

# 4 Logic of Inquiry

## SCIENCE AND LOGIC

*Science* is an approach to the problem of human knowledge, based on the attempt to develop general principles, derived from empirical observations (i.e., from the experience of the senses). Science is based on the assumption that the biases and values of the observer can be relatively controlled so that a reasonable degree of objectivity is possible. In simple words, science involves reasoning based on scientific evidence. *Logic*, on the other hand, deals with the principles, methods, and criteria of correct reasoning, or distinguishing correct (good) from incorrect (bad) arguments. It deals with the relation between evidence (beliefs held to be true) and conclusion; or it may be said, it is concerned with the evaluation of the adequacy of the evidence to affirm a conclusion. People hold that certain ways of reasoning are acceptable but others are not. The aim of logic is to state the principles upon which this distinction is made. We have to understand these principles of reasoning so that we understand and accept the scientific observations. Logic tells us whether the evidence justifies the conclusion.

### ELEMENTS OF LOGICAL ANALYSIS:

#### TERMS, PROPOSITIONS, ARGUMENTS AND SYLLOGISMS

Logic clarifies our thinking by expressing reasoning. Singleton and Straits (1999:47) have discussed three fundamental elements of logical analysis: terms, propositions and arguments. A *term* is a word with a specific meaning. A term is neither true nor false. A *proposition* is the meaning of a sentence. The meaning of sentence is different from the sentence itself. Propositions, unlike terms, are either true or false. Logicians are concerned with what the proposition says, i.e., *reasoning* given in it. The proposition may either be *conditional* (also called hypothetical) or *categorical*. The former is a statement based on the words 'if' and 'then', but the latter does not provide any condition.

For example, “all heavy things fall on earth” is a categorical proposition while “if the advertisement is good, it will increase the sale” is a conditional proposition. *Argument* is a group of two or more propositions, one of which is claimed to follow from the other(s). For example, “he failed because he did not study and did not work hard”. The cause of failure is explained on the argument of ‘not working hard’. The proposition which is affirmed is known as ‘conclusion’, while one that supplies evidence for accepting the conclusion is known as ‘premises’. Argument given by logicians is called *syllogism*. Syllogisms are arguments composed of three propositions—two premises and a conclusion that premises logically imply.

Syllogism = One argument supplying evidence + another argument supplying evidence + conclusion derived from arguments.

For example:

- Attempting to seek MPs’ support to vote with the government on a vote of confidence in parliament by offering them money is a corrupt and illegal practice
- Two central ministers gave lakhs of rupees to four MPs of one political party to get their support
- The ministers (including one former Prime Minister) were convicted and sentenced for bribery (political corruption) and purchasing votes.

The media thereupon comments “the activist judiciary is filling the vacuum in administration created by the collapse of the executive branch of the central government”.

Here is another example:

- The predominant emotion in a crowd makes its members suggestible, imitative and irrational.
- The cinema hall suddenly catching fire created the emotion of fear among the audience.
- All people rushed towards that one exit which was opened in the hall, without caring to find out other exits.

While ‘term’ is judged on the basis of its meaning, ‘proposition’ is judged on the basis of its truth, and syllogisms are judged on the basis of their validity. The validity of the syllogism solely depends on the relation between its premises and its conclusion. If the premises are true, then the conclusion must be true and the syllogism must be valid.

## VALIDITY AND TRUTH

The goal of logic is to evaluate reasoning (whether the propositions are true or false), while the goal of science is to establish knowledge about the empirical world. Scientists evaluate not only the adequacy of their reasoning but also the actuality of their statements to justify their conclusions about reality. In other words, scientists are concerned with both *validity* and *truth*. Logic is concerned only with one thing: whether the premises are properly related to the conclusion. Logic can tell us: given X and Y, we can reasonably infer Z, but it cannot tell us whether X and Y are true. It is scientific observation which alone can prove the truth of X and Y.

X - A person with an IQ of 130 is intellectual.

Y - Ram has IQ of 135.

Z - Ram is intellectual.

## TYPES OF REASONING/ARGUMENTS

Two major types of reasoning or arguments are *inductive* and *deductive*. In all arguments, the claim is made that the premises supply evidence for the truth of the conclusions. However, in some kinds of arguments, the premises provide *absolutely conclusive* evidence, while in other kinds, the premises supply only *some* evidence. The former are known as *deductive* arguments while the latter are called the *inductive* arguments. The common distinction between these two types of arguments is that deductive arguments consist of reasoning from general principles to particular instances, while the inductive arguments are reasoning from specific or particular facts to general principles. This difference is said to be misleading. Currently, 'logic' is generally used to refer to only the study of deductive arguments.

