UNIT-3 INDUCTIVE AND DEDUCTIVE LOGIC*

Structure

3.0 OBJECTIVES

This unit titled *Inductive and Deductive Logic* aims at familiarizing you with nature and scope of deductive logic (formal logic) and inductive logic (material logic). Logic, traditionally, has been divided in into two types; deductive and inductive. This unit will elaborate on intricate features of these two types of logical reasoning. By the end of this unit you will learn:

- The role played by reasoning and inference in the development of logic.

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- The distinction and connection between two types of reasoning process.
- Distinction between universalization and generalization.
- Different types of inductions.

3.1 INTRODUCTION

Logic is the science of reasoning. Logic as a discipline trains a person in certain methods, devices, tools and techniques that help in differentiating right reasoning from wrong ones. Reason/Reasoning is used to form inferences; conclusions drawn from propositions or assumptions that are supposed to be true. A piece of reasoning involves argument that is a relational arrangement of premises (evidences, facts, assumptions) and conclusion. As there are more than one ways to start with information and arrive at a conclusion; thus, there are more than one ways to reason. Each has its own strengths, weaknesses, and applicability to the real world. Depending on the type of logical relationship (probable or necessary) between premises and conclusion, there are two forms of reasoning- inductive and deductive and corresponding two types of logic. Inductive logic deals with inductive arguments and deductive logic deals with deductive arguments. Though the nature of reasoning in both of them is not same, their aim is same. Both inductive and deductive logic provide methods and criterion to differentiate correct reasoning from incorrect ones. Deductive reasoning is the process in which conclusions are drawn with logical certainty from given premises. This type of reasoning is used in mathematical proofs or when dealing with formal systems.

In inductive reasoning one draws the "best" conclusion suggested by the set of observations/ experiential statements. Here observations used as evidence are always incomplete and insufficient to support a definitive conclusion, therefore one can never be certain of the conclusions one makes. This process is analogous to the scientific process in general. From the above discussion it can be observed that logic is a discipline of study to learn how to reason well. Meanwhile, reasoning is the mental process used to draw inferences from certain assumptions, beliefs, facts or observations; and arguments are the structural arrangement of content of thought process (premises and conclusion). Due to this intimate connection of meanings, one may find, these terms *logic, inference, argument* and *reasoning* are quite often used interchangeably while explaining induction and deduction. To understand the nature and scope of inductive and

deductive logic, we shall now look at the intricate features of two forms of reasoning at length in the following sections.

3.2 DEDUCTIVE REASONING

In deductive reasoning the relation between premises and conclusion is of necessity i.e. conclusion necessarily follows from premises. In other words, premises offer *conclusive ground* for conclusion. *Conclusive ground* means evidences are complete and sufficient enough to support the conclusion. Acceptance of premises leaves no room for any reasonable or meaningful doubt about acceptance of conclusion.

Let us take an example:

Argument 1: P1: All men are mortal

P2: Mahatma Gandhi is a man

C: Therefore, Mahatma Gandhi is mortal

The conclusion "Mahatma Gandhi is mortal" is already contained in the premises. What is already contained in the premises in implicit form, reasoning just makes it explicit in conclusion. There is no novelty. No new information is given in the conclusion. So, in any valid deductive argument it can never be the case that false conclusion is drawn from all true premises. If we have assumed something to be *true* in premises, how can it be opposite i.e. *false* in conclusion? It is a contradiction in itself. In deductive reasoning, we don't go beyond what is stated in the set of premises.

Deductive Reasoning provides necessary and certain knowledge: One may even wonder that if the conclusion does not go beyond premises and no new information is acquired in the process, then what the significance of deductive arguments is. This curiosity finds its answer in understanding the point that *knowledge is not mere acquisition of new information.* Knowledge is the outcome of critical, reflective and analytical attitude. There is an ancient Indian saying: *eliminate ignorance (avidya) and become enlightened.* Deductive argument helps us to know what is imbedded in the premises. It is an expedition into the analysis of the meaning of the premises. We analyze and reflect on the information provided in the premises and form

connections between different aspects. And then what's already there in implicit form, stated out in conclusion explicitly. We can comprehend now, why the denial of conclusion in such a case amounts to denying the meaning of the premises which were accepted earlier. Therefore, we say that a valid deductive argument is characterized by logical necessity. An argument is valid if its premises necessarily imply its conclusion, otherwise it becomes invalid. In a valid deductive argument, conclusion is either equal to the premises or less than them, but never states anything which goes beyond or wider than information given in premises.

Moreover, addition of more information to premises does not affect the conclusion of valid deductive argument. In the above cited argument any further addition to the already given set of premises, for instance adding "Mahatma Gandhi preached Non-violence and Truth", "Mahatma Gandhi was the author of Hind Swaraj" etc. makes no difference to the conclusion. Given set of premises (P1 and P2) in the above argument are complete, sufficient, proper to entail conclusion (C). A valid argument cannot become more valid in virtue of addition of one or more premises. On the other hand, if any one or more premises are taken out of a valid argument, then the argument does not become 'less valid', it simply becomes 'invalid'. Subtraction of premise from argument changes the status of argument straight away from valid to invalid. So, a deductive argument is either valid or invalid. Validity is not a matter of degree. Differences between valid and invalid arguments are only in kind. The premises in a valid argument constitute necessary and sufficient conditions to accept the conclusion. An argument is invalid due to a 'missing link' in the class of premises.

