**ASTRONOMY 698 HW3: DUE Thursday October 21, 2004**

1. You have undertaken a survey of 10 QSOs. After computing the rest equivalent width detection limits for each, you obtain the results given in Figure 1. You detected the systems given in the included table, which lists their redshifts and rest–frame equivalent widths.

   - From your data, compute $q(W_{min}, z)$ for $W_{min} = 0.3$ Å for $\Delta z = 0.25$ redshifts intervals from $z = 0$ to $z = 4$. Plot the results of $g(0.3, z)$ versus $z$.
   - From your list of detected systems compute the redshift path density, $\mathcal{N}(z)$ for the redshift ranges $z = (0, 4)$, and $(0, 1), (1, 2), (2, 3), (3, 4)$. For the latter four bins, plot $\mathcal{N}(z)$ as a bar graph (or something similar– just no connecting the points.)

2. Write down the expressions for the joint probability function for the exponential distribution

$$n(x; N_*, X_*) = \frac{N_*}{X_*} \exp\left[-\left(\frac{x}{X_*}\right)\right],$$

   Now, assume a survey with $M$ data points (the $x_i$), and perfect survey sensitivity of $g(x) = 1$ for all $x$ and $x_{min} = 0$. Assuming that the normalization of the above distribution function is $K$, with uncertainty $\sigma_K$, use the maximum likelihood method to derive the expressions to compute $X_*$ and $N_*$ and their uncertainties directly from the data. (HINT: any intgerals will have analytic expressions, so it is expected that all integrals will be symbollically integrated; you should obtain very intuitively obvious results for $X_*$ and $N_*$).