STA209 HW5 key

Notes

Each of these problems contains multiple parts, generally with each being worth a single point. If you find problems where the answer for one part is dependent on the answer for a previous, only take off one point if the first is incorrect, though make a note for the rest. For the last two problems, worth four points each, they should be divided as:

- 1 point for doing the problem
- 2 points if the expression is written out correctly
- 1 point for the correct value

Section 3.1 Problems

Problem 3.5 – Coin Flips (3pts, 1 each)

If you flip a fair coin 10 times, what is the probability of...

A. Getting all tails

- **Answer:** $(0.5)^{10}$

B. Getting all heads

- **Answer:** $(0.5)^{10}$

C. Getting at least one tails

- **Answer:** 1 - $(0.5)^{10}$

Problem 3.8 – Poverty and Language (6 pts, 1 each)

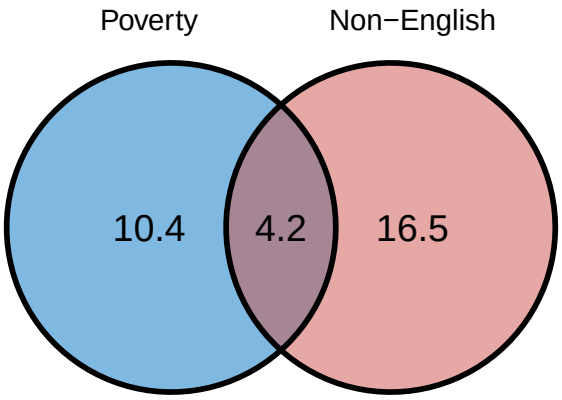
The American Community Survey is an ongoing survey that provides data every year to give communities the current information they need to plan investments and services. The 2010 American Community Survey estimates that 14.6% of Americans live below the poverty line, 20.7% speak a language other than English (foreign language) at home, and 4.2% fall into both categories.

A. Are living below the poverty line and speaking a foreign language at home disjoint?

- **Answer:** No – 4.2% fall into both categories

B. Draw a Venn diagram summarizing the variables and their associated probabilities.

- **Answer:** (Ok if they do not produce this, do not take off points)



C. What percent of Americans live below the poverty line and only speak English at home?

- **Answer:** 10.4%

D. What percent of Americans live below the poverty line or speak a foreign language at home?

- **Answer:** 10.4 + 4.2 + 16.5 = 31.1%

E. What percent of Americans live above the poverty line and only speak English at home?

- **Answer:** 1 - 31.1% = 68.9%

F. Is the event that someone lives below the poverty line independent of the event that the person speaks a foreign language at home?

- **Answer:** Not independent

Problem 3.10 – Guessing on an Exam (3 pts, 1 each)

In a multiple choice exam, there are 5 questions and 4 choices for each question (a, b, c, d). Nancy has not studied for the exam at all and decides to randomly guess the answers. What is the probability that:

A. the first question she gets right is the 5th question?

- **Answer:** $(0.75)^4(0.25)$

B. she gets all of the questions right?

- **Answer:** $(0.25)^5$

C. she gets at least one question right?

- **Answer:** 1- $(0.75)^5$

Section 3.2 Problems

Problem 3.13 – Joint and conditional probabilities (6 pts, 1 each)

P(A) = 0.3, P(B) = 0.7

A. Can you compute P(A and B) if you only know P(A) and P(B)?

- **Answer:** No

B. Assuming that events A and B arise from independent random processes,

- B.1 what is P(A and B)?
  - **Answer:** P(A and B) = P(A)P(B) = 0.21
- B.2 what is P(A or B)?
  - **Answer:** P(A or B) = P(A) + P(B) - P(A and B) = 0.79
- B.3 what is P(A|B)?
  - **Answer:** P(A|B) = P(A) = 0.3

C. If we are given that P(A and B) = 0.1, are the random variables giving rise to events A and B independent?

- **Answer:** No, see b.1

D. If we are given that P(A and B) = 0.1, what is P(A|B)?

- **Answer:** P(A|B) = P(A and B)/P(B) = 0.1 / 0.7 = 0.143

Problem 3.18 – Assortative Mating (4pts total)

Assortative mating is a nonrandom mating pattern where individuals with similar genotypes and/or phenotypes mate with one another more frequently than what would be expected under a random mating pattern. Researchers studying this topic collected data on eye colors of 204 Scandinavian men and their female partners. The table below summarizes the results. For simplicity, we only include heterosexual relationships in this exercise.

A. What is the probability that a randomly chosen male respondent or his partner has blue eyes?

- **Answer:** P(M or P) = (108+114-78)/(204) = -.7059

B. What is the probability that a randomly chosen male respondent with blue eyes has a partner with blue eyes?

- **Answer:** P(P|M) = 78/114

C. What is the probability that a randomly chosen male respondent with brown eyes has a partner with blue eyes? What about the probability of a randomly chosen male respondent with green eyes having a partner with blue eyes?

- **Answer:** P(P|M brown) = 19/54
- **Answer:** P(P|M green) = 11/36

D. Does it appear that the eye colors of male respondents and their partners are independent? Explain your reasoning.

- **Answer:** No- men with blue eyes are far more likely to have a partner with blue eyes

Problem 3.20 – Predisposition for Thrombosis (4 pts)

A genetic test is used to determine if people have a predisposition for thrombosis, which is the formation of a blood clot inside a blood vessel that obstructs the flow of blood through the circulatory system. It is believed that 3% of people actually have this predisposition. The genetic test is 99% accurate if a person actually has the predisposition, meaning that the probability of a positive test result when a person actually has the predisposition is 0.99. The test is 98% accurate if a person does not have the predisposition. What is the probability that a randomly selected person who tests positive for the predisposition by the test actually has the predisposition?

Work

- P(T) = 0.03
- P(+|T) = 0.99
- P(-|T) = 0.98
- $P(T|+) = \frac{(P+|T)P(T)}{(P(+)}$
- $P(T|+) = \frac{(P+|T)P(T)}{P(+|T)P(T) \ + \ P(+|nT)P(nT)}$
- $P(T|+) = \frac{0.99*0.03}{(0.99*0.03)+(0.02*0.97)}$
  - **Answer:** = (0.99 * 0.03)/ ((0.99 * 0.03) + (0.02 * 0.97)) = 0.6049

Problem 3.22 – Exit Poll (4 pts)

Edison Research gathered exit poll results from several sources for the Wisconsin recall election of Scott Walker. They found that 53% of the respondents voted in favor of Scott Walker. Additionally, they estimated that of those who did vote in favor for Scott Walker, 37% had a college degree, while 44% of those who voted against Scott Walker had a college degree. Suppose we randomly sampled a person who participated in the exit poll and found that he had a college degree. What is the probability that he voted in favor of Scott Walker?

Work

If + ≡ support Walker and c ≡ college

- P(+) = 0.53
- P(C|+) = 0.37
- $P(+|C) = \frac{P(C|+)P(+)}{P(C)}$
- $P(+|C) = \frac{P(C|+)P(+)}{P(C|+)P(+) \ + \ P(C|-)P(-)}$
- **Answer:** = (0.1961)/(0.4029) = 0.49