ECO-HC-1026: MATHEMATICAL METHODS IN ECONOMICS-I

Unit: 1 (Preliminaries)
Topic: Sets
B.A./B.Sc (Hons.) 1st Sem.

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What is set?

- A collection of objects viewed as a whole is called a ***set***.
- The objects are called the **elements of the set**.
- **Example:**
- The economics honours students of B.A. 1st semester of Rangia College. Here all the students of economics honours of the 1st semester of Rangia College viewed as a whole is a set and each students of the semester is the elements of the set.
- Mathematically,
    - S= {a, b, c, d, e, f, g, h, i, j, k, m, n, o, p, q, r, s,t}

Different types of sets

Infinite Set: If a set contain an infinite number of elements then it is called the infinite set.

- **Example:**
- A set of all whole numbers, W= {0, 1, 2, 3, 4,…}
- The set of leaves on a tree

2. **Finite Set**: A set is said to be a **finite set** if it contains a finite number of different elements.

Example:

- The Set of Months in a year
- The Set of Days in a week

3. **Null or empty set:** An empty or null set contains no element. It is denoted by Greek letter φ (Phi).

Example:

❖The set of integers which are both even and odd.

Standard Notations used in Set

$$x \varepsilon S$$

- indicates that x is an element of S.

➢ To express the fact that x is not a element of S, we write

$$x \notin S$$

➢ For example, $b \notin \{a, e, i, o, u\}$ means that b is not an element of the set {a, e, i, o, u}.

Q. When two sets are considered equal?

Ans: Two sets A and B are considered equal if each element of A is an element of B and each element of B is an element of A. In this case, we write A=B. This means that the two sets consist of exactly the same elements.

Consequently, {1,3,5} = {5,3,1}, because the order in which the elements are listed has no significance; and {1,3,5,5}={1,3,5}, because a set is not changed if some elements are listed more than once.

Subsets

- Let A and B be any two sets. Then A is a subset of B if every element of A is also an element of B. So A is smaller than B in some sense, even though A and B could actually be equal. This relationship is expressed symbolically by $A \subset B$.
- *A special case of a subset is when A is a proper subset of B, meaning that* $A \subset B$ *and* $A \neq B$
- *Examples:*

1. The set A = {1, 2, 3} is a proper subset of B = {1, 2, 3,4,5}.
2. The set D = {1, 2, 3} is a subset (but *not* a proper subset) of E = {1, 2, 3}

Set operations

- Three important Set operations are-

1. Union
2. Intersection and
3. The difference of a set

Table: Set Operations

Notation	Name	The set consists of
A U B	A union B	All the elements of A and B
A ∩ B	A intersection B	The elements that belongs to both A and B
A\B	A minus B	The elements that belongs to A but not to B
B\A	B minus A	The elements that belongs to B but not to A

