

# Conditional Probability: Intermediate: Takeaways

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## Concepts

- Given events A and B:
  - $P(A)$  means finding the probability of A
  - $P(A|B)$  means finding the conditional probability of A (given that B occurs)
  - $P(A \cap B)$  means finding the probability that both A and B occur
  - $P(A \cup B)$  means finding the probability that A occurs or B occurs (this doesn't exclude the situation where both A and B occur)

- For any events A and B, it's true that:

$$P(A|B) = 1 - P(A^C|B)$$

$$P(A^C|B) = 1 - P(A|B)$$

- The order of conditioning is important, so  $P(A|B)$  is different  $P(B|A)$ .
- If event A occurs and the probability of B remains unchanged (and vice versa), then events A and B are said to be **statistically independent** (although the term "independent" is used more often). Mathematically, statistical independence between A and B implies that:

$$P(A) = P(A|B)$$

$$P(B) = P(B|A)$$

$$P(A \cap B) = P(A) \cdot P(B)$$

- If events events A and B are **statistically dependent**, it means that the occurrence of event A changes the probability of event B and vice versa. In mathematical terms, this means that:

$$P(A) \neq P(A|B)$$

$$P(B) \neq P(B|A)$$

$$P(A \cap B) \neq P(A) \cdot P(B)$$

- If three events A, B, C are **mutually independent**, then two conditions must hold: they should be pairwise independent, but also independent together. If any of these two conditions doesn't hold, then the events are not mutually independent.
- The multiplication rule for dependent events:

$$P(A \cap B) = P(A) \cdot P(B|A)$$

$$P(A \cap B \cap C) = P(A) \cdot P(B|A) \cdot P(C | A \cap B)$$

- The multiplication rule for independent events:

$$P(A \cap B) = P(A) \cdot P(B)$$

$$P(A \cap B \cap C) = P(A) \cdot P(B) \cdot P(C)$$

$$P(A \cap B \cap \dots \cap Y \cap Z) = P(A) \cdot P(B) \cdot \dots \cdot P(Y) \cdot P(Z)$$

## Resources

- [An intuitive approach to understanding independent events](#)
- [An easy intro to some basic conditional probability concepts](#)
- [A brief reminder on set complements](#)