Convex Polytopes, Partially Ordered Rings and Positive Polynomials

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Abstract

This talk will be a short summary of a research project that I worked on under the supervision of David Handelman at the University of Ottawa. The material is based on ideas presented in some of Handelman's own papers, circa 1988.
Given a convex polytope, K, in $\mathbb{R}^d$, we define a partially ordered ring, $R[K]$, whose elements are polynomials in d variables. Given a specific polynomial $f \in R[K]$, we want to decide if f is positive in $R[K]$ (with respect to the partial order). In general it is very difficult to decide, but in certain cases, necessary and sufficient conditions are given for f to be positive.
In this talk I will introduce the background material on partially ordered rings and convex polytopes before giving the construction of $R[K]$ and presenting some concrete examples. The rest of the talk will focus on the specific cases for which the question is already solved and the work that we did towards solving the question in general.