

Go to the class website and download this file: [SDSS_DR7.dat](#)

It contains data from the final (Data Release 7) SDSS galaxy redshift survey. Specifically, the file contains 550,166 lines, where each line has the following info for a single galaxy:

RA – right ascension
 DEC – declination
 z – redshift
 M_g – absolute g -band magnitude
 M_r – absolute r -band magnitude

a) Familiarize yourself with the data: Make a plot of DEC (y-axis) vs. RA (x-axis) showing the positions of the galaxies on the sky. Make a plot of M_r (y-axis) vs. z (x-axis) also showing all the galaxies (invert the y-axis so that more luminous galaxies are up).

b) Make a plot of the $(g-r)$ color distribution of galaxies. Using a cut between red and blue galaxies of $(g-r)=0.75$, calculate the fraction of blue galaxies in the sample.

c) Plot the r -band luminosity function of galaxies: plot $\log(dn/dM_r)$ as a function of M_r , where dn is the number density of galaxies (in units of $h^3\text{Mpc}^{-3}$) in bins of M_r (use bins of width 0.1). To compute the density, you need to estimate a volume. This is difficult for a flux-limited sample since it has no clear redshift boundary, so just use the median redshift survey depth of $z<0.1$. You will also need the area on the sky covered by the SDSS DR7, which is $7,675.2 \text{ deg}^2$ (2.295 steradians).

d) Construct three volume-limited sub-samples of the full dataset that contain galaxies more luminous than -20, -19, and -18, respectively. List the redshift bounds, the volume, and the number of galaxies for each sample. Calculate new blue galaxy fractions for these samples.

e) Make a single plot of the luminosity functions measured from these three volume-limited samples. How do these look different from the luminosity function made using the flux-limited sample?

f) Make a new plot of the galaxy luminosity function using the full flux-limited sample, but this time applying a $1/V_{\text{max}}$ weighting. How does the weighting change the luminosity function?