### Deductive reasoning

This is one in which the premises are believed to supply absolutely conclusive evidence for the truth of the conclusions (Manheim, 1977:30). This means that if the premises are true, the conclusion must be true. For example:

Premise:               Factions exist almost in all political parties.

Conclusion:           Political parties fail to get people's support because of lack of internal unity.

Another example:

Premise: The CBI searched the house of a minister of the central government when he had gone for medical treatment to Britain, and found crores of rupees in his house.

Conclusion: The court, on the basis of the evidence submitted, declared him a corrupt minister and convicted and sentenced him.

It was said that the judicial interpretation created precedence that would close a loophole in the penal code and help to enforce minister's accountability. But, since on appeal, the case is still in the court and the concerned culprit continues to enjoy high political status in his state, it has deepened the disillusionment of the people towards the democracy as well as the judiciary. Here, the premises supply absolutely conclusive evidence for the truth of the conclusions. But, in some cases, the premises do not entail the conclusion. Sometimes, a very careful and rigorous examination of an argument will show that the conclusion is not entailed by the premises, even though a superficial examination seems to indicate that it is. It is the task of the logic to enable one to distinguish between such arguments and to make distinction between valid and invalid deductive arguments.

Let us now take the example of invalid syllogisms:

Premise: Broken homes produce juvenile delinquents.

Premise: Ram comes from a broken home.

Conclusion: Ram is a juvenile delinquent.

The first premise is not true because all broken homes do not produce juvenile delinquents and all juvenile delinquents do not necessarily come from broken homes. Other premise may be correct, but conclusion is invalid.

Summarising for all combinations of true and false premises valid and invalid arguments, and true and false conclusions, Manheim (1977:35) has made following three useful statements with certainty:

- If all the premises are true and the argument is valid, the conclusion must be true.
- If the conclusion is false and all the premises are true, the argument must be invalid.
- If the conclusion is false and the argument is valid, at least one premise must be false.

## Inductive reasoning

As defined earlier, inductive reasoning is one in which the premises supply only *some* evidence for the truth of the conclusion. There are two kinds of inductive arguments:

(i) induction by enumeration, called inverse inference. The conclusion is *probable* on the basis of many individual observations of similar events or phenomena. Finding certain things to be true of each of these observations, we conclude that the same things are true of all such phenomena. For example:

a man A has two legs,  
 a man B has two legs,  
 a man C has two legs,  
 a man D has two legs,  
 Therefore, all men have two legs.

Or, a policeman A accepts money for manipulating evidence to protect the criminal.

a policeman B also does the same thing,  
 a policeman C also does the same thing,  
 a policeman D also does the same thing,

Therefore, all policemen accept money to manipulate evidence and are corrupt.

Since we do not observe *all* policemen, either because of practical considerations or because it is not considered worthwhile, therefore the inference that all policemen are corrupt is not true.

(ii) Induction by conclusions not from *similar* observations but *other* kinds of observations. This is called *predictive* inference. For example, concluding that all thefts are committed because of poverty; all murders are committed because of hatred; all rapes are committed because of sexual perversion.