Example

Q. Let $A=\{1,2,3,4,5,6\}$ and $B=\{1,3,5,7,9\}$. Find $A \cup B$, $A \cap B$, $A \setminus B$ and $B \setminus A$.

Solution: $A \cup B = \{1,2,3,4,5,6,7,9\}$

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

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

$B \setminus A=\{7,9\}$

Q. Let $A=\{1,2,3,4,5,6\}$ and $B=\{7,8,9\}$. Find $A \cap B$.

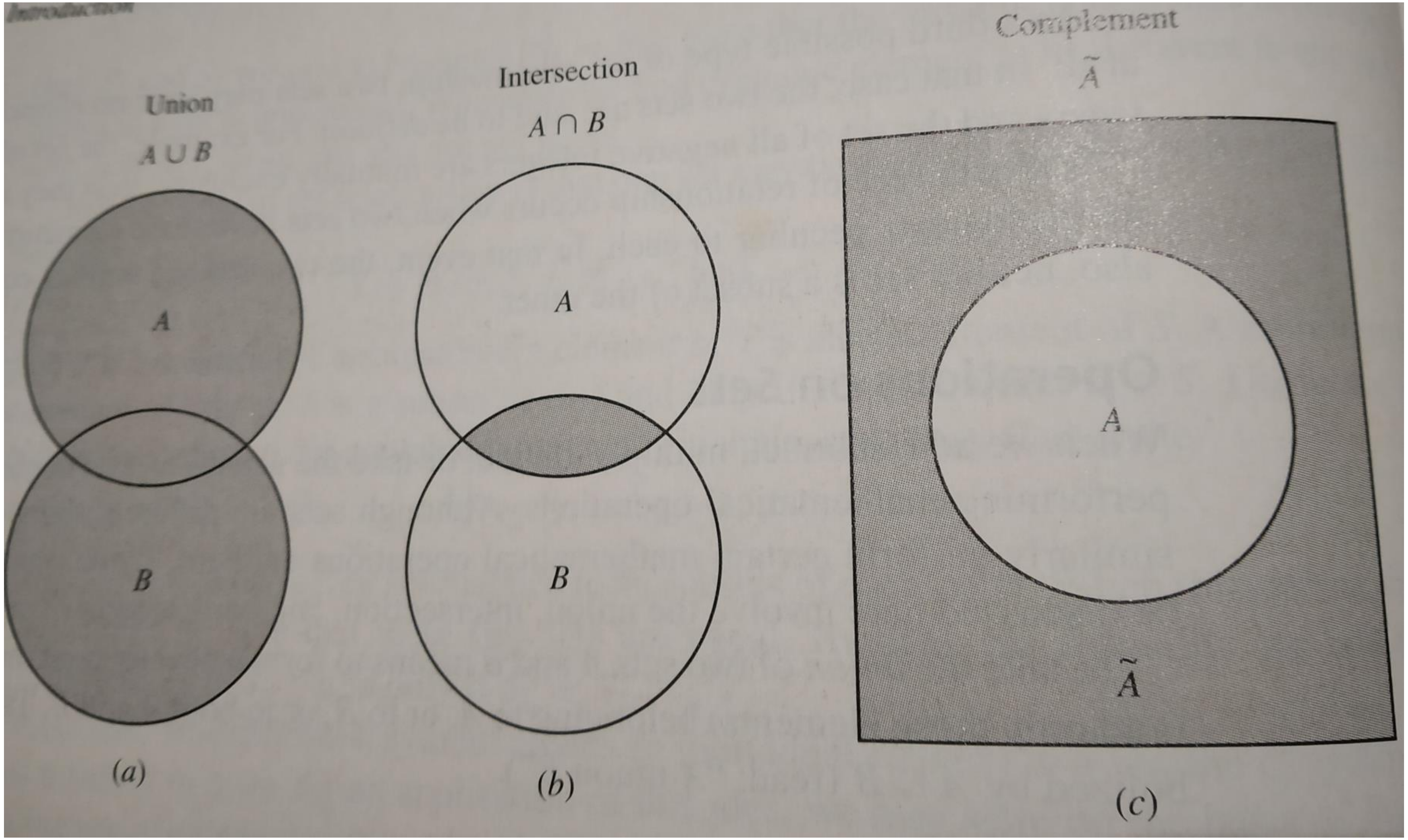
Solution: $A \cap B= \varphi$

If two sets A and B have no elements in common, they are said to be disjoint. Thus, sets A and B are disjoint if and only if $A \cap B= \varphi$

Problem

1. Let $A = \{2, 3, 4\}$, $B = \{2, 5, 6\}$, $C = \{5, 6, 2\}$, and $D = \{6\}$.
   a. Determine if the following statements are true: $4 \in C$; $5 \in C$; $A \subset B$; $D \subset C$; $B = C$; and $A = B$.
   b. Find $A \cap B$; $A \cup B$; $A \setminus B$; $B \setminus A$; $(A \cup B) \setminus (A \cap B)$; $A \cup B \cup C \cup D$; $A \cap B \cap C$; and $A \cap B \cap C \cap D$.

