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Finding the Hubble Constant and the Age of the Universe

The question of the beginning and end of our universe has been and is still of great scientific interest. Our goal for this project was to gain insight into and attempt to answer part of this question. In particular, calculating the age of the universe was our focus. In order to do so we utilized data on the redshifting of light from type 1a supernovae collected and analyzed in Cosmological Results From High-z Supernovae by Tonry et al. We used their data table of the calculated distances and receding velocities of over 200 supernovae to create our graphs and fit models.

Starting off, we imported the necessary python packages of numpy, matplotlib, and astropy. Then we uploaded the data file from Tonry et al., but the data in the table needed to be converted from their raw logarithmic scale into a linear space to more easily see and analyze using a linear fit model. After doing this, we plotted the data and utilized numpy's polyfit function to fit a linear model to the data. The slope of this line is our calculated Hubble constant.

Our calculated Hubble constant was 48.5 km/Mpc/s, and the inverse of this totalling an estimation of the age of the universe to be 20.2 Gigayears. This contrasts with what we have previously learned in class that scientists' current estimation of the Hubble constant to be about 70 km/Mpc/s and their estimation of the age of the universe to be roughly 14 Gigayears.

This discrepancy in results from the general accepted value can be attributed to many sources. The largest source of error can be traced to the inclusion of every single data point in the dataset. The further away the supernova was, the greater the measurement error. Those more distant and less accurate points were also of high leverage to the data. The inclusion of these points greatly skews our analysis away from the expected values. This led to our model not only having a much lower value for the Hubble constant, but also not crossing the origin. Our model implied a much greater age of the universe, and that the universe did not begin at a single point like the widely accepted theory of The Big Bang, but with some starting volume.

Working with the assumption that we needed to limit the data points to the more accurate and more densely populated range of 700 Megaparsecs rather than the dataset's upper limit of over 10^4 Megaparsecs, we were able to get a linear fit that had a slope of 67.5 and an age of the universe calculated to be 14.5 Gigayears. These calculations were much closer to our original estimations of a slope equalling the Hubble constant of 70 km/Mpc/s and an age of the universe equalling 14 Gigayears.

In this project we both worked on our code separately, and convened later to compare our projects. Our slide show was created around the code that used the unrestricted data set, and this written report compared both to most accurately show what we learned during this project. We did not use AI in this project.

The End