Worcester Polytechnic Institute   Fall 2021 - A Term
Department of Mathematical Sciences
Professor: Stephan Sturm
Teaching Assistant: Dane Johnson

MA 2631

Probability Theory

Section AL01 / AD01

Syllabus

1. **Contact & office hours:**

   Stephan Sturm
   Stratton Hall 202C   (508) 831-59 21
   ssturm@wpi.edu
   Monday, 11:00–11:50am,
   Tuesday, 1:00-1:50pm
   Thursday, 10:00–10:50am,
   Friday, 1:00-1:50pm
   and upon request per email
   and upon request via https://calendly.com/ssturm-2
   https://users.wpi.edu/~ssturm/

   Dane Johnson
   Stratton Hall 204
   djohnson3@wpi.edu
   Tuesday, 5:00-5:50pm in SH 014
   https://www.wpi.edu/people/doctoral-student/djohnson3

2. **Class and conference:**

Lecture:	Mon, Tue, Thu, Fri,	12:00-12:50pm,	Stratton Hall 308
Conference:	Wed,	12:00-12:50pm,	Stratton Hall 202

3. **Textbook** (recommended):
   Lecture Notes to the class will be provided incrementally on Canvas and should be more than sufficient. For those who want to have a little bit a deeper look (and in particular more exercises), I recommend the following two books

   Sheldon Ross, *A First Course in Probability*. Pearson Education, Inc., Upper Saddle River. 9th edition, 2013. `ISBN 978-0-321-79477-2`
   I based my lecture mainly on this.

   Matthew A. Carlton, Jay L. Devore, *Probability with Applications in Engineering, Science, and Technology*. Springer, 2014. `ISBN 978-3-319-52400-9`
   This book has the great advantage that it can be downloaded for free via the Gordon Library https://link.springer.com/book/10.1007%2F978-3-319-52401-6

4. **Videos**: Videos from a previous offering of this course re provided on Canvas and can help students that have to miss some class (or for review purpose). Everybody who intends the course fully or mainly online should contact Prof. Sturm as soon as possible to discuss details.

5. **Expectations**:
   The time spent in class is a **small** fraction of the time you should work for the class. WPI expects about 17h work for a 1/3 unit course (as MA 2631 Probability Theory) for the *average* student. As the organized part consists of 4h class instruction per week, it follows that 13h / week are expected for work **outside** the classroom: revision, conference, office hours, **homework**, preparation.

6. **Resources**:

   - The learning management system for the course is Canvas, https://canvas.wpi.edu/courses/26742. Homework, lecture notes and videos will be posted there. Solutions to homework problems will not be published, but students who do not understand the problem after receiving the graded homework are *highly encouraged* to discuss it in office hours. Problems that are challenging to several students might be discussed in a special video upon several students' request.

   - A discussion forum will be hosted on piazza, https://piazza.com/class/ksksn75rhii2pr. The forum supports different formatting options, and in particular the inclusion of mathematical symbols via LaTeX. See https://piazza.com/help/formatting.html for the general formatting guidelines and https://en.wikibooks.org/wiki/LaTeX/Mathematics#Symbols for a list of commands for specific symbols. While discussions (also about homework) are encouraged, please refrain from giving complete solutions of homework questions. Giving hints is okay, providing a solution is *dishonest* and will be treated as violation of the academic honesty policy, see 11. Instructors will endorse correct student answers and provide only answers if there is no student answer in reasonable time. Feel free to ignore the requests for contributions on piazza!

- Grades will be posted on Canvas

7. **Help**:
   You have not only the possibility to ask for help, you are encouraged to do so. However, it is expected that you invest a major effort (i.e., several hours of work) in your work and you provide an explanation about what you have done and tried so far. Sources for help are in particular.

   - Conference
   - Discussions with peers
   - Online discussions on piazza
   - Office hours by the professor
   - Office hours by the TA

   Questions per email are **explicitly discouraged**, please post instead your questions on piazza (you can do this anonymously or semi-anonymously)

8. **Course description** as per course catalog:

   The purpose of this course is twofold:

   - To introduce fundamental ideas and methods of mathematics using the study of probability as the vehicle. These ideas and methods may include systematic theorem-proof development starting with basic axioms; mathematical induction; set theory; applications of univariate and multivariate calculus.
   - To introduce the student to probability. Topics to be covered will be chosen from: axiomatic development of probability; independence; Bayes theorem; discrete and continuous random variables; expectation; special distributions including the binomial and normal; moment generating functions; multi-variate distributions; conditional and marginal distributions; independence of random variables; transformations of random variables; limit theorems.

   This course is designed primarily for Mathematical Sciences majors and those interested in the deeper mathematical issues underlying probability theory. A more applications-oriented course with similar content is MA 2621 Probability for Applications which is primarily designed for students in departments other than Mathematical Sciences.

