UNIT 2 DEDUCTIVE REASONING

Contents

2.0 OBJECTIVES

This unit will help you to study:

- one type of deductive argument known as immediate inference
- the truth-conditions, which define the relations
- which terms are distributed or undistributed
- the subsequent units
- the limitations of immediate inference which have been briefly touched upon

2.1 INTRODUCTION

Since any reasoning involves argument, we shall begin with the type of relations between statements, which constitute an argument. A study of relation between propositions is also known as 'Eduction' in classical logic and eduction is one of the types of inference called immediate inference because we infer from one premise only.

2.2 DEDUCTIVE ARGUMENTS: TRUTH CONDITIONS OF RELATIONS

For the sake of convenience, let p and q denote premise and conclusion respectively. Any relation between p and q is defined by the truth-value, which they take. Let us first, define these relations. 'True' and 'False' are denoted respectively by 1 and 0.

1. p – 1, q – 1 } Relation
   p – 0, q – 1
   or
   p – 0, q – 0 } Independence
   p – 1, q – 0

2. p – 1, q – 1
   p – 0, q - 0 } Equivalence

3. p – 1; q – 0
   p – 0; q - 1 } Contradiction

4. p – 1; q – 1
   p – 0; q – Ind. } Superaltern
   Ind. stands for indeterminate.

5. p – 1; q – 0
   p – 0; q – Ind. } Contrary or contrariety

6. p – 1; q – Ind.
   p – 0; q – 1 } Subcontrary

7. p – 1; q – Ind.
   p – 0; q - 0 } Subaltern

No argument consists of independent statements. For example, a grouping of statements like 'Obama is the President of USA' and 'Grass is green' does not result in any type of argument. Therefore it does not interest us. Out of six relations, equivalence belongs to one category and relations from 3 – 7 belong to another category. Let us begin our study with the last category, which is known as 'opposition of relations'.

2.3 OPPOSITION OF RELATIONS

We shall establish various types of relation among four classes of categorical propositions. This study is restricted to categorical proposition.

1. **Contradiction**: This relation holds good for four pairs of propositions, which differ in quality and quantity.

	1	2	3	4
1. Premises	A	'O'	E	I
Conclusions	'O'	A	I	E

Accordingly, if it is true that 'All rabbits are herbivorous' (RAH) -1, then it is false that 'some rabbits are not herbivorous (ROH) and if it is false that 'All rabbits are herbivorous' (RAH), then it is true that 'some rabbits are not herbivorous' (ROH). It is customary to represent the terms by the first letter of respective terms.

	Statement	Symbol	Truth-Value	
2. Premise	No statements are true.	SET	1	0
Conclusion	Some statements are true.	SIT	0	1

	Statement	Symbol	Truth-Value	
3. Premise	Some crows are not black.	COB	1	0
Conclusion	All crows are black.	CAB	0	1

	Statement	Symbol	Truth-Value	
4. Premise	Some lions are ferocious.	LIF	1	0
Conclusion	No lions are ferocious.	LEF	0	1

2. **Contrary**: This relation holds good 'only' between universal propositions, which differ in quality.

	Statement	Symbol	Truth-Value	
5. Premise	All bats are mammals.	BAM	1	0
Conclusion	No bats are mammals.	BEM	0	Ind.

	Statement	Symbol	Truth-Value	
6. Premise	No fish can fly.	FEF	1	0
Conclusion	All fish can fly.	FAF	0	Ind.

3. **Superaltern:** When a particular conclusion is deduced from a universal proposition without affecting the quality, then superaltern relation holds good between the universal premise and particular conclusion. In this case the quality of proposition is irrelevant.

	Statement	Symbol	Truth-Value	
7. Premise	All metals are hard.	MAH	1	0
Conclusion	Some metals are hard.	MIH	1	Ind.

	Statement	Symbol	Truth-Value	
8. Premise	No fruits are bitter.	FEB	1	0
Conclusion	Some fruits are not bitter.	FOB	1	Ind.

4. **Subaltern:** When premise and the conclusion in superaltern are reversed we obtain subaltern. In other words, when we deduce universal conclusion from particular premise, the process results in subaltern.

	Statement	Symbol	Truth-Value	
9. Premise	Some planets are small.	PIS	1	0
Conclusion	All planets are small.	PAS	Ind.	0

	Statement	Symbol	Truth-Value	
10. Premise	Some comets are not dense.	COD	1	0
Conclusions	No comets are dense.	CED	Ind.	0

5. **Subcontrary:** This relation holds good between two particular propositions.

