

1-2014

## M 584.01: Topics - Extremal Combinatorics

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### Recommended Citation

Palmer, Cory T., "M 584.01: Topics - Extremal Combinatorics" (2014). *Syllabi*. 1101.  
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# Extremal Combinatorics

Spring 2014

M 584: Topics in C&O: Extremal Combinatorics

MWF 2:10–3:00 p.m. in M 108

Credits: 3      CRN: 32149

Instructor: Cory Palmer    [cory.palmer@umontana.edu](mailto:cory.palmer@umontana.edu)

**Description:** One of the most typical questions in extremal combinatorics is the study of the maximum or minimum possible size of an object from some family of objects (e.g. graphs, sets) subject to some given constraints. For example, what is the maximum number of edges in an  $n$ -vertex graph without triangles? Another classic: what is the maximum number subsets of an  $n$ -element set such that no subset contains another one? We will concentrate on questions of these types although extremal combinatorics also includes the important subjects of graph colorings and Ramsey theory. Extremal combinatorics is one of the most actively studied areas of combinatorics with many recent significant breakthroughs. Extremal problems often have important consequences in subjects such as computer science and number theory.

**Topics:** Forbidden subgraphs (e.g. Turán's theorem, Erdős-Stone-Simonovits theorems, forbidden bipartite subgraphs, forbidden subhypergraphs); Szemerédi's regularity lemma (e.g. triangle-removal lemma, Roth's theorem); Set systems (e.g. size of Sperner and intersecting systems, multiple proofs of Erdős-Ko-Rado theorem, Ahlswede-Khachatrian complete intersection theorem); additional topics (e.g. block designs, matroids)

**Textbook:** There is no set textbook for this class. I will provide electronic notes with references. Some of the forbidden subgraph material can be found in the graph theory books of Bollobás (Modern Graph Theory, Extremal Graph Theory), Bondy and Murty (Graph Theory), Diestel (Graph Theory), or West (Combinatorial Mathematics). Diestel (Graph Theory) contains an excellent section on the regularity lemma. Set systems are covered well by the books of Bollobás (Combinatorics) and Anderson (Combinatorics of Finite Sets).

**Grading:** Based on homework exercises.

**Office hours:** Friday, 3-4 p.m. in M 108

**Class website:** <http://www.math.unt.edu/palmer/584spring2014/>

**Prerequisites:** Familiarity with graph theory and general combinatorics will be assumed. Students are expected to have taken Graph Theory (M 485) or Combinatorial Mathematics (M 581).

**Accommodations:** If you are entitled to accommodations sanctioned by DSS, you should notify me soon so we can make appropriate adjustments.