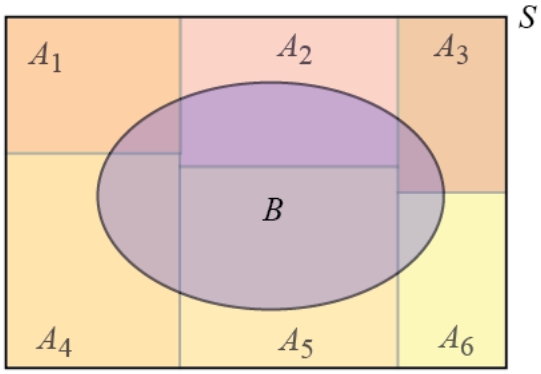
TOOL: The Law of Total Probability states that, given a partition A_1, A_2, A_3, ..., A_n of sample space S, the probability of any event B is given by the sum of the probabilities of B intersected with each of the A_i:

$$P(B) = P(B \cap A_1) + P(B \cap A_2) + P(B \cap A_3) + \ldots + P(B \cap A_n)$$

The Law of Total Probability is often used to find one unknown probability of the intersection of events when all of the other terms (including $P(B)$) are known.

A Venn diagram illustrates the law of total probability in an intuitively obvious way.



Here, $n = 6$. It is easy to see that the area of B, which represents $P(B)$, is equal to the areas of the overlaps of B with each of the A_i.