UNIT 11: NATURE AND KINDS OF INDUCTION

UNIT STUCTURE

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11.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- explain the nature of Induction
- discuss the characteristics of induction
- describe the different stages of induction
- analyze the problem of induction
- describe the essential points of difference between Deduction and Induction
- discuss the various kinds of Induction
- identify the fallacies of induction.

11.2 INTRODUCTION

This unit introduces to you to the nature and kinds of induction. Logic is a branch of philosophy. It is a systematic study of reasoning. Reasoning is a process of knowing that we use for inferring what is not directly given. It is a fundamental human activity. Through this mental activity we move from something known to something unknown.

An inference or reasoning when expressed in language is called an Argument. An Argument, is a group of propositions of which one is claimed to follow from the others, which are regarded as proving support or grounds for the truth of that one.

Every argument has a basic structure. It has a very specific meaning in logic. The statements that make up an argument consist of one or more premises and one and only one conclusion. The premises are the statements that set forth the reasons or evidences or grounds for accepting the conclusion and the conclusion is the statement that is claimed to follow from the premises.

In western logic inferences have been divided into Deductive and Inductive.

11.3 NATURE AND CHARACTERISTICS OF INDUCTIVE INFERENCES

Induction is a particular kind of logical reasoning in which we proceed from known premises or from observed cases to infer about unknown or unobserved cases. We do not draw the conclusion by analyzing only what is already explicitly stated or implied by the given premises. So, the conclusion of induction is in some way intended to 'go beyond' the content of the premises. For example:

Ram is mortal.
Hari is mortal.
Jadu is mortal.
Madhu is mortal.
$\therefore$ All men are mortal

J.S. Mill defines induction as 'the operation of discovering and proving general propositions'. According to him, "Induction is the name given to the operation of the mind, by which we infer that what we know to be true in particular case or cases, will be true in any other case or cases of a similar kind." ***Francis Bacon***, the founder of the Modern Inductive Philosophy advocated the conception of Induction as the search for causes. In order to discover the form or causes of things Bacon adopted the method of elimination.

In Western logic the word 'Induction' is used to mean both the process and product of induction. But in Indian logic the word 'reasoning' is used to mean the process of reasoning, not the products.

From the above discussion we can note the following characteristics of induction.

- Inductive inference is essentially based on the observation of particular facts of experience. Observation and experiment supply its premises.
- In induction a general conclusion is established on the basis of particular facts of experience which is called generalization. Generalization is an important characteristic of induction. Generalization is a process of arriving at a universal conclusion from facts about particular samples.
- A very important and unique characteristic of induction is the involvement of the inductive leap or 'a leap in the dark'. Inductive leap is a leap or jump from the known to the yet unknown or from the cases observed so far to the yet unobserved cases. It is a jump from certainty to uncertainty. Through the inductive leap we try to gain new knowledge.
- Induction primarily aims at material truth. The material truth of induction depends on the material truth of its premise or premises. The universal proposition established by induction as its conclusion must conform to the actual state of being.
- The conclusion of induction does not follow necessarily from the premises. It goes beyond the premises. The premises here do not provide full justification or complete proof for its conclusion. The premises give only partial support for the conclusion. The conclusion follows from the premises only with some degree of probability. So, the conclusion of inductive inference is more probable or less probable, but can never be certain. Better inductive arguments will provide stronger probabilistic support and worse inductive arguments will provide weaker probabilistic support for their conclusion.

- The conclusion of induction goes beyond the premises. The basis of going beyond the premises lies in two presuppositions-the law of uniformity of nature, and the law of causation. These two principles guarantee the formal truth of Induction and thus they are called formal grounds of Scientific Induction.
- Inductive inference is non-monotonic. This is because new information can change the strength of an inductive argument. The importance of additional information is always a relevant consideration in inductive reasoning.



LET US KNOW

The word induction is derived from the Latin word 'epagoge' a term used by Aristotle. It is defined as 'a process of ascending from the particulars to the universal on an examination of all the particulars'.

Conclusive Support: If the premises are true, the conclusion can not but be true.

Partial Support: Premises offering some evidential support for the conclusion but not absolute certainty.

