Lecture 4 problems

1. The probability of a certain medical test being positive is 90%, if a patient has disease D. 1% of the population have the disease, and the test records a false positive 5% of the time. If you receive a positive test, what is your probability of having D?

2. *Compare with Lecture 1 problem 5.* A 1-degree survey finds 20 quasars. What is the posterior probability distribution for the quasar number density?

3. *Compare with Lecture 1 problem 3.* I observe 100 galaxies, 30 of which are AGN. What is the posterior probability distribution of the AGN fraction p, assuming (a) a uniform prior, (b) that Bloggs et al. have already measured that p has a Gaussian distribution with mean 0.35 and standard deviation 0.05?

4. *Use the correlation data of recession velocities and distances discussed in Lecture 2.* Use Bayesian correlation testing to determine the posterior probability distribution of the correlation coefficient of Lemaitre and Hubble's distance vs. velocity data, assuming a uniform prior.

5. Solve problem 1 above using a Monte Carlo simulation.

6. Run a Monte Carlo simulation of Hubble's distance-velocity investigation, assuming that D and V are drawn from a bivariate Gaussian distribution with parameters set by the data. What is the resulting error in the Hubble parameter?