Assignment 1 Part II

Question 1

A random sample of adults was asked how many books they typically read in a year. The following contingency table shows these results along with their age group.

Number of Books	Less than 40 Years Old	40 Years or More
None	15	27
1-2	21	30
3-5	24	36
6-10	18	33
11 or more	42	54

a) What is the probability that a randomly selected person from this sample typically reads 1-5 books per year? (3 points)

Answer: $P(\text{1-2 or 3-5}) = \frac{51}{300} + \frac{60}{300} = \frac{111}{300} = 0.37$

b) What is the probability that a randomly selected person from this sample typically reads 6-10 books per year or is 40 years or older? (3 points)

Answer: $P(\text{6-10 or 40+ Years}) = \frac{51}{300} + \frac{180}{300} - \frac{33}{300} = \frac{198}{300} = 0.66$

c) What is the probability that a randomly selected person from this sample typically reads 11 or more books per year and is less than 40 years? (3 points)

Answer: $P(\text{11+ Books and Less than 40 Years}) = \frac{42}{300} = 0.14$

d) Given that a randomly selected adult from this sample reads 3-5 books per year, determine the probability that this person is less than 40 years old. (3 points)

Answer: $P(\text{Less than 40} \mid \text{3-5 Books}) = \dfrac{P(\textit{Less than 40 and 3-5 Books})}{P(\textit{3-5 books})}$

$P(\text{Less than 40 and 3-5 Books}) = \dfrac{24}{300} = 0.08$

$P(\text{3-5 books}) = \dfrac{60}{300} = 0.20$

$P(\text{Less than 40} \mid \text{3-5 Books}) = \dfrac{0.08}{0.20} = 0.40$

e) Given that a randomly selected adult from this sample is 40 years or more, determine the probability that this person reads 6-10 books per year. (3 points)

Answer:

$P(\text{6-10 Books} \mid \text{40 Years or More}) = \dfrac{P(\textit{6-10 Books and 40 Years or More})}{P(\textit{40 Years or More})}$

$P(\text{6-10 Books and 40 Years or More}) = \dfrac{33}{300} = 0.11$

$P(\text{40 Years or More}) = \dfrac{180}{300} = 0.60$

$P(\text{6-10 Books} \mid \text{40 Years or More}) = \dfrac{0.11}{0.60} = 0.183$

Question 2.

Suppose that David can decide to go to work by one of three modes of transportation, car, bus, or commuter train. Because of high traffic, if he decides to go by car, there is a 50% chance he will be late. If he goes by bus, which has special reserved lanes but is sometimes overcrowded, the probability of being late is 20%. The commuter train is almost never late, with a probability of only 1%, but is more expensive than the bus.

a) Suppose that David is late one day, and his boss wishes to estimate the probability that David would choose to drive to work by car. Since David's boss does not know which mode of transportation David usually uses, David's boss gives a prior probability of 1/3 to each of the three possibilities. What is the boss' estimate of the probability that David would drive to work given that he is late? (5 points)

Answer:

$Pr\{bus\} = Pr\{car\} = Pr\{train\} = 1/3$

$Pr\{late \mid car\} = 0.5$

$Pr\{late \mid train\} = 0.01$

$Pr\{late \mid bus\} = 0.2$

Using bays theorem:

$$Pr\{car \mid late\} = \frac{Pr\{late \mid car\}Pr\{car\}}{Pr\{late \mid car\}Pr\{car\} + Pr\{late \mid bus\}Pr\{bus\} + Pr\{late \mid train\}Pr\{train\}} = 0.7042$$

b) Suppose that a coworker of David's knows that he almost always takes the commuter train to work, never takes the bus, but sometimes, 10% of the time, takes the car. What is the coworker's estimate of the probability that David would drive to work that day, given that he was late? (5 points)

Answer:

Repeat the identical calculations as the above, but instead of the prior probabilities being1/3, we use Pr{bus}= 0, Pr{car}= 0.1, and Pr {train}=0.9.
Plugging in to the same equation with these three changes, we get Pr{car | late}= 0.8475

Note: You should follow the plan-do-report format to present your solution.

MINI case studies

Market Segmentation

The marketing manager for a department store wants to know how important quality is to her customers. A consultant reports that based on past research, 30% of all consumers nationwide are more interested in quantity than quality. The marketing manager suspects that customers from her store are different, and that customers of different ages might have different views as well. Using conditional probabilities, marginal probabilities, and joint probabilities constructed from the data in the file **ch08_MCSP_Market_Segmentation**,[4] write a report to the manager on what you find.

As you do your analysis and write up your report, keep in mind that the manager may be more interested in the opinions of "frequent" customers than those who never or hardly ever shop at her store. These "frequent" customers contribute a disproportionate amount of profit to the store.

Variable and Question	Categories
Age *Which age group are you in?*	18–24 years old 25–34 35–44 45–54 55–64 65 or over
Frequency *How often do you shop for women's clothing at [this department store]?*	Never–hardly ever 1–2 times per year 3–4 times per year 5 times or more
Quality *For the same amount of money, I will generally buy one good item in preference to several of lower price and quality.*	1. Definitely disagree 2. Generally disagree 3. Moderately disagree 4. Moderately agree 5. Generally agree 6. Definitely agree

Source: Sharpe, De Veaux, Velleman, Wright, "Business Statistics", Second Canadian Edition, ISBN-10: 0321876199,ISBN-13: 9780321876195, Pearson Education Canada, p.250