Inductive Leap: A unique characteristic of induction. A jump from certainty to uncertainty.

Generalization: A process of arriving at general proposition from the particular facts of experience.



CHECK YOUR PROGRESS

Q.1: State whether the following statements are True or False:

a) Induction is a process of reasoning in which we proceed from observed cases to unobserved cases. (True/ False)

b) Inductive leap is a unique characteristic of induction. (True/False)

c) Induction aims at formal truth. (Truth/False)

d) The conclusion of inductive inference is more probable. (True/False)

Q.2: Fill in the blanks:

a) Induction primarily aims at .....

b) Inductive inference is .....

Q.3: What is inductive leap? (Answer in about 60 words)

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11.4 STAGES OF INDUCTION

Logicians have recognized certain well-defined steps or stages in our process from particular facts to general laws. They are–

- Observation
- Formation of a hypothesis
- Generalization
- Verification.

Now, let us discuss these stages in detail.

- Observation is a well-defined perception for a certain definite purpose. It supplies the materials of induction. It involves analysis and elimination.
- A hypothesis means a provisional supposition. At first it may appear that several explanations of the phenomenon under investigation are possible. So, in order to determine what is real we have to fix upon one of the possible explanations for further investigation and this is called 'framing a hypothesis'. According to Whewell, it is the most important stage in the inductive process.
- Generalization is a process of arriving at general proposition on the observation of particular facts. According to Mill, induction is complete at the stage of generalization.
- Verification means examining by appealing to facts whether the general proposition which is arrived at is really true or not. Verification may be direct or indirect. In direct verification, we directly observe

facts while indirect verification involves two steps– Deduction from the general proposition and Testing the Deduction. According to Jevons, Verification is the most important stage in the inductive process.

These stages are the objective or logical conditions of inductive inference.

The subjective conditions of inductive inference are–

- Freedom from Prejudices
- Patience and Perseverance
- Belief in the Uniformity of Nature
- The Law of Causation.

The process of inductive inference and forming concepts are almost same but in the case of induction we establish a proposition, while in conception we merely establish a concept or notion.

11.5 THE PROBLEM OF INDUCTION

Induction seeks to establish the material truth of universal real proposition. The premises of induction are derived from experience. Experience provides us with only particular facts. For example, experience informs us that some men whom we knew are dead. From these experience of particular facts we establish a universal proposition-'All men are mortal'. The problem of induction thus refers to the question as to how it is possible for induction to arrive at a universal real proposition on the basis of observation of particular facts?

The solution to this problem lies in the fact that in passing from the particular to the general, Induction relies on two fundamental principles viz., the Law of the Uniformity of Nature and the Law of Causation. The Law of Causation states that every event has a cause. The Uniformity of Nature states that nature is uniform; the same cause produces the same effect under similar conditions. In experience we observe particular cases of death and find that there is something in 'humanity' that causes 'mortality'. This result is extended to other similar cases on the assumption that the same cause will produce the same effect under similar circumstances in all places and at all times.

Uniformity of Nature and Problem of Induction: Induction has to rely upon assumption; that the future will uniformly follow the past. For example, we assume that the sun will rise tomorrow as it has raisen everyday in the past. This kind of assumption forms the backbone for any kinds of induction.

David Hume, a philosopher, saw a problem for induction in this assumption. He posed the question: how do we form conclusions about matters of fact that we have not yet observed? Hume said that previous experiences play a part in the formation of such knowledge. He claimed that out of the past experiences we arrive at opinions about the unobserved by induction.

Next, Hume asked is what the reason to believe in uniformity of nature? How do we know that uniformity of nature will hold in future? He argued that we have no good reason at all. We can not settle this question by direct observation. Also, it is quite possible to imagine that tomorrow we might find the opposite happening. It is possible that the regularities that we have so far observed, for example, e.g. summer following winter, may not hold in future.

But every induction uses uniformity of nature. It serves as hidden premise in induction. Thus, Hume concluded that there is no non-circular, good reason for us to feel justified about using induction. Of course, Hume does not urge us to reject induction. His point is that we can have rational beliefs about unobserved matter by induction, even when we cannot provide any conclusive reason for it. Thus, 'I believe' is an important lesson to learn.