Formal character of the deductive argument: One of the significant features of deductive logic is its formal character. It puts emphasis upon the structure and form of an argument. Form or structure of the argument is order, pattern, arrangement in which all the elements (terms and propositions) stand in relation to one another. Form is the only deciding factor in assessing the validity/invalidity of deductive arguments. In inductive logic matter or content is of primary importance. When we deal with the form of deductive argument, we also deal with 'validity' and 'invalidity', on the one hand, and 'truth' and 'falsity' on the other. Only propositions are evaluated as true or false whereas deductive arguments are evaluated as valid or invalid.

We generally think that a combination of true statements will lead to valid argument and false to invalid, but this is not the case. It means that truth and validity may or may not coincide with

each other. Structure of the argument plays an important role in deciding validity and invalidity of argument. There is a distinction between material truth and logical truth. Material truth is what is stated by matter of fact. Logical truth is the outcome of the form of argument. A deductive logician does not question the status of premises. It does not matter to him or bother him if the premises are actually true or not. He merely checks what necessarily follows from the given set of premises. He does not do empirical enquiry. In deductive reasoning one assumes premises to be true (irrespective of their actual/material truth value) and then arranges them in such a manner that conclusion necessarily follows from them.

All possible combinations of the connection between truth- falsity of the statements of the argument and validity- invalidity of that argument can be summarized as shown in the table below. (Reason with examples for each case shall be explained at length in the next unit *Truth and Validity*. It has been discussed here in brief to make you appreciate and comprehend the formal nature of deductive reasoning.)

	Premises	Conclusion	Arguments
1	TRUE	TRUE	VALID
2	TRUE	TRUE	INVALID
3	**TRUE**	**FALSE**	**INVALID**
4	FALSE	TRUE	VALID
5	FALSE	TRUE	INVALID
6	FALSE	FALSE	VALID
7	FALSE	FALSE	INVALID

Table 1: Relation between Truth and Validity

Through this table we can observe that:

a) A valid argument (1, 4 and 6) may consist of a true premise with true conclusion (1) or false premise with false conclusion (6) or false premise and true conclusion (4).

b) An invalid argument (2, 5 and 7), similarly, may consist of statements in exactly the same manner as mentioned above. It may consist of a true premise with true conclusion (2) or false premise with false conclusion (7) or false premise and true conclusion (5).

c) Case-3 points out towards the logical necessity associated with deductive reasoning. In any valid deductive argument false conclusions cannot be drawn from all true premises. In this case, necessity is of a particular kind, i.e. logical necessity. We have already mentioned this point in previous paragraphs as a significant aspect of deductive reasoning. An argument is called sound if it is valid and the premises are materially true.

From the above combinations it is clear that even with all false propositions one can give a valid argument and with all true propositions an invalid argument. The point to note here is that validity and invalidity are formal notions and hence applied to formal reasoning or formal logic only.

Deductive logic like mathematics is a formal science. The arguments in deductive or formal logic are categorized into different classes according to the general form/structure they possess. Arguments having the same form are treated in the same manner even if the content of each argument is different. The logicians search for formal similarity among the arguments. For example, argument 2 and argument 3 given below have the same form though the content is different.

Argument 2

P1: All Mathematicians are Logicians.	All x are y.
P2: Some Mathematicians are Scientists.	Some x are z.
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C: Therefore, Some logicians are scientists.	∴ Some y are z.

Argument 3

P1: All Philosophers are writers.	All x are y.
P2: Some Philosophers are poets.	Some x are z.
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C: Therefore, Some writers are poets.	∴ Some y are z.

We can observe clearly that the structure of these two arguments (argument 2 and 3) is identical. The difference consists in subject matter only and it is possible to construct numerous arguments having the same structure as argument 2 and argument 3. The essence of formal logic consists in saying that P1 & P2 imply C. Only implication and entailment are relevant here. Strawson has made it clear that *implication or entailment is independent of subject matter.*

The logical principles or rules that are used to determine correctness (validity) and incorrectness (invalidity) of an argument are formulated on the basis of common logical features of the argument. Thus, the logical form of an argument is the most precious thing in logic. If the form of the argument gives a valid argument, then any argument which has the same form as that argument will be valid irrespective of the content of the argument or material truth of the statements used to form that argument. The formal logicians frame rules and formulae for testing the validity of arguments on the basis of logical form they possess. If there have been separate rules for each argument, then testing validity/ invalidity of argument would have become a cumbersome task. The representative formulae or the general rules of argument do not disagree with each other. They are connected and thus provide an ideal and organic system of logic.

