The classification of **sample spaces** into **finite, infinite, discrete, and continuous** depends on the nature and countability of the possible outcomes:

**1. Finite Sample Space**

* The number of possible outcomes is **limited (finite)**.
* Example: Rolling a six-sided die → S={1,2,3,4,5,6}S = \{1, 2, 3, 4, 5, 6\}S={1,2,3,4,5,6}
* Example: Tossing a coin → S={H,T}S = \{H, T\}S={H,T}

**2. Infinite Sample Space**

* The number of possible outcomes is **unlimited (infinite)**.
* It can be **countably infinite** (like natural numbers) or **uncountably infinite** (like real numbers).
* Example (Countably Infinite): Rolling a die **until** a 6 appears → S={1,2,3,4,5,6,7,… }S = \{1, 2, 3, 4, 5, 6, 7, \dots\}S={1,2,3,4,5,6,7,…}
* Example (Uncountably Infinite): Measuring the weight of a randomly chosen person → S=(0,∞)S = (0, \infty)S=(0,∞)

**3. Discrete Sample Space**

* Contains **separate (distinct) outcomes** that can be counted.
* Can be **finite or countably infinite**.
* Example (Finite): Rolling a die → S={1,2,3,4,5,6}S = \{1, 2, 3, 4, 5, 6\}S={1,2,3,4,5,6}
* Example (Countably Infinite): Number of attempts to pass an exam → S={1,2,3,… }S = \{1, 2, 3, \dots\}S={1,2,3,…}

**4. Continuous Sample Space**

* Contains an **uncountable** number of possible outcomes, often within a range of real numbers.
* Example: Measuring a person’s height → S=(0,∞)S = (0, \infty)S=(0,∞)
* Example: The time a randomly chosen person takes to finish a race → S=[0,∞)S = [0, \infty)S=[0,∞)

**Relationship Between These Types:**

* **Finite sample spaces** are always **discrete**.
* **Infinite sample spaces** can be **discrete (countable) or continuous (uncountable)**.
* **Discrete sample spaces** can be **finite or infinite**.
* **Continuous sample spaces** are always **infinite**.