REASONING AND PROBLEM-SOLVING TECHNIQUES

COURSE CODE: M23PH02SC

Skill Enhancement Compulsory Course

Postgraduate Programme in Philosophy

Self Learning Material

SREENARAYANAGURU OPEN UNIVERSITY

The State University for Education, Training and Research in Blended Format, Kerala

SREENARAYANAGURU OPEN UNIVERSITY

Vision

To increase access of potential learners of all categories to higher education, research and training, and ensure equity through delivery of high quality processes and outcomes fostering inclusive educational empowerment for social advancement.

Mission

To be benchmarked as a model for conservation and dissemination of knowledge and skill on blended and virtual mode in education, training and research for normal, continuing, and adult learners.

Pathway

Access and Quality define Equity.

Reasoning and Problem-Solving Techniques

Course Code: M23PH02SC

Semester - IV

Skill Enhancement Compulsory Course
Postgraduate Programme in Philosophy
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(With Model Question Paper Sets)

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MESSAGE FROM VICE CHANCELLOR

Dear learner,

I extend my heartfelt greetings and profound enthusiasm as I warmly welcome you to Sreenarayanaguru Open University. Established in September 2020 as a state-led endeavour to promote higher education through open and distance learning modes, our institution was shaped by the guiding principle that access and quality are the cornerstones of equity. We have firmly resolved to uphold the highest standards of education, setting the benchmark and charting the course.

The courses offered by the Sreenarayanaguru Open University aim to strike a quality balance, ensuring students are equipped for both personal growth and professional excellence. The University embraces the widely acclaimed "blended format," a practical framework that harmoniously integrates Self-Learning Materials, Classroom Counseling, and Virtual modes, fostering a dynamic and enriching experience for both learners and instructors.

The University aims to offer you an engaging and thought-provoking educational journey. The Skill Enhancement Course, offered as part of the MA Philosophy programme , equips learn - ers with essential analytical and reflective skills for personal and profes - sional growth. This course focuses on applying philosophical principles to real - life situations , enhancing problem - solving , ethical reasoning , and interpersonal communication. The Self-Learning Material has been me - ticulously crafted , incorporating relevant examples to facilitate better comprehension.

Rest assured, the university's student support services will be at your disposal throughout your academic journey, readily available to address any concerns or grievances you may encounter. We encourage you to reach out to us freely regarding any matter about your academic programme. It is our sincere wish that you achieve the utmost success.

Regards,
Dr. Jagathy Raj V. P.

01-09-2025

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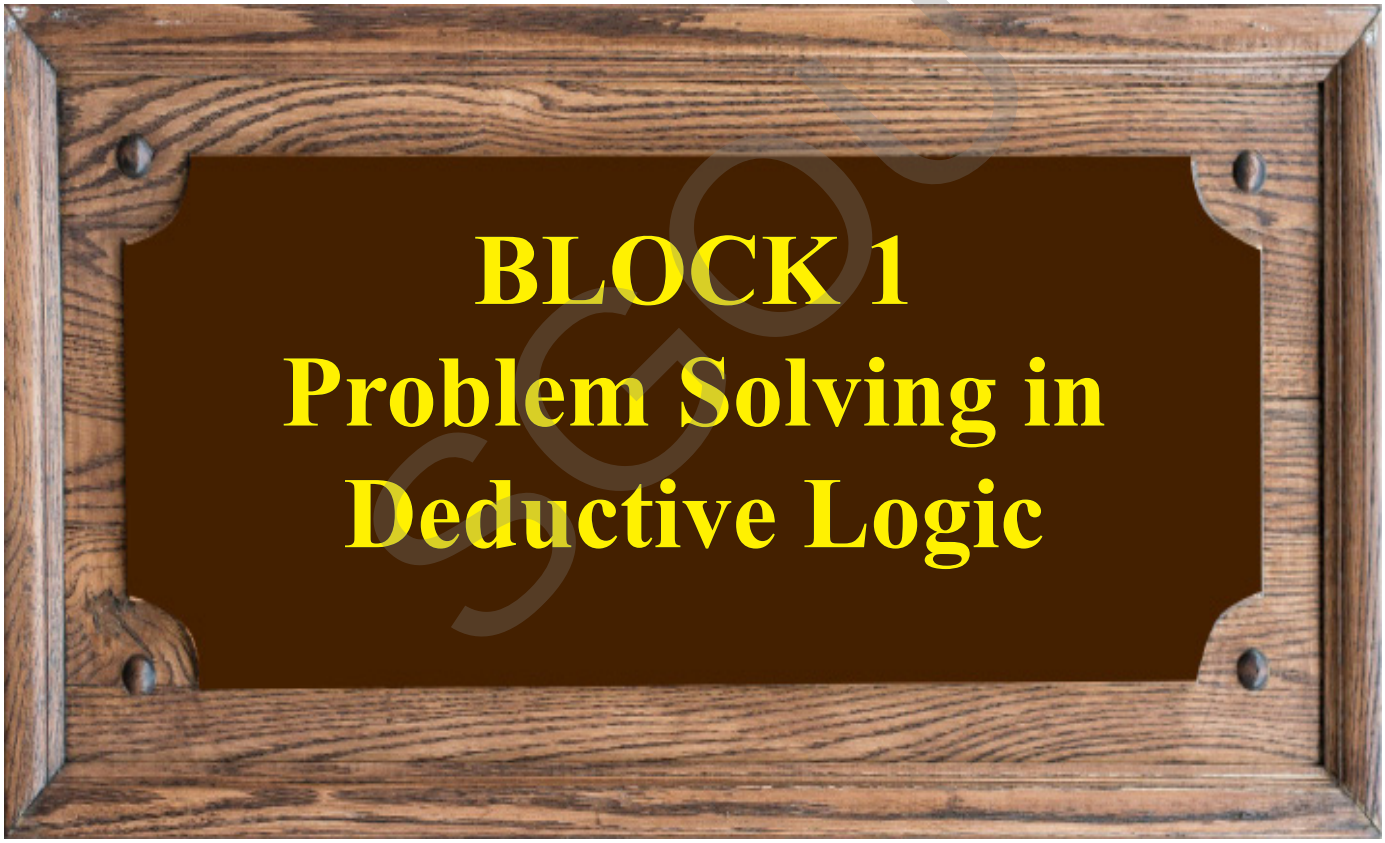
BLOCK 1
Problem Solving in
Deductive Logic

