Random Variables and Signals

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Random Experiments as ~~Prob~~ Probability Spaces

We use a prob. space to represent a random experiment mathematically. This consists of

1. The sample space — the set of all possible outcomes
2. A collection of ~~set~~ sets of outcomes, called events, to which probabilities are assigned
3. A function mapping events to probabilities, the prob. measure.

Set Theory

Defn. A set is a collection of objects called elements, members, or points.

Notation: $w \in A$ means that w is an element of the set A

$w \notin A$ means w is not in A.

Two ways to specify a set:

(1) Explicitly list the elements between $\{\}$

For example,

$A = \{1, 2, 3, 4, 5, 6\}$ or

$A = \{1, \ldots, n\}$ for finite n integers from 1 to n,

or

$A = \{1, 2, \ldots\}$ all positive integers

(2) Specify a rule for membership:

Example.

$$A = \{ w \in \mathbb{Z} : 1 \leq w \leq 6 \}$$

(all) — the set of integers — such that

Defn. The <u>universal set</u>, or space, is the set containing all possible elements. We will denote this as $\mathcal{S}$.

Defn. The set containing no elements is called the empty set, or the null set.

Denoted ϕ, or $\{\}$

Note: $\{\phi\}$ is not the empty set. It is a set containing one element, the empty set.