Written as per the revised syllabus prescribed by the Maharashtra State Board of Secondary and Higher Secondary Education, Pune.

Std. XI Commerce

Mathematics & Statistics - I

Salient Features

- Exhaustive coverage of entire syllabus.
- Topic-wise distribution of all textual questions and practice problems at the beginning of every chapter.
- Covers answers to all textual and miscellaneous exercises.
- Precise theory for every topic.
- Neat, labelled and authentic diagrams.
- Relevant and important formulae wherever required.
- Practice problems and Multiple Choice Questions for effective preparation.

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Preface

Mathematics is not just a subject that is restricted to the four walls of a classroom. Its philosophy and applications are to be looked for in the daily course of our life. The knowledge of mathematics is essential for us, to explore and practice in a variety of fields like business administration, banking, stock exchange and in science and engineering.

With the same thought in mind, we present to you "**Std. XI Commerce: Mathematics and Statistics-I**" a complete and thorough book with a revolutionary fresh approach towards content and thus laying a platform for an in depth understanding of the subject. This book has been written according to the revised syllabus.

At the beginning of every chapter, topic–wise distribution of all textual questions including practice problems have been provided for simpler understanding of different types of questions. Neatly labelled diagrams have been provided wherever required. We have provided answer keys for all the textual questions and miscellaneous exercises. In addition to this, we have included practice problems based upon solved exercises which not only aid students in self evaluation but also provide them with plenty of practice. We've also ensured that each chapter ends with a set of Multiple Choice Questions so as to prepare students for competitive examinations.

We are sure this study material will turn out to be a powerful resource for students and facilitate them in understanding the concepts of Mathematics in the most simple way.

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.

Please write to us on: mail@targetpublications.org

Best of luck to all the aspirants!

Yours faithfully
Publisher

Edition: Second

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01 Sets, Relations and Functions

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Syllabus:

Introduction

All basic concepts of modern mathematics are based on set theory. The concepts involving logic can be explained more easily with the help of set theory.

It plays a crucial role in the study of relations, functions, probability and is used extensively in various other branches of mathematics. We shall briefly revise and study some more concepts about sets.

1.1 Sets

A set is a well-defined collection of objects. These objects may be actually listed or may be specified by a rule. A set is usually denoted by the capital letters A, B, C, N, R, etc. Each object in a set is called an *element* or a *member* of the set and is denoted by the small letters a, b, c, etc.

If x is an element of set A, then we write it as $x \in A$ and read it as 'x belongs to A' and if y is not an element of set A, then we write it as $y \notin A$ and read it as 'y does not belong to A'.

Example:

If A = {2, 4, 6, 8}, then $4 \in A$, $7 \notin A$, $8 \in A$, $10 \notin A$

The set of natural numbers, whole numbers, integers, rational numbers and real numbers are denoted by N, W, I, Q and R respectively.

Methods of Representation of Sets

There are two methods of representing a set which are as follows:

i. Roster method (Listing method):

In this method all the elements are listed or tabulated. The elements are separated by commas and are enclosed within two braces(curly brackets).

Example:

The set A of all positive even integers less than 9 can be written as A = {2, 4, 6, 8}.

ii. Set-Builder method:

In this method, the set is described by the characteristic property of its elements.

In general, if all the elements of set A satisfy some property P, then write A in set-builder notation as A = {x/x has property P} and read it as 'A is the set of all x such that x has the property P'.

Example:

Let B = {3, 4, 5, 6, 7, 8}

Using the set-builder method, B can be written as $B = \{x/x \in N, 3 \le x \le 8\}$

Since B = {3, 4, 5, 6, 7, 8} can also be stated as the set of natural numbers from 3 to 8 including 3 and 8.

Some standard sets are as follows:

N = set of all natural numbers
= {1, 2, 3,…..}

Z or I = set of all integers
= { ….–3, –2, –1, 0, 1, 2, 3 …}

Q = set of all rational numbers

$$= \left\{\frac{p}{q} / p, q \in Z, q \neq 0\right\}$$

1.2 Types of sets

1. Empty set:

A set which does not contain any element is called an empty set and it is denoted by ϕ or { }. It is also called null set.