	Statement	Symbol	Truth-Value	
11. Premise	Some whales are heavy.	WIH	1	0
Conclusion	Some whales are not heavy.	WOH	Ind	1

	Statement	Symbol	Truth-Value	
12. Premise	Some dogs do not attack.	DOA	1	0
Conclusion	Some dogs attack.	DIA	Ind	1

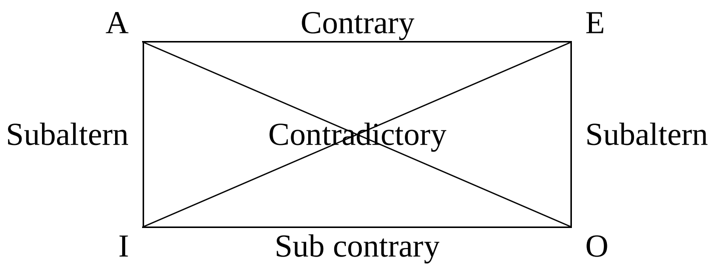
It is important to notice asymmetry which results when we consider propositions differing in quantity. Keeping aside the relations, let us consider proposition pairs, which can be obtained by reversing the position of propositions found in the first pair. This reversal is coupled with the comparison of truth-values.

	Superaltern		**Subaltern**	
p:	1	0	1	0
q:	1	Ind.	Ind.	0

The truth-value of conclusion in superaltern differs from that of conclusion in subaltern. In other words, the relation, which connects universal premise with particular conclusion, is not the same as the relation which connects particular premise with universal conclusion. It is in this sense that between universal and particular there is asymmetry. In all these cases, the premises and the conclusion have the same subject and predicate. In fact, this is one of the preconditions to be satisfied to establish any opposition. The other condition may be stated as follows. Either quality or quantity, or both may be altered from premises to conclusion. Each change produces unique relation. In some cases, quantity of proposition determines the type of relation. This is how contrary and subcontrary can be accounted. Superaltern is understood in this way. A is the superaltern whereas I is its subaltern. Similar is explanation for E and O.

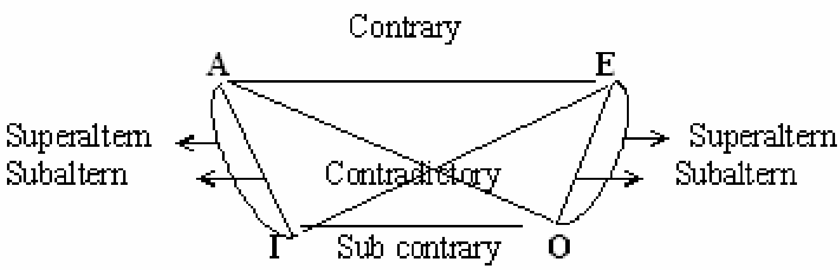
Traditional logic ignored asymmetry while identifying the relation. This is best explained with the help of a square:

1)



However, Susan Stebbing noticed asymmetry and she replaced square by a figure:

2.



1 and 2 differ on only one count; i.e., the relation between universal and particular. On all other counts, the type of relations remained the same.

2.4 CATEGORICAL PROPOSITION AND DISTRIBUTION OF TERMS

Since classification of propositions depends upon quality and quantity, we should know about those elements which determine quantity of propositions (there is no need to say anything about quality at this stage). Quantity of any proposition is determined by the magnitude (extension) of subject(s). Only sets have magnitudes (this is so as far as logic is concerned). A set is defined as the collection of well-defined elements as its members. A null set or an empty set does not have any element. A term, therefore, must be a set if it must possess any magnitude.

If magnitude of any term is complete or total, then it is said that, that term is **distributed**. If magnitude is incomplete, then that term is **undistributed**. Any term is distributed only when the entire term (set) is either included in or excluded by another term (set). This is another way of explicating what complete magnitude means.