Some contemporary thinkers think that it makes sense to discuss induction. They usually point to Hume's problem of induction. But the study of the principles underlying induction is regarded as the pre-requisite for solving many scientific and philosophical problems.



ACTIVITY 11.1

What are the essential features of induction? Explain.

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CHECK YOUR PROGRESS

Q.4: What do you mean by problem of induction? (Answer in about 30 words)

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Q.5: What are the two fundamental principles on which induction relies on?

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Q.6: What are the three different stages of induction?

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Q.7: Fill in the blanks:

a) ..... means provisional supposition.

b) ..... is a well defined perception.

c) According to ....., induction is complete at the stage of generalization.

11.6 KINDS OF INDUCTION

Following Mill, generally, induction may be classified under two heads:

A) Inductions proper

B) Inductions improperly so-called

Induction proper is that in which there is 'inductive leap'. Induction improperly so-called is that in which there is no inductive leap.

Induction proper may be sub-divided into the following heads:

- Scientific Induction
- Unscientific Induction or Induction per Simple Enumeration or Incomplete Induction
- Analogy

Inductions improperly so-called may be sub-divided into the following heads:

- Perfect Induction or Induction per Complete Enumeration
- Induction by Parity of Reasoning
- Colligation of Facts

A) Induction Proper:

I) Scientific Induction: Scientific induction is the establishment of a general real proposition based on observation of particular instances, in reliance on the principle of the Uniformity of Nature and the Law of Causation.

The analysis of the definition describes the following characteristics of scientific Induction.

- Scientific induction establishes a Universal Real Proposition as its conclusion:
  - Scientific Induction establishes a proposition, not an idea or concept. A proposition explicitly states a relation between two terms.
  - Scientific Induction establishes a universal, not a particular proposition. A Universal proposition is one in which the predicate is affirmed or denied of the whole subject.
  - Scientific Induction establishes a real or synthetic proposition, not a verbal or analytic proposition. In a real proposition the predicate asserts an additional fact about the subject not contained in the connotation of the latter. For example: 'All men are mortal'.
  - Scientific Induction is based on observation of facts: Scientific Induction depends upon observation of facts in order to establish a materially true Universal Proposition. Observation and experiment supply materials of induction. For example: the universal proposition 'All men are mortal' is established on the basis of an observation of particular cases of death of persons we have come across. Observation and experiment guarantee the material truth of induction and thus they are called the material grounds of induction.

- In Scientific Induction there is an 'Inductive leap' or Hazard': Inductive leap consists in passing from the observed cases to the unobserved cases. In scientific induction we move from 'the known to the unknown', from 'some' to 'all'. So it involves some hazard or risk. According to Mill and Bain, this inductive leap constitutes the very essence of Induction.
- Scientific Induction is based on two presuppositions, viz., the principle of the Uniformity of Nature and the Law of Causation: To overcome the Inductive Leap, Scientific Induction relies on two fundamental principles viz., the principle of the Uniformity of Nature and the Law of Causation. These two principles guarantee the formal truth of Induction and thus they are called formal grounds of Scientific Induction. Law of Causation states that every event must have a cause. In scientific induction a causal connection is proved between 'humanity' and 'mortality' and the general proposition 'All men are mortal' is established on the strength of this causal connection. Based on the principle of the Uniformity of Nature we then assume that this causal connection will be true in all cases, under similar circumstances.
- The conclusion of Scientific Induction is regarded as certain.

II) **Unscientific Induction:** Unscientific induction is the establishment of a universal real proposition on the basis of mere uniform or uncontradicted experience without any attempt at discovering causal connection. For example, 'All crows are black'. After observing a large number of black crows and finding not a single instance to the contrary, the general conclusion is established.

Characteristics of Unscientific Induction:

- Unscientific Induction is the establishment of a Universal Real Proposition.
- Unscientific Induction is based on observation of particular facts of experience.