UNIT 1
Brain Teasers Exercises

Learning Outcomes

Upon completion of this unit, the learner will be able to:

- appreciate methods to enhance reasoning skills
- familiarise themselves with the deductive nature of brainteasers
- solve puzzles and riddles in competitive examinations
- contrive logical puzzles
- enhance focus, patience, lateral thinking, and creativity

Background

Assimilating information and deriving conclusions based on it is one of the fundamental components of the human thought process. Our reasoning ability helps us determine whether certain statements do or do not follow from a set of statements. Often, we make mistakes while reasoning due to a failure in understanding the logical structure of statements presented in ordinary language. Logic or critical thinking courses focus more on refining one's theoretical knowledge about various kinds of reasoning activities. However, it is the hands-on experience of solving problems that requires essential knowledge of the principles of reasoning, thereby strengthening theoretical knowledge and enhancing practical problem-solving skills. This course offers learners experience in solving various kinds of problems by applying the principles of reasoning. This block deals with deductive reasoning, while the one addresses inductive reasoning. Here current block familiarises learners with the deductive nature of common brainteasers.

Keywords

Reasoning skills, Deductive reasoning, Contrived puzzle, Brainteaser

Discussion

1.1.1 Reasoning and Problem Solving

- Reasoning activity is part of everyday life

Reasoning is the advancement from known or assumed facts to conclusions. It is not an activity exclusive to scientists or academics; all human beings partake in reasoning in their everyday lives. Whether deciding how to act in a particular moment, judging or evaluating the conduct of others, or making concrete decisions such as what food to eat, which clothes to wear, or which means of transport to use, we conclude certain things based on the information we possess. On a macro level, reasoning is indispensable across all disciplines, jobs, and international forums.

- Logic is the study that helps us to be more reasonable

Since reasoning is central to human life, the skill of devising sound arguments - connecting reasons and conclusions accurately - and understanding and evaluating the arguments of others becomes very valuable. Although humans are inherently capable of rational discourse, we often encounter situations where emotions or impulses guide our judgments instead of proper reasoning. Logic, as the study of the principles underlying valid reasoning, helps us overcome these difficulties and become more reasonable in our conduct.

- Solving contrived logical problems enhances reasoning skills

Enhancing reasoning skills is achieved not merely through theoretical courses but through hands-on experience in problem-solving. The problems may pertain to real life or be contrived, designed to test and strengthen logical skills. Ancient reasoning games such as chess, widely known commercial games like Clue and Mastermind, and the puzzles and riddles encountered in various aptitude tests are all examples of contrived problems. Such problems demand high levels of patience and concentration from us, and they can often be frustrating. Long chains of reasoning, along with the creative combination and recombination of previously given or discovered information, may be required to solve them. In fact, they are often more straightforward than real-life problems, as they typically require no information beyond what is provided. Nonetheless, problems of logic are not merely models for employing reasoning skills; in addition to the satisfaction derived from successfully solving them, these problems also provide enjoyment. As John Dewey said, “The enjoyment of the doubtful is a mark of the educated mind.”

- Deductive reasoning deduces information that is implicit in the reasons with certainty

Reasoning is generally classified into deductive and inductive. In deductive reasoning, the conclusions logically follow from the reasons with certainty. The information already available is analysed and examined thoroughly to discover the implicit facts, which are then made explicit as conclusions. Deductive reasoning is exemplified greatly by mathematics. In contrast, inductive reasoning attempts to generate new information based on the available evidence, compromising the certainty of the conclusion. In this case, the wider scope of the conclusion is valued over the probability and lack of certainty.

1.1.2 Brainteasers: What are they?

- Brainteaser involves deductive reasoning and demands no specialized knowledge

One type of problem in deductive reasoning is the common brainteaser, where we must answer questions based on the cues provided, applying basic principles of logic and lateral thinking. These problems do not demand from us any sort of specialised knowledge like algebra, geometry, computational skill etc. but only clear thinking, creativity, child-like curiosity, and of course a bit of cunningness. In real-world problems, the solution may depend on some additional general knowledge. But in contrived logical puzzles like the brainteasers, as in the writing of a good murder mystery, all the information that is sufficient for the solution would be given. We only need to deduce the solution that is implicit in the cues given.