Example:

$A = \{x/x \in N, 3 < x < 4\}$

B = {x/x is a positive integer < 1}

Note:

The set {0} and {ϕ} are not empty sets as they contain one element, namely 0 and ϕ respectively.

2. Singleton set:

A set which contains only one element is called a singleton set.

Example:

A = {5},

B = {3},

X = {$x/x \in$ N, $1 < x < 3$}

The set A = set of all integers which are neither positive nor negative is a singleton set since A = {0}

3. Finite set:

A set which contains countable number of elements is called a finite set.

Example:

A = {a, b, c}

B = {1, 2, 3, 4, 5}

C = {a, e, i, o, u}

4. Infinite set:

A set which contains uncountable number of elements is called an infinite set.

Example:

N = {1, 2, 3, 4……}

Z = {…–3, –2, –1, 0, 1, 2, 3,…..}

5. Subset:

Set A is called a subset of set B, if every element of set A is also an element of set B i.e., if $x \in$ A, then $x \in$ B.

We denote this relation as A $\subseteq$ B and read it as 'A is a subset for B'. It s clear that

i. Every set is a subset of itself i.e., A $\subseteq$ A.

ii. An empty set ϕ is a subset of every set.

Example:

If A = {2, 4, 6, 8} and B = {2, 4, 6, 8, 10, 12}, then A $\subseteq$ B.

If A $\subseteq$ B, then B is called a superset of A, denoted by B $\supseteq$ A.

6. Proper subset:

A set A is said to be a proper subset of a set B if every element of set A is also an element of the set B and B contains atleast one element which is not in A. We denote it by A $\subset$ B.

Example:

1. A = {x/x is a natural number less than 5}

$\therefore$ A = {1, 2, 3, 4}

2. B = {x/x is a divisor of 12}

$\therefore$ B = {1, 2, 3, 4, 6, 12}

$\therefore$ A $\subset$ B

Note:

i. Every set is a subset of itself.

ii. Empty set is a subset of every set.

$\therefore$ A and ϕ are improper subsets of A.

7. Universal set:

A non-empty set of which all the sets under consideration are subsets, is called a universal set. It is usually denoted by X or U.

Example:

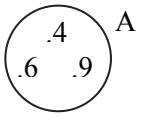
If A = {1, 2, 3, 4}, B = {2, 8, 13, 15} and C = {1, 2, 3, …, 50} are sets under consideration, then the set N of all natural numbers can be taken as the universal set.

<u>Venn diagram:</u>

A set is represented by any closed figure such as circle, rectangle, triangle, etc. The diagrams representing sets are called venn diagrams.

Example:

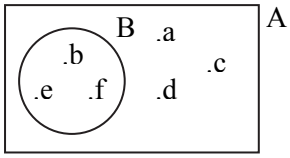
i. A = {4, 6, 9}



ii. A = {a, b, c, d, e, f}

B = {b, e, f}

B $\subset$ A



8. Equal sets:

Two sets A and B are said to be equal if they have the same elements and we denote this as A = B.

From this definition it follows that "two sets A and B are equal if and only if A $\subseteq$ B and B $\subseteq$ A"

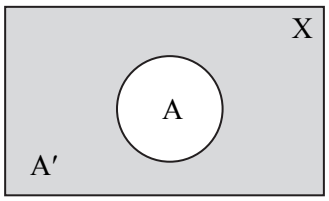
Example:

If A = {1, 2, 3, 4}, B = {2, 4, 1, 3}, then A = B.

9. Complement of a set:

Let A be a subset of a universal set X then the set of all those elements of X which do not belong to A is called the complement of set A and it is denoted by A′ or A^c.

Thus, A′ = {$x/x \in$ X, $x \notin$ A}



The shaded region in the above figure represents A′.