Conditional Probability

Introduction

Sta 771 - Spring 2016

Duke University, Department of Statistical Science

Princeton Lee

1. Main Topics
2. Example/Definitions
3. Tricks/Shortcuts
4. Review

Ideas for Today:

Today, we are going to discuss, define and learn how to use *Conditional Probability* to solve real world problems. The terms that you should be familiar with at the end of the lesson are:

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- *Marginal Probability*
- *Joint Probability*
- *Conditional Probability*

Table: Flu Shot Contingency Table

		Vaccinated: Yes	Vaccinated: No	
Flu Test Result	Pos	2	14	16
	Neg	9	9	18
		11	23	34

Source: Dr. Roy Benaroch, The Pediatric Insider

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What is the joint probability of being vaccinated and getting a positive flu test?

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- Conditional Probability
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What is the conditional probability of a person having a positive flu test given that s/he has been vaccinated?

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- Continuing example:

What is the conditional probability of a person having a negative flu test given that s/he has been vaccinated?

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- Trick
  - Given that a person has been vaccinated, how many different flu test outcomes are there?

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- Continuing example:

What is the conditional probability of a person having a negative flu test given that s/he has been vaccinated?

- Trick
  - Given that a person has been vaccinated, how many different flu test outcomes are there?
  - If we let C_1 = Positive Flu Test and C_2 = Negative Flu Test. Notice that $P(C_1|A) + P(C_2|A) = 1$

- Assume a standard deck of cards for the following questions. Remember that a standard deck has 4 suits. Each suit has 13 unique cards from Ace to King.
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  - What is the joint probability that a card drawn is red and a King?
  - What is the conditional probability of getting a King, given that you drew a red card?

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- Here are some easy and simple tips to help you work faster and more accurately:
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  - If A and B are independent, then

$$P(B|A) = \frac{P(A \text{ and } B)}{P(A)} = \frac{P(A)P(B)}{P(A)} = P(B)$$

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- Marginal Probability refers to one variable occurring.
- Joint Probability refers to two or more variables *jointly* happening.
- Conditional Probability refers to the probability of an event *conditional* on another event happening first.