Above description can be further clarified with the help of concepts of *constants* and *variables*. Let us represent terms used in the above two arguments by 'x', 'y' and 'z'. Represent the terms 'Mathematicians' and 'Philosophers' with 'x', 'Logicians' and 'Writers' with 'y' and 'Scientists' and 'Poets' with 'z'. Representative/symbolic form is shown on the right hand side of the respective arguments (argument 2 and argument 3). In this particular framework, without knowing the contents of 'x', 'y', and 'z' we can know that 'P1 and P2 together imply/ entail/leads to C'. The same explanation holds good for any invalid or inconsistent argument where premises do not imply conclusion.

Such forms are called logical forms. A logical form has two components: variables and constants x, y, z etc. in above examples are variables. Quantifiers like 'All', 'Some' and logical connectors/ operators like 'if ……. then', 'either…or', 'and', 'not' and 'if and only if' are called logical constants. In the final analysis, the structure of an argument is determined by constants, and not by variables. Every class of argument has fixed constants. The structure of one class of

arguments is different from the structure of some other class of arguments. When the structure of an argument differs, the laws also differ.

Over centuries, logicians devised powerful techniques to discriminate valid arguments from invalid one. Though the traditional techniques and methods for determining validity differ from those used by modern logicians, the fundamental task is the same. To name few 'six rules of valid categorical syllogism', 'Venn diagram method', 'nine rules of inference', 'ten rules of replacement', 'truth table method', 'shorter truth table (*reductio ad absurdum*)' are some techniques discussed in deductive logic to check validity/invalidity of an argument or to construct formal proof of validity. Predicate calculus was introduced to make the internal structure of propositions more clear. It deals with forms of arguments which, on account of their complexity, are beyond the scope of propositional calculus.

The form or structures of argument and rules used to determine validity (invalidity) are mutually dependent. If it is possible to decide the structure of an argument and also different classes of arguments, then it is possible to achieve what is called formalization or systematization. So, *generality*, *form* and *system* are three features of formal logic.

Deductive logic provides a priori knowledge: We have observed in above discussions that like Mathematics, Logic is formal Science. It deals with relations which are applicable to actual as well as possible objects. It is deductive in character. Another similarity is that method of both is a priori i.e., independent of experience. Deductive arguments are like analytic statements. Knowledge obtained from an analytic statement is necessarily a priori, i.e. knowledge prior to sense experience. In analytic statements the predicate term is contained in the subject term. For example in the statement "All bachelors are unmarried" the term 'unmarried' is already contained in the subject 'bachelor'. In deductive argument, conclusion is contained in the premises. Deductive logic provides knowledge a priori, though the premises and conclusion considered separately are not analytic. Let us explain it with the help of an example:

Argument 4: P1: All businessmen are wealthy people.
P2: All wealthy people are philanthropists

C: Therefore, all businessmen are philanthropists.

Evidently, there is no need to examine businessmen and wealthy people to know that the conclusion is true. Indeed, it is not even necessary that there should be businessmen who are wealthy as well as philanthropists. This being the case, argument takes the following form without leading to distortion of meaning.

"If all businessmen are wealthy people and all wealthy people are philanthropists, then all businessmen are philanthropists."

The argument is transformed into a statement which involves relations. All hypothetical or implicative relations (the present relation is of one such kind) are such that without the help of sense experience, but only with the laws of formal logic, it is possible to derive a conclusion. Thus like an analytic statement, any valid deductive argument provides a priori knowledge and hence it is devoid of novelty. Here sense experience takes back seat and intellect or reason becomes the prime means of acquiring knowledge. Following the footsteps of Descartes, who is regarded as the father of rationalism, we can conclude that deductive logic is rational. So we have sketched three characteristics of deductive reasoning: logical necessity, a priori and rational.

But sometimes the conclusion of an argument does not stand in such a necessary relation with premises. Quite often in our daily dealings we use non- deductive reasoning. Doctor's diagnosis of the patient for finding the root cause of his/her illness is done in a non-deductive manner. Even legal experts/lawyers use inductive methods to decide what law governs in a particular case. Inductive arguments are tentative, probable, and provisional. No empirical science, natural or social, which aims to describe nature, world, or society, can do without induction. Let us now look at inductive reasoning in detail.

Check Your Progress I

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

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

1. Analyze the relation between validity and formal character of deductive arguments.

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3.3 INDUCTIVE REASONING

In inductive reasoning, conclusion is drawn on the basis of some observed instances. This type of argument begins with sense experience. The premises of inductive argument are statements which directly result from sense-experience. However, the conclusion is not an observational statement i.e. its material truth is not known. In inductive reasoning, though the premises do not imply the conclusion with certainty, yet the premises give good reasons that suggest a particular conclusion. Contrast to the deductive reasoning, conclusion of an inductive argument doesn't get implied or entailed by the premises. Therefore, inductive reasoning does not provide a necessarily true and certain knowledge. The evidences (premises) only support the conclusion and do not entail it. Let us take an example of inductive argument:

Argument 5: P1: Professor x is a writer and he is wealthy.
P2: Professor y is a writer and he is wealthy.
P3: ……..
P : multiple observations of the same kind
Pn: ……..

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Therefore, All professors who are writers are wealthy.

