

3.3: The Addition and Complement Rules

The Addition Rule

Two events are considered **mutually exclusive** if they cannot both occur. If events A and B are mutually exclusive, the probability that event A or event B will occur is the sum of the individual probabilities. Formulaically speaking, If events A and B are mutually exclusive, $P(A \text{ or } B) = P(A \cup B) = P(A) + P(B)$.

If events are **not mutually exclusive**, they *can* both occur. Here we add the probability of each event, and subtract the overlap (A and B) because it was counted twice. Formulaically speaking, If events A and B are not mutually exclusive, $P(A \text{ or } B) = P(A \cup B) = P(A) + P(B) - P(A \cap B)$.

These make up the **addition rule**.

1. Let's return to the census data on sex and marital status.

Marital Status	Married	Widowed	Divorced	Separated	Never Married	Total
Male	64.5	3.4	12.2	2.1	47.5	129.7
Female	63.4	11.8	16.5	2.9	41.5	136.1
Total	127.9	15.2	28.7	5	89	265.8

- a. Are the events “divorced” and “separated” mutually exclusive? Explain.

- b. What is the probability that a randomly selected adult in the US is divorced or separated? Round your answer to three decimal places. Show your thinking using the table.

Marital Status	Married	Widowed	Divorced	Separated	Never Married	Total
Male	64.5	3.4	12.2	2.1	47.5	129.7
Female	63.4	11.8	16.5	2.9	41.5	136.1
Total	127.9	15.2	28.7	5	89	265.8

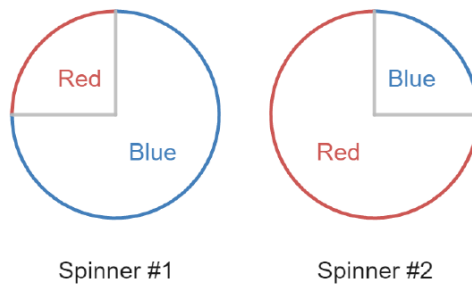
$$P(\text{divorced} \cup \text{separated}) = \underline{\hspace{1cm}} + \underline{\hspace{1cm}} \approx$$

- c. Are the events “separated” and “female” mutually exclusive? Explain.

d. What is the probability that a randomly selected adult in the US is separated or female? Use probability notation in your answer and round your answer to three decimal places. Show your thinking using the table.

Marital Status	Married	Widowed	Divorced	Separated	Never Married	Total
Male	64.5	3.4	12.2	2.1	47.5	129.7
Female	63.4	11.8	16.5	2.9	41.5	136.1
Total	127.9	15.2	28.7	5	89	265.8

2. Here's a new game with two spinners. For this game, we say the spinners "match" if they land on the same color (e.g., both red, or both blue).



Images are created with the graphing calculator, used with permission from Desmos Studio PBC.

a. What is the probability that both spinners land on red?

b. What is the probability that both spinners land on blue?

c. What is the probability that the spinners match (both red or both blue)? Use probability notation in your answer.

The Complement Rule

The **complement** of an event A is “not A ” and is denoted A^c . Because one of these events must occur, their probabilities must add to one. Therefore, we can compute the probability of event A using the rule of complements.

$$P(A) = 1 - P(\text{complement of } A) = 1 - P(A^c) \text{ and } P(\text{complement of } A) = P(A^c) = 1 - P(A)$$

This rule is useful when the computation of the probability of event A is complicated, but the probability of the complement of A is simpler.

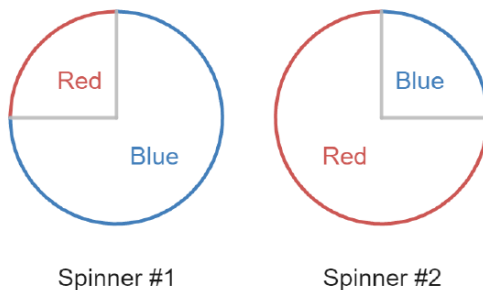
3. Let's return to the census data on sex and marital status.

Marital Status	Married	Widowed	Divorced	Separated	Never Married	Total
Male	64.5	3.4	12.2	2.1	47.5	129.7
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a. Define event A to be “widowed, divorced, separated, or never married”. What is the complement of A in words?

b. Compute $P(A^c)$.

4. Here's a new game with two spinners. For this game, we say the spinners "do not match" if they don't land on the same color.



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Use your answer to 2c. to find the probability that the spinners don't match. Use probability notation in your answer.

5. Marjorie forgets to prepare for a multiple choice quiz so she randomly guesses on all 3 questions. Each question has 5 answer options.
- a. What is the probability that Marjorie gets a question correct on the quiz?

 - b. What is the probability that Marjorie gets a question incorrect on the quiz?

 - c. What is the probability that Marjorie gets all 3 questions correct?

 - d. What is the probability that Marjorie gets at least 1 question incorrect?