

Math 3215: Introduction to Probability and Statistics

Fall 2026

Schedule & location: Tue/Thu 12:30–1:45pm, College of Computing 17

Instructor: **Dmitrii M. Ostrovskii** – ostrov@gatech.edu – Skiles 263

Office hours: Tue 5:00–6:00pm & Wed 2:00–3:00pm, Skiles 263 + on request

Canvas: <https://gatech.instructure.com/courses/541208>

Disclaimer. This is meant as the first class in probability and statistics, introductory but rigorous. Our first goal is to acquire a solid foundation in probability theory, and this is what the first stage of the class is devoted to. In the second stage, we will explore statistical inference, with main emphasis on applied aspects, but with several brief forages into theory.

Prerequisites. Multivariate calculus: Taylor expansion in $\mathbb{R}^n$ (Math 2550 or 2551 or 2561); Linear algebra: eigenvalue decomposition for symmetric matrices (Math 1553 or 1554 or 1564).

Topics outline. The list below is approximate; in particular, the *relative order* might change.

Probability basics:

- Discrete probability space (experiment).
- Venn diagram, inclusion-exclusion formula.
- Conditional probability and independence of events. Bayes theorem.

Univariate distributions:

- Discrete and continuous distributions. Related functions: c.d.f., p.m.f., p.d.f.
- Expectation and variance. Moment-generating function and Chernoff bound.
- Important families: Gaussian, exponential, Poisson, binomial.
- Change of variable. Location-scale families.

Multivariate distributions:

- Expectation and covariance matrix for random vectors.
- Marginals, conditional expectation.
- Multivariate Gaussian family and its geometry.
- Law of large numbers. Central limit theorem (with a proof).

Estimation:

- Maximum likelihood estimation (MLE), method of moments.
- Estimation quality. Unbiasedness, sufficiency, consistency.
- Asymptotic efficiency of MLE. Cramèr-Rao bound.
- Confidence intervals.

Hypotheses testing:

- Introduction to formal hypothesis testing. Type I and II errors, power function.
- Likelihood ratio test (LRT). Neyman-Pearson theorem. Consistency of the NP test.
- Connection of confidence intervals with hypotheses testing.
- One- and two-sided testing for the mean of $\mathcal{N}(\mu, \sigma^2)$.
- Asymptotic efficiency of LRT.

Literature. The lectures will not follow a single textbook, and will occasionally go deeper.

- G. Grimmett, D Stirzaker. *Probability and Random Processes, 3rd or later ed.*
This is our main textbook for the first part (probability). We will cover Chapters 1 to 5.
- R. V. Hogg, E. A. Tanis, D. L. Zimmerman. *Probability and Statistical Inference, 9th ed.*
This is our main textbook for the second part (statistics). We will cover Chapters 6 to 8.
- G. Casella, R. L. Berger. *Statistical Inference, 2nd ed.*
Supplementary book for the second part of the class; will be used occasionally.

These books will be useful but not absolutely necessary. Most likely, you will be fine relying on class notes and an occasional visit to the library. Use office hours – students find them useful.

Contact. The best way to contact me is by email (put 3215 in the subject field) or in person (Skiles 263) in the office hours. Meetings outside of the office hours can be arranged via email.

Modus operandi. We will have a homework assignment every 2–3 weeks (5–6 in total) and a quiz every 3 weeks (4–5 in total), two midterms (early Oct and mid-Nov) and a final exam.

- **Homework:** homework assignments include mandatory problems and comprehensive ones (marked with an asterisk). Grade breakdown will be chosen to allow for an *A* without solving comprehensive problems – these are for the students who like to be challenged :)
- **Quizzes:** they will have a few questions (taking about 10–15 minutes in total), mainly to make sure you are keeping up with the material. I will drop your 3 lowest quiz grades, but there will be no makeups. This should be an easy way to improve your grade, and won't require any studying beyond attending the previous classes (and staying awake).
- **Midterms:** We will have have two midterms (in-class), on **October 1** and **November 24**. Electronic devices will not be allowed.
- **Final exam:** As per the official GT schedule: **Thursday, Dec 17, 11:20 a.m. –2:10 p.m.** In our usual classroom (College of Computing 17). Electronic devices will not be allowed.

Grading. 20%/20%/30%/30% for homeworks/quizzes/midterms/final, might be curved later.