No matter how many observations we have, as stated in premises P1, P2...Pn, they cannot prove the conclusion 'All professors who are writers are wealthy.' The premises offer, at best, reasonable grounds to 'believe' in such a conclusion. However, 'belief' is not the same as proof. The statement 'All professors who are writers are wealthy' not only includes observed cases of Professors who are writers and wealthy, but also includes unobserved cases (of past and future). It is this component of unobserved cases and the leap taken in conclusion that is the root cause of endless debate on the nature of inductive inference. Uncertainty and sense experience characterize any inductive argument. Aristotle used the word 'epagoge' for 'induction' and C.S.

Peirce called them ‘ampliative’, as in this type of argument the conclusion always goes beyond the premises.

There is nothing contradictory in accepting all true premises and a false conclusion in inductive/non- deductive arguments. In the above example all the premises are true but the conclusion is only probable or may turn out to be false later on, and still it is not contradictory to accept it. If someday one comes across a professor who is a writer but not wealthy, this evidence will change the status of the above argument completely.

In deductive reasoning, it is impossible to deny the conclusion, when the premises are accepted as true, without contradicting itself. But inductive arguments escape from this contradiction. The reason is that the conclusion includes more information than the premises. After accepting the premises if we deny the conclusion, we deny only that component of the conclusion which does not coincide with the premises. Therefore, denial does not imply contradiction.

Let us take one more example here which has same form as argument 5 but is more appealing and strong:

Argument 6: P1: Crow X is black.
P2: Crow Y is black.
P3: ……
P : multiple observations of the same kind
Pn: ……
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C: Therefore, All crows are black.

In this kind of argument one can never be sure that all crows are black in colour. It is possible that in future one may come across a crow which is not black in colour. Since one can not rule out this future possibility and the leap is taken in the conclusion on the basis of limited observations of the past and present, the conclusion is only probable not certain. Though argument 5 and argument 6 have same form with different content, argument 4 appears weaker and argument 6 to be stronger in drawing respective conclusions. In case of deductive reasoning arguments with the same form share the same truth value (both valid or both invalid) but in inductive reasoning depending on the content arguments with the same form have different strengths.

Logical form of two inductive arguments given above is as follows:

P1: The element x1 of the set A has the property B.
P2: The element x2 of the set A has the property B.
P3: …….
P : multiple observations of the same kind
Pn: The element xn of the set A has the property B.

C: Therefore, all the elements of the set A have the property B.

The results of inductive reasoning are only probable. Inductive arguments are not evaluated as valid or invalid. The relation between evidences and conclusion is not of necessity but rather of suggestion. Probability is a matter of degree. Assume that 'truth' takes value '1' and 'falsity' takes value '0'. Then the numerical value of probability of conclusion varies from 0 to 1 without reaching either lower limit or upper limit. The favorable premises raise the probability value of conclusion, making the inductive argument strong. Addition of premises may change the status of argument from inductive to deductive, if on probability scale it becomes 0 (false) making argument invalid or 1 (true) making augment valid. Therefore, an inductive argument may consist of any number of premises, but what makes an argument more acceptable (strong) or less acceptable (weak) is the probability value that it takes. An inductive argument is evaluated by degrees such as weaker or stronger, appealing or non- appealing, convincing or non - convincing, etc. depending on the strength of evidences. A strong inductive argument with true premises is called a cogent inductive argument.

Here, it is necessary to remove a misconception regarding inductive arguments. It is held erroneously that inductive argument proceeds from particular premises to universal conclusion. Arguments 5, argument 6 and arguments with similar forms may also give this impression. Sometimes a distinction between inductive and deductive argument is also made on the same line. Deductive inferences are considered to go from general/ universal premises to the particular conclusion and inductive arguments from particular premises to general/ universal conclusion. But this is not always true. The conclusion of an inductive argument may or may not be in the form of universal statement but yes it is always based on some kind of generalization. In deductive arguments, the conclusion may or may not be a particular statement but it is true that premises always have one or more universal/ general statements. The error and misconception arise due to confusing universal statements with generalization. A universal

statement differs from generalization because a universal statement can be constructed within the limits of sense experience without involving generalization (which goes beyond sense experience). For example, when a teacher concludes after checking all the answer scripts of a class that every student of that class scored above 80 marks, the conclusion is a universal statement. But it is not an instance of generalization, because there is no leap from observed to unobserved or unobservable.

To make the above point more clear let us take one example of each; deductive and inductive reasoning where this dichotomy (that is, in deductive inferences particular conclusion is drawn from universal/ general premises and in induction universal/ general conclusion is drawn from particular premises) does not fit.

Argument 7: P1: All rectangles are quadrilaterals.

P2: All squares are rectangles.

C: Therefore, All squares are quadrilaterals.

Argument 7 is a valid deductive argument, where universal conclusion is inferred from universal premises.

Argument 8:

In a law court, a case of murder was presented in front of Judge. Mr. *X* was charged for murdering Mr. *Y*. The argument which was given against Mr. *X* was formed on the basis of following evidences:

> Mr. *X* and Mr. *Y* were business partners for 23 years but things were not going well between them for the past 2 years. They had a dispute over a property which they purchased jointly. *X* was also not happy about a business deal which *Y* finalized without taking *X's* consent. Mr. *X* was seen in Mr. *Y's* office two days before *Y's* murder. On that day, Mr. *Y's* office staff heard Mr. *X* threatening and forcing *Y* to sign property papers. In police investigation Mr. *X's* fingerprints are also found on the weapon obtained from murder site.

