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Primitive Points in Polygons

A point $(a, b) \in \mathbb{Z}^2$ is called primitive if $\gcd(a, b) = 1$. Given a lattice polygon $\mathcal{P}$ in the plane, the number of primitive points inside a t-dilation of $\mathcal{P}$ as $t \to \infty$ is equal to $\frac{\text{Area}(\mathcal{P})}{\zeta(2)} t^2 + E(t)$ where $E(t) = O(t \log t)$. Our main result shows that this error term cannot be improved greatly, and that $E(t) = \Omega_{\pm}\left(t\sqrt{\log\log t}\right)$. To do this, we prove an independence result over the rational numbers for the error term of the Totient summatory function. This expands on the lower bound results of Montgomery 1987. This is joint work with Imre Bárány, Greg Martin and Sinai Robins.