

# MATH 5382: Advanced Probability I

**Time & Place:** MWF 12:00-12:50 in MATH 109

**Instructor:** Hongwei Mei

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**Office:** MA217

**Office Hours:** MWF 10:00-11:00, 13:00-14:00 or by Appointment

**Textbook:** *Probability and Measure*, 3rd Edition, by Patrick Billingsley.

**Course Goals:** This is a one-semester course covering essential topics in probability underpinning theoretical statistics. One of the main goals of this course is to provide you with adequate theoretical background and mathematical tools to access the literature in mathematical statistics. The course is comprised of three modules: (1) basic measure theoretic concepts in probability; (2) modes of stochastic convergence and their applications in statistics and (3) concentration of measure and concentration inequalities.

**Homework:** Homework will be assigned after each chapter is finished. The homework will be posted on

<https://www.math.ttu.edu/hongwei/MATH5382.html>

**Final Exam:** Final Exam consists of two parts:

1. In-Person part.
2. Take-home part: 4-5 problems.

**Grading Policy:**

Attendance and Class Participation: 50 points.

Homework: 300 points.

In-Person FinalExam: 150 points.

Take-Home FinalExam: 500 points.

**Grading Scale:**

A: 900 and more.

B: 800-899.

C: 700-799.

D: 699 and less

F: Missing the Final Exams.

## Course Outline and Tentative Schedule

<b>Chapter I: Probability</b>	<b>7</b>
$\sigma$ -Algebra and Probability Measures	2
Outer measure and Lebesgue measure	1
Denumerable Probabilities	1
Simple Random Variables, Expected Value and some Formulas	2
Convergence of Random Variables and The Law of Large Numbers	1
<b>Chapter II: Measures</b>	<b>5</b>
General Measures	1
Outer Measure	1
Measures in $\mathbb{R}^n$	1
Measurable Functions and Mappings	1
Distribution Functions, Weak Convergence	1
<b>Chapter III: Integration</b>	<b>7</b>
The Integral	2
Properties of The Integral	2
The Integral w.r.t. Lebesgue Measure	2
Product Measure and Fubini's Theorem	1
<b>Chapter IV: Random Variables and Expected Values</b>	<b>4</b>
Random Variables and Vectors	2
Expected Values	1
Sums of Independent Random Variables	1
<b>Chapter V: Convergence in Distribution</b>	<b>7</b>
Weak Convergence	2
Characteristic Functions	1
The Central Limit Theorem	2
Limit Theorems in $\mathbb{R}^n$	2
<b>Chapter VI: Conditional Probability</b>	<b>5</b>
The Randon-Nikodym Theorem	2
Conditional Probability	1
Conditional Expectation	2