These evidences strongly suggest that Mr. *X* murdered Mr. *Y*.

In the above inductive argument we moved from particular premises to particular conclusion.

What inductive reasoning provides in conclusion is merely a statement which depends upon experience, but in itself is not an experiential statement. No one has seen Mr. *X* murdering Mr. *Y*, but this conclusion is drawn with high probability based on the available evidences.

In some cases, experience can vouch for the conclusion, but in some other cases, it cannot. In inductive reasoning, conclusion is characterized by a sort of leap, leap from 'observed to unobserved/unobservable'. This is known as 'inductive leap' which always leads to generalization. Induction cannot even be conceived in the absence of generalization. In the above example also some generalizations are made. There is progress from particular observations to generalized statements (past experiences of similar situations where somebody murdered the other due to disputes, murderer fingerprint found on weapon lead to form generalization about all similar cases) and from them to particular conclusion. So generalization is used to reach this conclusion.

In Inductive inference both form and matter of an argument play a role in evaluation of its status. But more than structure of argument, the subject matter is relevant. The acceptability or relevance of the conclusion varies from one argument to another. Further, adding and subtracting some information from premises affect the conclusion of the inductive argument. It becomes strong or weak or changes its type from inductive to deductive on adding some more information. Addition of any future observation which contradicts previous observations will change the nature of inductive argument to deductive. Addition of this information that 'Mr. X was not in the city on the day Mr. Y was murdered' will change the status of the argument. Or availability of CCTV footage which shows presence of some other person on murder site will make argument weaker.

Consider one more example where inductive reasoning is used but is different in form from previous argument:

In the outbreak of Covid19 in 2019-2020 all over the world, people were made aware about the bodily symptoms of corona disease and advised to follow the prescribed guidelines to stop the

further spread of disease. On observation of multiple corona patients few symptoms were considered to be pointing out towards the presence of Corona disease. It had been observed that most people who were detected with Corona virus and hospitalized for its treatment had symptoms like high body temperature (fever), dry cough, loss of smell or taste or both, shortness of breath, mucus or phlegm, congestion or runny nose. So here on the basis of multiple observations a generalized conclusion is drawn about the presence of Corona virus in a person with above symptoms.

But later on different cases also came into picture where people who had no such symptoms were also found suffering with Corona and people who had some of the above symptoms were not detected with Corona. So, the presence of some symptoms or absence of them gave no certainty about drawing this conclusion that somebody is Corona positive or Corona negative. Unless and until that person's lab test is done, it is only a matter of speculation. This kind of reasoning is inductive in nature; we merely speculate something based on available evidences. Inductive arguments which appear to be strong at one point of time may lose their strength with addition of more observations which do not agree with previous observations.

This analysis makes two points clear. Content alters the acceptability of inductive argument and they are neither valid nor invalid. In other words, an inductive conclusion is neither true nor false. At best it is probable and at worst it is improbable.

In inductive arguments the relation between premises and conclusion is like 'synthetic' statements where the meanings of subject and predicate are different, but otherwise related as in the case of the statement, 'The table in the dining area is round'. Synthetic sentences are descriptions of the world that cannot be taken for granted. It is possible to ascertain the truth or falsity of such proposition, but it is not possible to know it before sense experience.

Some cases of inferences are future-oriented and in principle 'verifiable'. However, inductive inference need not be so always. It can also be past-oriented which is surely, 'unverifiable'. History, anthropology, geology, etc. consist of arguments which are past-oriented. But the mechanism involved in both the cases is exactly the same. Therefore, the prime characteristic of induction is that the conclusion does not necessarily follow from the premises and that experience precedes inference which means that inductive inference is uncertain and *a*

posteriori. Whatever knowledge we acquire 'after experience', or whatever depends upon experience is called *a posteriori* as opposed to *a priori*.

So inductive reasoning is synthetic, a posteriori, reason- based and has been used in natural and empirical sciences.

Check Your Progress II

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

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

1. Explain briefly the characteristics of inductive reasoning.

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3.4 RELATION BETWEEN TWO TYPES OF REASONINGS

It is not correct to consider deduction and induction as opposed, antithetical or contradictory to each other. They are rather complementary and supplementary to one another. The relation between deductive and inductive reasoning is more like team mates in a race. One type of reasoning should not be considered to be more fundamental than the other. Deduction begins where induction ends. The conclusion of inductive reasoning may serve as a premise for deductive reasoning. They differ only in their 'beginning points'.

Just as deductive logic has affinity with mathematics, inductive logic has affinity with the methods employed by the scientists. But to think that empirical sciences whether natural or social are purely inductive is not correct. The deductive reasoning also occurs in empirical sciences. If you look closely at argument 8 discussed above deductive reasoning followed up after inductive reasoning Arthur in his *An Introduction to Philosophy of Science* says "there is no other way of testing an empirical hypothesis- especially one of highly theoretical character, such as the hypothesis of universal gravitation, or the atomic hypothesis- than by deducing from it directly testable consequences." (Arthur, P139)

3.5 ARGUMENTS AGAINST INDUCTIVE AND DEDUCTIVE REASONING

Hume says there are two possible types of arguments, “demonstrative” (equated with deductive) and “probable” (equated with inductive), but neither of them serve to draw some conclusion without fallacy. A demonstrative argument produces the wrong kind of conclusion, and a probable argument would be circular.

