جـامـعـة بنهـــا

كلية الحاسبات والذكاء الإصطناعي

Probability and Statistics

Lecture 01

Dr. Ahmed Hagag

Faculty of Computers and Artificial Intelligence
Benha University

Spring 2023

Introduce Myself

Dr. Ahmed Hagag

Lecturer, Scientific Computing Department,
Faculty of Computers and Artificial Intelligence,
Benha University.

Email: ahagag@fci.bu.edu.eg

Basic Course Information

- Course Code: **FBS111-NBS111**
- Course Name: **Probability and Statistics**
- Level: **1^{st} Year / B.Sc.**
- Course Credit: **3 credits**
- Instructor: **Dr. Ahmed Hagag**

Assessment

Final Exam

50

الامتحان النهائي

Section

20

حضور و واجبات
ومشاركة في السكاشن

Midterm

15

منتصف الفصل

Quizzes

10

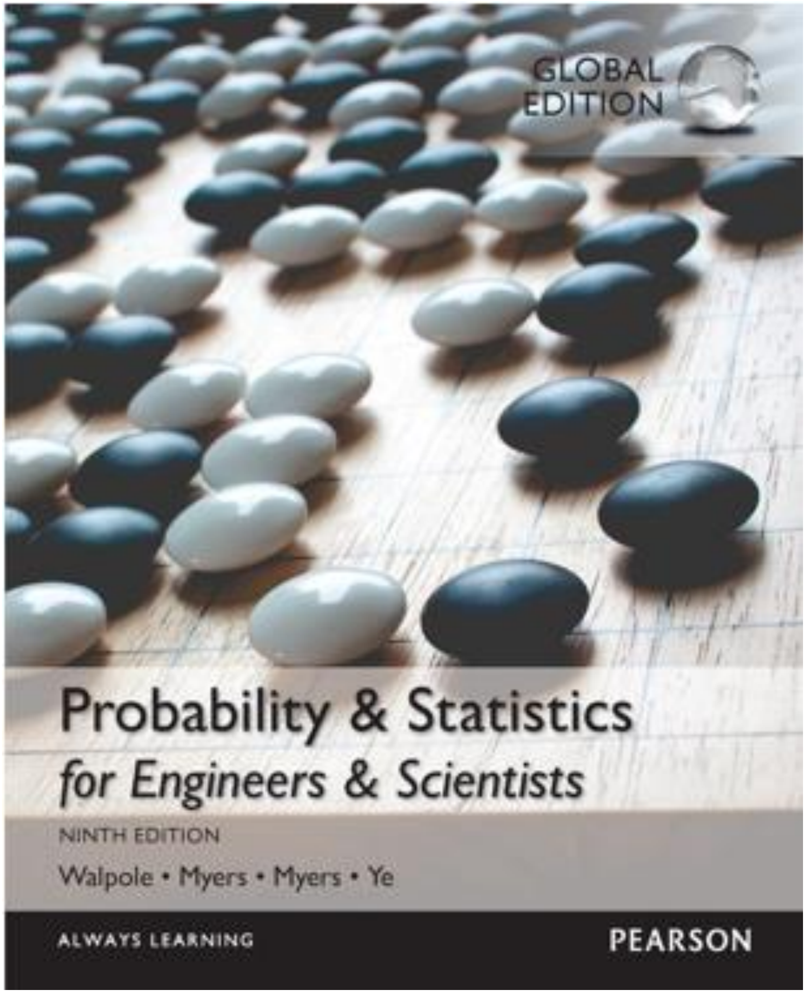
الاختبارات
الفصلية

Attend

5

حضور

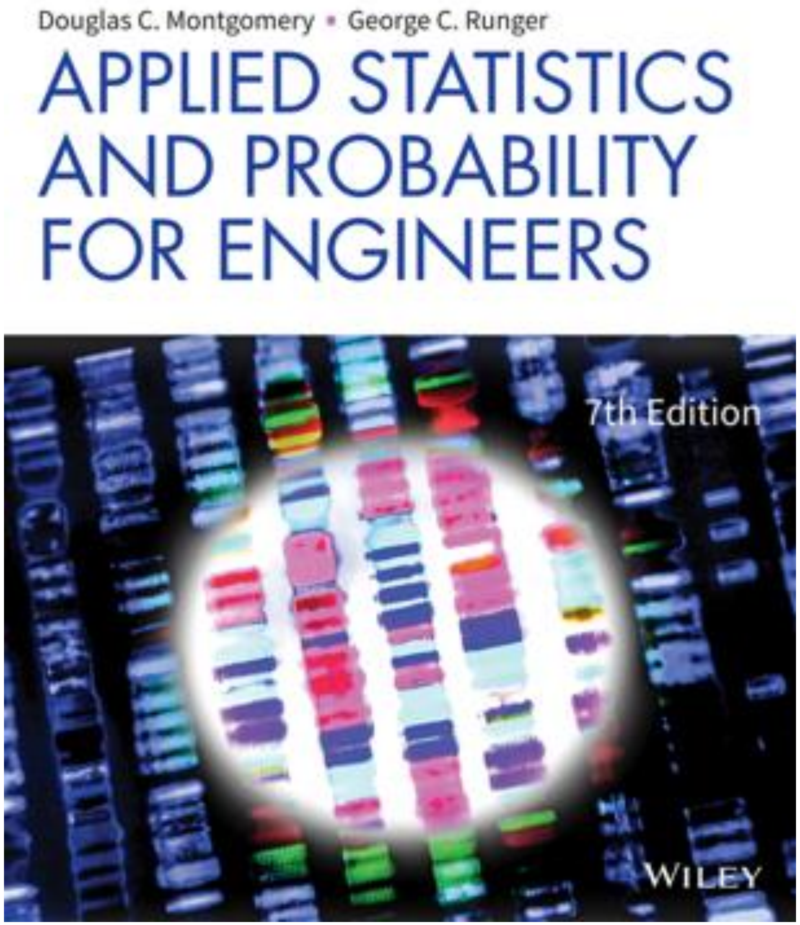
Lectures References (1/2)



