Public Policy 529
Fall 2023: Problem Set #3

Due Tuesday, September 26

Please show your work for all problems if possible, or describe your steps/logic.

1. The random variable X takes on the values listed below with the given probabilities:

$$X = \begin{cases} 1 & \text{with probability .1} \\ 2 & \text{with probability .4} \\ 3 & \text{with probability .2} \\ 4 & \text{with probability .3} \end{cases}$$

   Suppose that Event $A = \{1, 3\}$. Event $B = \{3, 4\}$.

   (a) What is $E[X]$ (in other words, the expected value of X)?

   (b) What is $E[(X - \mu_x)^2]$ (in other words, the variance of X)?

   (c) What is $P(A \text{ and } B)$? Show your work.

   (d) What is $P(A \text{ or } B)$? Show your work.

   (e) What is $P(\sim A \text{ and } \sim B)$?

2. Suppose that, to save time, the admissions office for Ohio State University decided to just admit students randomly. Each applicant is admitted with probability .7. Consider a sample of four applicants.

   (a) What is the probability that all four applicants are accepted?

   (b) What is the probability that just one of the four applicants is accepted?

   (c) What is the probability that *at least* three applicants are accepted?

3. Suppose you have a jar with 12 quarters in it. Seven were minted in Denver (marked D), five were minted in Philadelphia (P). You draw a quarter at random and note the outcome: D or P. You then draw a second quarter without replacing the first one. It will likely be helpful to make a probability tree diagram representing this scenario to help you answer the questions below.

(a) What is the probability of at least one quarter marked D?

(b) If the first quarter is P, what is the probability the second one is D?

(c) Suppose you have not drawn a quarter yet. With what probability will the second quarter be P?

4. A researcher uses the 2014 General Social Survey to explore whether handgun ownership and beliefs about the afterlife are related. She obtains the following joint frequency distribution for beliefs about life after death and the respondent's handgun ownership. Some respondents refused to answer the question.

Belief in Life	Owns Pistol or Revolver ?			
After Death?	Owner	Non-Owner	Refused	Total
Yes	274	885	48	1,207
No	54	237	5	296
Total	328	1,122	53	1,503

Suppose that you are drawing a person at random from this sample.

(a) Calculate $P(\text{Yes})$.

(b) Calculate $P(\text{Yes} \mid \text{Owner})$.

(c) Calculate $P(\text{Yes} \mid \text{Non-Owner})$.

(d) Are these two variables, belief in life after death and handgun ownership, independent? Explain.