- In Unscientific Induction, there is an 'Inductive Leap'.
- In Unscientific Induction, the generalization is made on the basis of mere uniform or uncontradicted experience: On the strength of uniform or uncontradicted experience Unscientific Induction establishes a universal proposition. It rests on the belief that the unobserved cases will resemble the observed ones. Thus, uncontradicted experience is the ground of Unscientific Induction.
- Unscientific Induction is not based on the Law of Causation.
- The conclusion of Unscientific Induction is only probable. Unscientific Induction is based on mere uniform experience, not on causal connection. So, its conclusion is probable only.

This form of Induction is Induction proper, because 'inductive leap' is present in it. This induction is unscientific as there is no knowledge of any causal connection. It is also called Induction per Simple Enumeration, because the conclusion is drawn on the ground of mere enumeration or counting of instances. It is also known as Imperfect Induction to distinguish it from the so-called Perfect Induction or Induction by Complete Enumeration. In perfect Induction all the particulars coming within the universal proposition are enumerated.

Value of Unscientific Induction: The conclusion of Unscientific Induction or Induction per Simple Enumeration is merely probable because the knowledge of causal connection is absent in this form of induction. Probability, however, is a matter of degree. According to Fowler, the value of Induction per Simple Enumeration depends on two considerations:

- The more the number of positive instances, the greater the probability.
- The absence of negative instances, whenever experience is of wide range, shows that the conclusion attains a high degree of probability.

But the conclusion of Induction per Simple Enumeration can never attain the certainty of scientific induction. But it cannot be

held that Unscientific Induction has no value at all. Because it suggests causal connection. If in a large number of instances two phenomena are found to go together, we may suppose that they may be causally connected. This supposition again may lead to discovering and proving causal connection between them. So, if causal connection can be discovered and proved then, Unscientific Induction is elevated to the rank of Scientific Induction. Hence, Induction per Simple Enumeration is regarded to be the starting point of Scientific Induction. As Grumley rightly puts "the chief value of the unscientific Induction lies in its power to suggest causal relation." Mill rightly says, "We must often rely on it provisionally in the absence of means for more searching investigation." Inductive enumeration then is not altogether worthless from the scientific point of view; it should be regarded at least as a valuable aid to Scientific Induction.

III) **Analogy:** Analogy is a kind of Induction in which on the basis of observation of resemblance in some particular properties between two things, we infer further resemblance in some other property between them.

In Analogy, at first, we observe that two different things resemble each other in one or more respects. Secondly, one is known to possess an additional property and so it is inferred on the ground of previous resemblance, that the other things also possesses that property. For example:

Symbolic Example:

A and B are two things.

A resembles B in certain properties, viz., a, b, c, d, e.

B further possesses the property f.

∴ A resembles the B in having the property f.

Concrete Example:

Both Mars and Earth are two planets of the Solar System.

Mars resembles the Earth in certain respects, viz., in being a planet, possessing moderate temperature, land, seas, similar

atmosphere, air, polar regions; revolving round the Sun and borrowing light from the Sun.

The Earth possesses the further property of being inhabited.

∴ Mars possesses the property of being inhabited

Characteristics of Analogy:

- In Analogy we pass from particular to particular.
- Resemblance in certain properties between two things is the ground of analogical argument.
- Analogy is based on imperfect similarity.
- In Analogical argument there is an 'Inductive Leap'.
- In Analogy, there is no knowledge of causal connection between the common properties and the inferred properties.The conclusion of Analogical argument is probable, not certain.

Value of Analogy: Analogy is based on imperfect similarity and its conclusions are accordingly probable in character. But probability is not a fixed quantity; it is a matter of degree. It may have any degree of probability from zero almost up to the limit of certainty. So, in order to determine the value of analogy we must put emphasis on the number of the points of resemblance and also on their importance. We may consider the following conditions to determine the value of analogy.

- The greater the number and the importance of the known points of resemblance, the greater is the value of the analogical argument.For example, the points of resemblance between the Earth and Mars are more numerous and more important than the points of resemblance between the Earth and the Moon. So, the analogical conclusion 'Mars possesses the property of being inhabited' is more probable than the conclusion 'Moon possesses the property of being inhabited'.
- The greater the number and the importance of the known points of difference, the less is the value of analogical argument. For example: The known points of difference

between the Earth and the Moon are more numerous and more important than those between the Earth and Mars. The absence of air in Moon is an important point of difference between Earth and Moon. Hence, the analogical conclusion 'The Moon is inhabited like the Earth' is less probable than that "Mars is inhabited like the Earth'.

