



Al-Mustaqbal University College
Department of Computer
Engineering Techniques



Information Theory and coding
Fourth stage

Lecture 1
Probability

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Probability

Probability: is the core mathematical tool for communication theory.

signal is a random process in nature:

- Message is random. No randomness, no information.
- Interference is random.
- Noise is a random process.
- And many more (delay, phase, fading, ...)
- Other real-world applications of probability and random Processes

Probability: is the study of randomness and uncertainty.

In the early days, probability was associated with games of chance (gambling).

Random experiment :a **random experiment** is a process whose outcome is uncertain.

Examples:

- Tossing a coin once or several times
- Picking a card or cards from a deck
- Measuring temperature of patients

Event & Sample Spaces

The set of all possible outcomes of a statistical experiment is called the sample space and is represented by the symbol S .

Each outcome in a sample space is called an element or a member of the sample space, or simply a sample point. If the sample space has a finite number of elements, we may



list the members separated by commas and enclosed in braces. Thus, the sample space S , of possible outcomes when a coin is flipped, may be written $S = \{H, T\}$, where H and T correspond to heads and tails, respectively.

Example 1: Consider the experiment of tossing a die. If we are interested in the number that

shows on the top face, the sample space is

$$S_1 = \{1, 2, 3, 4, 5, 6\}.$$

If we are interested only in whether the number is even or odd, the sample space is simply

$$S_2 = \{\text{even, odd}\}.$$

Example 2: Experiment: Toss a coin 3 times.

- Sample space S

$$S = \{HHH, HHT, HTH, HTT, THH, THT, TTH, TTT\}.$$

Event :An event is a subset of a sample space.

- Examples of events include

1-at least two heads

$$A = \{HHH, HHT, HTH, THH\}$$

2- Exactly two tails

$$B = \{HTT, THT, TTH\}$$

3- Even number in the die-tossing experiment

$$A = \{2, 4, 6\}$$

4-odd number in the die-tossing experiment

$$B = \{1, 3, 5\}$$



The Characteristics of Probability:

1- For any event , $0 \leq P(x_i) \leq 1$.

2- $\sum_{i=1}^n P(x_i) = 1$

For the good solution you must solve as these points

- 1-called the experiment
- 2-define the sample pace
- 3- Define the event (outcome) :from the question
- 4-define the probability

Example 3: Consider the experiment of tossed a die. If we are interested in the number that shows on the top face, find the probability for it? Sol:

the sample space is $S1 = \{1, 2, 3, 4, 5, 6\}$.

Events: show the top face: 1,2,3,4,5,6

$P(1)=1/6$; $p(2)=1/6$; $p(3)=1/6$;

Example 4: find the probability for Toss a coin one times.

$S=\{H, T\}$

$P(H)= 1/2$, $p(T)= 1/2$



Example .5: find the probability for experiment tossed a coin 3 times to get

1-Top face. 2-at least two heads. 3-exactly three tails Sol:

$S = \{HHH, HHT, HTH, HTT, THH, THT, TTH, TTT\}$.

1- the probability of the top face is:

$P(HHH)=1/8, P(HHT)=1/8, P(HTH)=1/8$ 2- At least

two heads: $A = \{HHH, HHT, HTH, THH\}$

$P(A)=1/8+1/8+1/8+1/8=4/8$ 3- Exactly three tails: $B =$

$\{TTT\}$

$P(B)=1/8$

H.W: find the probability for tossed the die two time for all events?