



THE UNIVERSITY OF  
CHICAGO

Department of Statistics

SCIENTIFIC AND STATISTICAL COMPUTING SEMINAR

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Optimization Over Nonnegative and Convex Polynomials

THURSDAY, May 14, 2015 at 4:30 PM  
133 Eckhart Hall, 5734 S. University Avenue

#### ABSTRACT

The problem of optimizing over nonnegative and convex polynomials appears in numerous areas of applied and computational mathematics. After a brief overview of application domains, we turn to an algorithmic study of these optimization problems. We first show that deciding convexity of polynomials of degree as low as four is strongly NP-hard. This answers a question of N.Z. Shor that appeared on a list of seven open problems in complexity theory for numerical optimization in 1992. We then present an algebraic, semidefinite programming (SDP) based sufficient condition for convexity known as sum-of-squares-convexity and present a characterization of the cases where it is equivalent to convexity. In the final part of the talk, which has a more practical motivation, we present alternatives to sum of squares algorithms that enjoy much better scalability properties. These algorithms, which we call DSOS and SDSOS optimization, work with a subset of the sum of squares cone and result in linear programs and second order cone programs.

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