- The greater the number of unknown points as compared with the number of known points, the less is the value of the analogical argument. For example, The number of known points of the planet Saturn is very small in comparison to the number of unknown points. Hence the conclusion 'Saturn is inhabited like the Earth' loses much of its value.

Some logicians have expressed the value of analogical argument mathematically in the form of fraction thus:

$$\frac{\text{Resemblance}}{\text{Difference + Unknown points}}$$

But the determination of the value of analogical argument in the mathematical process has some difficulties, such as: Firstly, in practice, it is difficult to reconcile the number of points and their importance. Secondly, it is difficult to talk about the number of unknown points.

Good Analogy and Bad Analogy: A good analogy is one in which the conclusion is drawn from the presence of essential points of resemblance between two things. For example, Lower animals resemble men in being animals. Men feel pleasure and pain. Therefore, like men lower animals feel pleasure and pain. On the other hand, a bad analogy or false analogy is one in which conclusion is drawn from superficial points of resemblance. For example, Plants like men have birth, growth, decay and death. Men possess intelligence; therefore plants also possess intelligence. It is a bad analogy.

Inductions improperly so-called may be sub-divided into the following heads:

- Perfect Induction or Induction per Complete Enumeration.

- Induction by Parity of Reasoning.
- Colligation of facts.

B) Induction Improperly So-Called:

I) Perfect Induction: Perfect Induction is the establishment of a universal proposition on an examination of all the particular instances covered by it. For example, 'All known planets move round the Sun'. Here, we separately examine each and every particular instance and then establish a universal proposition. It is an inference from each to all. Therefore, the number of instances must be limited. Thus, perfect Induction is possible only when there is a limited totality. The conclusion of perfect Induction is certain because conclusion is established after examining each and every particular instance separately.

Aristotle's Induction by Complete Enumeration has been called perfect Induction by J. S. Mill. William Kneale suggests the name Summative Induction and Johnson calls it Summary Induction.

Mill and Bain hold the view that Perfect Induction is not induction at all. Because, first, there is no inductive leap in perfect induction. Secondly, the conclusion established in Perfect Induction is universal only in appearance. It is a mere summation of the results of separate examination of each and every particular instance coming within it. However, it has great importance. Because it enables us to deal with a great number of particular facts in a very brief space.

II) Induction by Parity of Reasoning: Induction by Parity of Reasoning is a process of inference in which we establish a general proposition on the ground that the same reasoning which establishes a particular case will establish every other similar case coming under the general proposition.

In this process of inference parity or reasoning is the ground of passing from a particular case to a general proposition. This is illustrated in geometrical proofs. For example, we draw the

diagram of a triangle ABC on a piece of paper and prove that its three angles are equal to two right angles.

Having proved with the help of this diagram, we establish the general proposition "all triangles have their three angles as equal to two right angles" on the basis of the same reasoning. The same reasoning which applies to the diagram will also apply to every other similar triangle.

Mill observes that induction by Parity of Reasoning is 'an induction improperly so-called', because, first, geometrical figures are abstract conceptions; so, in Parity of Reasoning there is no observation of facts. Secondly, it does not involve 'Inductive Leap'. The particular diagram to which the proof is applied is not really particular; it represents all similar diagrams.

Induction by Parity of Reasoning is nothing but geometrical reasoning in character. Geometrical proofs are rather purely deductive than inductive in character. In Geometry, we start with certain axioms, postulates and definitions and proceed deductively to draw conclusions from them. So Induction by Parity of Reasoning is regarded not as an induction at all, but as a deductive process.

III) **Colligation of Facts:** Mill defines Colligation of facts as "the mental operation which enables us to bring a number of actually observed phenomena under a description; or which enables us to sum up a number of details in a single proposition". For example, a navigator while sailing in the ocean discovers a land. At first he cannot determine whether it is a continent or an island; but he coasts around it, and after a few days he finds he has completely sailed round it. He then brings together the observed facts under the conception of an island and declares it to be an island.