Probability & Statistics for Engineers & Scientists

9th Edition

Lectures References (2/2)



Applied Statistics and Probability for Engineers

7th Edition

Discussion Question

Why do we study this course?

Course Syllabus

Some topics from the following chapters:

- Chapter 1: Probability.
- Chapter 2: Random Variables.
- Chapter 3: Probability Distributions.
- Chapter 4: Descriptive Statistics.

Chapter 1: Probability

- Sample Space.
- Events.
- Counting Techniques.
- Probability of an Event.
- Additive Rules.
- Conditional Probability.
- Independence, and the Product Rule.
- Bayes' Rule.

Sample Space (1/9)

Random (Statistical) Experiment:

- An experiment <with known outcomes> whose outcome cannot be predicted with certainty, before the experiment is run.

Sample Space (1/9)

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- An experiment <with known outcomes> whose outcome cannot be predicted with certainty, before the experiment is run.

The roll of a dice

The toss of (flipping) a coin

Sample Space (2/9)

Sample Space (S):

- Set of ALL possible outcomes of a random experiment.
- A sample space is discrete if it consists of a finite or countable infinite set of outcomes.
- A sample space is continuous if it contains an interval (either finite or infinite) of real numbers.

Sample Space (3/9)

Sample Space (S):

- Set of ALL possible outcomes of a random experiment.

The roll of a dice

Sample Space (3/9)

Sample Space (S):

- Set of ALL possible outcomes of a random experiment.

The roll of a dice

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

Sample Space (3/9)

Sample Space (S):

Discrete

- Set of ALL possible outcomes of a random experiment.

The roll of a dice

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

Each outcome in a sample space is called an **element** or a **member** of the sample space, or simply a **sample point**.

Sample Space (4/9)

Sample Space (*S*):

- Set of ALL possible outcomes of a random experiment.

Flipping a coin

Sample Space (4/9)

Sample Space (S):

- Set of ALL possible outcomes of a random experiment.

Flipping a coin

$$S = \{Head, Tail\}$$

$$S = \{H, T\}$$

Sample Space (5/9)

Example1:

Find the sample space for the random experiments (flipping) a coin of two times?

Sample Space (5/9)

Example1:

Find the sample space for the random experiments (flipping) a coin of two times?

Answer:

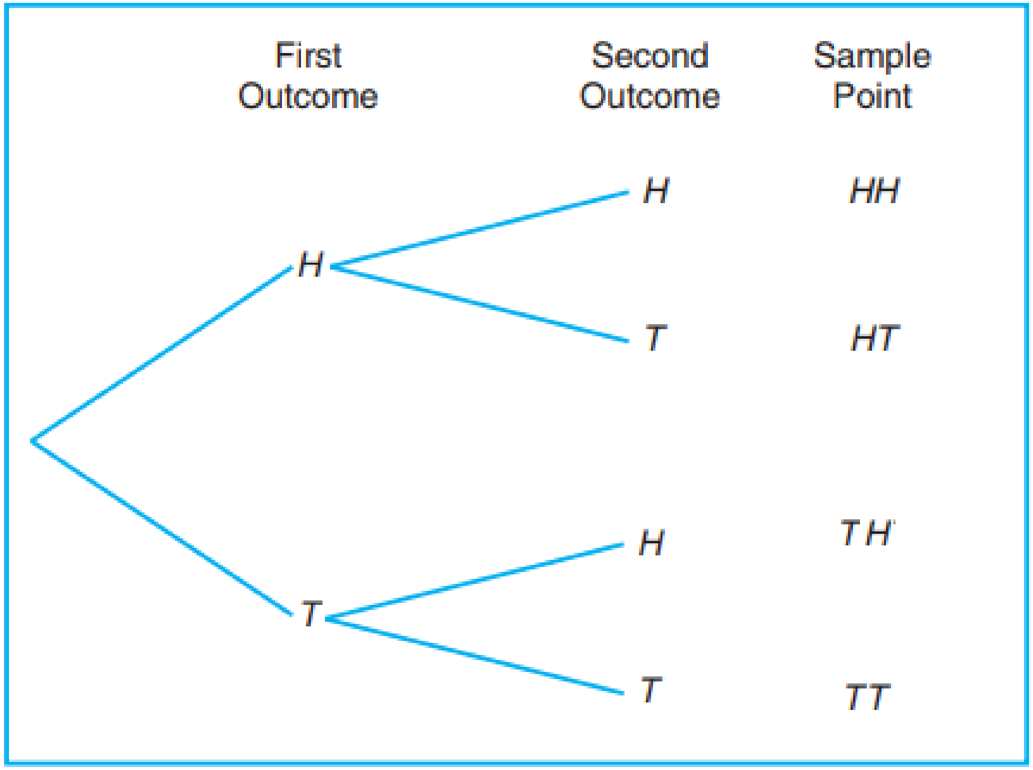
$S = \{HH, HT, TH, TT\}$

Sample Space (6/9)

Tree Diagrams:

Sample spaces can also be described graphically with *tree diagrams*.

$S = \{HH, HT, TH, TT\}$



Sample Space (7/9)

Example2:

An experiment consists of flipping a coin and then flipping it a second time if a head occurs. If a tail occurs on the first flip, then a die is tossed once.

Sample Space (7/9)

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An experiment consists of flipping a coin and then flipping it a second time if a head occurs. If a tail occurs on the first flip, then a die is tossed once.

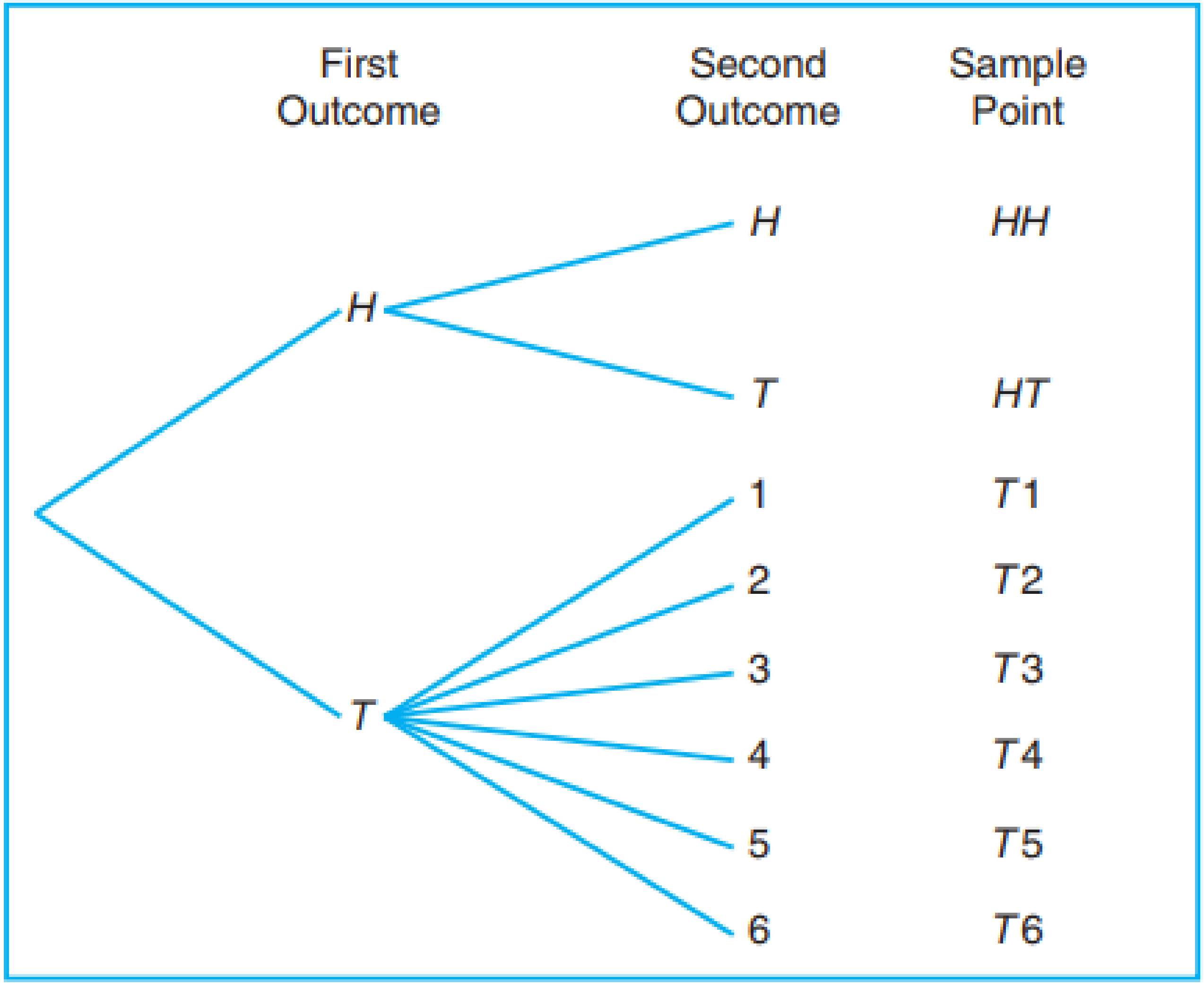
Answer:

$$S = \{HH, HT, T1, T2, T3, T4, T5, T6\}$$

Sample Space (8/9)

Example2:

$S = \{HH, HT, T1, T2, T3, T4, T5, T6\}$



Sample Space (9/9)

Example3:

Continuous

Consider an experiment that selects a cell phone camera and records the recycle time of a flash (the time taken to ready the camera for another flash).

$$\boldsymbol{S} = R^{+} = \{x|\, x > 0\}$$

If it is known that all recycle times are between 1.5 and 5 seconds, the sample space can be

$$\boldsymbol{S} = \{x|\, 1.5 < x < 5\}$$

Events (1/19)

Event (E):

- A result of *none* , *one* , or *more* outcomes in the sample space. An event is a subset of the sample space of a random experiment.

Events (2/19)

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The roll of a dice

$$S = \{1,2,3,4,5,6\}$$
$$E = \{2,4,6\}$$

Even Numbers

Events (3/19)

Example1:

A dice is rolled twice. What is the Event that the sum of the faces is greater than 7, given that the first outcome was a 4?

Events (4/19)

Example1:

A dice is rolled twice. What is the Event that the sum of the faces is greater than 7, given that the first outcome was a 4?

Answer:

$S = \{11, 12, 13, 14, 15, 16, 21, 22, 23, 24, 25, 26,$

$31, 32, 33, 34, 35, 36, \mathbf{41}, \mathbf{42}, \mathbf{43}, \mathbf{44}, \mathbf{45}, \mathbf{46},$

$51, 52, 53, 54, 55, 56, 61, 62, 63, 64, 65, 66\}$

$E = \{44, 45, 46\}$

Events (5/19)

We can also be interested in describing new events from combinations of existing events. Because events are subsets, we can use basic set operations such as *unions*, *intersections*, and *complements* to form other events of interest. Some of the basic set operations are summarized here in terms of events:

1. The union of two events is the event that consists of all outcomes that are contained in either of the two events. We denote the union as $E_1 \cup E_2$.

Events (6/19)

We can also be interested in describing new events from combinations of existing events. Because events are subsets, we can use basic set operations such as *unions*, *intersections*, and *complements* to form other events of interest. Some of the basic set operations are summarized here in terms of events:

2. The intersection of two events is the event that consists of all outcomes that are contained in both of the two events. We denote the intersection as $E_1 \cap E_2$.

Events (7/19)

We can also be interested in describing new events from combinations of existing events. Because events are subsets, we can use basic set operations such as *unions*, *intersections*, and *complements* to form other events of interest. Some of the basic set operations are summarized here in terms of events:

3. The complement of an event in a sample space is the set of outcomes in the sample space that are not in the event. We denote the complement of the event E as E'. The notation E^C is also used in other literature to denote the complement.

Events (8/19)

Example2:

In the tossing of a die, we might let A be the event that an even number occurs and B the event that a number greater than 3 shows.

Events (9/19)

Example2:

In the tossing of a die, we might let A be the event that an even number occurs and B the event that a number greater than 3 shows.

Then the subsets $A = \{2, 4, 6\}$ and $B = \{4, 5, 6\}$ are subsets of the same sample space $S = \{1, 2, 3, 4, 5, 6\}$.

Example2:

Then the subsets $A = \{2, 4, 6\}$ and $B = \{4, 5, 6\}$ are subsets of the same sample space $S = \{1, 2, 3, 4, 5, 6\}$.

$$A \cap B = \{4, 6\}$$

$$A \cup B = \{2, 4, 5, 6\}$$

$$A' = \{1, 3, 5\}$$

$$B' = \{1, 2, 3\}$$

Events (11/19)

Mutually Exclusive, or Disjoint:

Two events A and B are *mutually exclusive*, or *disjoint*, if $A \cap B = \emptyset$, that is, if A and B have **no** elements in common.

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

$A \cap B = \{\ \} = \emptyset$

Events (12/19)

Venn Diagrams:

Diagrams are often used to portray relationships between sets, and these diagrams are also used to describe relationships between events. We can use Venn diagrams to represent a sample space and events in a sample space.

