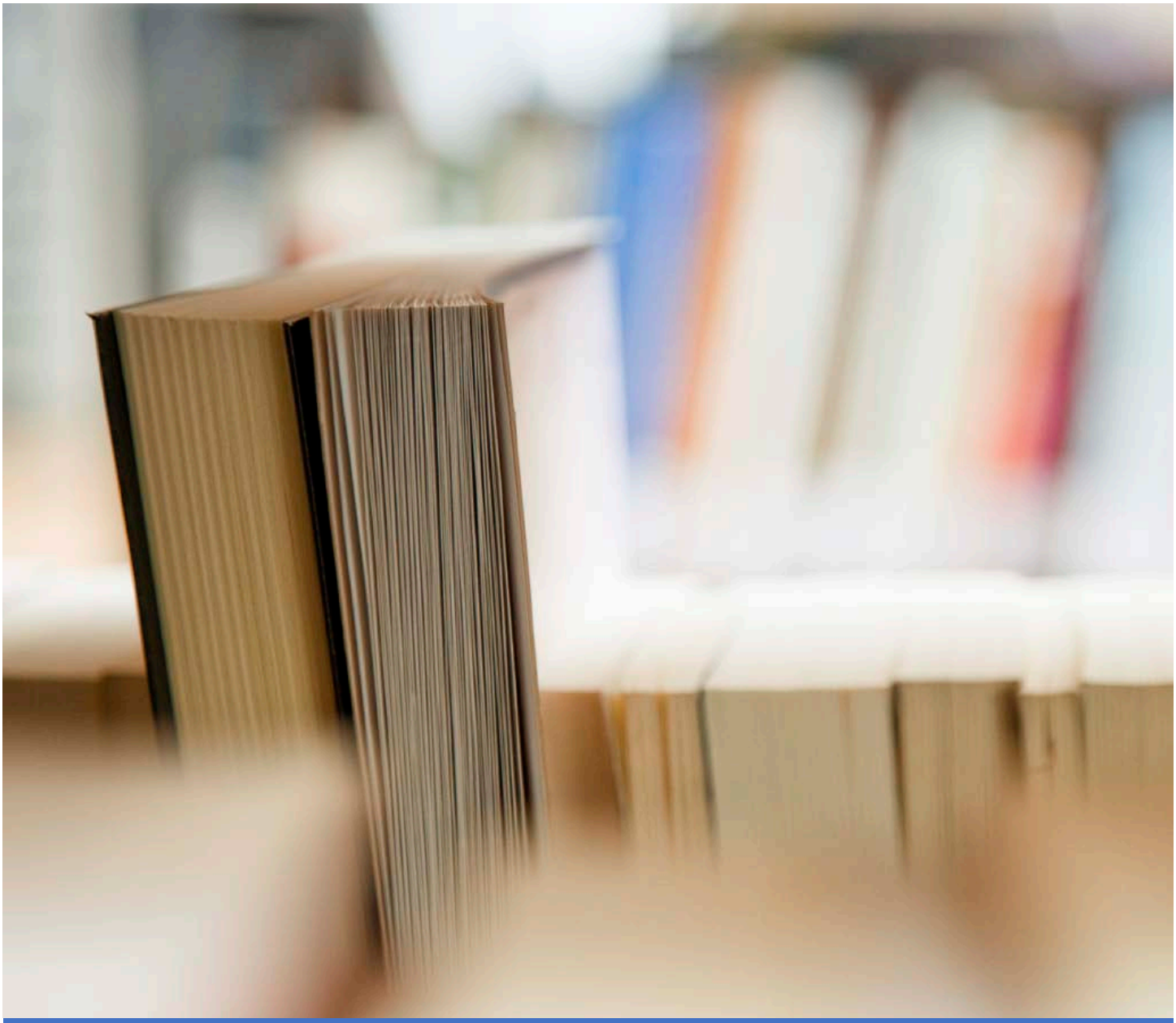

Information Theory and Coding

Forth Stage

MSc. Zahraa Niema Kamal

Lecture One

first Course

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
S1 = {1, 2, 3, 4, 5, 6}.

If we are interested only in whether the number is even or odd, the sample space is simply
S2 = {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?