- Brainteasers tease and twist our brains and improvise our ability to think clearly

The best puzzles are like poetry. They pique our interest with elegance and brevity. They "kindle our competitive spirit, test our ingenuity, and in some cases reveal universal truths." Many brainteasers do not easily open their doors for us. They are not the easiest to solve. They tease and twist our brains in unfamiliar ways. However, the strategies that one uses to solve the most frivolous and contriving puzzles will no doubt expand one's armoury for tackling different challenges in life. The smile that one's face wears when a brainteaser is successfully cracked is a worthy pay-off.

1.1.3 Exercises on brainteasers

Q1. Three on-off switches are on the wall of a building's first floor. Only one switch operates a single-bulb lamp on the third floor. The other two switches are bogus, unconnected to anything. You are permitted to set the switches in any desired on-off order. You then go to the third floor to inspect the lamp. Without leaving the lamp's room, how can you determine which switch is genuine?

Solution: We may call the three switches A, B, and C. One way to know which switch is genuine is as follows.

It is said that the switches can be set in any order before going to the lamp's room. Turn on the switch A and keep the switches B and C off wait for a few minutes. Then turn off the switch A. Keep in mind that A was on for a few minutes and is now off. Now, turn on B keep in mind that, B was off earlier and has just now been turned on. Also remember that, C has not been turned on yet.

Go to the floor where the lamps are there. There are three possibilities.

1. The lamp is off, but its bulb is warm.

This shows that the lamp was on for a few minutes and then got off. This means that A is the genuine switch.

2. The lamp is on, but its bulb is cold.

This shows that the lamp has just become on. So, B is the genuine switch.

3. The lamp is off, and its bulb is cold.

This shows that the lamp has not become on recently. This will prove that C is the genuine switch.

Q2. Alonzo, Kurt, Rudolf, and Willard are four creative artists of great talent. One is a dancer, one is a painter, one is a singer, and one is a writer, though not necessarily in that order.

1. Alonzo and Rudolf were in the audience the night the singer made his debut on the concert stage.
2. Both Kurt and the writer have had their portraits painted from life by the painter.
3. The writer, whose biography of Willard was a best-seller, is planning to write a biography of Alonzo.
4. Alonzo has never heard of Rudolf.

What is each man's artistic field?

Solution: As stated in statement (A), Alonzo and Rudolf were in the audience when the singer was performing on stage, which indicates that neither Alonzo nor Rudolf is the singer. Statement (B) clarifies that Kurt, the writer, and the painter are three different individuals. Therefore, it can be concluded

that Kurt is neither the writer nor the painter. Statement (C) indicates that the writer has written a biography of Williard and is planning to write a biography of Alonzo. This implies that neither Alonzo nor Williard is the writer.

Thus, the first three statements together imply that the writer is not among Kurt, Alonzo, and Williard. Hence, Rudolf must be the writer.

From (B), we know that Rudolf, the writer, has had his portrait painted by the painter. However, (D) states that Alonzo has never heard of Rudolf. Therefore, it becomes clear that Alonzo is not the painter. From (A), we already know that Alonzo is not the singer either. The only artistic role left is that of the dancer. Thus, Alonzo is the dancer.

From (B), we already know that Kurt is not the painter. Therefore, Williard must be the painter, and Kurt must be the singer.

Q3. Sid Salt, Phil Pepper, and Reese Relish are all having lunch together when one of them notices that one has picked up the salt, another the pepper, and the third the relish. The person with the salt replies: 'What gives our situation some spice is that no one is holding the condiment that matches their surname!' 'Pass the relish!' adds Reese. If the man does not have the relish, what does Phil have?

Solution: Solve this by assuming each of the three individuals is the man and then deducing the respective consequences. (Hint: The man and the person with the salt are two different individuals. Also, the person with the salt and Reese are two different individuals. But check whether Reese can be the man or not.)

Q4. A woman either always answers truthfully, always answers falsely, or alternates between true and false answers. How can you determine, in two questions, each answered with a yes or no, whether she is a truther, a liar, or an alternator? (Note: an alternator is someone who alternates between truth and lies).

Solution: One way to solve this problem is to ask the woman, "Are you an alternator?" twice. There are three possible sets of answers.

1. If she answers "No" for both questions, she is a truther. The first "No" would mean that she is not an alternator and that she would not change her answer in the next

instance. With the second "No," she keeps her word and is thus a truther.

2. If she answers "Yes" for both questions, she is a liar. The first "Yes" would mean that she is an alternator and that she would change her answer in the next instance. However, she again said "Yes," which means she did not behave as an alternator even though she responded to the first question claiming to be one. Therefore, she is a liar.

3. If she alternates between "Yes" and "No" for the two questions in any order, then it means that she is an alternator.

Q5. A logician vacationing in the South Seas finds himself on an island inhabited by the two proverbial tribes of liars and truth-tellers. Members of one tribe always tell the truth, while members of the other always lie. He comes to a fork in the road and has to ask a native bystander which branch he should take to reach a village. He has no way of telling whether the native is a truth-teller or a liar. The logician thinks for a moment, then asks one question only. From the reply, he knows which road to take. What question does he ask?

Solution: There are several possible solutions. Suppose the logician points to one of the roads and says to the native, "If I were to ask you if this road leads to the village, would you say 'yes'?"

There is nothing to worry about if the native is a truth-teller. However, this peculiar way of questioning can make the liar respond in the same way as the truth-teller.