All universal propositions distribute subject whereas no particular propositions distribute subject. Just as distribution is explicated, undistribution also must be explicated. Any term is undistributed when inclusion of one term in another or exclusion of one term from another is partial. It is necessary to understand the meaning of partial inclusion and partial exclusion accurately. If subject has to be undistributed, then, it is necessary that the proposition should either include or exclude only 'some' members. When do we say or when are we allowed to use 'some'? Let the magnitude of S be x. Let S* (to be read s-star) denote the part of s, which is included in or excluded by a proposition. Now the formula, which represents undistribution of S can be represented as follows:

|x|>S*e"1 …………(1)

This is the way to read: "The modulus of x (|x|) is greater than S* greater than or equal to 1." It is highly rewarding to use set theory here. (1) indicates that S* is a proper subset of S. Therefore its magnitude must be smaller than that of x which is the magnitude of S. However, S* is not a null set. Because (1) shows that there is or exists at least one member in S*. Therefore in the case of undistribution the magnitude of S* varies between 1 and | x-1|. Now it is clear that in A and E, S (subject) is distributed while in I and O it is undistributed. Just to complete this aspect, let us state that all affirmative propositions undistribute P (predicate), whereas all negative propositions distribute P.

2.5 DIAGRAMMATIC PRESENTATION OF DISTRIBUTION

A better way of presenting distribution of terms was invented by Euler, an 18th C. Swiss mathematician and John Venn a 19th C. British mathematician. An understanding of the method followed by them presupposes some aspects of set theory.

Let S and P be non-null (non-empty) sets with elements as mentioned below (it is important that the status of set must invariably be mentioned, i.e., null or non-null). The following pairs shall be considered.

1. S = {a,b,c,d,e,f}, P = {g,h,i,j,k}

All letters within parentheses are elements of respective sets. In the first grouping there is no common element in these sets. Now, consider following groupings.

2. S = {a,b,c,d,e,f}, P = {a,b,c,d,e,f,g,h,i}
3. S = {a,b,c,d,e,f}, P = {b,c,d,g,h}
4. S = {a,b,c,d,e,f}, S* = {a,b,c}, P = {m,n,g,h}
5. S = {a,b,c,d,e}, P = {a,b,c,d,e}

Fifth group is unique in the sense that these two sets possess exactly the same elements. Therefore the magnitude of these sets also remains the same. Such sets are called identical sets. In 1908, Zermelo proposed what is called 'Axiomatic set theory'. One of the principal axioms in this theory is known as the Axiom of Extension or Extensionality. This Axiom helps us to understand the structure of identical sets. This theory was modified later by A Fraenkal and T. Skolem. Let us call this theory Zermelo – Fraenkel – Skolem set theory (ZFS theory). This theory states the above mentioned axiom as follows.

ZFS1: If a and b are non-null sets and if, for all x, x $\in$ a iff x b, then a = b

[Note '$\in$' is read 'element of' and 'iff' is read 'if and only if']

Symbolically, it is represented as follows:

$\{Sa \wedge Sb\} \wedge \{ \forall \square x \ (x \in A <=> x \in b) => a = b$

This is the way to read:

Sa = a is a set

$\wedge$ = and

$\forall$ = for all values of

<=> = if and only if

=> = if …then

The summary of this formula is very simple. Whatever description applies to S (here a) also applies to P (here b). When distribution of terms is examined, the magnitude and elements of sets also are examined. Therefore it is wrong to assert that when S and P are identical sets, P is undistributed in A. Let us designate this type of proposition as A+ (read A cross). Consider these two propositions:

13. All bachelors are unmarried men. (BAU)

14. All spinsters are unmarried women. (SAU)

Knowledge of English is enough to accept that B a" U and S a" U (a" reads identical).

First group corresponds to 'E'. When this group is compared with the remaining groups, it becomes clear that it differs from all other groups because in this group nothing is common to 'S' and 'P'. Consider 2nd 3rd and 4th groups. They correspond, respectively, to A, I and O. A brief description will suffice. In A proposition S is a proper subset of P, or P includes S, symbolized by

$S \subset P$ or $P \supset S$ ($\subset$ reads proper subset and $\supset$ reads includes)

The third group corresponds to 'I'. Here S and P intersect. So we have

$S \cup P = \{b,c,d\}$

($\cup$ reads 'intersect')

The fourth group requires some clarification. S* is incomplete, i.e., undistributed and P is completely excluded by S*. It means that 'O' distributes P.

Let us return to E to which the first group corresponds.

