere free of sexual violence, harassment, bias, and discrimination. Should you wish to report an incident of sexual assault, harassment, discrimination, or bias, visit <https://umdearborn.edu/faculty-staff/human-resources/campus-wide-incident-report>.