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Multidimensional Ehrhart Reciprocity

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We generalize Ehrhart's idea of counting lattice points in dilated rational polytopes. Given a rational polytope, that is, a polytope with rational vertices, we use its description as the intersection of halfspaces, which determine the facets of the polytope. Instead of just a single dilation factor, we allow different dilation factors for each of these facets. We give an elementary proof that the lattice point counts in the interior and closure of such a *vector-dilated* polytope are quasipolynomials satisfying an Ehrhart-type reciprocity law. This generalizes the classical reciprocity law for rational polytopes. As a corollary, we also generalize a reciprocity theorem of Stanley.