Events (13/19)

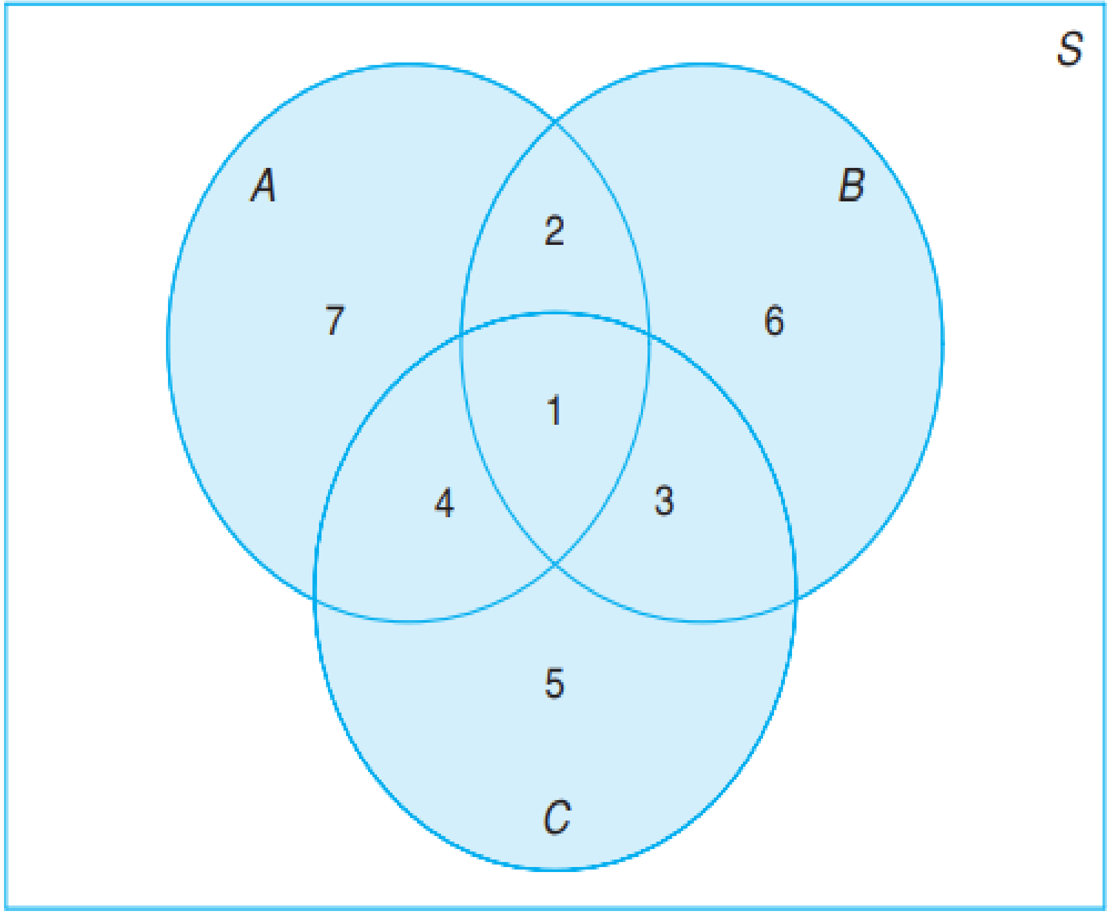
Example1:

$$S = \{1, 2, 3, 4, 5, 6, 7\}$$

$$A = \{1, 2, 4, 7\}$$

$$B = \{1, 2, 3, 6\}$$

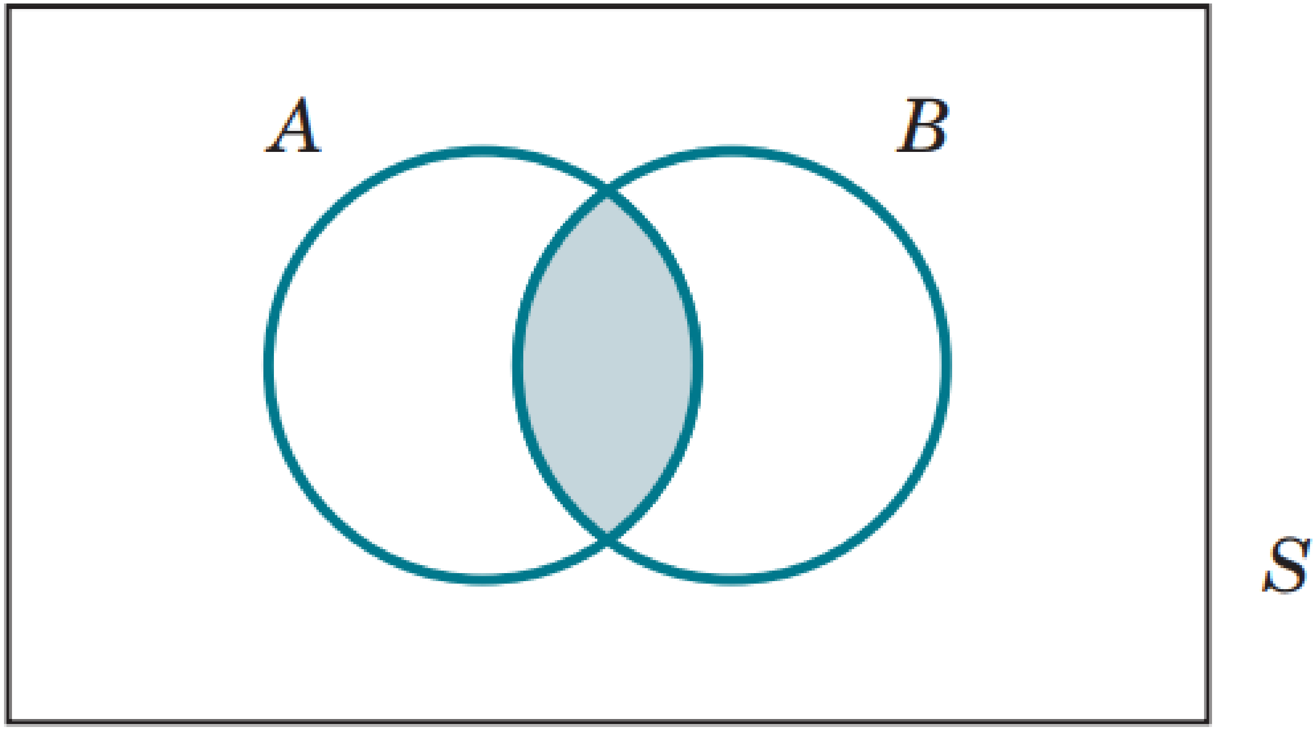
$$C = \{1, 3, 4, 5\}$$



Events (14/19)

Example2:

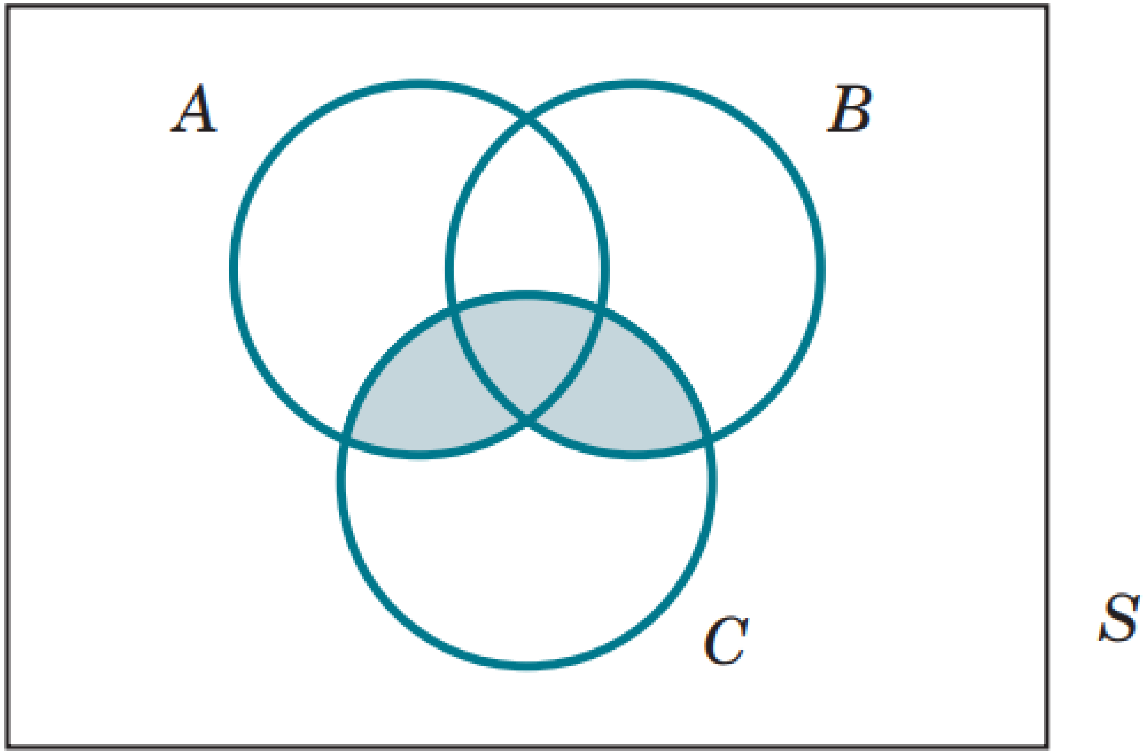
$A \cap B$



Events (15/19)

Example3:

