Galaxy Data

Roeder (1990) gives the data set and uses it to exemplify her theoretical results. Here is a brief description.

According to the Big Bang theory, matter in the universe expanded at a tremendous rate. Gravitational forces caused the formation of galaxies. Astronomers speculate that gravitational pull led to clustering of galaxies and the research indicates the presence of super-clusters of galaxies surrounded by large voids (string-and-filament pattern). Measurements have recently become available for the distances between our galaxy and others. The distance is estimated by the red shift in the light spectrum in a fashion similar to how the Doppler effect measures the changes in speed via changes in sound. Under the expansion-universe paradigm, the furthest (from our galaxy) galaxies must be moving at greater velocities, because the distances and velocities are proportional. If, in reality, the galaxies are clumped, the velocities should have a multimodal distribution, each mode corresponding to a cluster.

In the region of *Corona Borealis* the velocities of 82 galaxies were measured. The relative measurement error is believed to be smaller than 0.5%. The data (**galaxy**) are given in the table below.

9172	9350	9483	9558	9775	10227	10406	16084	16170	18419	18552	18600
18927	19052	19070	19330	19343	19349	19440	19473	19529	19541	19547	19663
19846	19856	19863	19914	19918	19973	19989	20166	20175	20179	20196	20215
20221	20415	20629	20795	20821	20846	20875	20986	21137	21492	21701	21814
21921	21960	22185	22209	22242	22249	22314	22374	22495	22746	22747	22888
22914	23206	23241	23263	23484	23538	23542	23666	23706	23711	24129	24285
24289	24366	24717	24990	25633	26960	26995	32065	32789	34279		

References

[1] Roeder, K. (1990). Density estimation with confidence sets exemplified by superclusters and voids in the galaxies. *JASA,* **85** *617-624.*

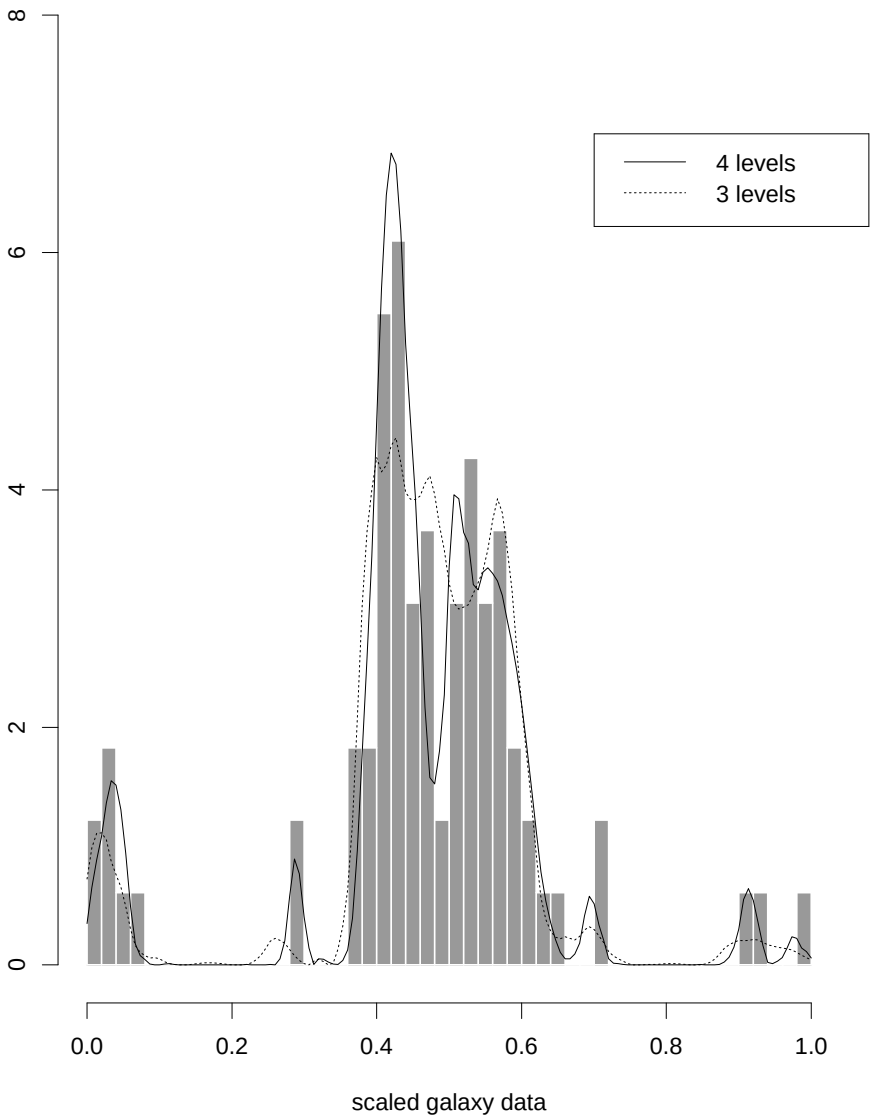

Figure 1: Galaxy Data Set and Wavelet Density Estimator for 3 and 4 detail levels. Wavelet used DAUB4.