Project 1

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To characterize the Root Mean Square (RMS) deviation of line-of-sight galaxy velocities from the Hubble flow, it is necessary to bin these values based on both distance and absolute magnitude. These data are obtained from Karachentsev et al (2013). The deviation from the Hubble flow is $dV = V_{gal} - HR$, where H is the Hubble constant and R is the distance to the galaxy.

In Figure 1, I plot the values of dV for each galaxy in the catalog. It is seen that galaxies at large distances have a large negative deviation from the Hubble flow, meaning that their recessional velocity is smaller than predicted by the Hubble flow. In Figure 2, the left-hand plot shows the absolute value of the deviation, as well as the binned RMS ($\sqrt{\frac{1}{n} \sum x_i^2}$). 20 bins uniformly spaced in distance are used to obtain the trend.

On the right-hand side of Figure 1 and Figure 2, the same analysis is performed, but testing the dependence of the deviation on absolute magnitude instead. A relatively flat trend emerges from the data, indicating that there is less of a systematic dependence of the Hubble flow deviation upon magnitude.

This study calls into question the ability of the Hubble law to accurately predict line-of-sight velocities of galaxies, especially at large distances ($R > 10$ Mpc).