If the native is a liar and the road does lead to the village, the liar would have said "No" to the direct question, "Is this the road that leads to the village?" But here the question is phrased differently. So, if the native is a liar who does not wish to tell the truth "Yes" to the question about the road, he would lie again about the question "Would you say Yes?" and respond "Yes," which then becomes the truth. Even if the road does not actually go to the village, the liar is still forced to reply "No" to the inquirer's question.

Thus, regardless of the native's character, the answer to the question will always be true.

Q6. You are in a room with two doors. One door leads to freedom, and the other leads to certain doom. There are two

guards, one who always tells the truth and one who always lies. You can ask one guard one question to determine which door leads to freedom. What do you ask?

Solution: Solve yourself.

Q7. Three men stand before you. One always answers questions truthfully, one always responds with lies, and one randomises his answers, sometimes lying and sometimes not. You do not know which man does which, but the men themselves do. How can you identify all three men by asking three questions? Each question may be directed toward any man you choose, and each must be a question that is answered with yes or no.

Solution: Solve yourself.

Q8. In front of you are three boxes, the first labelled "apples," the second "oranges," and the third "apples and oranges." One box contains apples, one contains oranges, and the other contains apples and oranges. Each label, however, is on the wrong box. Your job is to correctly reassign the labels. You cannot see (or smell) what is in any of the boxes. But you are allowed to stick your hand in one of them and remove a single piece of fruit. Which box do you choose, and once you see that piece of fruit, how do you deduce the correct contents of all the boxes?

Solution: There are three labels and three sets of fruits, given that the labels and the sets are wrongly matched.

Suppose we stick our hand in the box labelled "apples and oranges" and the piece of fruit we pull out is an apple. We can conclude that the box contains apples only. If it contained oranges as well, then the labelling would be correct. However, it is stated that each box is labelled incorrectly. There are two boxes left: one labelled "oranges" and the other "apples." The two sets of items remaining are oranges and apples and oranges. Since the labels are incorrect, we can infer that the box labelled "oranges" does not contain oranges only. Therefore, it must contain both apples and oranges, while the box labelled "apples" must contain oranges only.

Now, suppose we stick our hand in the box labelled "apples and oranges" and the piece of fruit we pull out is an orange. We can deduce that the box contains oranges only. If it contained apples as well, then the labelling would be correct. However, it is stated that each box is labelled incorrectly. There are two boxes left: one labelled "oranges" and the other "apples." The two sets of items remaining are apples and apples and oranges.

Since the labels are incorrect, we can infer that the box labelled "apples" does not contain apples only. Hence, it must contain both apples and oranges, while the box labelled "oranges" must contain apples only.

Thus, by sticking our hand in and removing one and only one fruit from the box labelled "apples and oranges," we can infer all the required information. This may not be possible if we try with the boxes with other labels.

Q9. Alberta and Bernadette are playing in the garden. They come inside. The sisters can see each other's faces, but not their own. Their father, who can see both girls, tells them that at least one of them has a muddy face. He then asks them to stand with their backs to the wall. "Please step forward if you have a muddy face," he says. Nothing happens. "Please step forward if you have a muddy face," he repeats. What happens and why?

Solution: The statement that at least one of them has a muddy face can mean either only Alberta has a muddy face, only Bernadette has a muddy face, or both have muddy faces.

Case 1: Only Alberta has a muddy face.

Alberta sees that Bernadette has a clean face. Since their father said that at least one of them has a muddy face, Alberta would conclude that she is the one with the muddy face, as she observes Bernadette's clean face. However, it is given that when their father said, "Please step forward if you have a muddy face," nobody moved. If Alberta knew that she had a muddy face, she would have stepped forward. Thus, this is not the actual case.

Case 2: Only Bernadette has a muddy face.

Thinking like in case 1, Bernadette should have moved forward in response to the first question. So, we can conclude that this is also not the case.

Case 3: Both have muddy faces.

Both have seen each other's faces, but neither of them moved forward in the first instance because they did not know anything about their own faces. However, suppose Alberta thinks this: "If I have a clean face, then Bernadette must have noticed that and inferred that she is the one with the muddy face. So, upon our father's words, Bernadette would have

moved forward. But she did not. This means that my face is not clean; it is muddy." Then, in the next instance, when their father asks them to move forward, Alberta would move forward. Similarly, Bernadette thinks the same way and concludes that she has a muddy face, as her sister did not move forward in the first instance. In the next instance, Bernadette would also move forward.

In short, both sisters did not know anything about their faces at first, which is why they did not move forward. However, each one of them noticed that her sister could not infer the presence of mud on her own face. This implied that one's own face is muddy. Hence, in the next instance, each of them moved forward.

Q10. Algernon, Balthazar, and Caractacus have a box that contains three red hats and two green hats. They each close their eyes, take a hat from the box, and put it on. They close the box and open their eyes so that each of them can see the colour of the hat worn by the other two. They do not know the colour of their own hat, nor which hats are left in the box.

Algernon says, "I do not know the colour of my hat."

Balthazar says, "I do not know the colour of my hat."

Caractacus, seeing that the other two both have red hats, says, "I know the colour of my hat!" What colour is it?

Solution: Given that there are three red hats and two green hats.

