

## Syllabus and Information for Math 235A Topics in Combinatorics

Spring 2019

Instructor: Jacob Fox  
[jacobfox@stanford.edu](mailto:jacobfox@stanford.edu),  
Office: Building 380, Room 383-K

Time: Monday, Wednesday, Friday  
11:30am - 12:20am

Location: Building 200, Room 200-030

Office hours: By appointment

Textbooks: The proof is lecture based. Some related materials can be found in:  
Ramsey theory by Graham, Rothschild, Spencer  
Extremal combinatorics by Jukna  
Modern Graph Theory by Bollobas

Grades: 4 Problem sets 100%

Prerequisites: Permission by instructor. Basic knowledge of combinatorics and graph theory is assumed, as well as a mathematical background commensurate with a completed mathematics undergraduate major.

Objective: To learn and appreciate the problems and methods in extremal combinatorics

Description: Math 235A is an advanced graduate class on extremal combinatorics, focusing on Ramsey theory, extremal graph theory, and regularity methods. Important results and open problems will be highlighted.

Suggestions: Class participation and discussion are highly encouraged. Please feel free to ask questions before, during, or after class.

Course page: [stanford.edu/~jacobfox/235ASpring2019.html](https://stanford.edu/~jacobfox/235ASpring2019.html)

Homework: 4 homeworks (about one every two weeks)

The homework problems form an integral part of the course; they are easily the most reliable check of your progress in assimilating the material in a manner which is sufficiently deep to allow you to solve problems which are at least one level removed from routine application of definitions and formulae. While it is quite O.K. (and even encouraged) for you to discuss the problems in general terms with your peers, it is expected that what you hand in is your own work, and not a joint project of several people; i.e. you may NOT systematically work together with others on writing up solutions to the homework problems, and such behavior would constitute a violation of the Honor Code.

Honor Code: Please be sure you are aware of the requirements of the Stanford Honor Code and your responsibilities under the code.

## **Tentative Schedule:**

Week 1, 4/1: Ramsey's theorem for graphs and hypergraphs and applications.

Week 2, 4/8: Theorems of van der Waerden, Hales-Jewett, and Szemerédi

Week 3, 4/15: No class

Week 4, 4/22: Theorems of Turán and Erdős-Stone-Simonovits, and applications

Week 5, 4/29: Bipartite Turán problems, hypergraph generalizations, algebraic constructions

Week 6, 5/6: Szemerédi's regularity lemma, counting lemmas and applications

Week 7, 5/13: Regularity applications - removal lemmas, Roth's theorem, property testing and variants

Week 8, 5/20: Regularity applications and alternative methods

Week 9, 5/27: Variants: weak regularity, hypergraph regularity, sparse regularity, and applications (no class on 5/27 for Memorial Day)

Week 10, 6/3: Sparse counting and arithmetic progressions in primes

**Students with Documented Disabilities**

Students who may need an academic accommodation based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is being made. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk (phone: 723-1066, URL: <http://oae.stanford.edu>).

**Affordability of Course Materials**

Stanford University and its instructors are committed to ensuring that all courses are financially accessible to all students. If you are an undergraduate who needs assistance with the cost of course textbooks, supplies, materials and/or fees, you are welcome to approach me directly. If you would prefer not to approach me directly, please note that you can ask the Diversity & First-Gen Office for assistance by completing their questionnaire on course textbooks & supplies: <http://tinyurl.com/jpqbam> or by contacting Joseph Brown, the Associate Director of the Diversity and First-Gen Office ([jlbrown@stanford.edu](mailto:jlbrown@stanford.edu); Old Union Room 207). Dr. Brown is available to connect you with resources and support while ensuring your privacy.