

PROBABILITY TOPICS: VENN DIAGRAMS (OPTIONAL)*

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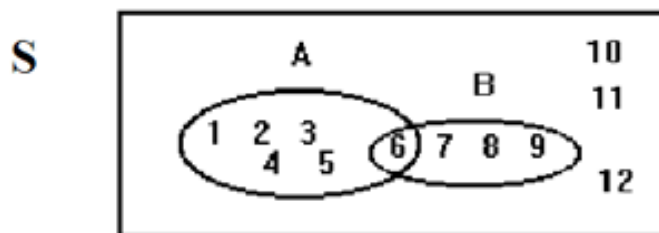
Abstract

This module introduces Venn diagrams as a method for solving some probability problems. This module is included in the Elementary Statistics textbook/collection as an optional lesson.

A **Venn diagram** is a picture that represents the outcomes of an experiment. It generally consists of a box that represents the sample space S together with circles or ovals. The circles or ovals represent events.

Example 1

Suppose an experiment has the outcomes 1, 2, 3, ..., 12 where each outcome has an equal chance of occurring. Let event $A = \{1, 2, 3, 4, 5, 6\}$ and event $B = \{6, 7, 8, 9\}$. Then $A \text{ AND } B = \{6\}$ and $A \text{ OR } B = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$. The Venn diagram is as follows:



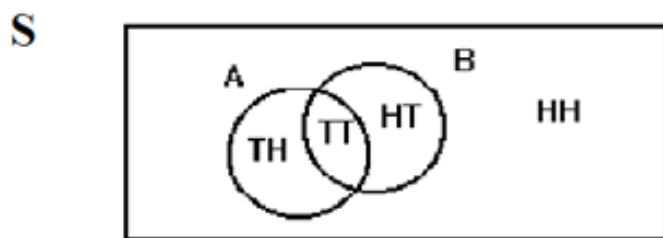
Example 2

Flip 2 fair coins. Let $A =$ tails on the first coin. Let $B =$ tails on the second coin. Then $A = \{TT, TH\}$ and $B = \{TT, HT\}$. Therefore, $A \text{ AND } B = \{TT\}$. $A \text{ OR } B = \{TH, TT, HT\}$.

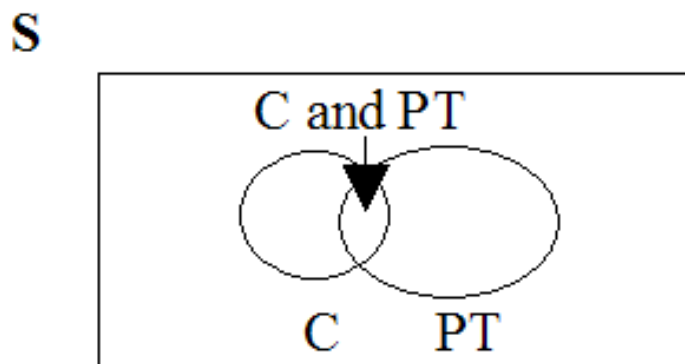
The sample space when you flip two fair coins is $S = \{HH, HT, TH, TT\}$. The outcome HH is in neither A nor B . The Venn diagram is as follows:

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**Example 3**

Forty percent of the students at a local college belong to a club and **50%** work part time. **Five percent** of the students work part time and belong to a club. Draw a Venn diagram showing the relationships. Let C = student belongs to a club and PT = student works part time.



If a student is selected at random find

- The probability that the student belongs to a club. $P(C) = 0.40$.
- The probability that the student works part time. $P(PT) = 0.50$.
- The probability that the student belongs to a club AND works part time. $P(C \text{ AND } PT) = 0.05$.
- The probability that the student belongs to a club **given** that the student works part time.

$$P(C|PT) = \frac{P(C \text{ AND } PT)}{P(PT)} = \frac{0.05}{0.50} = 0.1 \quad (1)$$

- The probability that the student belongs to a club **OR** works part time.

$$P(C \text{ OR } PT) = P(C) + P(PT) - P(C \text{ AND } PT) = 0.40 + 0.50 - 0.05 = 0.85 \quad (2)$$

Glossary

Definition 1: Venn Diagram

The visual representation of a sample space and events in the form of circles or ovals showing their intersections.