A FRAMEWORK FOR INFERRING TAXONOMIC CLASS OF ASTEROIDS

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Introduction: Taxonomic classification of asteroids based on their visible / near-ir spectra or multi band photometry has proven to be a useful tool to infer other properties about asteroids. Meteorite analogs have been identified for several taxonomic classes, permitting detailed inference about asteroid composition [1], [2]. Trends have been identified between taxonomy and measured asteroid density [3]. Thanks to NEOWise and Spitzer, approximately twice as many asteroids have measured albedos than the number with taxonomic classifications. (If one only considers spectroscopically determined classifications, the ratio is > 40.) We present a bayesian framework that provides probabilistic estimates of the taxonomic class of an asteroid based on its albedo. Although probabilistic estimates of taxonomic classes are not a replacement for spectroscopic or photometric determinations, they can be a useful tool for identifying objects for further study or for asteroid threat assessment models [4].

Inputs & Framework:
The framework relies upon two inputs: the expected fraction of each taxonomic class in the population and the albedo distribution of each class. Luckily, numerous authors have addressed both of these questions. For example, the taxonomic distribution by number, surface area and mass of the main belt has been estimated by [5] and a diameter limited estimate of fractional abundances of the near earth asteroid population was made by [6]. Similarly, the albedo distributions for taxonomic classes have been estimated by [7] and [8] for the combined main belt and NEA populations in different taxonomic systems and by [6] and [9] for the NEA population specifically.
The framework utilizes a Bayesian inference appropriate for categorical data. The population fractions provide the prior while the albedo distributions allow calculation of the likelihood an albedo measurement is consistent with a given taxonomic class. These inputs allows calculation of the probability an asteroid with a specified albedo belongs to any given taxonomic class.

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