Math 60610, Spring 2009

Discrete Mathematics

Instructor: David Galvin

Course Announcement

Combinatorics comes in a variety of flavours. *Enumerative combinatorics* is concerned with counting how many objects have a particular property — in how many ways can a set of size n be partitioned? In how many ways could the votes in the recent Alaskan senate race have been counted so that Begich (the eventual winner) never trailed Stevens (the loser)? *Structural combinatorics* is the study of structures defined on finite sets (if they exist) — is there a 668 by 668 matrix with all entries ± 1 whose rows are mutually orthogonal? Can a knight travel around the chessboard, visiting each square once and only once? *Extremal combinatorics* deals with finding the largest or smallest object that have a certain property — what's the largest family of subsets of a set of size n such that no subset is properly contained in any other? What's the smallest collection of non-neighbouring counties of Indiana with the property that every other county is a neighbour of at least one in the set?

This course is intended to be an introduction to the fundamental ideas and results of combinatorics, in all its flavours. Among the topics we will possibly touch on:

- **Enumeration**: counting, recurrences, generating functions, inclusion/exclusion, Pólya counting
- **Structures**: graphs, set systems, designs, tableaux, partially ordered sets
- **Extremal problems**: Turán's Theorem, Sperner's Lemma, Ramsey Theory.

Along the way we will encounter some powerful methods from other areas of mathematics, most notably probability and linear algebra. The only prerequisite for the course is a willingness to think combinatorially.

Arrangements

- **Meetings**: MWF 11.45am-12.35am, room TBA; first meeting in Hurley 258. **THIS IS A CHANGE FROM THE ORIGINALLY ANNOUNCED TIME.**
- **Text**: The main text will be *Combinatorial Mathematics*, by Douglas West. This book hasn't been published yet; I will distribute photocopies of the first few chapters at the beginning of the semester, and a week or so into the semester I will have copies of the full text to distribute, probably at a cost of about $40. Other useful books will be put on reserve at the library.
- **Course grade**: Based on weekly homeworks (30%), a mid-term exam (30%) and a final exam (40%).
- **Course website**: http://www.nd.edu/~dgalvin1/60610/.