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*Introduction to Probability*  
*First Edition*



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## *Preface*

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# 1

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## *Fundamentals of Probability and Its Axioms*

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### 1.1 Combinations and Permutations

Counting plays a very important role in probability. In probability, we often deal with sets, and counting methods such as combinations and permutations help us find the number of elements in a set. Specifically, in probability, we deal with a set called the **sample space** which is the set of all possible outcomes of some random experiment and **events**, which are subsets of the sample space. Typically, the sample space is denoted by  $S$  or  $\Omega$ . Consider the following example:

**Example 1.1.** Suppose a fair coin is flipped twice. What is the probability of flipping at least one head?

**Example Solution.**

The sample space of this experiment can be expressed as  $S = \{HH, HT, TH, TT\}$ . Now, consider the event:

$$A = \{\text{At least one outcome is a head}\}$$

Notice that  $A \subset S$  ( $A$  is a subset of  $S$ ). Since  $A = \{HH, HT, TH\}$ , we can find the probability as follows:

$$P(A) = \frac{\text{\#elements in } A}{\text{\#elements in } S} = \frac{3}{4}.$$





## 2

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### *Basic Probability*

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