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An elimination problem in semidefinite programming is solved by means of tensor algebra. It concerns families of matrix cube problems whose constraints are the minimum and maximum eigenvalue function on an affine space of symmetric matrices. An LMI representation is given for the convex set of all feasible instances, and its boundary is studied from the perspective of algebraic geometry. This generalizes earlier work with Parrilo on k-ellipses. (Received June 03, 2008)