

Assignment #13 — Due Wednesday, April 29, 2009, by 5:00 P.M.

Turn in homework in lecture, discussion, or your TA's mailbox. Indicate the discussion section in which you expect to attend to pick up this assignment on the assignment.

311: Monday 1:20–2:10**312:** Monday 12:05–12:55

This assignment involves a few questions from Chapter 10.

1. (*Bayesian Review*) Suppose that data sample $s = (x_1, \dots, x_n)$ is modeled to be an i.i.d. sample from a likelihood model with density $f(x | \theta) = \theta e^{-\theta|x|}/2$ for $-\infty < x < \infty$ and that the prior distribution for θ is $\pi(\theta) = e^{-\theta}$ for $\theta > 0$.
 - (a) Find $E(X)$.
 - (b) Find $\pi(\theta | s)$. Identify which named distribution this is, and identify the parameters.
 - (c) For the specific sample $s = (2.05, -1.12, -0.68, -2.50, -0.11)$, find the posterior density, mean, and mode.
2. (*Likelihood ratio test review*) Suppose that $X_i \sim \text{Geometric}(\theta_i)$ for $i = 1, 2, 3$ and that these random variables are independent. Conduct a likelihood ratio test of the null hypothesis $\theta_1 = \theta_2 = \theta_3$ versus the alternative that they are not all equal for the data $s = (1, 0, 6)$. (To find a p-value, you may assume that the test statistic has an approximate chi-square distribution.)
3. Enter the data in Exercise 10.3.8 into a file to read into R.
 - (a) Use `xyplot()` from the `lattice` library to make a scatterplot of the data. Does it make sense to fit a linear model to this data?
 - (b) Use `lm()` to fit a linear model to predict strength from hardness and use `summary()` to find estimates of the regression coefficients and the standard deviation.
 - (c) Use R to find the means, standard deviations, and correlation coefficient of the variables and verify that the regression equations presented in class result in the same numerical estimates of the regression coefficients.
 - (d) Find a 95% confidence interval for the slope using the results from `summary()`.
 - (e) Verify that the numerical estimates of the standard errors of the regression coefficients from `summary()` match those found by plugging into equations from Theorem 10.3.6.
 - (f) Verify the p-value from `summary()` for the test of the hypothesis that the slope is zero.
 - (g) Calculate the ratio between the variance of the residuals and the variance of the variable strength. How does this value relate to the square of the correlation coefficient between strength and hardness?

Work to do, but not turn in.

- Read Chapter 10, sections 10.3–10.4.