Lab 3: Probability

STAT 111

6/5/2015

Complete the following problems on a separate piece of paper. Read these instructions carefully.

- Hand in your answers at the end of lab – make sure to include you name and the lab number. Instructions are included for making graphs and finding the necessary statistics for each problem.
- Each question will be worth two points, and you can receive partial credit for incorrect answers if your process was correct.
- Write your final answer **as a sentence** and include all steps you used to get there, otherwise you will receive partial credit.
- When performing calculations, keep intermediate steps rounded to **four decimal places**, and round your final answer to **three decimal places**.

Formulas:

$$\hat{p} = \frac{\text{\# of occurances}}{\text{\# of trials}} = \frac{x}{n}$$

$$P(A) = \frac{\text{\# of ways A can occur}}{\text{total \# of outcomes}}$$

$$P(A \text{ OR } B) = P(A) + P(B) - P(A \text{ AND } B)$$

$$P(A \text{ AND } B) = P(A) \times P(B \mid A) = P(B) \times P(A \mid B)$$

$$P(A \mid B) = \frac{P(A \text{ AND } B)}{P(B)}$$

A and B are independent if $P(A) = P(A \mid B)$, $P(B) = P(B \mid A)$, or if $P(A \text{ AND } B) = P(A) \times P(B)$

A and B are disjoint if $P(A \text{ AND } B) = 0$.

Part A: Attendence and Grades

For a particular statistics class, 75% of the class attends lectures regularly, 70% of the class passes the course, and 90% of those who attend class regularly pass the course. Let A be the event that a student attends lectures regularly and B be the event that a particular student passes the course.

1. What is the probability of randomly selecting a student who attends the lecture regularly and passes?
2. What is the probability a student doesn't attend regularly passes the course?
   Hint: $P(B) = P(A \text{ AND } B) + P(A^C \text{ AND } B) \rightarrow P(A^C \text{ AND } B) = P(B) - P(A \text{ AND } B)$.
3. Given that a student passes, what is the probability that they attended the lecture regularly?

Part B: Gender and Video Games

A media researcher surveyed 417 people and obtained the following partial results.

1. Complete the following table:

Gender/Plays	Yes	No	Total
Male	119		230
Female			
Total	203		417

2. Are being male and playing video games independent? Make sure to provide evidence.

Part C: Breast Cancer Testing

The follow numbers are **real** probabilities concerning women in their forties and mammograms, which test for breast cancer. Among these women, the rate of breast cancer is quite low, only about 1.4%. Mammograms are not very sensitive tests, they only detect cancer when it exists 75% of the time. On the other hand, they have a false positive rate (saying there is cancer when there is not) of 10%. Let's denote these probabilities as follows:

Event	Notation	Probability
Has Cancer	C	$P(C) = 0.014$
True Positive	$+ \mid C$	$P(+ \mid C) = 0.75$
False Positive	$+ \mid C^C$	$P(+ \mid C^C) = 0.10$

1. What is the probability that a woman in her 40s has cancer and tests positives to the mammogram? Hint: $P(A \text{ AND } B) = P(A) \times P(B \mid A)$
2. What is the probability that a women in her 40s doesn't have cancer and tests positive? Hint: use the same process as in Question 1, but with C^C.
3. Using your answers from Questions 1 and 2, find the probability that a woman has a mammogram and tests positive, regardless of whether or not she has cancer. Hint: $P(B) = P(A \text{ AND } B) + P(A^C \text{ AND } B)$
4. Using the answers to Question 1 and Question 3, find the probability that a woman has cancer, given that she tests positive.
5. Doctors often refuse to give mammograms to women under 50 unless they are at particularly high risk, especially because the follow-up tests to confirm the breast cancer diagnosis can have dangerous complications. Use your answer to Question 4 to argue for or against this policy.