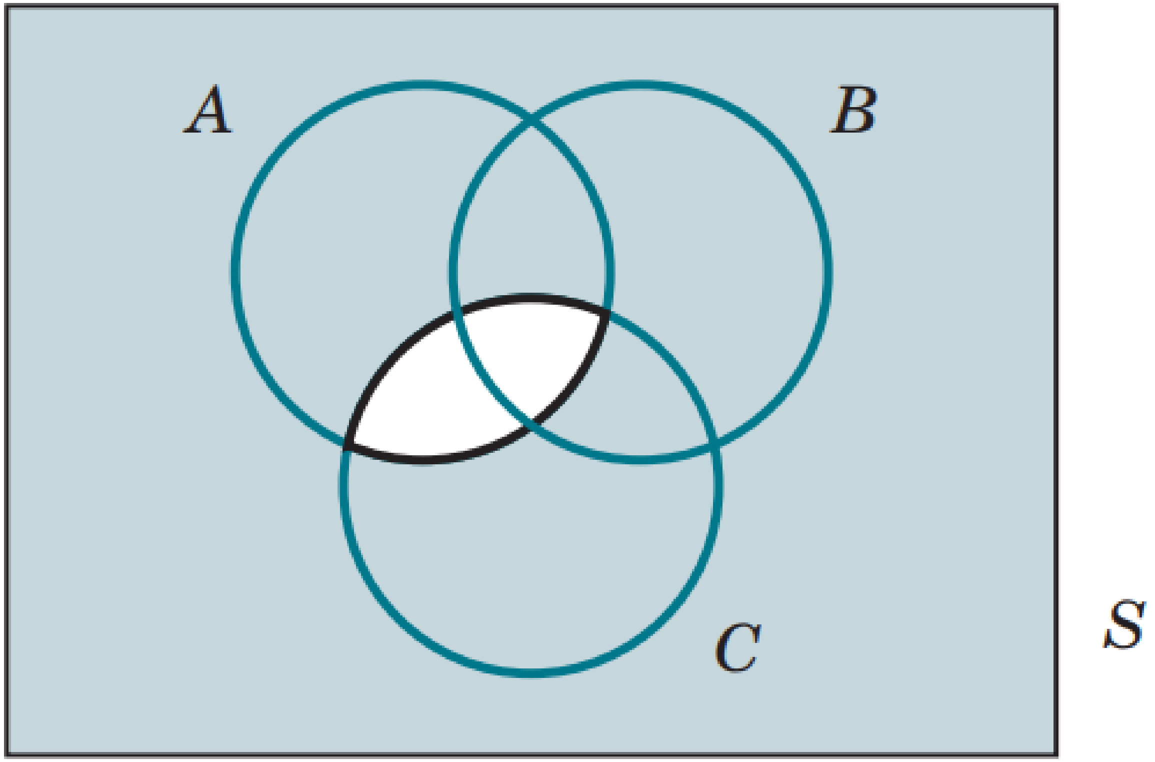
$(A \cup B) \cap C$



Events (16/19)

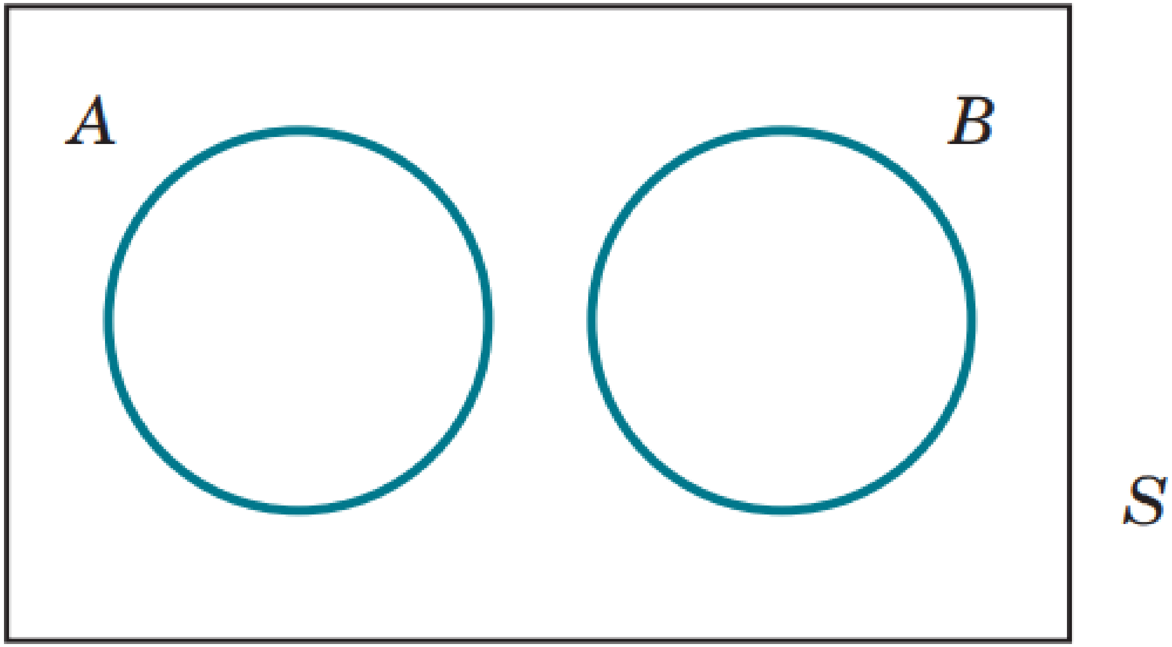
Example4:

$(A \cap C)'$



Events (17/19)

Example5:



Mutually exclusive events.