LET US KNOW

The word 'Colligation of Facts' was first used by Whewell. The term is derived from 'con' meaning together' and 'lingare' meaning to 'bind'. So colligate literally means 'to bind together'.

Colligation and Induction: According to Whewell, colligation is same as Induction. But Mill holds that colligation should not be confused with Induction. Because,

- There is no inference at all in colligation. In it certain facts are observed and brought together under a notion that we already have.
- In Colligation, we merely describe the observed facts but in Induction we seek to explain them.

Again, According to Bain, Colligation is sometimes deductive in character. But Mill says that colligation is a 'process subsidiary to Induction' or 'a necessary preliminary to Induction'. However, Induction is something more than Colligation. Therefore, "Induction is Colligation but Colligation is not necessarily Induction".

However, both the views of Whewell and Mill are only partially true. Mill is wrong in holding that Colligation is always a mere summation and description, for it may involve real inference. And Whewell is wrong in holding that every Colligation is induction because sometimes it maybe a purely deductive operation. We, therefore, conclude that colligation cannot be identified with induction; but it is not always a mere summary and description of facts and it involve inference.

Perfect and Imperfect Induction: The scholastic logicians of the Middle ages divided induction into Perfect and Imperfect. According to them, Perfect Induction is the establishment of a universal proposition on an examination of all the particular instances covered by it; while Imperfect Induction is the establishment of a universal proposition, on an examination of some of particulars only.

If we fully appreciate the implications of the definition, Imperfect Induction not only include Unscientific Induction but also Scientific Induction. But they do not include Scientific Induction under their definition of Imperfect Induction.

Some modern logicians like Carveth Read have sub-divided Imperfect Induction into (a)Imperfect Immethodical Induction which is same as Unscientific Induction or Induction by Simple enumeration and (b) Imperfect Methodical Induction Which is same as Scientific Induction.

Some other logicians use the expression 'Imperfect Induction' as the opposite of Scientific Induction. In this sense it includes Induction by Simple Enumeration and argument from Analogy. They are called imperfect because they are not based on the knowledge of a causal connection.

Complete and Incomplete Induction: Some logicians have used 'complete Induction' as a synonym for Scientific Induction. In this sense also Incomplete induction includes Unscientific induction and Analogy. They are incomplete because no causal connection has been discovered.

Certain logicians like Bain use the expression 'Complete Induction' to include not only Scientific Induction but also Unscientific Induction. Following it, Complete Induction is sub-divided into- (a) Complete Methodical Induction which is same as Scientific Induction and (b) Complete Immethodical Induction which is same as Unscientific Induction. In this sense Incomplete Induction denotes Analogy as there is no generalization in it.

11.7 INDUCTIVE FALLACIES

Inductive fallacies usually occur when the premises of inductive arguments fail to provide the desirable amount of probabilistic support for their conclusions. Inductive fallacies are of two kinds, viz.,

- Inferential
- Non-inferential.

A) Inferential Inductive Fallacies: These types of Fallacies arise out of the violation of the rules of inductive inferences. The main forms of inferential fallacies are:

i) fallacies of causation

ii) fallacies Generalization

iii) fallacies of Analogy

i) Fallacies of Causation:

a) Post hoc ergo propter hoc: To assume any and every antecedent as the cause of an event is to commit the fallacy of Post hoc ergo propter hoc.

For example, in 1910, the Halley's Comet was seen and King Edward VII died. From this it is inferred that the appearance of the comet is the cause of the death of the king.

b) Fallacy of mistaking one condition of a phenomenon for the whole cause: This kind of fallacy occurs when some one condition, which is prominent, is identified with the whole cause.

For example, a man slips his foot on a ladder, falls and is killed. The slipping is said to be the cause of the man's death. This is fallacious because other conditions such as the man's physical constitution, the height from which he fell etc. are omitted in this conclusion.

c) Fallacy of neglecting the negative conditions to which a cause is subject: This kind of fallacy occurs when we state only the positive conditions as constituting the cause of an event and neglect the negative conditions to which a cause is subject.

