Galaxies Assignment

Estimating the Dynamical Mass of a Galaxy Cluster

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In this assignment, using the SDSS data information on galaxies with redshifts between 0.05 and 0.20 found within a 10-arcminute radius circle centered on the (RA, Dec) = 258.1294, 64.0926 is used.

After retrieving the data we got 139 rows, out of which few rows were the same. So the duplicates were removed. After that only 92 rows were left.

For any further analysis spectroscopic redshift was used rather than photometric for better accuracy.

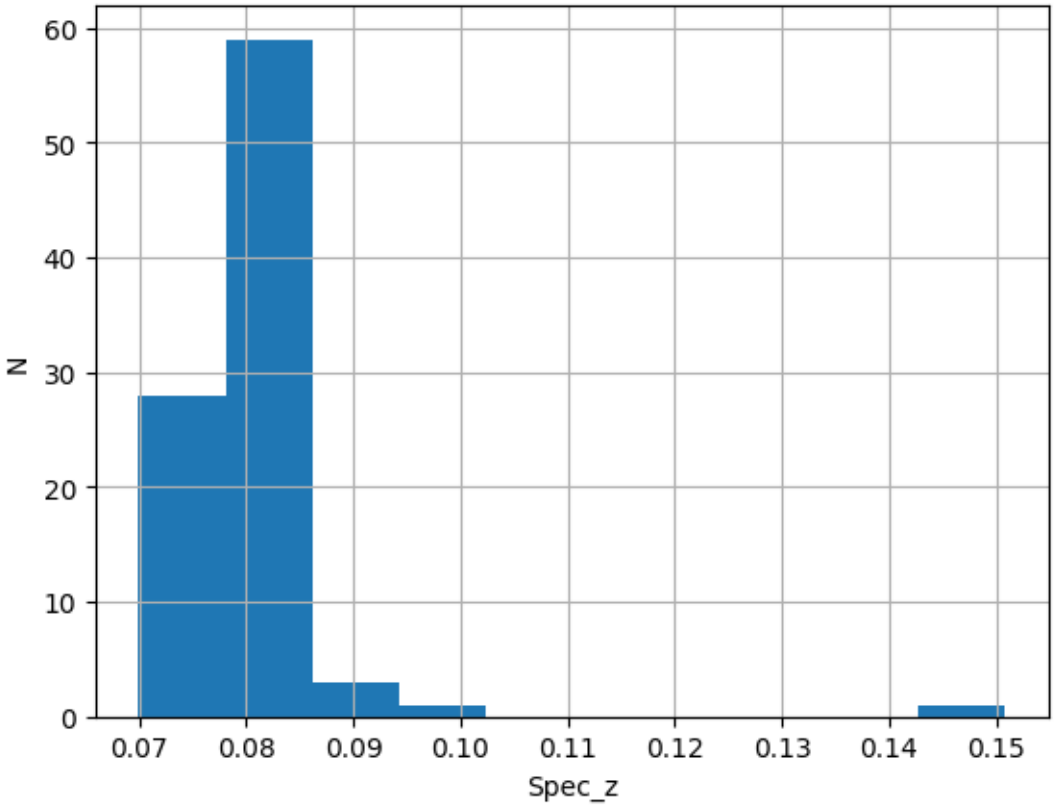

Fig 1: Histogram plot of spectroscopic redshift.

From the figure, further cleaning was done to select only the members that have nearby redshift. Hence a constraint of spec_z< 0.11 was applied (91 members remaining). After that, the average redshift and the redshift of each row are used by the formula below to calculate the peculiar velocity.

$V_i = c*((1+z_i)^2 - (1+z_{avg})^2)/ ((1+z_i)^2 + (1+z_{avg})^2)$

The plot is given below:

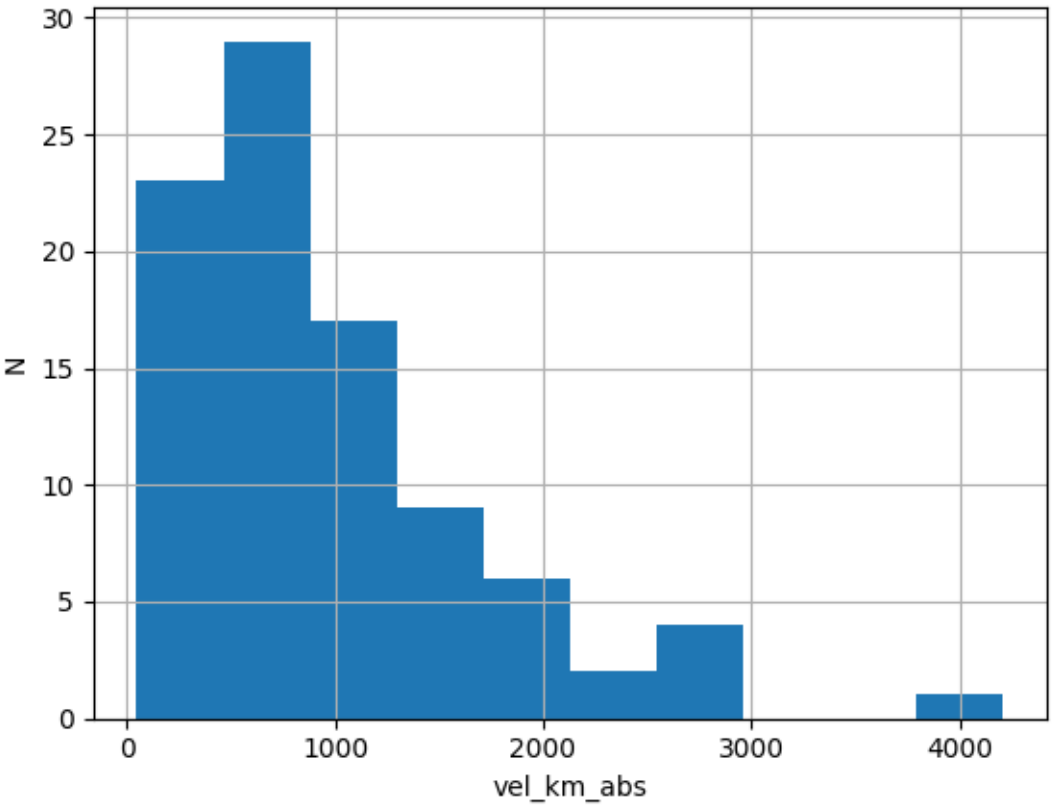

Fig 2: Histogram Plot of the absolute velocity in km/s

After that the angular separation of each galaxy from the other was calculated without double counting and then it is plotted in the figure below.

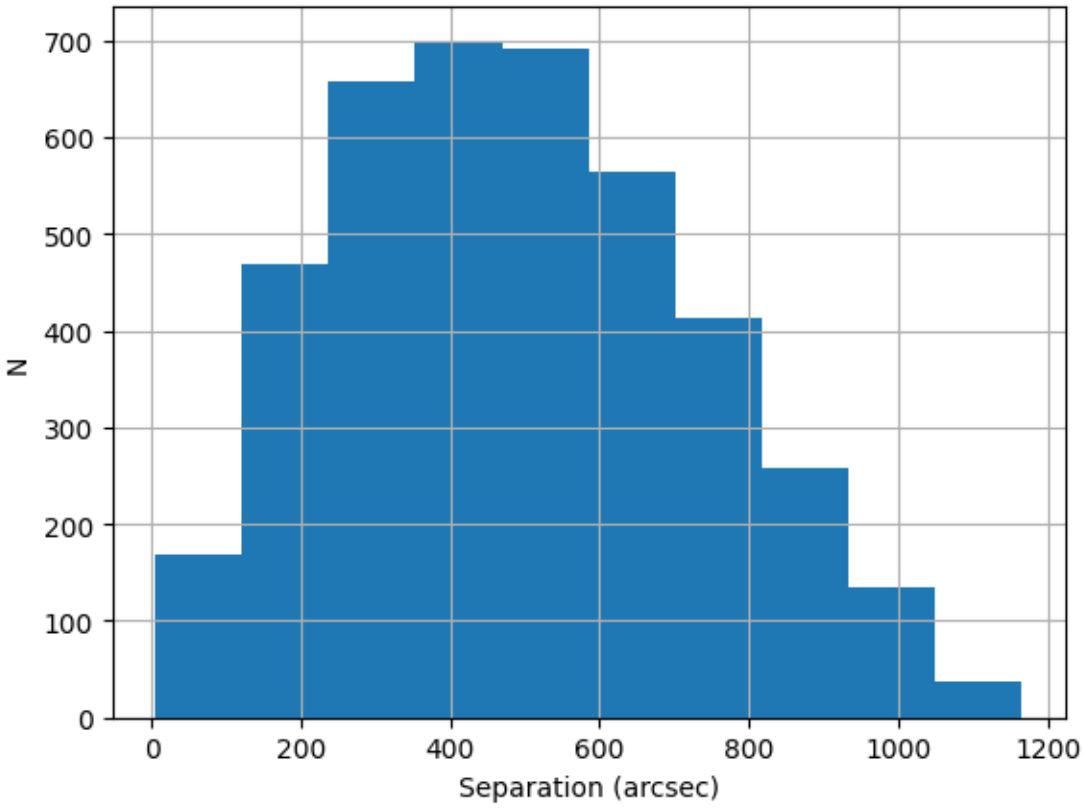

Fig 3: Histogram of the separation of each galaxy from the other.

The maximum separation, theta = 932 ‘’

Z_avg = 0.0800637

Now using Romberg and trapezoid method (for base case) is used for the integration from 0 to z_avg. Which is divided by (1+z_avg) to get the angular distance.

Angular distance = 311.43 Mpc
r = Z_avg* theta (in radian) = 1.41 Mpc

sigma_net = 2099 km/s

Using the formula for dynamical mass, M_dyn = sigma2 * r/G

We got M_dyn = 1.44* 10^{15} solar mass

If we divide the M_dyn/ no. of galaxies = 1.58* 10^{13} solar mass. This is 1-2 order of magnitude more than that of Milky Way suggesting the presence of dark matter in the intra cluster space.