# **MATH 3180.001 (Fall 2025): Probability for Engineers, Syllabus**

## Instructor Contact

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**Office Location:** GAB 433, NTDP E245B

**Course Meets:** NTDP B142, Tuesday and Thursday: 10am-11:20am

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**Office Hours:**

* Tuesday and Thursday: 11:30am - noon (NTDP E245B),
* Wednesday: 2-3pm (GAB 433)

If you would like to schedule a Zoom appointment, please submit your request at least 24 hours in
advance by E-mail.

## How to Communicate with Your Instructor

1. If you have a question about a **specific homework problem**, please come to my office hours or make an appointment to meet with me in class.
2. If you have a general question about the course material, please send me a Canvas message or an email with “**MATH 3180.001**” in the subject line. *To protect your privacy, I will only reply to emails sent from your UNT account.*

I will check my messages every day (**except weekends and holidays**) and will make every effort to respond within 24 hours.

## Course Description

## (3 credit hours)This course introduces classical probability tools and their applications in engineering. Topics include counting techniques, the multiplication and addition rules, Bayes' theorem, conditional probability, and independence. Both discrete and continuous random variables are covered, along with their probability distributions, including single and multiple variables. The course also covers Gaussian random vectors.

## Course StructureThis is a 15-week, face-to-face course designed for engineering majors. It serves as a fundamental, calculus-based introduction to probability. Students are expected to attend all lectures, participate in in-class quizzes, read assigned textbook sections, and complete corresponding homework. The course includes three midterm exams and a comprehensive final exam.

## Course Prerequisites

MATH 2730 (Multivariable Calculus) and MATH 2700 (Linear Algebra). Students should have a solid understanding of differential and integral calculus for both single and multivariable functions, including techniques such as integration by parts and double integrals. A working knowledge of basic matrix operations is also required.

## Course Objectives

By the end of this course, students will be able to:

* **Apply fundamental counting techniques** (e.g., permutations and combinations) to solve engineering-related probability problems.
* **Use the addition and multiplication rules** to compute probabilities in a variety of engineering scenarios.
* **Evaluate conditional probabilities** and apply **Bayes' Theorem** to update probabilities based on new evidence.
* **Distinguish between independent and dependent events** and analyze their implications in system reliability and risk assessment.
* **Model real-world phenomena using discrete and continuous random variables**, including deriving and interpreting their probability distributions.
* **Calculate expectations, variances, and higher-order moments** for both discrete and continuous distributions relevant to engineering problems.
* **Work with joint, marginal, and conditional distributions** of multiple random variables, and compute associated statistics.
* **Analyze and apply properties of Gaussian (normal) distributions**, including **Gaussian random vectors**, in the context of noise, signal processing, and other engineering applications.
* **Use probabilistic reasoning and modeling** to support engineering decision-making under uncertainty.

How to Succeed in this Face-to-Face Course

The best way to ensure you pass this course is to work consistently throughout the semester. In mathematics courses topics always build one upon the other making it very difficult to catch up later if you fall behind. To master the course material, you must exert consistent effort throughout the semester:

* **Read the relevant textbook section before each lecture.** This will help you identify what topics you need to focus on and what questions to ask during class.
* **Begin each homework assignment as soon as possible after the corresponding lecture.** Starting early reinforces your understanding while the material is still fresh.
* **When preparing for exams, make a genuine effort to solve all review problems on your own before watching the video solutions.** This strengthens your problem.

UNT strives to offer you a high-quality education and a supportive environment, so you learn and grow. As a faculty member, I am committed to helping you be successful as a student. To learn more about campus resources and information on how you can be successful at UNT, go to [unt.edu/success](https://www.unt.edu/success/) and explore [unt.edu/wellness](https://wellness.unt.edu/). To get all your enrollment and student financial-related questions answered, go to [scrappysays.unt.edu](http://scrappysays.unt.edu/).