$S = \{a,b,c,d,e,f\}$

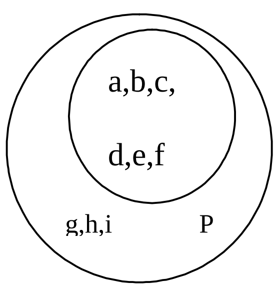
$P = \{g,h,I,j,k\}$

No element of P is an element of S and no element of S is an element of P. The reader must be in a position to notice that there is symmetric difference between S and P (What we have in this case is, evidently, difference and nothing else), symbolized by:

$S \triangle P$ ($\cap$ reads del)

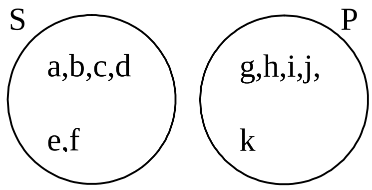
Now we can directly proceed to Euler's diagrams.

1) SAP



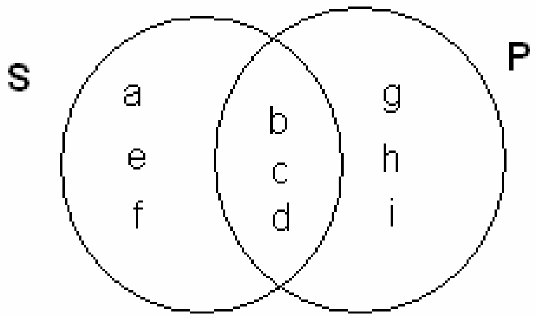
$S = \{a,b,c,d,e,f\}$
$P = \{a,b,c,d,e,f,g,h,i\}$
$\therefore S \subset P$ or $P \supset S$

2) SEP



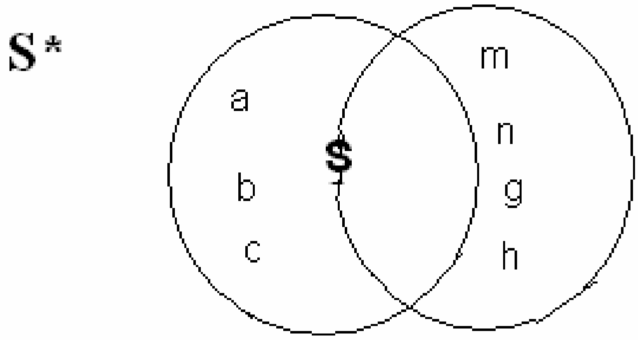
S = {a,b,c,d,e,f}
P = {g,h,i,j,k}
∴ S △ P

3) SIP



S = {a,b,c,d,e,f}
P = {b,c,d,g,h,i}
S∩P = {b,c,d}

4) SOP



S* = {a,b,c}
P = {m,n,g,h}

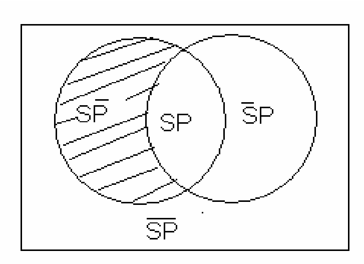
A brief explanation is required for SOP, which runs as follows:
1. S = {a,b,c,d,e,f}
2. S* = {a,b,c}; there is no information regarding d,e and f.
3. S* ⊆ S (S* d” S); S* is smaller than or equal to S
4. Let S – S* = S** (S** e” Φ)
‘Φ’ reads phi which stands for null set.
5. S** ⊆ P
6. S* || S**|| shows that elements of subsets S* and S** are different.
∴ S* || P
∴ Elements of S* and P are different.

John Venn (1834-1923) followed a very different method. Consider this proposition. All philosophers are simple – PAS. Since philosophers are humans, the universe of discourse is, obviously, ‘humans’. Venn represents this with a rectangle. If philosophers are the elements of the Set P, then all humans other than philosophers constitute the complement of the set P. Complement of P is represented by $\overline{P}$ and the same explanation holds good for all classes. Now a new term is introduced, viz., ‘*product class*’. Any product class is an intersection of two or more than two sets (as far as logic is concerned, the number is restricted to three). PS is the product class of P and S. Such product classes may or may not be null sets. But P and S are null sets only which show that the product of a set and its complement is always a null set. When there are two terms, we get four product classes, which are as follows:

1 {PS} Set of philosophers, who are simple.
2 {P$\bar{S}$} Set of philosophers, who are not simple.
3 {$\bar{P}$ S} Set of humans other than philosophers, who are simple.
4 {$\bar{P}$ $\bar{S}$} Set of humans who are neither philosophers nor simple.

