Lecture 11:
Lesson and Activity Packet

MATH 232: Introduction to Statistics

October 26, 2016

Homework and Announcements

- Homework 12 due in class on Friday
- Election Prediction Project
  - Friday will be a project day
  - Deadline for ASA submission is Sunday at 8 p.m.
  - Deadline for group report, proof of ASA submission, and individual report is Monday at 11:59 p.m.
  - Please let me know before Sunday whether your group wants to present in class on Monday
- Book Review Project
  - Details to be given after the Election Project, **but** you should buy or procure (by legal means...) the book of your choice now, from among the following three choices:
    1. *Moneyball: The Art of Winning an Unfair Game*, by Michael Lewis
    2. *Dataclysm: Love, Sex, Race, and Identity—What Our Online Lives Tell Us about Our Offline Selves*, by Christan Rudder
    3. *How Not to Be Wrong*, by Jordan Ellenberg

Last time

- Conditional probability

Recap of today

- More conditional probability
- Independent events
- Multiplication rules

Recall the definition of conditional probability: $P(E|F)$ is the probability that E will occur (or will be discovered to have occurred), given that F has occurred (or has been discovered to have occurred). $P(E|F)$ can be computed according to the following rule:

Definition 1

If $P(F) > 0$, *then*

$$P(E|F) = \frac{P(E \text{ and } F)}{P(F)}.$$

All of the examples we saw in Packet 10 were derived from classical probability. Let's try some examples with a relative frequency definition.

Example 1

Suppose that a consumer research organization has studied the service under warranty provided by the 200 tire dealers in a large city, and that their findings are summarized in the following table:

	Good service under warranty	*Poor service under warranty*	*Total*
Name-brand tire dealers	*64*	*16*	*80*
Off-brand tire dealers	*42*	*78*	*120*
Total	*106*	*94*	*200*

If one of these tire dealers is randomly selected (that is, each one has the probability $\frac{1}{200}$ *of being selected), the probability of choosing a name-brand dealer is* $P(N) :=$_______. *The probability of choosing a dealer who provides good service under warranty is* $P(G) :=$_______. *The probability of choosing a name-brand dealer who provides good service under warranty is* $P(N \text{ and } G) :=$_______.

Definition 2 (*Independent Events*)

If $P(B) \neq 0$ *and if* $P(A|B) = P(A)$*, we say that event* A *is* independent *of event* B*. That is, event* A *is independent of event* B *if the probability of* A *is not affected by the occurrence or non-occurrence of event* B*.*

Group Exercise 1

The probabilities that it will rain or snow in a given city on Christmas Day, on New Year's Day, or on both days, are $P(C) := 0.60$*,* $P(N) := 0.60$*, and* $P(C \cap N) := 0.42$*. Check whether* N *and* C *are independent.*

Some interesting Multiplication rules follow from

$$P(E|F) = \frac{P(E \text{ and } F)}{P(F)}.$$

A few are:

Theorem 1

General multiplication rule

$$P(E \cap F) = P(F) \cdot P(E|F)$$

Theorem 2

General multiplication rule

$$P(E \cap F) = P(E) \cdot P(F|E)$$

If A and B are independent, then:

Theorem 3

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