MENTORED PROJECTS
MATH 52B
SPRING 2009

Goals: The aim of this exercise is to provide you with a valuable and fun experience in independent study, teamwork, and communication while introducing you to fellow mathematics students and faculty members who can be valuable resources.

Description: Teams of three or four class members will choose a topic and a mentor from the department of Mathematics & Statistics to help them prepare a self-contained 30 to 40-minute presentation to the class during a regularly-scheduled class meeting during the last two weeks of the semester. You may decide how to share responsibility for the presentation among the team members, but all must contribute their fair share to the preparation. The presentation should cover material beyond the basic syllabus of the course, and include at least one proof and one assigned homework problem that the presenters will collect from the class and grade, preferably within the same class period. Whenever possible, you should point out connections with topics we have studied in class. The presentation may include Mathematica demonstrations, a computer lab component, posters, visual aids, or other approved means of conveying your message. You should give references and correct attribution for ideas which are not your own, and be sure to thank your mentor. Needless to say, your presentation should be as professional as possible in conception and presentation.

Deadlines: I need to approve teams, topics and mentors by Friday, March 6. Presentations will be scheduled between April 17 and April 29. I will assist in the formation of teams, and the choice of topics and mentors as needed.

Topics: We can talk about any ideas that you have. The only restriction is that your topic should have significant mathematical content not already familiar to the team and be accessible to the class in a short presentation. You may choose to pursue a familiar concept in greater depth or explore an unfamiliar branch of mathematics. These may be taken from chapters in books, articles in journals, or other sources provided by your mentor. Here are some ideas: integer solutions to equations; points on curves, formulas for sums of the first n cubes or fourth powers, sums of two squares, Gaussian (complex) integers, approximation of real numbers by rational numbers, scheduling tournaments, magic squares, coding theory, finite geometry, graph theory, combinatorial designs, articles from the American Math Monthly or Mathematics Magazine such as “How to wager in Final Jeopardy,” approximating functions by polynomials, cryptography, fractals, chaos, analysis of algorithms, cardinality, the Cantor set, group theory, Fermat primes, Mersenne primes, the number of divisors of n, the geometry of complex numbers, the mathematics of music, cellular automata, data compression, number of lattice points in a region, Rubik’s cube or other puzzles,

Grading Criteria: There will be two components to your grade on this project: 40% of the grade will be based on presentation, and 60% will be based on content. **Presentation** will be judged on the basis of clarity, organization, timeliness, preparation, and effective communication including neatness, legibility of writing, audibility of speaking, and engagement of the audience. Giving appropriate references to sources used and credit to the team mentor are also important. **Content** will be evaluated on the quality of new mathematical ideas introduced, connections made with concepts in Math 52, accuracy and care with details, thoroughness in presenting a proof, and appropriateness of the assigned homework. **Homework** that you complete for other teams will be worth up to 5 bonus points on the final exam.

Mentors: The following mathematics faculty members have volunteered to serve as mentors, and suggested some topics. Other mentors and topics are possible, limited only by your imagination! See me if you have a topic idea and need a mentor and/or you need some teammates.

Prof. Dan Archdeacon: symmetry, the tree of all rational numbers, how to wager in Final Jeopardy
Prof. Richard Foote: symmetry in art, dance, chemistry, nature
Prof. John Voight: Pick's theorem for determining area by counting points, the worst case scenario for the Euclidean algorithm
Prof. Jeff Dinitz: stable marriage theorem, enumeration, error-correcting codes, Latin squares and magic squares, Hadamard matrices, scheduling tournaments
Prof. Tony Julianelle: Cardinality, logic, topology, voting, graph theory
Prof. Greg Warrington: Mathematics of juggling, mathematics of voting, enumerative combinatorics (counting special configurations) eg. Catalan numbers.