For example, brilliant intellectual parts do not lead to success in life because many gifted men prove failures. This is fallacious because a brilliant intellect is certainly one of the positive conditions of success but it may not be instrumental to success because of some negative conditions such as poverty, drunkenness etc.

d) Fallacy of mistaking remote condition for cause: To take a remote condition as the cause of an event is to commit the fallacy of mistaking remote condition for the cause.

e) **Fallacy of regarding the co-effects as cause and effect:** To regard the co-effects of a common cause as cause and effect is to commit the fallacy of regarding co-effects as cause and effect.

For example, it is wrong to suppose that the falling of the mercury in the thermometer causes the neighbouring lake to freeze, because they are the co-effects of the same cause, viz., fall of temperature.

f) **Fallacy of confusing the whole or part of the cause with the effect:** To confuse the cause with effect is to commit the fallacy of confusing the whole or part of the cause with the effect.

For example, Meteorologists are not agreed whether the copious or sudden downpours which usually attend thunder-storm are the cause or the effect of the electric discharge. The common opinion is that they are the effect but sir John Herschel held that they were the cause.

ii) **Fallacies of Generalization:**

a) **Illicit or Hasty Generalization:** The cases observed are too small to support an inductive generalization. For example, I have met two Americans and both were dishonest, so all Americans are dishonest.

b) **Fallacy of Generalization based on Unrepresentative Sample:** It is a subtype of illicit generalization, where the sample is unrepresentative of the whole class.

For example, the tiger that I saw was white, so all tigers must be white.

c) **False Analogy:** Induction based upon the comparison of two samples when the samples being compared are almost dissimilar.

For example, Tables have four legs, elephants have four legs too. Hence, tables, just like elephants are animals.

iii) **Fallacies of False Analogy:** The fallacy of false Analogy arises out of the fallacious use of the analogical argument. It is based

upon the comparison of two samples when the samples being compared are almost dissimilar.

For example, Tables have four legs, elephants have four legs too. Hence, tables, just like elephants are animals. Here we confuse between essential and inessential points of similarity.

B) Non-inferential Inductive Fallacies may arise out of the violation of the rules of processes which are intimately connected with or subsidiary to induction.

The different forms of Non-Inferential Inductive Fallacies are:

- Fallacies of Observation
- Fallacies of Explanation

i) The Fallacies of Observation: The fallacies of observation are of two types, viz.,

a) Non-observation and

b) Mal-observation.

In the fallacy of non-observation the error consists in overlooking or neglecting facts of particulars which ought to have been observed. We may overlook either instances, or essential circumstances in those instances. So we have two forms in which the fallacy of Non-observation may occur; thus:

- In the fallacy of Non-observation of instances we overlook the instance which are relevant to our enquiry.
- On the other hand in the fallacy of Non-observation of essential circumstances we overlook the essential circumstances in our inductive enquiries.

Mal observation consists in observing a thing wrongly. For example, in the dark we mistake a rope for a snake.

ii) Fallacious of Explanation: An explanation is fallacious when it violates the conditions of Scientific Explanation. It is an explanation only in appearance. For example, in explaining why opium produces sleep, we say it has soporific properties.



CHECK YOUR PROGRESS

Q.8: What is scientific induction? (Answer in about 30 words)

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Q.9: What is unscientific induction? (Answer in about 25 words)

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Q.10: Fill in the blanks:

a) The conclusion of scientific induction .....

b) The conclusion of unscientific induction .....

c) The conclusion of perfect induction .....

d) The conclusion of bad analogy is derived from the .....

e) According to Bain, colligation is sometimes ..... in character.

Q.11: What are the two kinds of inductive fallacies?

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Q.12: What do you mean by post hog ergo propter hoc? (Answer in about 25 words)

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11.8 LET US SUM UP

- Induction aims at establishing a universal proposition on the basis of particular instances.