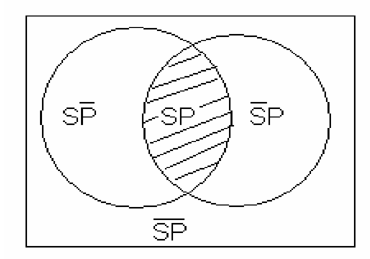
It is pertinent to note that if there are three terms, then there are not six product classes, but eight product classes, i.e., if x is the number of terms, then 2^x is the number of product classes (i.e., 2×2×2=8). Now the time is ripe to introduce Venn's diagrams.

SAP



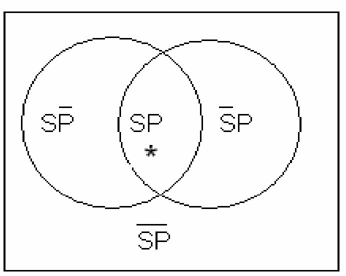
$S\bar{P} = \Phi$

SEP



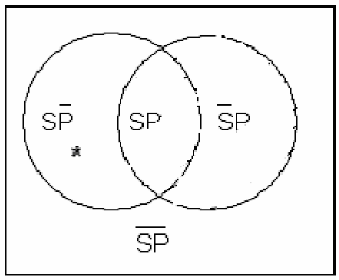
$SP = \Phi$

SIP



$SP \geq 1$ or $SP \neq \Phi$

SOP



$S\bar{P} \geq 1$ or $S\bar{P} \neq \Phi$

The statement (proposition is also called statement), 'All philosophers are simple', does not really mean that there are philosophers and all those philosophers are simple. On the other hand, the statement really means that if there are philosophers, then, they are simple. Clearly, it means that in the set of non-simple humans not a single philosopher can be found. Therefore P$\bar{S}$ is a null set. Similarly, the statement 'No philosophers are simple' – (PES)' indicates that in the set of simple humans not a single philosopher can be found. Therefore PS is a null set. PAS and PES only demonstrate that there are null sets, but they are silent on non-null sets. Therefore an important conclusion is imminent; universal propositions do not carry existential import.

It is widely held that all scientific laws are universal. An important fall-out of this assumption is that if universal propositions do not carry existential import, then, it also means that scientific laws do not carry existential import in which case they apply only to non-existing entities. Therefore all bodies or physical objects only approximate to these laws. In other words, a scientific law has to be construed as a limiting point when it is stated in absolute terms. In Figure 1 and 2, those parts of the circle or circles which represent null sets are shaded.

The case of particular proposition is different. The statement 'some philosophers are simple – PIS' is true only when 'there exists at least one philosopher who is simple, not otherwise. Therefore the product class PS is a non-null set. On the same lines, it is easy to know how POS shows that Pis also a non-null set. Therefore particular propositions carry existential import.

If we know how the results are symbolically represented, it becomes useful at a later stage.

PAS: $(\square \forall x)\ \{X \in P) \Rightarrow (X \in S)\}$ $\square \forall$ x is read ‘for all values of X’

PES: $(\forall \square x)\ \{X \in P) \Rightarrow (x \notin S)\}$ $\notin$ is read ‘not an element of’

PIS: $(\exists x)\ \square \ni \{(X \in P)\ \Lambda\ (X \in S)\}$ $\exists x$ is read ‘there exists at least one x; $\square$ is read ‘such that’.

POS: $(\exists x)\ \square \ni \{(x \in P) \Lambda (X \notin S)\}$

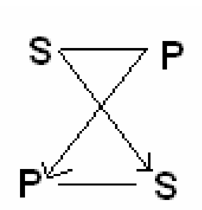
$\forall$ is known as universal quantifier and $\exists$ as existential quantifier.

2.6 EQUIVALENCE RELATION

When there is a change in the structure of sentences, meaning, generally, changes. But it does not always happen. In such cases it only means that the very same information may be provided in different ways. Recognition of this simple fact helps us in testing accurately the validity of arguments and also in avoiding confusions. There are only two primary forms of equivalent relations; conversion and obversion. Other forms can be said to be derivatives of these primary forms.

Conversion: This is governed by three laws which only deserve to be mentioned. No proof is given to these laws.

1st Law: S and P must be transposed. This law can be easily shown how it has to be applied.



After transposition P becomes subject and S becomes predicate. This is the 1st stage.

