

9.6 Striving for Independence

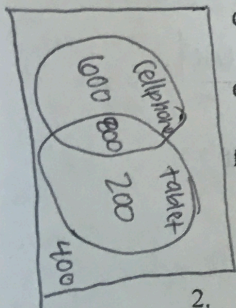
A Practice Understanding Task

Use your knowledge of conditional probability (the probability of A given B as $P(A \text{ and } B)/P(B)$) as well as the definition of independence (two events (A and B)) are said to be independent if $P(A|B) = P(A)$ and $P(B|A) = P(B)$) to answer the following questions. Keep track of how you are determining independence for each type of representation.

1. Out of the 2000 students who attend a certain high school, 1400 students own cell phones, 1000 own a tablet, and 800 have both. Suppose a student is randomly selected. Create a Venn diagram model and use notation to answer the following questions.

	tab.	not tab.	Total
cellphone	800	600	1400
not cellphone	200	400	600
Total	1000	1000	2000

- a) What is the probability that a randomly selected student owns a cell phone?
 $P(\text{cellphone}) = \frac{1400}{2000} = 0.7 = 70\%$
- b) What is the probability that a randomly selected students owns both a cell phone and a tablet?
 $P(\text{cellphone} \cap \text{tablet}) = \frac{800}{2000} = 0.4 = 40\%$
- c) If a randomly selected student owns a cell phone (was one of the 1400 with a phone), what is the probability that this student also owns a tablet?
 $P(\text{tablet} | \text{cellphone}) = \frac{800}{1400} = 0.57 = 57\%$



- d) How are questions c and d different?
 Question B is a combined prop. out of everyone, Question C is conditional prob. out of those with a cellphone
- e) Are the outcomes owns a cell phone and owns a tablet independent? Explain.
 $P(C \cap T) = \frac{800}{2000} = 0.4$ $P(C) = \frac{1400}{2000} = 0.7$ $P(T) = \frac{1000}{2000} = 0.5 \rightarrow 0.4 \neq 0.7 \cdot 0.5$ so not independent
- f) If question e is not independent, what number of students would own a tablet to create independence?

$$0.4 = 0.7 \cdot x \rightarrow x = 0.57 = \frac{y}{2000} = 0.57 \rightarrow y = 1,143 \text{ need to own a tablet to be independent}$$

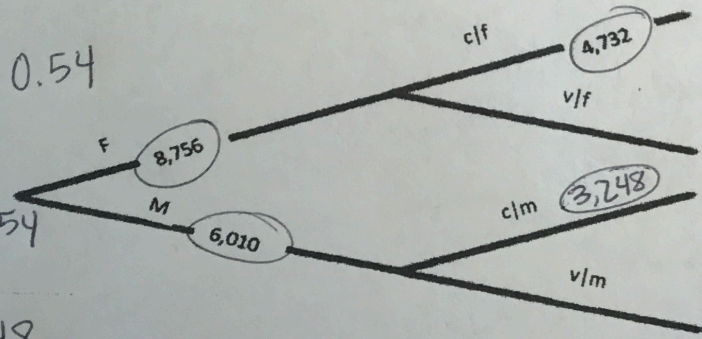
2. Below is a partially completed tree diagram from the task *Chocolate vs Vanilla*.
- a) Circle the parts of the diagram you would use to determine if choosing chocolate is independent of being a male or female.
- b) Complete the diagram so that choosing chocolate is independent of being male or female.

$$P(C|F) = \frac{4,732}{8,756} = 0.54$$

$$P(C|M) = \frac{x}{6,010} = 0.54$$

$$x = 3,248$$

$$P(C) = 0.54$$



3. Use the titanic data below to answer the following questions.

	Survived	Did not survive	Total
Men	146	659	805
Women	296 *	106	402
Total	442	765	1207 *

- a. Determine if survival was independent of gender. Explain. *No, independent because $P(w|s) = \frac{296}{442} = 0.66$ $P(w) = \frac{402}{1207} = 0.33$*
- b. If gender would not have mattered, what would have been the number of males that would have survived, given the data for the number of females who survived and the total number of passengers on the ship. *$P(w \cap s) = P(w) \cdot P(s)$
 $P(w \cap s) = \frac{296}{1207} = 0.25$ $P(w) = \frac{402}{1207} = 0.33$ $P(s) = \frac{x}{1207} \rightarrow 0.25 = 0.33 \cdot \frac{x}{1207}$
 $x = 914$*

4. Determine whether the second scenario would be dependent or independent of the first scenario. Explain.

- a) Rolling a six-sided die, then drawing a card from a deck of 52 cards. *ind.*
- b) Drawing a card from a deck of 52 cards, then drawing another card from the same deck. *dep.*
- c) Rolling a six-sided die, then rolling it again. *ind.*
- d) Pulling a marble out of a bag, replacing it, then pulling a marble out of the same bag. *ind.*
- e) Having 20 treats in five different flavors for a soccer team, with each player taking a treat. *dep.*

So $914 - 296 = 618$ men needed to survive

5. The definition of independence is that two events (A and B) are said to be independent if

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

Explain what this looks like in a Venn diagram, a tree diagram, and a two-way table.