Let us start with Algernon first. He can see the hats of his friends. There are three possibilities: either he sees two green hats, or two red hats, or one red and one green hat. Among these, the case where he sees two green hats is important. If he sees that, he can infer that his own hat is red, as there are only exactly two green hats. However, Algernon says that he does not know the colour of his hat. This means that what he sees is not two green hats; in other words, it is not the case that both Balthazar and Caractacus have green hats. At least one of them has a red hat or both of them have red hats.

Similarly, if Balthazar sees two green hats on the others, he can infer that his own hat is red. But he also says he does not know the colour of his hat. This means that what he sees is not two green hats; i.e., it is not the case that both Algernon and Caractacus have green hats. At least one of them has a red hat or both of them have red hats.

Now, it is given that Caractacus sees two red hats on the others. His own hat may be red or green. Suppose Caractacus's hat is green. Then, Algernon would have seen a red hat with Balthazar and a green hat with Caractacus. As he cannot infer anything about his hat merely based on this information, he correctly says he does not know. But Balthazar would also have seen the red hat with Algernon and the green hat with Caractacus. From Algernon's words, Balthazar would have understood that his own hat is not green. Otherwise, Algernon would have seen two greens and reported the same by inferring his own hat as red. Thus, in this scenario, Balthazar could conclude that his own hat is not green but red. However, he also says he does not know. This is possible only if Caractacus has a red hat.

In fact, all three of them have red hats.

Summarized Overview

Reasoning is the advancement from known or assumed facts to conclusions. It is not something that is exclusively done by a scientist or an academician of any kind. All human beings, in one way or another, partake in reasoning activities in their everyday lives. Skill in devising sound arguments, i.e., connecting reasons and conclusions accurately, and in understanding and evaluating the arguments of others is of enormous value. Enhancement in the skill of reasoning is gained not merely through some theoretical courses but through hands-on experience while solving problems. The problems may be contrived in the sense that they are designed to test and strengthen logical skills. One such kind of problem is the common brainteaser in which we should try to answer the questions based on the cues provided, applying basic principles of logic and lateral thinking; we need to deduce the solution that is implicit in the given cues. These problems do not demand from us any sort of specialised knowledge like algebra, geometry, computational skills, etc., but only clear thinking, creativity, child-like curiosity, and, of course, a bit of cunningness. Many brainteasers do not easily open their doors for us. They are not the easiest to solve. They tease and twist our brains in unfamiliar ways. However, the strategies that one uses to solve the most frivolous and contrived puzzles will undoubtedly expand one's arsenal for tackling different challenges in life.

Self-Assessment

1. You are in a room with three light switches, each controlling one of three light bulbs in another room. You can only enter the room with the light bulbs once. How do you determine which switch controls which bulb?

2. The employees of a small loan company are Mr Black, Mr White, Mrs Coffee, Miss Ambrose, Mr Kelly, and Miss Earnshaw. The positions they occupy are manager, assistant manager, cashier, stenographer, teller, and clerk, though not

necessarily in that order. The assistant manager is the manager's grandson, the cashier is the stenographer's son-in-law, Mr Black is a bachelor, Mr White is 22 years old, Miss Ambrose is the teller's stepsister, and Mr Kelly is the manager's neighbour. Who holds each position?

3. Berta says that Greta tells lies. Greta says that Rosa tells lies. Rosa says that both Berta and Greta tell lies. Who is telling the truth?

4. "Feemster owns more than a thousand books," said Albert. "He does not," said George. "He owns fewer than that." "Surely he owns at least one book," said Henrietta. If only one statement is true, then how many books does Feemster own?

5. Four people - John, Paul, George, and Ringo - are on one side of a gorge connected to the other by a rickety bridge that can only carry two people at a time. It is night, and the structure is precarious, so whoever crosses must use a torch. The group has a single torch, and the gorge is too wide for them to be able to throw it from one side to the other, so the torch must be walked back and forth over the bridge as the people cross. John can cross the bridge in 1 minute, Paul in 2, George in 5, and Ringo in 10. If two people cross together, they walk at the speed of the slowest of the two. How does the foursome get over in the quickest possible time?

Assignments

1. A boy and a girl are sitting on the front steps of their commune. "I'm a boy," says the one with black hair. "I'm a girl," says the one with red hair. If at least one of them is lying, then which one is which?

2. On a certain train, the crew consists of the brakeman, the fireman, and the engineer. Their names, listed alphabetically, are Jones, Robinson, and Smith. On the train are also three passengers with corresponding names: Mr Jones, Mr Robinson, and Mr Smith. The following facts are known: Mr Robinson lives in Detroit. The brakeman lives halfway between Detroit and Chicago. Mr Jones earns exactly $40,000 a year. Smith once beat the fireman at billiards. The brakeman's next-door neighbour, one of the three passengers mentioned, earns exactly three times as much as the brakeman. The passenger living in Chicago has the same name as the brakeman. What is the engineer's name?

3. In a certain mythical community, politicians never tell the truth, and non-politicians always tell the truth. A stranger meets three natives and asks the first of them, "Are you a politician?" The first native answers the question. The second native then reports that the first native denied being a politician. The third native says that the first native is a politician. How many of these three natives are politicians?

4. A man is walking down the village road with a tiger, a goat, and a bundle of grass. Soon he arrives at the riverbank where there is one tiny boat that can carry him and another animal or grass at a time. Here is the problem: Left alone, the tiger will eat the goat. Similarly, the goat will eat the grass bundle. How is he going to take all three across the river safely?

