MA162: Finite mathematics

Paul Koester

University of Kentucky

November 18, 2013

Schedule:

- Web Assign assignment (Chapter 7.4) due on Tuesday, November 19 by 6:00 pm.
- Web Assign assignment (Chapter 7.5 and 7.6) due on Friday, November 22 by 6:00 pm.
- Exam 3 on Monday, November 25, 5:00 pm to 7:00 pm.

Today is Chapter 7.5, Conditional Probability

Conditional Gaming

	PS 3 only	X-Box only	Both	Neither	Total
$<$ 2 hours	47	23	7	17	94
2 to 6 hours	34	41	11	3	89
$>$ 6 hours	15	18	25	2	60
total	96	82	43	22	243

Restrict attention only to gamers who own both consoles. What is probability they play at least two hours per week?

This is an example of a conditional probability.

Let B denote the event that gamer owns both gaming consoles. Let T denote the event that the gamer plays at least two hours per week.

The $P(T|B)$ is the probability that the gamer plays at least two hours per week, given that they own both gaming consoles.

In the parlance of probability, we have "conditioned on the event of owning both gaming consoles."

Conditional Gaming

For comparison, what is $P(B|T)$?

7.5: Conditional Probability

- A and B are two events in a probability space
- The probability of A conditioned on B, denoted $P(A|B)$ is computed as

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

- Read $P(A|B)$ as "probability of A, given B" or "probability of A, conditioned on B"

7.5: Smoking and lung cancer

Facts taken from http://lungcancer.about.com/od/Lung-Cancer-And-Smoking/f/Smokers-Lung-Cancer.htm

- 0.2% probability of lung cancer for men who never smoked
- 5.5% probability of lung cancer for male former smokers
- 15.9% probability of lung cancer for current male smokers
- 24.4% probability of lung cancer for male "heavy smokers" defined as smoking more than 5 cigarettes per day

These are examples of conditional probabilities. Determine a reasonable sample space, and determine events so that each of the above probabilities can be expressed as a conditional probability.

7.5: Independence

- A and B are two events in a probability space
- We say A and B are independent if

$$P(A \cap B) = P(A)P(B)$$

- Equivalently, A and B are independent if

$$P(A|B) = P(A)$$

7.5: Independent

- Flip a fair coin 5 times. What is probability of getting a heads on the third flip?

- Flip a fair coin 5 times. What is probability of getting a heads on the third flip, given that the previous flip was tails?

- A fair coin is flipped 20 times. Each flip turns up heads. What is the probability of getting tails on the 21st flip?

7.5: Dependent

Two cards are drawn from a standard deck of 52.

- What is the probability that the second card is an Ace, given that the first card is not and Ace?

- What is the probability that the second card is an Ace, given that the first card is an Ace?

- What is the probability the second card is an Ace?

7.5: Coinage

I have 2 quarters, a dime, and three nickels in my pocket. I pick out three coins at random.

- What is the probability the third coin is a quarter?
- Try to answer these first: Probability third coin is a quarter given that neither of the first two are quarters?
- Probability third coin is a quarter given exactly one of the first two are quarters?
- Probability third coin is a quarter given that both of the first two are quarters?

7.5: Accident Severity

- An insurance company is evaluating automobile accident claims.
- In each case, the driver is classified as being "Unharmed," "Mild injured," "Severely injured"
- Let U denote event "unharmed," M the event "Mildly injured," and S the event "Severely injured"
- It is also noted whether the driver was wearing their seat belt.
- Let N denote event "wearing seatbelt"

	Unharmed	Mild injury	Severe injury
Seatbelt	306	107	18
No seatbelt	166	214	63

7.5: Accident Severity

	Unharmed	Mild injury	Severe injury
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- Find $P(U)$
- Find $P(N)$
- Find $P(U \cap N)$
- Find $P(U|N)$
- Are U and N independent?
- Explain the difference between $P(U|N)$ and $P(N|U)$