There are many academic resources available to help you succeed in this course:

* [Navigate’s Study Buddy](https://navigate.unt.edu) (https://navigate.unt.edu)
* [Math Lab](https://math.unt.edu/mathlab) (https://math.unt.edu/mathlab)
* [UNT Learning Center](https://learningcenter.unt.edu/) (https://learningcenter.unt.edu/)
	+ [Tutoring](https://learningcenter.unt.edu/tutoring) (<https://learningcenter.unt.edu/tutoring>)

ADA Accommodation Statement

The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking reasonable accommodation must first register with the [Office of Disability Access](https://studentaffairs.unt.edu/office-disability-access/) (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with a reasonable accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request reasonable accommodation at any time; however, ODA notices of reasonable accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of reasonable accommodation for every semester and must meet with each faculty member prior to implementation in each class. Students are strongly encouraged to deliver letters of reasonable accommodation during faculty office hours or by appointment. Faculty members have the authority to ask students to discuss such letters during their designated office hours to protect the privacy of the student. For additional information, refer to the [Office of Disability Access](https://studentaffairs.unt.edu/office-disability-access) website (https://studentaffairs.unt.edu/office-disability-access). You may also contact ODA by phone at (940) 565-4323.

Creating an Inclusive Learning Environment

Every student in this class should have the right to learn and engage within an environment of respect and courtesy from others. We will discuss our classroom’s habits of engagement and I also encourage you to review UNT’s student code of conduct so that we can all start with the same baseline civility understanding ([Code of Student Conduct](https://policy.unt.edu/policy/07-012)) (<https://policy.unt.edu/policy/07-012>).

Required Course Materials

This course has digital components. To fully participate in this class, students will need internet access to reference content on the [Canvas Learning Management System](https://clear.unt.edu/supported-technologies/canvas/requirements) (https://clear.unt.edu/supported-technologies/canvas/requirements).

Students will be expected to bring to class (including exams) a graphing calculator with statistical functions.

## Required Texts

Yates and Goodman, “Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers”, 3rd Ed., Wiley.

## Course Topics:

The following chapters and sections of the textbook will be covered according to the projected schedule below. Dates may change as events warrant.

Chapter 1: Experiments, Models and Probability

* 1.1: Set Theory
* 1.2: Applying Set Theory to Probability
* 1.3: Probability Axioms
* 1.4: Conditional Probability
* 1.5: Partitions and the Law of Total Probability
* 1.6: Independence

Chapter 2: Sequential Experiments

* 2.1: Tree Diagrams
* 2.2: Counting Methods
* 2.3: Independent Trials
* 2.4: Reliability Analysis

Chapter 3: Discrete Random Variables

* 3.1: Definitions
* 3.2: Probability Mass Function
* 3.3: Families of Discrete Random Variables
* 3.4: Cumulative Distribution Function
* 3.5: Averages and Expected Value
* 3.6: Functions of a Random Variable
* 3.7: Expected Value of a Derived Random Variable
* 3.8: Variance and Standard Deviation

Chapter 4: Continuous Random Variables

* 4.1: Continuous Sample Space
* 4.2: The Cumulative Distribution Function
* 4.3: Probability Density Function
* 4.4: Expected Values
* 4.5: Families of Continuous Random Variables
* 4.6: Gaussian Random Variables
* 4.7: Delta Functions, Mixed Random Variables

Chapter 5: Multiple Random Variables

* 5.1: Joint Cumulative Distribution Function
* 5.2: Joint Probability Mass Function
* 5.3: Marginal PMF
* 5.4: Joint Probability Density Function
* 5.5: Marginal PDF
* 5.6: Independent Random Variables
* 5.7: Expected Value of a Function of Two Random Variables
* 5.8: Covariance, Correlation, and Independence
* 5.9: Bivariate Gaussian Random Variables
* 5.10: Multivariate Probability Models

Chapter 8: Random Vectors

* 8.1: Vector Notation
* 8.2: Independent Random Variables and Random Vectors
* 8.3: Functions of Random Vectors
* 8.4: Expected Value Vector and Correlation Matrix
* 8.5: Gaussian Random Vectors

