

1. (20%) A coin that lands heads 25%, 50%, or 75% of the time. Before seeing any data you assume that each possibility is equally likely. You toss the coin 10 times, and it lands heads 7 times.

- (a) What is your posterior probability that  $p=.5$ ?
- (b) What is your prediction for the probability that the coin will land heads the next time it is tossed?
- (c) Suppose you wanted to test  $H_0:p=.5$  against  $H_1:p>.5$ . What is the observed p-value?

2. (15%) To find whether our undergraduate students should take an English course, a campus poll is taken and the results are as shown below:

	Fresh/Soph	Jr/Seniors	Totals
Should	190	197	387
Should not	245	168	413
Totals	435	365	800

(a) Using the data given above, please test the hypothesis that responses do not differ according to year of class in the total population of students. Use a Chi-square test to answer the question.

3. (15%) There are 20 black balls and 5 red in a box. Each time one ball is chosen at random (with replacement).

- (a) What is the chance that a black ball is chosen on the first three draws?
- (b) What is the chance of choosing exactly two red balls in the first five draws?
- (c) What is the chance of choosing a red ball on the fifth draw given that you chose a black one on each of the first four draws?

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4. An important part of the customer service responsibilities of a natural gas utility company concerns the speed with which calls relating to no heat in a house can be serviced. Suppose that one service variable of importance refers to whether or not the repair person reaches the home within a two-hour period. Past data indicate that the likelihood is 0.60 that the repair person reaches the home within a two-hour period. If a sample of five service calls for "no heat" is selected, what is the probability that the repair person will arrive at
- (a) At least three houses within the two-hour period? (5%)
  - (b) In this typical textbook exercise, what questions would you like to ask if you were the manager of a customer service center? Explain why. (10%)
5. The director of a large employment agency wishes to study various characteristics of its job applications. A sample of 200 applicants has been selected for analysis. Seventy applicants have had their current jobs for at least five years; 80 of the applicants are college graduates; 25 of the college graduates have had their current jobs at least five years.
- (a) What is the probability that an applicant chosen at random
    - (1) Is a college graduate *and* has held the current job less than five years? (3%)
    - (2) Is a college graduate *or* has held the current job at least five years? (3%)
  - (b) Given that a particular employee is a college graduate, what is the probability that he or she has held the current job less than five years? (5%)
  - (c) Determine whether being a college graduate *and* holding the current job for at least five years are statistically independent. (4%)
  - (d) As the director, can you explain the managerial meanings and implications from the answer of (b)? (10%)
6. There are two different kinds of estimators: Maximum Likelihood Estimator (MLE) and Least Squares Estimator (LSE). Why do we "maximize" the likelihood function to get the MLE? And why do we need to "minimize" the loss function to get the LSE? Are they always the same? Give an example to explain. (10%)

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