- Induction involves inductive leap or 'a leap in the dark'. According to Bain and Mill, this Inductive leap constitutes the very essence of induction.
- The word 'Induction' is sometimes used to mean the process of reasoning and sometimes to mean the product of such reasoning
- Induction may be classified into Induction proper and Induction Improperly so-called.
- Induction proper is sub-divided into Scientific, unscientific and Analogy.
- Induction Improperly so-called is sub-divided into Perfect induction, Induction by Parity of Reasoning, and Colligation of Facts.
- The premises of Inductive arguments provide probabilistic support for the conclusion. But when the premises fail to provide the desirable amount of probabilistic support for their conclusion then Inductive fallacies occur.
- Induction plays a great role in scientific enquiry. But it does not mean that scientific general propositions could be established by induction or that any inductive proposition is capable of proof.



11.9 FURTHER READING

1) Hurley, Patrick J. (2008); *Introduction to Logic*; Wordsworth. Cengage Learning.
2) Chakraborti, C. (2007); *Logic: Informal, Symbolic and Induction*; New Delhi: Prentice Hall of India Pvt. Ltd.
3) Baronett, S. & Sen, M. (2009); *Logic*. Delhi: Pearson.
4) Harel, D.; Kozen. D. & Tiuryn. J. (2007); *Dynamic Logic*; New Delhi: Prentice Hall.



11.10 ANSWERS TO CHECK YOUR PROGRESS

Ans. to Q. No. 1:) True, b) True, c) False, d)True

Ans. to Q. No. 2: a) Material truth, b) Non-monotonic

Ans. to Q. No. 3: Inductive leap is a leap or jump from the known to the yet Unknown or from the cases observed so far to the yet unobserved cases. It is a jump from certainty to uncertainty. The passage from the known to the unknown involves some hazard or risk. According to Bain and Mill, this inductive leap or hazard constitutes the very essence of Induction.

Ans. to Q. No. 4: The problem of induction refers to the question as to how it is possible for induction to arrive at a universal real proposition on the basis of Observation of particular facts.

Ans. to Q. No. 5: The law of uniformity of nature and the law of causation.

Ans. to Q. No. 6: Observation, Formation of hypothesis, Generalisation and Verification.

Ans. to Q. No. 7: a) Hypothesis, b) Observation, c) Bain

Ans. to Q. No. 8: Scientific induction is the establishment of a general real proposition based on observation of particular instances, in reliance on the principle of the Uniformity of Nature and the Law of Causation

Ans. to Q. No. 9: Unscientific induction is the establishment of a universal real proposition on the basis of mere uniform or uncontradicted experience without any attempt at discovering causal connection

Ans. to Q. No. 10: a) Certain, b) Probable, c) Superficial points of resemblance, d) Deductive

Ans. to Q. No. 11: Inferential and non-inferential.

Ans. to Q. No. 12: When we assume any and every antecedent as the cause of an event then we commit a fallacy that is post hoc ergo propter hoc.



11.11 MODEL QUESTIONS

A) Very Short Questions:

Q.1: What is Induction?

Q.2: What are the three stages of Induction?

Q.3: What is unscientific Induction?

Q.4: What is Analogy?

Q.5: Give an example of good analogy?

B) Short Questions: (Answer each question in about 150 words)

Q.1: Discuss the three stages of Induction.

Q.2: What do you mean by the problem of Induction?

Q.3: Discuss the role of uniformity of nature in the problem of Induction

Q.4: Discuss the value of Unscientific Induction.

C) Write short notes on: (Answer each question in about 150 words)

Q.1: Scientific Induction

Q.2: Unscientific Induction

Q.3: Induction by Parity of Reasoning

Q.4: Analogy

Q.5: Law of Uniformity of Nature

Q.6: Colligation of Facts

D) Distinguish between: (Answer in about 150 words)

Q.1: Scientific and Unscientific Induction

Q.2: Good analogy and Bad analogy

Q.3: Perfect Induction and Imperfect Induction

E) Long Questions: (Answer in about 300-500 words)

Q.1: Explain the nature and characteristics of Induction.

Q.2: What is Scientific Induction? Explain the characteristics of Scientific Induction.

Q.3: Discuss the nature and characteristics of Unscientific Induction.

Q.4: Discuss the different stages of Induction.

Q.5: Discuss briefly different kinds of induction as mentioned by Mill.

Q.6: Discuss the nature of analogy.

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