RESEARCH SUPERVISION

MARK SKANDERA

Many scientists today seek to integrate research into undergraduate education, and to increase the representation of women and minorities in the sciences. Actively supporting both of these efforts, I supervise small undergraduate research groups. I guide students through the investigation of open problems while also discussing the publication process, conferences, and electronic resources such as *MathSciNet* and *Maple*.

In the following research groups which I have supervised, students Bach, Ealba, Lee, Mathews, Palmo, Pechatnikov and Tohaneanu are female; students Cabezas, Juarez and Delgado are hispanic. Three of the listed students gave presentations at the Rose Hulman Undergraduate Mathematics Conference, four more attended similar conferences for young mathematicians, and six more attended standard mathematics conferences such as the annual Joint Meetings. Seven of the listed students coauthored mathematical papers before attending graduate school.

(1) *Dumont's statistic and descents.* (J. Allotta, E. Ealba, V. Shende, B. Young. Spring 2001.) Studied permutation statistics and bijections.
(2) *Enumeration of polynomials with real zeros.* (J. Allotta. Summer 2001.) Studied inequalities satisfied by the coefficients of polynomials which have only real zeros.
(3) *Enumeration of simplicial complexes.* (J. McClain. Fall 2001.) Studied functions characterizing the integer sequences which count faces in simplicial complexes.
(4) *Enumeration of* $(\mathbf{3}+\mathbf{1})$*-free posets* (P. Cabezas, F. Juarez, M. Ostrowski, B. Reed, T. Thorbeck. Fall 2001-Spring 2002.) Used total nonnegativity to prove that the f-vector of a $(\mathbf{3}+\mathbf{1})$-free posets is also the f-vector of a unit interval order [5].
(5) *A generalization of the Robinson-Schensted Correspondence.* (E. Hendrickson, J. McClain, R. Pistor. Spring 2002.) Studied the Robinson-Schensted Correspondence and generalizations implied by a result of Gasharov concerning $(\mathbf{3}+\mathbf{1})$-free posets.
(6) *Inequalties in products of minors of totally nonnegative matrices.* (M. Ostrowski, N. Palmo, Z. Pavlov, R. Pistor. Summer 2002.) Studied inequalities satisfied by products of minors of totally nonnegative matrices. Reformulated a characterization of these inequalities in terms of Temperley-Lieb algebras.
(7) *Polynomials with real zeros and simplicial complexes.* (K. Bach, W. Dulaney, E. Hendrickson. Summer 2002.) Studied functions characterizing the integer sequences which count faces in simplicial complexes.
(8) *Totally nonnegative polynomials.* (B. Drake, Z. Pavlov, A. Wagner. Fall 2002.) Used a poset of products of matrix minors to describe totally nonnegative polynomials.

Date: January 2, 2005.

(9) *Polynomials with real zeros and multicomplexes.* (K. Bach. Fall 2002.) Studied functions characterizing the integer sequences which count monomials in multicomplexes. Found smooth lower bound approximations for these functions.

(10) *The poset of lattice path partitions.* (B. Drake, B. Rhoades, E. Wong. Spring 2003.) Proved the validity of a combinatorial rule for comparing products of minors of totally nonnegative matrices [4].

(11) *Algebraic integers and balanced simplicial complexes.* (A. Clark, S. Gerrish, B. Polk, C. Lee. Spring 2003.) Studied Maclaurin's inequalities for conjugate algebraic integers and the relationship of these to f-polynomials of balanced simplicial complexes.

(12) *Totally nonnegative polynomials.* (B. Drake, S. Gerrish, Z. Pavlov, B. Rhoades. Summer 2003.) Found three new characterizations of the Bruhat order [1, 2], and a class of totally nonnegative f-immanants which forms a basis for the span of other known totally nonnegative polynomials [4].

(13) *Schur nonnegativity conjectures.* (J. Asher, S. Banerjee, E. Jacobson, A. Prokopiw. Fall 2003-Winter 2004.) Studied conjectures of Bergeron et. al., Fomin et. al.

(14) *Subtraction-free Laurent polynomials.* (C. Chen, A. Husain, J. Lewicke, B. Zhao. Winter-Spring 2004.) Used Maple to express totally nonnegative immanants as subtraction-free Laurent polynomials in matrix minors.

(15) *The Schur nonnegativity of Temperley-Lieb immanants.* (H. Brooks, F. Delgado, J. Wolfson. Summer 2004.) Studied jeu-de-taquin-like algorithms to express Temperley-Lieb immanants of Jacobi-Trudi matrices as sums of Schur functions.

(16) *Path tableaux and immanants.* (K. Parkhe, N. Tiruviluamala. Summer 2004.) Generalized Lindström's Lemma to interpret some irreducible character immanants.

(17) *Kahzdan-Lusztig immanants.* (B. Rhoades. Summer 2004.) Used the Kazhdan-Lusztig basis to define new immanants which are totally nonnegative and Schur nonnegative [3]. Proved the Schur nonnegativity of Temperley-Lieb immanants.

(18) *Schur nonnegative symmetric functions.* (H. Brooks, J. Lewicke, V. Pechatnikov, N. Tiruviluamala. Fall 2004, jointly supervised with R. Orellana.) Studying Kazhdan-Lusztig immanants and related symmetric functions.

(19) *Schur nonnegativity and the Kronecker product.* (S. Mathews, C. Ordonez, A. Tohaneanu. Fall 2004, jointly supervised with R. Orellana.) Studying the Schur expansion of symmetric functions defined in terms of the Kronecker product.

References

[1] B. Drake, S. Gerrish, and M. Skandera. Nonnegativity properties and the Bruhat order, 2004. In progress.

[2] B. Drake, S. Gerrish, and M. Skandera. Two new criteria for comparison in the Bruhat order. *Electron. J. Combin.*, **11** (2004). Note 6, 4 pp. (electronic).

[3] B. Rhoades and M. Skandera. Kazhdan-Lusztig immanants, 2004. In progress.

[4] B. Rhoades and M. Skandera. Temperley-Lieb immanants, 2004. Submitted.

[5] M. Skandera and B. Reed. Total nonnegativity and $(\mathbf{3}+\mathbf{1})$-free posets. *J. Combin. Theory Ser. A*, **103** (2003) pp. 237–256.