There are fewer criticisms raised against deductive arguments as compared to inductive arguments. One criticism that has been raised was by J. S. Mill against one type of deductive argument- syllogism (arguments with exactly two premises). In general, this is applicable to any deductive argument. Mill contends that syllogism just repeats the premises in the conclusion without going any further i.e. syllogisms are circular or non-ampliative and thus trivial. Mill claims that all attributes (terms, premises, and conclusion) are logically independent. Here, if we refer to argument -1 discussed above (All men are mortal, Mahatma Gandhi is a man. Therefore, Mahatma Gandhi is mortal.), Mill’s claim says that the truth of the major premise adds nothing to the truth of the particular propositions, ‘this man is mortal,’ ‘that man is mortal’, etc., whose conjunction it records. Accepting the major premise as true is simply a way, on the one hand, of accepting that particulars, one already knows, share the attributes in question (mortality), and, on the other hand, a determination that one will continue to affirm this connection of hitherto unexamined particulars. Deductive logic or syllogism adds nothing to our knowledge. The rules of formal logic, of syllogistic logic, are the rules of logic of consistency. We referred to this problem of novelty in 3.2, and also saw a powerful response to this objection.

But the objections raised against induction are more severe. The challenge for the empiricist is how to get universality and generality, necessity, and normativity out of particular, contingent experiences.

At first, inductive reasoning is not regarded as logical at all since in inductive arguments the truth of the conclusion does not necessarily follow from the truth of premises. This objection can be met by arguing that deductive standards need not to be applied to inductive logic, lest the distinction itself becomes superfluous.

Hume demonstrated that deduction cannot be used to explicitly prove the truth value of an inductive inference. The inductive inference to be proved must be taken as an axiom, thereby leading to circular logic between the premise and conclusion. Thus, inductive inferences are open-ended, and acting upon them requires faith that no contradictory case will eventually appear. Hume showed that we are not epistemically justified in using induction (though there is a psychological story that explains our confidence). While self-supporting inductive arguments involve arguing in a circle, any other attempt to justify induction results in infinite regress, i.e., if we use one principle to justify law in science, then this principle stands in need of justification, and so on.

Salmon, Max Black and Urmson defend induction whereas Russell and Popper reject induction. Popper's theory is known as anti-inductivism or non-inductivism. Popper replaces verifiability by falsifiability.

Check Your Progress III

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

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

1. Explain the concepts 'analytic and synthetic' and 'a priori and a posteriori'.

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2. Comment upon the criticisms made against deductive and inductive inferences.

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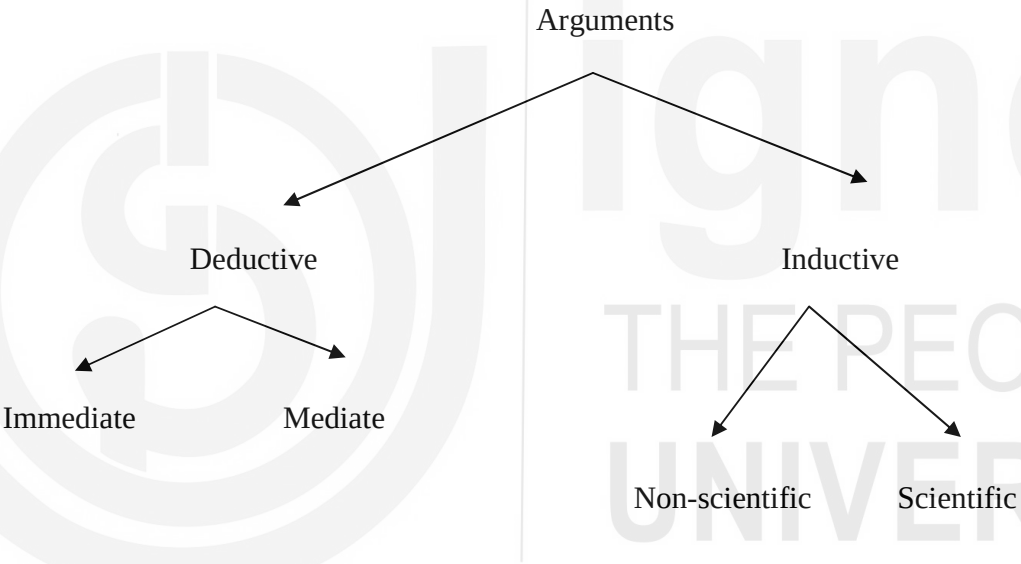
3.6 TYPES OF INDUCTIVE ARGUMENTS