## Tentative Face-to-Face Course Schedule

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| --- | --- | --- | --- |
| **Date** | **Lecture/Assignment** | **Sections** | **Topic** |
| **Week 1** |
| 8/19 | Lecture 1 | 1.1, 1.2, 1.3 | Set Theory, Probability Axioms |
| 8/21 | Lecture 2 | 1.4, 1.5  | Conditional Probability, Multiplication Rule,Law of Total Probability, Bayes’ Theorem |
|  | **Homework 1** |  |  |
| **Week 2** |
| 8/26 | Lecture 3 | 1.6, 2.1  | Independence and Addition Rule, Tree Diagrams  |
| 8/28 | Lecture 4 | 2.2  | Counting Methods |
|  | **Homework 2** |  |  |
| **Week 3** |
| **9/1/2025** | **Labors Day (No class)** |  |  |
| 9/2 | Lecture 5 | 2.3, 2.4 | Independent Trials, Reliability Analysis  |
| 9/6 | Lecture 6 | 3.1, 3.2, 3.4  | Discrete Random Variable, Probability Mass Function (PMF), Cumulative Distribution Function (CDF) |
|  | **Homework 3** |  |  |
| **Week 4** |
| 9/9 | Lecture 7  | 3.3, 3.5 | Examples of Discrete Random distributions, Average and Expected value  |
| 9/11 | Lecture 8 | 3.6, 3 7, 3.8 | Expected value, Variance, Standard Deviation of a derived random variable |
|  | **Homework 4** |  |  |
| **Week 5** |
| 9/16 | Review for Exam 1 |  |  |
| **9/18** | **Exam 1** | **Chapters 1, 2 and 3** | **(Lecture 1–8)** |
| **Week 6** |
| 9/23 | Lecture 9 | 4.1, 4.2, 4.3, 4.4  | Continuous Random Variable, Probability Density Function (PDF) and CDF, Expected Value |
| 9/25 | Lecture 10 | 4.5, 4.6  | Examples of Continuous Random distributions, Normal (Gaussian) distribution  |
|  | **Homework 5** |  |  |
| **Week 7** |
| 9/30 | Lecture 11 | 4.7  | Delta Functions, Mixed Random Variables |
| 10/2 | Lecture 12 | 5.1, 5.2, 5.3  | Joint CDF, Joint PMF and Marginal PMF |
|  | **Homework 6** |  |  |
| **Week 8** |
| 10/7 | Lecture 13 | 5.4, 5.5 | Joint PDF, Marginal PDF |
| 10/9 | Lecture 14 | 5.6, 5.7 |  Independent random variable, Expected Value of a function of Two Random Variables |
|  | **Homework 7** |  |  |
| **Week 9** |
| 10/14 | Review for Exam 2  |  |  |
| **10/16** | **Exam 2** | **Chapter 4 and 5.1-5.6** | **(Lecture 9 – 14)**  |
| **Week 10** |
| 10/21 | Lecture 15 | 5.8 | Covariance, Correlation, and independence |
| 10/23 | Lecture 16 | 5.9 |  Bivariate Gaussian Random Variables  |
|  | **Homework 8** |  |  |
| **Week 11** |
| 10/28 | Lecture 17 | 5.10, 8.1 | Multivariate Probability Models, Vector Notation |
| 10/30 | Lecture 18 | 8.2  | Independent Random Variables and Random Vectors |
|  | **Homework 9** |  |  |
| **Week 12** |
| 11/4 | Lecture 19 | 8.3 | Functions of Random Vectors |
| 11/6 | Lecture 20  | 8.4 | Expected Value Vector and Correlation Matrix |
|  | **Homework 10** |  |  |
| **Week 13** |
| 11/11 | Lecture 21 | 8.5 | Gaussian Random Vectors  |
| 11/13 | Lecture 22 | 8.5 | Gaussian Random Vectors |
|  | **Homework 11** |  |  |
| **Week 14** |
| 11/18 | Review for Exam 3 |  |  |
| **11/20** | **Exam 3** | Section 5.7-5.10 and Chapter 8 | **(Lecture 14 – 22)**  |
| **11/24/2025-11/30/2025: Thanksgiving Break (No class)** |
| **Week 15 (Pre Final week)** |
|  | Review for Final  |  |  |
| **Final Week (12/6-12/11)** |
| **12/11 (Thursday)**  | **Comprehensive Final exam** |  | **8:00am-10:00am**  |

## Emergency Notification & Procedures

UNT uses a system called [Eagle Alert](https://www.unt.edu/eaglealert.html) to quickly notify students with critical information in the event of an emergency (i.e., severe weather, campus closing, and health and public safety emergencies like chemical spills, fires, or violence). In the event of a university closure, please refer to the UNT Learning Management System (LMS) for contingency plans for covering course materials.