2nd Law: Quality of propositions should remain constant. That is if the premise is affirmative, the conclusion must be affirmative. If the premise is negative, the conclusion must be negative.

3rd Law: A term, which is undistributed in the premise, should remain undistributed in the conclusion. It can be stated in another way also. A term can be distributed in the conclusion only if it is distributed in the premise. However, a term, which is distributed in the premise, may or may not be distributed in the conclusion.

Now we shall convert A, E & I propositions. Later we will come to know that ‘O’ cannot be converted. In conversion, the conclusion is called converse.

		Statement	Symbol	Truth-Value	
15.		All stars are bright.	SAB	1	0
	Stage:1	bright stars (Law 1: Transposition of terms)	B S		
	Stage: 2	bright are stars (Law 2: Constancy of quality, both premise and conclusion are affirmative)			
	Stage: 3	Some bright things are stars. (Law 3: Terms undistributed in the premise (in this case ‘bright’ or ‘bright things’ remains undistributed in the conclusion. Also it is important to note that when an adjective becomes subject it is necessary to add appropriate countable noun like things.))	BIS	1	0

When A is converted it becomes I because the undistributed predicate (in this proposition bright) becomes undistributed subject after conversion. Since quantity changes from universal to particular this type of conversion is known as conversion per accidens. On the other hand, the conversion of E and I are simple because in these cases conversion does not require change of quantity.

		Statement	Symbol	Truth-Value
16.		No criminals are saints.	C E S	1 0
	Stage: 1	saints criminals (Law1: Transposition of terms)		
	Stage:2	saints are criminals. (Law2: Constancy of quality, both premise and conclusion are affirmative)		
	Stage: 3	No saints are criminals. (Law 3: Terms distributed in the conclusion are distributed in the premise as well).	S E C	1 0

		Statement	Symbol	Truth-Value
17.		Some books are useful.	B I U	1 0
	Stage: 1	useful books (Law 1: Transposition of terms)	U B	
	Stage: 2	useful are books (Law 2: Constancy of quality, both the premise and the conclusion are affirmative).		
	Stage: 3	Some useful things are books. (Law 3: Terms undistributed in the premise (in this case both S & P) are undistributed in the conclusion).	U I B	1 0

O does not have conversion, which needs some explanation. Consider this statement.

17. Some gods are not powerful.

$\therefore$ Some powerful beings are not gods.

This conversion is invalid because the term 'gods' is distributed in the conclusion while it is undistributed in the premise. This type of conversion violates one of the laws of conversion, which stipulates that any term, which is undistributed in the premise, should remain undistributed in the conclusion. The term 'gods' can remain undistributed in the conclusion only if the conclusion is affirmative. If we obtain affirmative converse from a negative premise, then we violate another law of conversion, which stipulates that quality should remain constant. It only means that if 'O' is converted, then one or the other law of conversion is violated. Therefore 'O' has no conversion.

Conversion of 'O' and simple conversion of 'A' lead to a fallacy called fallacy of illicit conversion. Any fallacy in formal logic arises when any law or rule is violated. Suppose that the statement 'All Europeans are white' is converted as 'All white people are Europeans.' Then this conversion commits the fallacy of illicit conversion because in this example also the term white (or white people) is distributed in the conclusion while it is distributed in the premise. However, there is an exception to the restricted conversion of A, which we will examine later.

Obversion: This is one technique of preserving the meaning of a statement after effecting change of quality. The procedure is very simple; simultaneously change quality of the premise and replace the predicate by its complementary. We apply this law to the premises (A,E,I, and O) to obtain conclusions. The conclusion is called obversion.

18.	p:	All Players are experts.	P A E	1	0
	q:	∴ No players are non-experts.	P E E	1	0
19	p:	No musicians are novelists.	M E N	1	0
	q:	∴ All Musicians are non-novelists.	MAN	1	0
20	p:	Some scholars are women.	S I W	1	0
	q:	∴ Some scholars are not non-women.	SOW	1	0
21	p:	Some strangers are not helpful.	SO H	1	0
	q:	∴ Some stranger are non-helpful.	S I H	1	0

Derivative forms: Alternate use of conversion and obversion generate other equivalent forms. Therefore conversion and obversion may be regarded as operators. Each operator provides results in different ways. Let us begin with conversion operator and see the results.