5. Cannibals ambush a safari in the jungle and capture three men. The cannibals give the men a single chance to escape uneaten. The captives are lined up in order of height and are tied to stakes. The man in the rear can see the backs of his two friends, the man in the middle can see the back of the man in front, and the man in front cannot see anyone. The cannibals show the men five hats. Three of the hats are black and two of the hats are white. Blindfolds are then placed over each man's eyes, and a hat is placed on each man's head. The two hats left over are hidden. The blindfolds are then removed, and it is said to the men that if one of them can guess what colour hat he is wearing, they can all leave unharmed. The man in the rear, who can see both of his friends' hats but not his own, says, "I do not know." The man in the middle, who can see the hat of the man in front but not his own, says, "I do not know." The man in the front, who cannot see ANYBODY'S hat, says, "I know!" How did he know the colour of his hat and what colour was it?

Reference

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Suggested Reading

1. Bellos, A. (2017). *Can You Solve My Problems? A Casebook of Ingenious, Perplexing, and Totally Satisfying Puzzles*. Guardian Books and Faber & Faber Limited.
2. Bennett, D. J. (2004). *Logic Made Easy: How to Know When Language Deceives You.* W. W. Norton & Company.

Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.

UNIT 2
Problem solving by Applying the Rules of Immediate Inference

Learning Outcomes

Upon completion of this unit, the learner will be able to:

- comprehend the formal structure of statements in ordinary language
- discuss the characteristics of the relation between various kinds of statement forms
- restructure statements without changing their meaning and logical status
- apply rules of immediate inference to analyse and evaluate various arguments in daily discourse as well as in the academic arena
- solve problems on immediate inference in competitive examinations

Background

What does the statement "Only citizens can vote" mean? Does it follow that all citizens are voters? Does it imply that all voters are citizens? Or does it indicate that only some of the voters are citizens? If we come to know that some members of a group have a certain property, is it logically valid to conclude that the remaining part of the group lacks that property? Also, if we are given "All X are Y", should we conclude "All Y are X" as well? Deriving conclusions from a single statement known to us is called immediate inference. We encounter situations where we need to infer validly from a single premise, either as part of our everyday discourse or as part of an academic endeavour. Interestingly, we often commit mistakes while doing so. This unit discusses the principles of deductive reasoning that pertain to immediate inferences and shows the ways in which problems involving immediate inferences can be solved.

Keywords

Immediate inference, Categorical proposition, Square of opposition, Conversion, Obversion, Contraposition

Discussion

1.2.1 Introduction

- Inference can be immediate or mediate

In our daily lives, we often draw conclusions from what we see, hear, or already believe. This process is called inference. An inference is made when we accept a statement as a conclusion based on one or more other statements, called premises. A premise is a statement that provides support or evidence to reach a conclusion. There are two main types of inference: immediate and mediate. In an immediate inference, the conclusion is drawn directly from a single premise, without the help of any other statement. For example, if we know "All humans are mortal," we can immediately infer that "Some mortals are humans." In a mediate inference, the conclusion is drawn from two or more premises working together. For instance, if we know "All humans are mortal" and "Socrates is a human," we can infer that "Socrates is mortal."

- Immediate and mediate inferences rely upon the principles of deductive reasoning

Both immediate and mediate inferences fall under deductive reasoning, which focuses more on the structure or form of the statements than on their content. In deductive reasoning, the conclusion is said to follow logically from the premises, which are regarded as offering conclusive evidence for the truth of the conclusion. The connection between the premises and the conclusion in a valid deductive inference is one of implication or logical necessity. However, we often make mistakes while reasoning. In cases where logical implication is absent between the premises and the conclusion, but an inference is attempted due to misunderstanding, the result is an invalid deductive inference. It should be remembered that the validity or invalidity of a deductive argument does not depend on the factual truth of its premises or conclusion. A valid deductive argument only claims that if the premises are true, then the conclusion is also true. It does not claim that the premises or conclusion independently account for factual truths. Since ancient times, philosophers have observed and examined the process of reasoning. They have analysed the structure of the factual statements we deal with and have explained certain principles by which reasoning

based on such statements becomes valid. They have also pointed out the numerous kinds of invalid reasoning, popularly known as fallacies.

1.2.2 Propositions and Arguments

Inference is based only on factual statements. Interrogative, imperative, and exclamatory sentences do not provide information and therefore are not part of the reasoning process. For example, the imperative sentence "Please tell me the capital of India" is not informative. In contrast, factual statements or assertive sentences assert something is the case or something is not the case. Such statements are informative and are the only ones that qualify as grounds for reasoning. In the terminology of logic, they are known as propositions. A proposition is thus always capable of being declared either true or false. Consider the assertive sentences "Delhi is the capital of India" and "Mumbai is the capital of India." They both assert something and are thus informative, even though one is declared true and the other false. They are examples of what we refer to as a proposition.

- A proposition is an informative statement that asserts something

Propositions are the fundamental elements or building blocks of arguments. By the term argument, we mean the set or group that comprises the premises that provide the grounds for the inference and the conclusion that is derived from the premises. In other words, an argument is an arrangement of propositions as premises and conclusions, showing how an inference has been carried out. A proposition is always either true or false, but an argument is not declared as true or false as it is not a single proposition but a set or group of propositions. A deductive argument is always termed valid or invalid depending on the connection between the premises and the conclusion.