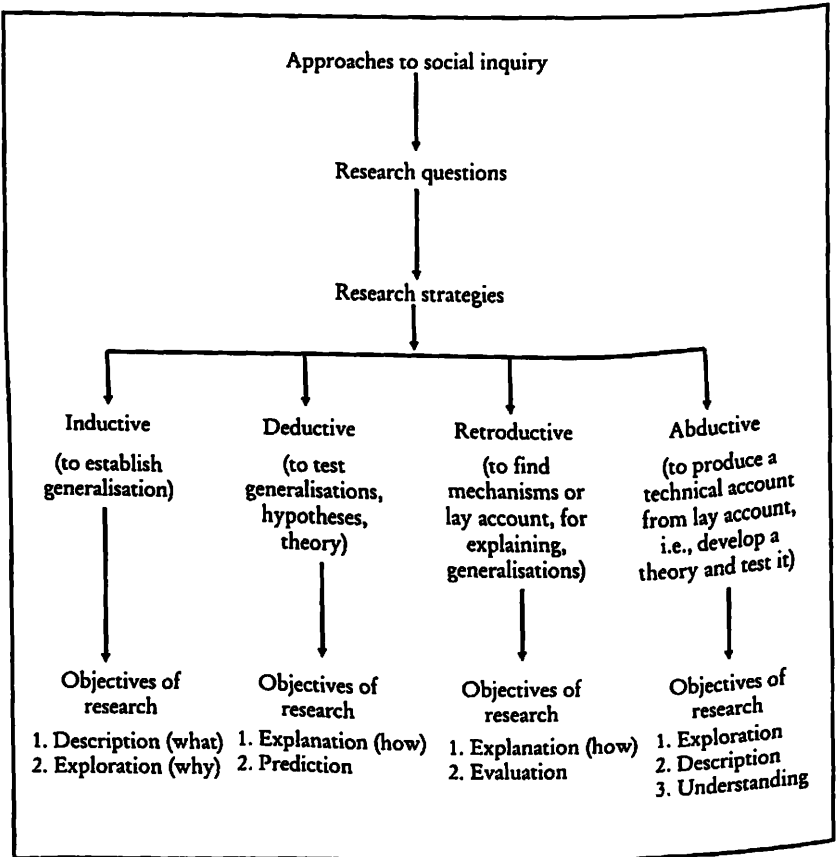
Here, the premises supply only some evidence for the truth of the conclusion. It may thus be concluded that deduction is not concerned with the truth of propositions while that is precisely the main concern of induction.

Inductive  
 reasoning:  
 Deductive  
 reasoning:

Conclusion is probably true but not necessarily true, if all premises are true.  
 Conclusion is absolutely true, if all premises are true.

### STRATEGIES IN RESEARCH

Norman Blaikie (2000: 85-127) has discussed the question of conducting research in a different way. He has focused on the strategies of undertaking a study and making appropriate observations, i.e., to answer research questions or to explain, explore, describe, evaluate, understand and predict. In simple words, this means, how to draw conclusions. He has pointed out four strategies for this purpose: inductive, deductive, retroductive and abductive. Before answering the question, how to choose the *appropriate* strategy out of these four strategies, let us first understand what these strategies are. Induction is 'logic of positivism', deduction is 'logic of critical rationalism', retroduction is 'logic of scientific realism', and abduction is 'interpretivism'.



### Inductive strategy

It is a process in which generalisations are inferred from specific facts, i.e., conclusions are derived from individual observations. For example, observing interaction of persons gathered temporarily in a place of accident/demonstration/riot, etc. (i.e., crowd) and generalising that crowd is characterised by interstimulation, predominance of some emotion, imitation and suggestibility. It is based on 'logic of positivism'. Positivism is a philosophical position that knowledge can be revived only from that which can be observed, i.e., experienced by the senses and *not* from speculation, intuition or subjective insight. Logical positivism holds that the truth of any statement lies in its verification through sensory experience. Any statement that cannot be verified through sensory experience is meaningless. The senses produce 'observations' or 'data'. Generalisations about their relationships are regarded as "shorthand summaries of particular observations". Thus, social reality can be described or explored by inductive strategy. Regularities that are recorded through observations are the basis for scientific laws or theoretical statements. Thus, inductive strategy consists of three principles: accumulation (of data), induction and instance generalising (from specific observations) and instance confirmation (giving general law). It may be said that the inductive strategy is characterised by four stages (Wolfe, 1974:450): (i) observing and recording facts, (ii) analysing, comparing and classifying these facts, (iii) inductively drawing generalisations, and (iv) further testing of these generalisations. In this way, the inductive strategy is used for two purposes: to explore and to describe facts or reality, i.e., to answer or to explain 'what'. Replication studies can be used to extend generalisations.