In deductive logic different types of deductive arguments are discussed based on the form of the argument. The form differs based on the number of premises and how terms, premises-

conclusion is arranged in relation to each other. In the deductive reasoning conclusion is certain and there is no difference in type of deductive arguments based on conclusion. On the other hand in inductive reasoning the conclusion differs in degree. Inductive reasoning takes specific information and makes a broader generalization, but there are other forms also different from generalization. There are other forms of inductive arguments in which conclusions are drawn by appeal to evidence, or authority, or causal relationships. Different methods used in deductive logic to find validity of arguments are the subject matter of your present logic course. It's been discussed at length in the next two blocks. Here in this section we will take a brief look at type of inductive arguments specifically type of inductive generalizations. Broader sub-categorization of these two types of arguments can be done as follows:

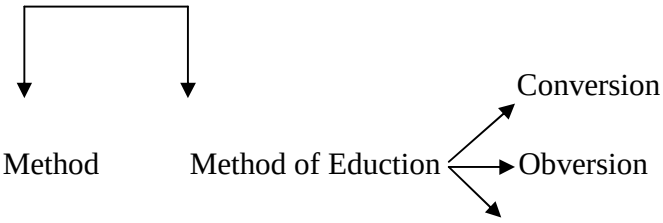


Graph 1: Arguments: deductive and Inductive

Immediate

(Arguments

having one Premise)

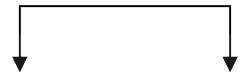


of Square of Contraposition

Opposition of Proposition

Graph 2: Immediate Argument

Mediate



Syllogistic Non-syllogistic

(Arguments (Arguments having more than two premises)

Having exactly

Two premises) Hypothetical

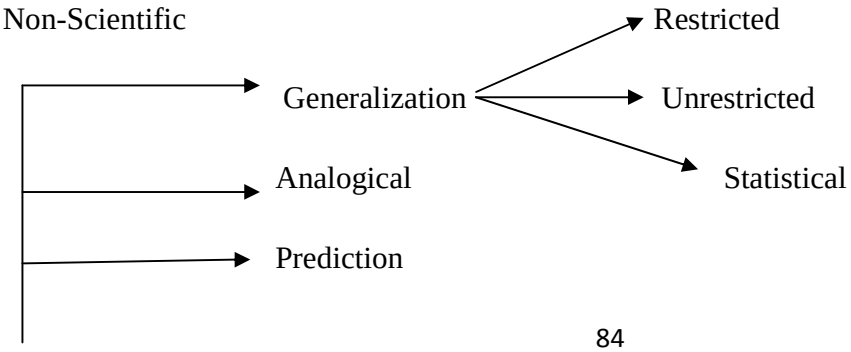
Categorical/Simple Non-categorical/Conditional propositions used

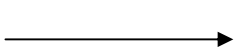
Propositions used Disjunctive

Graph 3: Mediate Argument

(Inductive)

Non-Scientific





Graph 4: Non-Scientific

Causal (Methods of Finding Causal Relationships: Method of agreement, Method of disagreement, Joint method, Method of residues, Method of concomitant variation)

Graph 5: Scientific

Let us now have a look at types of inductive reasoning:

Generalization: Inductive generalization proceeds from specific sample observations to general ideas about the whole population. In generalization one draws conclusions based on recurring patterns or repeated observations. To generalize, one observes multiple instances and finds common qualities or behaviors and then makes a broad or universal statement about them. There are some fallacies related to this type of generalization known as hasty generalization and biased sample usage. When generalization is done after observation of all the cases then it is known as induction by complete enumeration.

There are three types of generalizations: unrestricted, restricted and statistical.

Generalization is said to be unrestricted when it does not include exceptions in any form. It is restricted when some restrictions are imposed individual, spatial or temporal. Development in certain fields like statistics has given rise to a different type of generalization which may be called statistical generalization. Statistical generalization requires a fair sample within which a study is undertaken yielding a certain ratio. This is, surely, an example of empirical approach. Observations made within this sample are extended to the parent class, i.e. the class of which the sample forms a part. It is quite likely that we may arrive at a certain ratio within a fair sample whereas within the parent class we may arrive at some other ratio if certain other parameters influence the rest of the class. Another type of statistical generalization results when observations made in one sample become the ground to make observations in some other sample. In all such studies, it is frequency of occurrence of an event which matters. It is of

utmost importance that in any statistical study fair sample should consist of elements selected by the same procedure.

Analogical: Inductive analogy proceeds from known similarities between two things to a conclusion about an additional attribute common to both things. If some attribute A is true for X, Y and Z and later on we find that X and Y have attribute B, we based on analogy infer inductively that it is most likely that Z also possesses attribute B. The fallacy of false analogy is related to this process. Analogy excludes generalization of all types. Still, it is inductive, because with its help we pass from 'observed' to 'unobserved'. This particular inference is, evidently, intuitive and intuition is, essentially, subjective. But in this case the subjective nature of intuition does not pose any problem because what is inferred can be tested by anyone. Hence, analogy can be regarded as objective and also as inference.

Prediction: a conclusion about a future individual from a past sample.

Induction based on authority: An argument from authority draws a conclusion about the truth of a statement based on the proportion of true propositions provided by an authoritative source. It has the same form as a prediction.