- An argument is the arrangement of propositions as premises and conclusion

The following is an example of an argument that expresses some inference. It can be seen that the argument contains three propositions, among which the first two are premises and the third is the conclusion.

Example of an argument:

Philosophers are deep thinkers. (Premise 1)

Socrates is a philosopher. (Premise 2)

[Therefore,] *Socrates is a deep thinker*. (Conclusion)

In everyday discussions, arguments are not always expressed neatly like this. However, certain words indicate whether a statement acts as a premise or a conclusion. Words like "therefore," "thus," and "hence" are conclusion indicators, while words like "since," "for," "as," and "because" are premise indicators. For a detailed list of such words, see Table 1.2.1.

Table 1.2.1 Table of premise indicators and conclusion indicators

Premise indicators	since, because, for, as, for the reason that, as indicated by, follows from, as shown by, inasmuch as, in view of the fact that, may be derived from, may be inferred from
Conclusion indicators	therefore, thus, hence, so, accordingly, for this reason, it follows that, consequently, proves that, as a result, which shows that, which implies that

- Premise indicators and conclusion indicators help to understand the nature of statements in ordinary language

1.2.3 Standard form categorical propositions

Propositions come in different forms. A proposition is called categorical if it has a subject term and a predicate term, either of which stands for certain groups or classes, and a copula or connector (is/are/is not/are not) that determines whether the relation between the two terms is one of affirmation or negation. A categorical proposition depicts an unconditional relation between two classes. For example, "All oranges are fruits" is a categorical proposition that unconditionally affirms the relationship between the two classes of oranges and fruits, which are denoted respectively by the subject term "oranges" and the predicate term "fruits."

- A categorical proposition depicts an unconditional relation between two classes

Moreover, the quantity of a categorical proposition is universal or particular, depending on whether its subject term stands for all or some members of the class referred to. Accordingly, the proposition "All oranges are fruits" is universal, while the proposition "Some oranges are fruits" is particular. The quality of a proposition is determined by the relationship between the subject term and the predicate term. If the relationship is one of inclusion or affirmation, the proposition is affirmative; if the relationship is one of exclusion or negation, the proposition is negative. Accordingly, "All oranges are fruits" is affirmative, and "No oranges are fruits" is negative.

- Categorical propositions are universal/particular and affirmative/ negative

Another property that relates not to a proposition as a whole, but to its subject and predicate terms, is that of distribution.

- Subject and predicate terms in a categorical proposition are either distributed or undistributed

A term (subject or predicate) is distributed if it stands for or provides certain information about all the members of the class it refers to. The term is undistributed otherwise. The term "oranges" in "All oranges are fruits" is distributed as it stands for all oranges. However, the term "fruits" in the same proposition is undistributed, as we are not provided with any information about all members of the group called fruits based on how the term stands in the proposition.

Since ancient times, four kinds of standard-form categorical propositions have been popularised: namely, A, E, I, and O propositions, which are respectively universal affirmative, universal negative, particular affirmative, and particular negative propositions. It is said that all unconditional assertive statements belong to or can be reduced to one of these forms. Table 1.2.2 shows the name and structure of the four kinds of standard-form categorical propositions, along with their quantity, quality, and the nature of the distribution of terms. (Note: "S" stands for the subject term and "P" stands for the predicate term of the proposition.)

Table 1.2.2 Standard-form Categorical Propositions and Distribution of Terms

Name	Proposition Form	Example	Quantity	Quality	Distribution of terms
A	All S is P	All oranges are fruits	Universal	Affirmative	S is distributed
E	No S is P	No oranges are fruits	Universal	Negative	Both S and P are distributed
I	Some S is P	Some oranges are fruits	Particular	Affirmative	Neither S nor P are distributed
O	Some S is not P	Some oranges are not fruits	Particular	Negative	P is distributed

1.2.4 Conversion of statements to standard form

The propositions that we encounter in everyday life are not always in the standard forms of A, E, I, and O propositions. However, once we understand the structure of a statement in ordinary language, we can translate it into the appropriate standard form. There is no single rule for translation, as ordinary language is too complicated and multifaceted. Different types of translation are required in different contexts. For example, "Each and every human being is mortal" is translated as "All human beings are mortal," which is an A-type proposition. The statement "Only adults are voters" is translated as "All voters are adults." A few more examples are shown in Table 1.2.3.

Table 1.2.3 Translation of statements in ordinary language into standard-form propositions

Statements in ordinary language	Standard-form
Some flowers are beautiful	Some flowers are beautiful things
All people seek recognition	All people are seekers of recognition
Racehorses are all thoroughbreds	All racehorses are thoroughbreds
All is well that ends well	All things that end well are things that are well
Dogs are carnivorous	All dogs are carnivorous
Children are careless	Some children are careless persons
Every apple is a fruit	All apples are fruits
Wherever there is smoke, there is fire	All cases of smoke are cases of fire
If x is a human being, then x is mortal	All human beings are mortal
Chillies are never sweet	No chillies are sweet things
Most of the days are holidays	Some days are holidays
Politicians are hardly honest persons	Some politicians are not honest persons
Not any student is a player	No students are players
Not every student is a player	Some students are not players
Only citizens are voters	All voters are citizens
None but the citizens can vote	All voters are citizens
All except citizens are voters	All non-citizens are voters + No citizens are voters

- Statements in ordinary language can be translated into standard-form categorical propositions

Problems on conversion of ordinary language statements to standard form

Q1. Translate the following into standard-form categorical propositions:

a. Roses are fragrant.

b. Not everyone worth meeting is worth having as a friend.

c. Nothing is both safe and exciting.

d. Only members can use the front door.

e. All styles are good, except the tiresome.