Events (18/19)

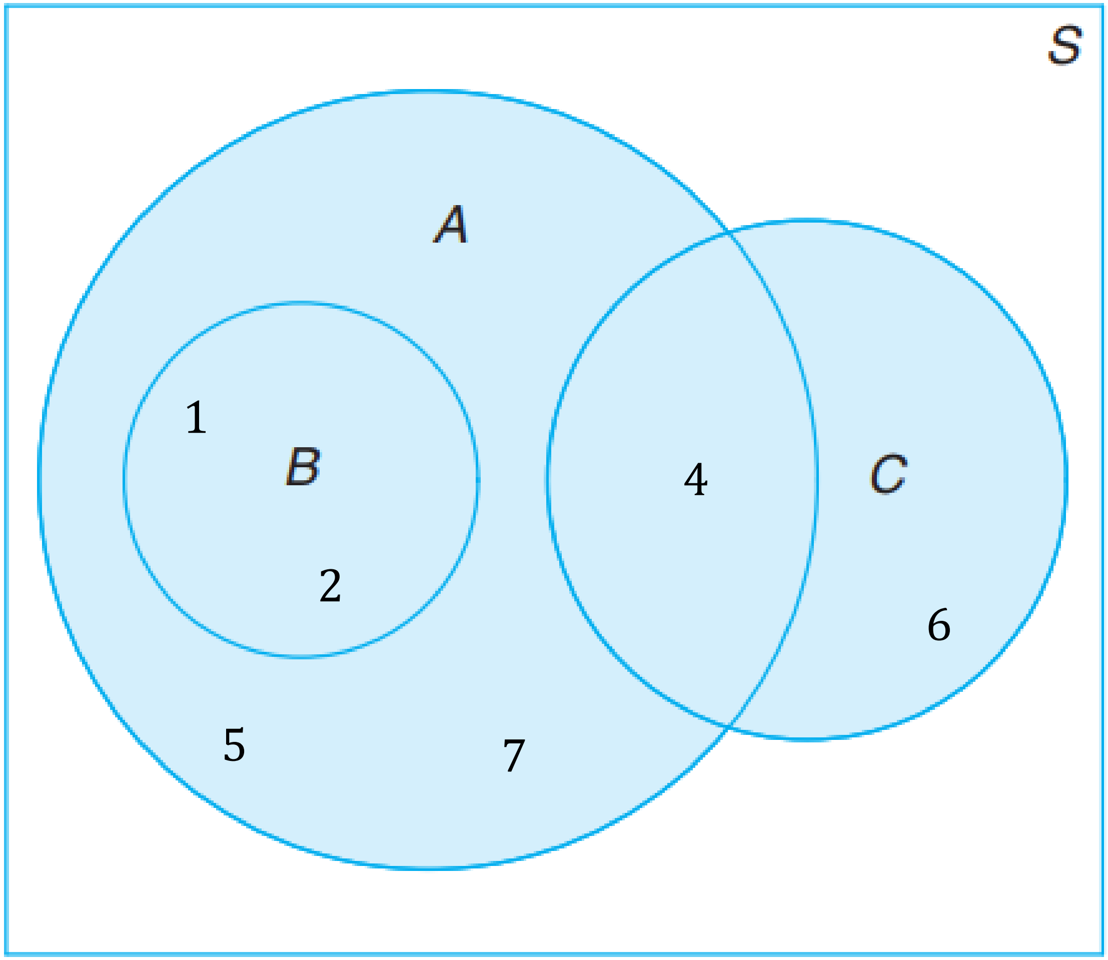
Example6:

$S = \{1, 2, 3, 4, 5, 6, 7\}$

$A = \{1, 2, 4, 5, 7\}$

$B = \{1, 2\}$

$C = \{4, 6\}$



Events (19/19)

Several Results:

1. $A \cap \phi =$
2. $A \cup \phi =$
3. $A \cap A' =$
4. $A \cup A' =$
5. $S' =$
6. $\phi' =$
7. $(A')' =$
8. $(A \cap B)' =$
9. $(A \cup B)' =$

Events (19/19)

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6. $\phi' = S$.
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9. $(A \cup B)' =$

Events (19/19)

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Video Lectures

All Lectures: https://www.youtube.com/playlist?list=PLxIvc-MGOs6gW9SgkmoxE5w9vQkID1_r-

Lecture #1: https://www.youtube.com/watch?v=GmJJ2iZzO8c&list=PLxIvc-MGOs6gW9SgkmoxE5w9vQkID1_r-&index=1&t=1s

Thank You

Dr. Ahmed Hagag
ahagag@fci.bu.edu.eg