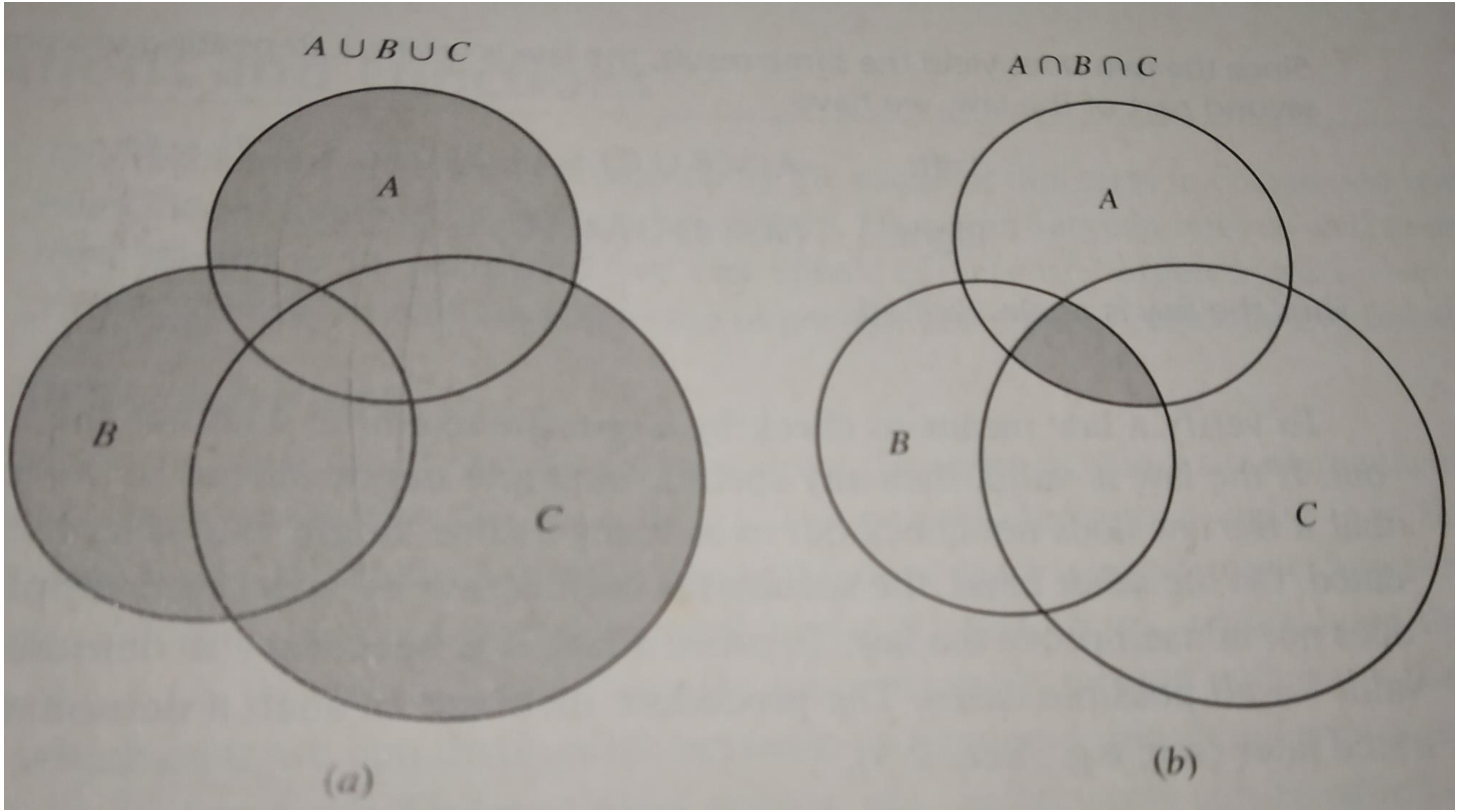
Venn Diagram



Universal Set and Complement of a set

- **A universal set** (usually denoted by U) is a set which has elements of all the related sets.
- **Complement of a Set**: The **complement of a set**, denoted by A', is the set of all elements in the given universal set U that are not in A.

Laws of Set Operations



Laws of Set Operations

- $A \cup B = B \cup A$
- $A \cap B = B \cap A$
- Associative law of unions and intersections

$$A \cup (B \cup C) = (A \cup B) \cup C$$

$$A \cap (B \cap C) = (A \cap B) \cap C$$

Note: These equations are similar of the algebraic laws $a+(b+c)=(a+b)+c$ and $a\times(b\times c)=(a\times b)\times c$

- Distributive law of unions and intersections

$$A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$$

$$A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$$

These equations are similar of the algebraic law $a\times(b+ c)= (a\times b)+ (a \times c)$

Example

Q1. Verify the distributive law, given A={1,2,3}, B={4,6} and C={5,7}.

Q2. Write the set of all real numbers greater than 2 but less than 100.

Solution:

$S = \{x \mid 2 < x < 100\}$

Q3. What is the meaning of $A \subset B$ and $A \supset B$?

Answer: $A \subset B$ means A is a subset of B

$A \supset B$ means B is a subset of A.

Q4. What is the meaning of $A \subset B$ and $B \supset A$?

[Note: Null is a subset of every set, $\emptyset \subset S$]

Exercise

Q1. Write the following in set notation:

a) The set of all real numbers greater than 10

b) The set of all real numbers greater than 9 but less than 99.

Q2. Given the sets A={2,4,6}, B={7,2,6}, C={4,2,6} and D={2,4}, which of the following statements are true?

a. A=C
b. A= R (set of real numbers)
c. $D \subset R$
d. $A \supset D$
e. $C \supset \{1,2\}$ f. $\emptyset \subset B$

Exercise

Q3. Given the sets A={2,4,6}, B={7,2,6}, C={4,2,6} and D={2,4}, find:

a) A U B
b) A U C
c) B ∩ C
d) B ∩ D
e) D ∩ B ∩ A
f) C U A U D

Exercise

Q4. Which of the following statements are TRUE?

i. $A \cup A = A$

ii. $A \cup U = U$

iii. $A \cup \emptyset = A$

iv. $A \cap A = A$

v. $A \cap \emptyset = \emptyset$

vi. $A \cap U = A$

Q5. Write all the subsets of the set {1,2,3,4}.

Q6. A survey revealed that 50 people liked coffee, 40 liked tea, 35 liked both coffee and tea, and 10 did not like either coffee or tea. How many persons in all responded to the survey?

Q. NO 7

A thousand people took part in a survey to reveal which newspaper, A, B, or C, they had read on a certain day. The responses showed that 420 had read A, 316 had read B, and 160 had read C. Of these responses, 116 had read both A and B, 100 had read A and C, 30 had read B and C, and 16 had read all three papers.

(i) How many had read A, but not B?

(ii) How many had read C, but neither A nor B?

(iii) How many had read neither A, B, nor C?

Next Class

- ✓ **Relations and Functions**