### Deductive strategy

It is a process of reasoning from general principles to particular instances. In this method, particular predictions are derived from broader theoretical principles. This strategy is also known as 'hypothetico-deductive' method or *falsificationism*. The core of the argument of this strategy is that as observations do not provide a reliable foundation for scientific theories and as inductive logic is weak, flawed, defective, a different logic is needed for developing theories. The criticism (of inductive strategy) is that observations are always

made with a specific viewpoint with a particular frame of reference, with a set of expectations, thus making the notion of presuppositionless observation impossible. The deductive strategy, therefore, maintains that rather than accumulating data, as in the inductive strategy, data be used to test the tentative answers, i.e., to see if the data match the hypotheses. The objective of the analysis should *not* be to answer 'why' questions but to verify the hypotheses, i.e., to match the theory with the data. While inductive strategy maintains that analysis should be for the purpose of developing a theory from observations, the deductive strategy holds that analysis should be to test a theory to account for observations. In other words, the data are to be used to eliminate false theories. But since we do not know when we have arrived at true theories, therefore, all theories that have survived testing, i.e., which have been corroborated, must remain tentative. They may be replaced in the future by better theories.

Deductive research strategy is criticised on the basis of following arguments (Blaikie, 2000:107):

1. How can realities be established confidently and theories be refuted conclusively?
2. The tentative acceptance of a yet unrefuted theory requires some inductive support.
3. It is not much important to determine where tentative theories should come from or how they might be constructed.
4. Paying too much attention to logic can stifle scientific creativity.

### **Retroductive strategy**

This strategy is associated with *scientific realism*. This makes distinction necessary between real, actual and empirical domains of events. The *empirical* domain consists of events that can be observed; the *actual* domain consists of events whether or not they are observed; and the *real* domain consists of mechanisms and structures that produce these events. *Social reality* is a socially constructed world in which social events are the products of social actors. It is also explained as social arrangements that are the products of unobservable structures of social relations. The aim of *realist science* is to explain observable phenomena with reference to underlying structures and mechanisms. Thus, analysis of data through retroductive strategy aims at revealing the underlying mechanisms and structures that account for the phenomena being examined or locating the structure or mechanism that



has produced the pattern or relationship.

On this basis, in the analysis of the functioning of political elite in India, what needs to be assessed (after data collection) are: vested interests of the power elite, factions in political parties, commitment of leaders to ideologies as well as to individual persons, barriers of split ideologies, and so on. The researcher is concerned with 'uncovering' the explanatory mechanisms that produce a pattern of relationship.

Constructing models of mechanisms may involve the use of analogies. Analogies involve borrowing ideas from other fields with which the researcher is familiar and transferring the principles to the issue being investigated. Blaikie (op.cit.: 110) has summarised the reproductive strategy of analysis as follows:

1. Discovering mechanisms that explain the observable phenomena.
2. Constructing a model (of mechanisms) by drawing upon already familiar sources.
3. The model should be such that it casually explains the mechanisms.
4. The model is then tested as a hypothesis.
5. The successful tests (of the validity of hypothesis) will prove the existence of these mechanisms.

Durkheim had used this model for explaining that the decision of an individual to commit suicide is due to his disintegration into a group or society (altruistic suicide) or due to his feelings of isolation, loneliness or confusion that results from normlessness or social and personal disorganisation (anomic suicide) or due to weak group integration or guilt for moral weakness and deviation from the existence of strong social norms for which the individual feels personally responsible (egoistic suicide). These factors are socially structured and vary with social cohesion and social support individual gets from family, community and organisation.

### **Abductive strategy**

This refers to the process of generating social scientific accounts from social actors' accounts or deriving theories from lay concepts and interpretations of social life. This strategy is peculiar to social sciences. It is not used in natural sciences. Since it rejects positivism (of inductive strategy) and critical rationalism (of deductive strategy), it is known as 'anti-positivist' strategy. Interpretivists (believing in abductive strat-

egy) argue that statistical correlations are not understandable on their own. It is necessary to find out what motives (meanings) people attach to the actions that lead to such patterns (of relationships), what leads unmarried people to commit more suicides than married people? Or what leads resourceless husbands to batter their wives more than husbands in normal families? These associations between marital status and suicide or between wife battering and husband's resources, according to interpretivists can only be understood once the relationship between these concepts has been established in terms of motives of the people concerned. In short, the abductive strategy in analysis focuses on assessing the motives of social actors.

### *Further Readings*

Blaikie, Norman, *Designing Social Research*, Polity Press, Cambridge, 2000.

Manheim, Henry L., *Sociological Research: Philosophy and Methods*, The Dorsey Press, Illinois, 1977.

Singleton, Royce A. (Jr) and Bruce C. Straits, *Approaches to Social Research* (3rd ed.), Oxford University Press, New York, 1999.