

Math 614 Enumerative Combinatorics Spring 2018

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Lectures MWF noon, CB 335
Office Hours: By appointment
<http://www.math.uky.edu/~readdy/614>

Text

Richard P. Stanley, *Enumerative Combinatorics. Vol. 1.* Second Edition, Cambridge Studies in Advanced Mathematics, 49, Cambridge University Press, Cambridge, 2011.

Prerequisite

Math 565 or permission of instructor.

Auditors

If you are sitting in on the course, you must register as an auditor for the course. Anyone who is not registered for the course, either for credit or as an auditor, will be asked to leave.

Material

An introduction to the basic notions and techniques in enumerative combinatorics. Topics include generating functions, principle of inclusion and exclusion, bijections, recurrence relations, partially ordered sets, the Möbius function and Möbius algebra, Lagrange inversion formula, the exponential formula and tree enumeration.

The material has applications to active areas of research including polytopal theory, hyperplane arrangements, computational commutative algebra, representation theory, symmetric functions, Coxeter groups and topology.

This is the second semester course in the Discrete Mathematics prelim sequence.

Course Outline

- I. Generating Functions.
- II. Stirling Numbers of the First and Second Kind.
- III. Permutations and Permutation Statistics.
- IV. q -analogues.
- V. The Twelffold Way.
- VI. Exponential Generating Functions.*
- VII. The Exponential Formula.*
- VIII. Tree Enumeration.*
- IX. Lagrange Inversion Formula.*
- X. Principle of Inclusion-Exclusion.
- XI. Partially Ordered Sets and Lattices.
- XII. The Fundamental Theorem of Distributive Lattices.
- XIII. The Incidence Algebra.
- XIV. The Möbius Inversion Formula.

- XV. The Möbius Function and Computational Techniques.
- XVI. The Möbius Algebra.
- XVII. Semi-modular Lattices and Hyperplane Arrangements.
- XVIII. The Zeta Polynomial.
- XIX. Rank-selection.
- XX. R -labelings.
- XXI. Eulerian Posets.
- XXII. Binomial Posets.
- XXIII. Other topics (symmetric chain decomposition, symmetric functions, ..), as time permits.

* Chapter 5 in EC II.

Homework

One problem will be posed during each lecture and is due at the start of the next lecture. No late homework will be accepted. Solutions should be written in complete sentences using correct English grammar and spelling, such as you would find in a mathematics textbook or journal article.

Students may discuss the course material with other students in the course. Students *may not*, however, discuss the homework with anyone. Internet searches for solutions are not permitted. Violations will be considered academic dishonesty. At a minimum, you will receive a zero for the assignment.

Midterm and Final Exams

The date of the midterm (in-class) will be announced two weeks before it occurs.

The final exam will be in-class on Monday, April 30, 2018 from 8:00 am – 10:00 am. The final exam is cumulative.

Grading

Your course grade will be a weighted average of the letter grades on your homework, midterm and final exam. The distribution is as follows:

- 30% Homework
- 30% Midterm
- 40% Final Exam

Students are expected to attend all of the lectures. More than two unexcused absences will result in dropping your course grade by one letter grade.

References on Reserve

R. P. Stanley, *Enumerative Combinatorics, Vol. 1*, Cambridge University Press, Cambridge, 1997.

R. P. Stanley, *Enumerative Combinatorics, Vol. 2*, Cambridge Studies in Advanced Mathematics, 62. Cambridge University Press, Cambridge, 1999.

J. H. van Lint and R. M. Wilson, *A course in combinatorics*, Second edition. Cambridge University Press, Cambridge, 2001.

Herbert S. Wilf, *Generatingfunctionology*, Second edition. Academic Press, Inc., Boston, MA, 1994.

Absences

Faculty Senate Rule 5.2.4.2 defines acceptable reasons for excused absences to be: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit “reasonable cause for nonattendance” by the professor. As required by University rules, you must present full documentation in order to request makeup work for a valid absence. Senate Rule 5.2.4.2 states that faculty have the right to request “appropriate verification” when students claim an excused absence because of illness or death in the family. Appropriate notification of absences due to University-related trips or a major religious holiday is required no later than 7 days prior to the absence.

Cheating

Don’t do it. It is an extremely serious offense. As a minimum response, I will give a zero to the offender.

Devices

No digital devices of any kind (cellphones, computers, calculators, etc) are allowed during quizzes and exams. By University policy the use of such constitutes cheating.

Laptops and/or cellphones are not allowed to be used at anytime in the classroom without the instructor’s prior consent.

Texting

Students who text during class will be asked to leave and receive a zero for that day’s homework.

Plagiarism

Plagiarism includes copying from outside sources, including internet sources. If charged, at minimum you will receive a zero. Maximum penalties include being suspended, dismissed or expelled from the University. For further information, consult the Faculty Senate rules.

Classroom Decorum

Code of Student Conduct (AR 4.10), Section V, Letter J, Instructional Setting Behavior:

“Students who engage in conduct that results in disruption of an instructional setting may be directed by the instructor to leave the class for the remainder of the instructional setting period.”

Students who violate classroom behavior standards during the lecture will be marked as an unexcused absence from that day’s attendance/work. Depending upon the severity of the disruption, the student will be asked to leave.

The instructor reserves the right to modify this syllabus at any time.