Assessing Your Work

|  |  |
| --- | --- |
| Homework | 20% |
| Quiz | 15% |
| Three regular exams and Final exam | 65% |
| **Total**  | **100%** |

Grading

A = 90–100 % B = 80–89.9% C = 70–79.9% D = 60–69.9% F = below 60%

Grades are based on mastery of the content. As a rule, I do not grade on a “curve” because that is a comparison of your outcomes to others. I do, however, encourage you to find opportunities to learn with and through others. Please come to office hours or take advantage of the academic resources listed above if you find yourself struggling.

If you need to pass this course because it is your last semester, your financial aid depends on it, your scholarship depends on it, or your parent/guardian has threatened you in some manners then do yourself a favor and start studying right away. **I will not entertain any pleas for extra credit or offers to do additional work at the end of the semester.**

Use of Generative AI Tools

Generative AI tools (e.g., ChatGPT, Microsoft Copilot) are *not* permitted on exams. When working on homework, I encourage you to take advantage of the many available resources: my office hours, email, the Math Lab, and other approved support options. These are all designed to help you learn and understand the material more effectively.

While AI might seem helpful, it is often unreliable for learning math and statistics and can produce incorrect or misleading results. More importantly, one of the key goals of this course is to strengthen your critical thinking and problem-solving abilities—skills.

Academic Integrity Standards and Consequences

According to UNT Policy 06.003, [Student Academic Integrity](https://policy.unt.edu/policy/06-003) (https://policy.unt.edu/policy/06-003), academic dishonesty occurs when students engage in behaviors including, but not limited to cheating, fabrication, facilitating academic dishonesty, forgery, plagiarism and sabotage. A finding of academic dishonesty may result in a range of academic penalties or sanctions ranging from admonition to expulsion from the University.

Attendance and Participation

Students are expected to attend class regularly and engage with the material. Research has shown that students who attend class are more likely to be successful. If you miss class, you will be responsible for obtaining a copy of the notes and any other information discussed by a classmate. You should attend every class unless you have a university excused absence such as active military service, a religious holy day, or an official university function as stated in the [Student Attendance and Authorized Absences Policy (PDF)](https://policy.unt.edu/policy/06-039) (<https://policy.unt.edu/policy/06-039>). If you cannot attend a class due to an emergency, please let me know. Your safety and well-being are important to me. You may also provide documentation verifying the reason for your absence to the [Dean of Students](https://deanofstudents.unt.edu/) (<https://studentaffairs.unt.edu/dean-of-students>).

Examination Policy

There will be 3 midterm exams and a comprehensive final exam. After the exam is graded, you have 48 hours to appeal your grade. I will not listen to any appeal after this 48-hour period. You may ask me to go over exam problems with you. However, all decisions on partial credit are final and not open for discussion.

**Your lowest exam score will drop.** If you are happy with your scores on the 3 midterms, then you may choose to omit the final exam.

**Make-up Policy:** Make up exams will NOT be given for any reason after the fact. I drop the lowest exam score to cover emergencies which may arise unexpectedly. An exam may be taken prior to the scheduled date if you have a conflict with another obligation and can provide documentation. I require notification a week in advance for this accommodation.

**Academic Dishonesty:** Cheating will not be tolerated. Any student caught cheating will receive a “0” on the exam and a report will be filed with the Office of Academic Integrity.

I reserve the right to test you on problems that are generalizations of material covered in the class and/or in the text. In short, the problems may not look exactly like the ones in the book. Everything that is covered in the course content is fair game for exam material. You will be responsible for everything unless I advise you to the contrary.

Quiz Policies

No make-up quizzes will be given for any reason. In the event of a schedule conflict with a university function, dental/physician’s appointment, wedding, formal, etc., you must take the quiz early. When computing grades, I will **drop the TWO lowest quiz grades** before computing the quiz average. I have this policy in case you get sick, a family emergency arises etc., during the semester.

Homework Policies

When computing grades, I will **drop ONE lowest homework grade** before computing the homework average. Therefore, in principle, you could get a 100% homework score and not turn in an assignment during the semester. I have this policy in case you get sick, a family emergency arises, etc., during the semester. You will still be responsible for the material in such assignments during the examinations. **Requests for manual extensions will NOT be granted.**