   Recommended background: Multivariable Differential and Integral Calculus (MA 1024, or equivalent).

   Undergraduate credit may not be earned both for this course and for MA 2621 Probability for Applications.

9. **Preliminary course outline**:
   Topic 1: Combinatorial analysis
   Topic 2: The axioms of probability
   Topic 3: Conditional probability and independence
   Topic 4: Discrete random variables
   Topic 5: Continuous random variables
   Topic 6: Joint distribution of random variables
   Topic 7: The classical limit theorems of probability theory

10. **Homework**: There will be two homework problem sets per week, due on Tuesday and Friday. The problem sets will be posted on Canvas and homeworks will be submitted via Canvas, as **single .pdf file per homework** (there are many free apps that allow to scan work on paper on a phone into a single pdf document, if you need help with this please ask). Homework due dates will be: 08/31, 09/03, 09/10, 09/14, 09/17, 09/21, 09/24, 09/28, 10/01, 10/05, 10/08, all by midnight.

    Guidelines:

    - Late submission policy: Up to three (3) late submissions are allowed without cause. However, as these should not be accidents but results of intentional planning, the extensions of the deadline will be granted ONLY as long as they are requested per email at least 24 hours in advance to the professor **and** TA . All other late written homework (when submitted before the corrected homeworks of the other students are returned) will be graded with a reduction by 50% of the points. This excludes of course extenuating circumstances such as long, severe illness, in which case you contact the instructors as soon as possible.

    - The homework submission has not only to contain the result, but carefully developed calculations and proofs that can actually be followed by a reader.

    - Whereas the discussion of homework problems in (small) groups is not only okay but encouraged, the final write-up has to be done individually. Any copying of homework is a violation of the academic honesty policy (see below) and will be treated as such.

11. **Exams**: Midterm and final exam consist both of a 50 minute written exam. Both exams will be closed books, but a (simple) calculator and one double-sided "cheat sheet" will be allowed. The final exam is **cumulative**, thus it covers the whole class.

    Exams will be

    Midterm exam
    Friday, September 17, 12:00–12:50pm
    Stratton Hall 308

    Final Exam
    Monday, October 11, 12:00–12:50pm
    Stratton Hall 308

    Prior to the start of each exam, you must place all of your belongings (e.g., cell phone, study materials, etc.) in your backpack and under your desk, so that no items are visible during the exam. **There are no makeup exams**.

12. **Grading**: The total score will be composed from the individual scores by using the following weighting:

- 30% Problem sets   —   lowest result will be dropped
- 5% Participation (in class or via piazza)
- 25% Midterm exam
- 40% Final exam (cumulative!)

The achievement of the following total score will be sufficient for the stated letter grades:

- A   85%
- B   75%
- C   60%

13. **Students with Accessibility Needs**: Students with approved academic accommodations should plan to submit their accommodation letters through the Office of Accessibility Services Student Portal. Should you have any questions about how accommodations can be implemented in this particular course, please contact us as soon as possible. Students who are not currently registered with the Office of Accessibility Services (OAS) but who would like to find out more information regarding requesting accommodations and what that entails should plan to contact them via email: AccessibilityServices@wpi.edu and/or via phone: (508) 831-4908.

14. **Academic Honesty**: Each student is expected to familiarize him/herself with WPI's Academic Honesty policies which can be found at https://www.wpi.edu/about/policies/academic-integrity/dishonesty. All acts of fabrication, plagiarism, cheating, and facilitation will be prosecuted according to the university's policy. If you are ever unsure as to whether your intended actions are considered academically honest or not, please contact your instructor in advance. Further information is available via https://www.wpi.edu/about/policies/academic-integrity. Let us highlight in particular the definition of plagiarism:

Plagiarism: Using as one's own the words, ideas, data, code, or other original academic material of another without providing proper citation or attribution. Plagiarism can apply to any assignment, including final or drafted copies. Examples include, but are not limited to: • Misrepresenting the work of another as one's own, •, Inaccurately or inadequately citing sources, • Paraphrasing (using the ideas of others in your own words) without citation.

15. **Further Resources**: Even the best of learners need help along the way. WPI has some great resources to support you in this class and beyond. Here are some to check out:

- Academic Resource Center, https://arc.wpi.edu/
- IT Service & Support, https://www.wpi.edu/offices/services-support
- Student Development and Counseling Center, https://www.wpi.edu/offices/student-development-counseling-center
- Accessibility Services, https://www.wpi.edu/offices/office-accessibility-services
- Health Services, https://www.wpi.edu/student-experience/health-counseling/health-services
- Multicultural Affairs, https://www.wpi.edu/offices/office-multicultural-affairs
- LGBTQ+ Support, https://www.wpi.edu/student-experience/resources/lgbtq-support
- International House, https://www.wpi.edu/offices/international-house

Enjoy the Course!