	Operator	SAP	Relation	Operator	SAP	Relation
A	Conversion	↓		Obversion	↓	
		PIS	Conversion		SE$\bar{P}$	Obversion
B	Obversion	↓		Conversion	↓	
		PO$\bar{S}$	Obverted		$\bar{P}$ES	Partial contraposition
					↓	
C	Conversion	↓	Converse	Obversion	$\bar{P}$A$\bar{S}$	Full contraposition
					↓	
D		--		Conversion	$\bar{S}$I$\bar{P}$	Full inversion
					↓	
E	'O' does not have conversion			Obversion	$\bar{S}$OP	Partial inversion
					↓	
				Ccnversion	—	

'O' does not have conversion.

It may be noted that when 'O' results from obversion, we hit dead end because O has no conversion. It actual marks the end of the process. We shall proceed to obtain derivative forms for the remaining propositions.

	Operator	SEP	Relation	Operator	SEP	Relation
a)	Conversion	↓		Obversion	↓	
		PES	Conversion		SA$\bar{P}$	Obversion
b	Obversion	↓		Conversion	↓	
		PA$\bar{S}$	Obverted		$\bar{P}$IS	Partial contraposition
c)	Conversion	↓	Converse	Obversion	↓	
		$\bar{S}$IP	Partial inversion		$\bar{P}$O$\bar{S}$	Full Contraposition
d)	Obversion	↓		Conversion	↓	
		$\bar{S}$O$\bar{P}$	Full inversion		—	
		↓				
e)	Conversion	—				

When conversion is the first operator with E, we obtain only the inversion of 'E' whereas when obversion is the first operator with A, we obtain both inversion and contraposition of A. So we require both operators to obtain inversion and contraposition for E. The reader can attempt the same with I & O.

Let us reconsider 'A'. Earlier, we observed that simple conversion of A is illegitimate. However, it has an exception, i.e., in some cases simple conversion of A is admissible. We shall recall proposition 13.

All bachelors are unmarried men. B A U

∴ All unmarried men are bachelors. U A B

We should examine how and why the term 'unmarried men' is distributed. (What applies to 13 also applies to 14). The terms 'bachelors' and 'unmarried men' possess the same number of or exactly the same elements. In set theory, it is called 'equi-numerous'. It only means equal number. In such case, every element of set S corresponds to every element of set P. In mathematics this is what is called one-to-one correspondence. Stoll has expressed this sort of identity in the following manner:

S ~ P

In mathematics, all relations are called functions. If A is a function of B it only means that A depends upon B. When S and P are identical, then there is relation. Equivalence relation is symmetric, transitive and reflexive. If S is identical with P, then P is identical with S. Therefore the relation is symmetric. If S a P and P a R, then, S a R. Therefore it is transitive. S a S or P a P. This is called reflexive. Therefore the relation of identity is an example for equivalence relation and therefore, it is a function.

Let us examine why conversion of 13 and 14 is regarded as equivalence relation. One of the laws in set theory is known as 'General Commutative Law'. This law states that 'An operation * (read star) in x is commutative iff a*b = b*a for all a and b in x. The first casuality of this law is conversion per accidens of A. As per the law a*b = b*a. But A ` I. Only simple conversion, i.e., conversion of E, I & exceptional form of A become legitimate whereas normal form becomes illegitimate. Surely, this is a paradox.

2.7 CRITICISMS

Last paragraph should encourage us to consider criticisms against various forms of eduction. Based on the results of Venn's diagrams, it has been argued that from universal quantifiers (universal proposition) alone existential quantifier (particular proposition) cannot be validly deduced and vice versa.

Accordingly, this stipulation invalidates superaltern and subaltern. Obviously, from $S\overline{P}$ =, we cannot deduce that SP'"Φ. Similarly, SP = Φ does not imply that S ≠ Φ. It only shows that contradiction is admissible. Let us proceed now in reverse order. From SP ≠ Φ we cannot validly deduce S = and from $S\overline{P}$ ≠ Φ we cannot validly deduce SP =Φ. For other reasons, contrary and sub contrary relations also do not hold good. Conversion per accidens is ruled out. Contraposition and inversion also are lost. A, in addition, loses obverted converse. It only shows that contradiction is admissible.

There are in all eighteen propositions for which all relations are not provided. It will be a rewarding exercise to provide missing relations. While doing so, follow the pattern provided in the study material. In order to strengthen your hold, select examples from books recommended for study and solve the same.

