

15.060 Data, Models, and Decisions
Homework 1
Due: MONDAY, September 15, 2014

1. The number of hits per hour at the website `http://thenextbigthing.com` is a random variable. The probability distribution of the number of hits per hour at this site is shown in Table 2.34.

Hits per Hour x_i	Probability p_i
0	0.03
1	0.09
2	0.24
3	0.27
4	0.25
5	0.09
6	0.03

Table 2.34: Probability distribution of hits per hour at the website
`http://thenextbigthing.com` .

- (a) For a given hour, what is the probability that the number of hits will be between 3 and 5 ?
 - (b) Compute the mean, the variance, and the standard deviation of the number of hits per hour.
2. It is estimated that 70% of all visitors to a given website are college students. The remaining 30% are either college graduates or have not attended college. Suppose the website had twelve visitors in the last two hours.
 - (a) Let X be the number of visitors (among the twelve) who are college students. What assumptions need to be satisfied in order for X to obey a binomial distribution?
 - (b) Modeling X as a binomially distributed random variable, what is n and what is p in this case?

- (c) What is the probability that exactly eight of the twelve visitors are college students?
- (d) What is the expected number of visitors (of the twelve) who are college students? What is the standard deviation of the number of visitors who are college students?
3. The website <http://MEGA-Retail.com> features a huge variety of fitness products for upscale consumers. These consumers are segmented into “smartphone consumers” and “desktop” consumers depending on whether or not the majority of their purchases are conducted via their smartphones or a less-mobile device such as a desktop or laptop computer. Indeed, 38% of the MEGA-Retail.com’s consumer base are smartphone consumers, with the remaining 62% being desktop consumers. The Consumer Fraud Division of the Department of Justice has begun a preliminary investigation into the online practices of MEGA-Retail.com after a newspaper article exposed complaints of padded charges. Their first task is to choose a random sample of 20 customers for interviews and data collection regarding their transactions with MEGA-Retail.com.
- (a) What is the probability that 7 of the 20 randomly chosen consumers will be smartphone consumers?
- (b) What is the probability that between 12 and 14 of the 20 randomly chosen consumers will be desktop consumers?
- (c) What is the probability that 3 or fewer of the randomly chosen consumers will be desktop consumers?
4. You have made it to the final round of a game show. The announcer asks you the final multiple choice question, which has four possible answers: (a), (b), (c), or (d). If you answer the question correctly, you win \$1,000,000. After listening to the question, you realize you are not sure of the answer! Rather, you think the answer is either choice (a) with probability 60%, or choice (b) with probability 40%. You know for sure the answer is not choices (c) or (d). You have three options at this point:
- Choose not to answer the question. In this case, you walk away with \$500,000.
 - Select an answer (either (a) or (b)). If you are correct, you win the \$1,000,000. If you are incorrect, you only win \$32,000.
 - Phone a friend. In this option, the announcer allows you to phone your friend and ask her/him for help. After listening to your friend’s response, you then will need to answer the question. You know that:

- Given that the correct answer is (a), your friend will say “a” with probability 80%.
 - Given that the correct answer is (b), your friend will say “b” with probability 80%.
- (a) What is the probability your friend says the answer is “a”? Hint: It may help to make a probability table.
- (b) What is the probability that the true answer is “b” given that your friend says it is “b”?
- (c) Make a decision tree to find your best strategy. In words, what should your strategy be? How much money do you expect to win?
5. A medical test for malaria is subject to some error. Given a person who has malaria, the probability that the test will fail to reveal the malaria is 0.06. Given a person who does not have malaria, the test will correctly identify that the person does not have malaria with probability 0.91.
- (a) If someone has malaria, what is the probability that the test will identify that person as having malaria?
- (b) Suppose three unrelated individuals who are not infected with malaria take the test. What is the probability that at least one of the three individuals will be identified by the test as having malaria?
- (c) In a particular area of a particular country, 20% of the population suffers from malaria. If a random person from this area is tested and his test results indicate that he has malaria, what is the chance that he actually has malaria?

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