Probability

Meeting Times: 10:20-11:15 am MWF in RBN 3038

Last day to withdraw: Monday, November 3, 2025.

Instructor: Nathan Smith

Office: RBN 4007

Contact: nsmith@uttyler.edu

Office Hours: Tentatively 1:30-2:30 MW, 9:00-10:00 F, with other times available by appointment.

Text: An online text *Introduction to Probability* by Grinstead and Snell, is available in Canvas in the Files section. If you want to purchase a hardcopy version, you can do so from amazon.

Course Topics: While probability, like algebra or geometry, is an object of mathematical interest and study in its own right, our interest in probability in this course is mainly in its role as a foundation to statistics. We will cover the standard topics for an introductory probability course, discrete and continuous random variables, conditional probability, multivariate distributions, moment generating functions, and the Central Limit Theorem. After successfully completing this course you should be mostly prepared to take exam **P** in the series of actuary exams.

Student Learning Outcomes: By the end of the course students should be able to:

1. Define and use the basic concepts from probability theory, including random variables, distribution and density functions, conditional probability, moments, expectations, generating functions, and the central limit theorem.

2. Identify, give density functions for, and apply the standard discrete random variables.

3. Identify, give density functions for, and apply the standard continuous random variables.

Computing: We will make mild use of the **R** programming language this semester, mostly drawing graphs and running a simulation or two. You won't be expected to do any programming. We will be using **R** in Statistics in the Spring and it won't hurt to get a little bit familiar with it this fall. You can download **R** for free from `www.r-project.org`. If you like snazzy modern IDE type things you might want to look at the RStudio IDE, available for free at `www.rstudio.com`.

Grading: There will be two tests as well as a final exam. Each will count one fifth of your final grade. The remaining two fifths of your final grade will be based on homework, quizzes, and other assignments.

The tests will be roughly late September and late November. Our final is scheduled for Monday, December 4, from 8 - 10am.

Missed work: It is not expected that you will miss the tests. If an emergency situation or university-sanctioned event forces your absence on test day and if you have discussed the situation in advance with the instructor your final exam grade will be used to replace your test grade. I am not responsible enough to handle late work (getting it on the same pile as other papers from the same assignment, grading it, recording the grade, etc.).

Student Academic Conduct: It is your responsibility to learn the material in this course for your own benefit. You should not let this discourage you from working together on your homework but in the end what you turn in should reflect your understanding, not just be copied from someone else. *During the midterm exams and the final exam, a code of honor will apply under which students are to work alone and neither give help to others nor receive help from any sources.* Students are also expected to help enforce this code. Students are encouraged to obtain a copy of *A Student Guide to Conduct and Discipline at UT Tyler*, available in the Office of Student Affairs.

University Policies: For University policies concerning Students' Rights and Responsibilities, Grade Replacement/Forgiveness, State-Mandated Corse Drop Policy, Disability Services, Student Absence due to Religios Observance, Student Absence for University-Sponsored Events and Activities, and the Social Security and FERPA Statement please see: *http://www.uttyler.edu/academicaffairs/syllabuspolicies.pdf*.

Artificial Intelligence: UT Tyler is committed to exploring and using artificial intelligence (AI) tools as appropriate for the discipline and task undertaken. We encourage discussing AI tools' ethical, societal, philosophical, and disciplinary implications. All uses of AI should be acknowledged as this aligns with our commitment to honor and integrity, as noted in UT Tyler's Honor Code. Faculty and students must not use protected information, data, or copyrighted materials when using any AI tool. Additionally, users should be aware that AI tools rely on predictive models to generate content that may appear correct but is sometimes shown to be incomplete, inaccurate, taken without attribution from other sources, and/or biased. Consequently, an AI tool should not be considered a substitute for traditional approaches to research. You are ultimately responsible for the quality and content of the information you submit. Misusing AI tools that violate the guidelines specified for this course (see below) is considered a breach of academic integrity. The student will be subject to disciplinary actions as outlined in UT Tyler's Academic Integrity Policy.

For this course, you may not use AI tools to produce anything turned in for a grade.

Course Outline:

1. Discrete Probability

   (a) Sample spaces

   (b) Probability functions

   (c) Random variables

   (d) Distribution functions and density/mass functions

2. Continuous Probability

   (a) Sample spaces, probability functions, random variables in a continuous setting.

   (b) Distribution and density functions

3. Combinatorics

   (a) Factorials,

   (b) permutations,

   (c) combinations

4. Conditional probability

   (a) Conditional probability, joint and marginal densities

   (b) Bayes' Theorem

   (c) Independence

5. All your favorite densities

   (a) Discrete and continuous uniform densities

   (b) Coin Flipping: Bernioulli, Binomial, Geometric, Negative Binomial

   (c) Waiting: Poisson, Exponential, Gamma

   (d) Normality and sampling: Normal, Student's T, χ^2, F

6. Expectation

   (a) Expected Value

   (b) Variance

   (c) Moment Generating functions

   (d) Inequalities

7. Sums of random variables

(a) Distributions of sums and means

(b) Moment generating functions of sums

(c) Law of large numbers

(d) Central limit theorem