Causal: A causal inference draws a conclusion about a causal connection based on the conditions of the occurrence of an effect. Premises about the correlation of two things can indicate a causal relationship between them, but additional factors must be confirmed to establish the exact form of the causal relationship.

3.8 LET US SUM UP

Reasoning is of two types: inductive and deductive.

Deductive Reasoning:	Inductive Reasoning:
● The relation between premises and conclusion is that of necessity. Premises are sufficient to draw a conclusion beyond any doubt. ● Addition of more statements to premises does not change the	● The relation between premises and conclusion is probable. Premises merely suggest a conclusion but do not entail or imply it. ● Addition or subtraction of information changes the status of conclusion in an

conclusion of a valid deductive argument. ● Deductive reasoning is formal in character. Form decides the status of the argument. ● Deductive argument is evaluated either as valid or invalid. ● Valid arguments may consist of either true statements or false statements. But a significant aspect of valid deductive argument is that a false conclusion cannot be drawn from all true premises. ● Sense experience is irrelevant in deductive logic. Intellect is the key to deductive inference. ● Logical certainty, a priori nature and rationality are the qualities of deduction.	inductive argument. ● In induction content/ matter determines acceptability of inference. ● Inductive arguments are evaluated as strong or weak, acceptable or not acceptable, sound or unsound, appealing or non- appealing. ● There is nothing contradictory in accepting all true premises and a false conclusion in an inductive argument. ● Premises are observational statements based on sense experience. Generality (in conclusion) is the characteristic of induction. ● Inductive inference is probable, uncertain, *a posteriori* and empirical.

3.9 KEY WORDS

Probability: Probability is a technical term used extensively in all sciences which use quantitative analysis. It is, generally, issued to deal with projection which is future-oriented or past-oriented. It is always expressed in proper fraction where the denominator points to the total number of possibilities and the numerator points to the issue at stake.

Axiom: In traditional logic, an axiom or postulate is a proposition that is not proved or demonstrated but considered to be either self-evident, or subject to necessary decision. Therefore, its truth is taken for granted, and serves as a starting point for deducing and inferring other (theory dependent) truths.

Hypothesis: A hypothesis consists either of a suggested explanation for an observable phenomenon or of a reasoned proposal predicting a possible causal correlation among multiple phenomena.

3.10 FURTHER READINGS AND REFERENCES

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3.11 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress I

1. One of the characteristics of deductive logic is its formal character in virtue of its emphasis upon the structure and form of argument. Only statements are true (or false) whereas only arguments are valid (or invalid). We generally think that combination of true statements will lead to valid arguments and false to invalid, but this is not the case. All true statements may give an invalid argument or all false statements can give valid arguments. Validity or invalidity of the argument depends on the form of the argument. It means that truth and validity may or may not coincide with each other. But, in any valid deductive argument false conclusions cannot be drawn from all true premises. In this case, necessity is of a particular kind, i.e. logical necessity.

Check Your Progress II

1. In inductive reasoning the relation between premises and conclusion is probable. Premises merely suggest a conclusion but do not entail or imply it. Premises of the inductive reasoning are observational statements based on sense experience. Generality (in conclusion) is the characteristic of induction. Probability of inference is a matter of degree which is always in a variable fraction. Inductive arguments are evaluated as strong or weak,

acceptable or not acceptable, sound or unsound, appealing or non- appealing. In induction content/ matter determines acceptability of inference. Addition or subtraction of information changes the status of conclusion. This may make inference more strong or weaken it. There is nothing contradictory in accepting all true premises and a false conclusion in inductive argument. Inductive arguments are uncertain, *a posteriori* and empirical.

Check Your Progress III

1. Analytic sentences are true by definition, and are self-explanatory. Let us take an example: 'All bachelors are unmarried men'. This statement is true in virtue of the meaning/ definition of the word 'bachelors'. In analytic statements the predicate term is contained in its subject term. Knowledge obtained from an analytic statement is necessarily a priori, i.e. knowledge prior to sense experience. Deductive logic provides knowledge a priori, though the premises and conclusion considered separately are not analytic. However, deductive argument and analytic statement share a common characteristic. In both the cases, denial leads to self-contradiction. Any knowledge before experience is a priori and that knowledge which comes after experience is called a posteriori. In synthetic statements the predicate term is not contained in its subject term but related to it. Consider the example 'All creatures with hearts have kidneys.' Here the subject 'creature with heart' does not contain this information that they 'have kidney'. Inductive arguments are considered to be of the nature of synthetic judgments.

2. Induction has attracted more criticism than deduction. The criticism against deduction was made by J.S. Mill with reference to one type of deductive argument known as syllogism. Mill contends that syllogism is guilty of repeating the premises in conclusion. The aim of logic is to achieve progress on knowledge. Deductive logic fails to achieve this particular aim.

   Induction, on the other hand, is open to more serious criticisms. Hume raises objections to one form of induction known as ampliative induction. Generalization is considered a hallmark of inductive reasoning. The objections to generalization are formulated on one ground; no proof in strict mathematical or deductive sense is possible when we deal with induction. Inductive inference can only be vindicated because any attempt to justify the same runs into infinite regress or becomes circular. Generalization can only be disproved or falsified though it cannot be proved.