A Novel Approach to Estimate the Number of Asteroids in Different Belts Using Weighted Regression

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The asteroid population is incomprehensibly large. Understanding, discovering and tracking asteroids are important to avoid catastrophic events to human civilization. Around one million asteroids have been discovered so far, but there are still many more left to be found. This project proposed a method to estimate the number of undiscovered Near Earth Asteroids (NEAs), Main Belt Asteroids (MBAs), and Trojan Asteroids(TJNs) using weighted linear regression models based on the power law of asteroid size distribution theory. The data in this project was retrieved from the NASA database. Exploratory data analysis (EDA) was first performed. Based on EDA results, a weighting function was carefully designed to consider various factors such as the observability of the asteroids with different diameter sizes and the kernel density estimation of the asteroid distribution on the diameters. Weighted linear regression models were built to calculate the powers and coefficients for different asteroid orbital classes. Statistical results of the models are summarized. The models that are used to predict the number of total NEAs greater than 1km, 140m and 10m are comparable to the results in existing literature. It was also discovered that the number of asteroids in the three belts follow a very similar power law of size distribution, which is with a power of -1.8 to -2. Through this model, the power law of asteroid size distribution was verified with current data, and the amount of undetected asteroids were calculated using mathematical models.

Awards Won:
American Mathematical Society: Third Award of $500