ASTR 5460, Fall 2013: Homework 3

Michael S. Brotherton, Instructor

due Thursday, Oct. 3

Research Project part 1: Quasars as standard candles?

This is a team project. I can organize you, or you can organize yourselves.

Read Baldwin (1977): http://adsabs.harvard.edu/abs/1977ApJ...214..679B

Read Shen et al. (2011): http://adsabs.harvard.edu/abs/2011ApJS..194...45S

The Shen et al. catalog is accessible using interfaces like Vizier: http://vizier.u-strasbg.fr/

Figure 14 from Shen et al. includes a version of the Baldwin effect, showing the significant scatter present in modern samples. There are approaches that may reduce this scatter (e.g., also see how FWHM is correlated with EW of CIV, but not with the continuum luminosity, which will create scatter in the Baldwin effect).

Note that one thing that might give us problems is the presence of broad-absorption lines (BALs). Shen et al. provides a BAL Flag. We probably want to exlude objects that have BAL flag values of 1 and 3.

First, let's reproduce the Baldwin effect seen in Fig. 14 using Shen et al. data. Use small points and/or learn to make a contour plot. Does it look like Figure 14? Make a best fit line incorporating the errors provided.

Now, let's repeat the exercise, but using subsamples binned by redshift. Divide the total sample up into several bins (on the order of 0.4 wide), each containing similarly large numbers of quasars. Repeat fits to the Baldwin effect for each. Are they in agreement?

Next, let's see if we can reduce the scatter by creating a modified Baldwin effect using a second variable, FWHM_{CIV}. For reasons to try this, in addition to the brief discussion above, see Brotherton and Francis (1999): http://adsabs.harvard.edu/abs/1999ASPC..162..395B

In this case, fit a relationship of the form: $logL_{cont\lambda 1350} = A * logEW_{CIV} + B * logFWHM_{CIV} + C$ to each of the redshift-binned subsamples. Are they consistent with each other? Is the scatter significantly reduced from fits without the FWHM term? If so, and I believe it should, continue.

Finally, let's check for problems in the cosmological model and see how we're doing now. Plot the quantity $(logL_{cont\lambda 1350} - (A * logEW_{CIV} + B * logFWHM_{CIV} + C))$ (using the best fits for A, B, C in your lowest redshift bin) vs. redshift z. Is there a correlation, or is this plot consistent with a flat line (and a lot of scatter)? If there's a correlation, there's a problem with the cosmological model, which I think is unlikely at this stage. We'll continue after seeing the results to this point, and when we have the knowledge to recompute luminosities for different cosmological models. The next part will allow us to see if we can distinguish traditional cosmological models with deceleration from the current model that features acceleration.

I'd like to see a report to go with the figures, explaining the methods used and the results. We don't need a significant introduction or disussion section at this stage. That will come later in the semester when we repeat this project using different cosmologies.