Chapter 6

Conclusions

6.1 Pair Weight Method

We presented a new method for analyzing galaxy redshift surveys called the pair weight compression method. This method is able to assign weights to each galaxy pair within the catalog. It is also able to determine the error bars on each measured parameter. The pair weight method is completely general. That is to say it works for models that include redshift distortions and nonlinearities (not included in this work). The pair weight method is able to accomodate any selection function that has no discrete jumps in the radial direction. The flexibility allows nearly any catalog to be analyzed using nearly any model.

However, the pair weight compression method is computationally expensive. If a classical method or brute force method will obtain the same results, then it is a good bet that the other method will be less computaionally expensive. This means that for scales smaller than the smallest physical dimension in the catalog, classical methods will be the methods of choice. If a brute force analysis is possible, then on the largest scales the brute force technique will be the method of choice. There are situations, however, where neither brute force techniques nor classical methods will work.

6.2 Las Campanas Redshift Survey

The Las Campanas Redshift Survey is the largest (in terms of number of galaxies) publicly available redshift catalog. It is divided into 327 observing regions. In each observing window, redshifts could be taken for up to 112 galaxies (at the same time). This means that the observing windows were not necessarily complete to the same level. This means that the selection function varies from observing window to observing window. This causes problems for both the classical method and for brute force techniques. The smallest size scale for the catalog is then approximately 7.5 h^{-1} Mpc. This means that classical methods will only be effective for the very smallest (and probably nonlinear) regions. The fact that the selection function is different from direction to direction makes the brute force route more tricky. This means that the number of "modes" that a brute force analysis can use is limited. This limits brute force techniques to only the largest scales as was done by Matsubara et al. (2000). LCRS, however, can be analyzed using the pair weight method. In fact, LCRS has exactly the kinds of problems that would force one to use the pair weight method.

6.2.1 Results

Redshift Space Power Spectrum

In Chapter 3, we presented the redshift power spectrum for LCRS. The power spectrum measured by the pair weight method was nearly a factor of two smaller than that measured by Lin et al. (1996b). In fact, the power spectrum agreed closely with the measurement of power from the PSCz (Sutherland et al., 1999) and the AMP measured by Gaztañaga and Baugh (1998). This came as quite a surprise since is is commonly thought that IRAS selected galaxies (PSCz) should be less biased, and thus have a lower galaxy-galaxy power spectrum, than optically selected galaxies (LCRS).

Real Space Power Spectrum

The real space power spectrum (Figure 5.1) is similar in shape and amplitude to the redshift space power spectrum. This implies that over the range of $k \approx .1 - .3$ nonlinearities and redshift distortions are small. This would lead to a relatively low estimate of β. Unfortunately, the power spectrum is noisier than one would like. This is due to the fact that the information is now shared amonst more parameters and that additional error is caused by miscalculation of off-diagonal Fisher matrix elements.

Measurement of β

Using the correlated measurement of the real space power spectrum as the shape of the power spectrum, we did a least-squares analysis to find the best fit amplitude and value of β. The calculation yielded an amplitude that was essentially one. This means that the best fit amplitude is the measured amplitude, as expected. The measurement of β was $\beta \approx .55^{+.35}_{-.30}$. This result is consistent with, but slightly higher than, the calculation done by Matsubara et al. (2000). The hope was that evidence of nonlinearities would arise in this calculation. However, the measurement of the smallest scales was too contaminated by aliasing of the Fourier transform to see anything conclusive about nonlinearities.

Possible Improvements With the analysis of the LCRS being the first analysis using the pair weight method, we made a number of decisions that turned out not to be ideal.

In the analysis, we used linearly spaced bins. This is not the best way to go. Logarithmically spaced bins have two clear advantages. The first is that by using the same number of bins one could cover a much larger portion of the spectrum. The second is that the calculations of the covariances involving large separations take much longer than calculations which only involve small separations. Using logarithmicly spaced bins places a higher fraction of the bins at small scales and thereby speeds the calculations.

The second place for improvement is in the calculation of the selection function. The selection function routine for this analysis fit the selection function to incomplete gamma functions. It is clear that incomplete gamma functions are not the fastest way to go. This causes the longest calculations to take several times as long to complete.

6.3 Conclusion

The pair weight compression method is a viable method of extracting power spectra and β from galaxy catalogs. The flexibility in the pair weight method allows for even a catalog with the selection properties of LCRS to be analyzed. The value of $\beta \approx .55^{+.35}_{-.30}$ extracted from LCRS is consistent with the analysis done by Matsubara et al. (2000). Unlike the analysis of Matsubara et al. (2000) the pair weight method was able to extract a real space power spectrum.

The pair weight method is successful in the analysis of the most complicated of catalogs. It is clear, however, that when the catalog is simpler then the computational overhead of the pair weight method makes other methods more attractive. For large angle catalogs with uniform depth, classical methods and brute force methods will be the methods of choice.