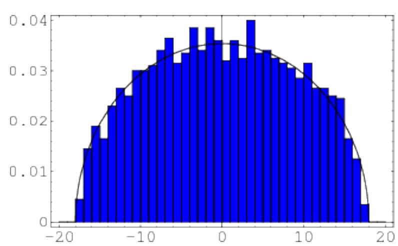
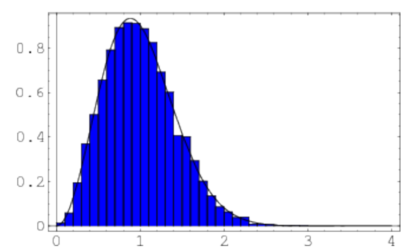
# Course announcement: Math 689
# Random Matrix Theory

Spring 2018, TR 2:20–3:35 p.m., location TBA.

**Instructors:** Michael Anshelevich, Blocker 533D, `manshel@math.tamu.edu`;
and Gregory Berkolaiko, Blocker 625C, `berko@math.tamu.edu`.

**Prerequisites:** basic familiarity with measure theory (usually part of a real analysis or measure-based probability course), probability theory and multivariate calculus. Participation in the 2017 class or some knowledge of classical Random Matrix ensembles will be helpful, but the overlap between the courses will be small, and necessary results will be reviewed.





**Learning Objectives:** Over the last 50 years, the study of random matrices has grown into an independent field. Its techniques come from probability, functional analysis, and combinatorics; and it draws problems from and provides applications to a long list of fields, including statistics, physics, integrable systems, wireless communication etc. In the spring 2017 class, we covered the following topics: proof of Wigner's theorem, at different levels of generality, by combinatorial, Stieltjes transform, mean field approximation, and tridiagonalization techniques; numerical simulation of Gaussian and circular ensembles; Dyson's threefold way; eigenvalue densities for Gaussian and circular ensembles; Weingarten calculus. In the spring 2018 class we will discuss free probability techniques in random matrix theory; correlation functions for classical ensembles; beta-ensembles; survey of universality results; further study of Weingarten calculus. Some of the results will be classical, while others will bring us to the frontier of research. Applications to physics and engineering will be pointed out. No background in free probability is expected, and only parts of the theory directly relevant to random matrix applications will be introduced.

The course should be of interest to mathematics students from the Mathematical Physics, Probability, Functional Analysis and Free Probability, and Combinatorics groups. In addition, physics, statistics, and engineering are also welcome to register for the course.

**Textbook:** The instructors will follow several chapters from the first text below, supplemented with more recent results from research surveys and articles.

- (freely available online) FREE PROBABILITY AND RANDOM MATRICES, by James Mingo and Roland Speicher, Springer, ISBN 978-1-4939-6941-8.
- RANDOM MATRICES, by Madan Lal Mehta, Academic Press.
- (freely available online) TOPICS IN RANDOM MATRIX THEORY, by Terrence Tao, AMS.
- ORTHOGONAL POLYNOMIALS AND RANDOM MATRICES: A RIEMANN-HILBERT APPROACH, by Percy Deift, AMS.

**Exams:** None.

**Grading:** The grade will be based on 4 homework assignments. A total score of 90% or more guarantees an A, a score of 80% or more a B, 70% or more a C, 60% or more a D.