Check Your Progress I

Note: a) Use the space provided for your answer.

b) Check your answers with those provided at the end of the unit.

1. If it is true that 'no taxpayers are poor', then determine the truth-value of the following. Also, mention the relation with the given statement.

   a) All tax payers are poor.

   b) Some taxpayers are poor.

   c) Some taxpayers are not poor.

   d) All taxpayers are non-poor.

   e) No taxpayers are non-poor.

   f) Some tax payers are non-poor.

   g) Some tax payers are not non-poor.

   h) No poor people are taxpayers.

   i) All poor people are non-taxpayers.

   j) Some non-taxpayers are poor.

   [N.B. It is not necessary that hyphen (-) should be used to obtain complement of the given term.]

2. Assume that the statement 'All players are sick' is false. Determine the truth-value of the following and state the relation with the given statement.

   a) Some players are sick.

   b) Some players are not sick.

   c) No players are sick.

   d) Some sick people are players.

   e) No players are nonsick.

   f) Some sick people are not nonplayers.

   g) All nonsick persons are nonplayers.

   h) No nonsick persons are players.

   i) Some nonplayers are nonsick.

   j) Some nonplayers are not nonsick.

3. Assume that the statement 'Some poets are philosophers' is true. Determine the truth-value of the following and state the relation with the given statement.

   a) Some poets are not philosophers.

   b) All poets are philosophers.

   c) No poets are philosophers.

   d) Some philosophers are poets.

e) Some philosophers are not nonpoets.

f) Some philosophers are not poets.

g) All philosophers are poets.

h) No philosophers are poets.

i) All philosophers are nonpoets.

j) Some philosophers are nonpoets.

4. Assume that the statement 'Some mangoes are sweet' is false. Determine the truth-value of the following and state the relation with the given statement.

   a) All mangoes are sweet.

   b) No mangoes are sweet.

   c) Some mangoes are not sweet.

   d) Some sweet things are mangoes.

   e) Some sweet things are not nonmangoes.

   f) No mangoes are nonsweet.

   g) Some nonmangoes are nonsweet.

   h) Some nonmangoes are not sweet.

   i) All mangoes are nonsweet.

   j) Some mangoes are nonsweet.

2.8 LET US SUM UP

One of the types of deductive inference is known as immediate inference. In this type we use one premise to derive conclusion. Traditional logic considers several varieties of deductive inference. They are also called relations. Each relation is uniquely defined by truth-conditions. Immediate inference provides an opportunity to understand how logic and mathematics have crossed. Apart from verbal description, diagrammatic representation also accurately describes these relations. A modern analysis helps us to understand the limitations and defects of traditional approach which results in the rejection of several relations as invalid which were, otherwise, accepted as valid.

2.9 KEY WORDS

Modulu : a modulus is a formal product of places of an algebraic number field. It is used to encode ramification data for abelian extensions of number field.

2.10 FURTHER READINGS AND REFERENCES

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2.11 ANSWERS TO CHECK YOUR PROGRESS

(Note: '1' stands for 'true', '0'stands for false and '?'stands for doubtful.)

1.

a) '0'; contrary

b) '0'; contradictory

c) '1'; superaltern

d) '1'; obverse

e) '0'; contrary of obverse

g) '0'; contradiction of obversion

h) '1'; converse

i) '1'; full contraposition

j) '1'; converse of full contraposition

2.

a) '?'; superaltern

b) '1'; contradictory

c) '1'; contrary

d) '0'; converse

e) '0'; obverse

f) '0'; obverted converse

g) '0'; full contraposition

h) '1'; contrary of full contraposition

i) '0'; full inversion

j) '1'; subcontrary of full inversion

3.

a) '?'; subcontrary

b) '?'; subaltern

c) '0'; contradictory

d) '1'; converse

e) '1'; obverted converse

f) ‘?’; subcontrary of converse

g) ‘?’; subaltern of converse

h) ‘0’; contradiction of conversion

i) ‘0’; contradiction of obversion

j) ‘0’; subcontrary of obversion

4.

a) ‘0’; subaltern

b) ‘1’; contradiction

c) ‘1’; subcontrary

d) ‘0’;converse

e) ‘0’; obverted converse

f) ‘0’;obverse of subaltern

g) ‘0’;full inversion of subaltern

h) ‘0’;partial inversion of subaltern

i) ‘1’;obversion of contradiction

j) ‘1’; obversion of subcontrary