Solution:

a. All roses are fragrant things.

b. Some people who are worth meeting are not people worth having as friends.

c. No safe things are exciting things.

d. All those who can use the front door are members.

e. All non-tiresome styles are good + No tiresome styles are good.

1.2.5 Guidelines for Immediate Inference

We have already defined what an immediate inference is. It is the inference based on a single premise. Some guidelines for carrying out a valid immediate inference are given below.

1.2.5.1 Traditional Square of Opposition

The four kinds of standard-form categorical propositions are opposed to each other in four different ways.

1. A and O propositions are opposed both in quantity and quality. They are thus called contradictories. If two A and O propositions have the same subject and predicate terms, then they cannot both be true and cannot both be false. Among them, the truth of one necessarily implies the falsity of the other, and the falsity of one necessarily implies the truth of the other. Accordingly, if the truth value of one is unknown, that of the other also remains unknown. E and I propositions also behave in the same manner and form another contradictory pair.

2. A and E propositions have universal quantity but differ in their quality. They are thus called contraries. If two A and E propositions have the same subject and predicate terms, then they cannot both be true but can be false together. Among them, the truth of one necessarily implies the falsity of the other. However, from the falsity of one, the truth value of the other cannot be determined with certainty.

3. I and O propositions have particular quantity but differ in their quality. They are called sub-contraries. If two I and O propositions have the same subject and predicate terms, then they can both be true but cannot be false together. Among them, the falsity of one necessarily implies the truth of the other. However, from the truth of one, the truth value of the other cannot be determined with certainty.

4. A and I propositions are both affirmative in quality, but they differ in their quantity. Their opposition is known as subalternation. If two A and I propositions have the same subject and predicate terms, then the universal A proposition is called superaltern, and the particular I proposition is called subaltern. They can both be true and can both be false. The truth of the superaltern necessarily implies the truth of the subaltern but not vice-versa. Also, the falsity of the subaltern necessarily implies the falsity of the superaltern but not vice-versa. E and I propositions also behave in the same manner and form another pair of superaltern and subaltern propositions.

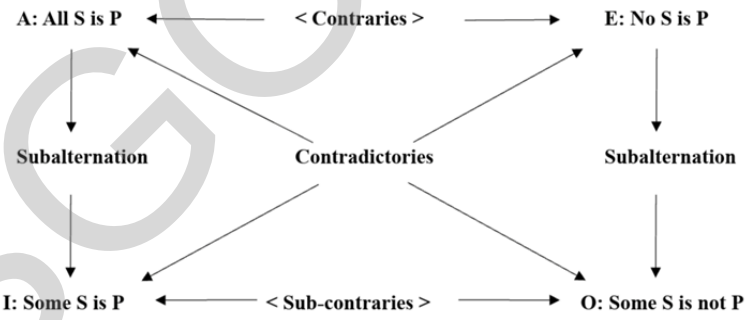

Fig. 1.2.1 Depicts the traditional square of opposition

Knowledge about the manner in which these proposition types are opposed to each other is useful in carrying out certain kinds of immediate inferences validly. For example, if we know that the A type proposition "All students are eligible candidates" is true, we may infer that – "No students are eligible candidates" is false; "Some students are eligible candidates" is true; and "Some students are not eligible candidates" is false. The list of possible immediate inferences using the traditional square of opposition is given in the table 1.2.4.

- Square of opposition shows how the four standard forms of categorical proposition are related to each other

Table 1.2.4 Immediate Inference: Traditional Square of Opposition

Given	Then, you may infer that
A is true	E is false; I is true; O is false
E is true	A is false; I is false; O is true
I is true	E is false; A and O are undetermined
O is true	A is false; E and I are undetermined
A is false	O is true; E and I are undetermined
E is false	I is true; A and O are undetermined
I is false	A is false; E is true; O is true
O is false	A is true; E is false; I is true

Problems based on traditional square of opposition

Q2. If we assume that the first proposition in the following set is true, what can we infer about the truth or falsehood of the remaining propositions in the set?

a. All successful executives are intelligent people.

b. No successful executives are intelligent people.

c. Some successful executives are intelligent people.

d. Some successful executives are not intelligent people.

Solution: All the propositions have the same subject term and predicate term. They differ in their quantity and quality and are respectively A, E, I, and O type propositions. We understand that the properties of the opposition between the four kinds of standard-form categorical propositions should be used to solve the question.

The first proposition is A type and is given as true. From the table 1.2.4 – If A type proposition is given as true, then the corresponding E type proposition with the same subject and predicate will be false, the corresponding I type proposition will be true, and the corresponding O type proposition will be false.

Hence, we conclude that –

"No successful executives are intelligent people" is false.

"Some successful executives are intelligent people" is true.

"Some successful executives are not intelligent people" is false.

Q3. If we assume that the first proposition in the following set is false, what can we infer about the truth or falsehood of the remaining propositions in the set?

a. Some college professors are not entertaining lecturers.

b. All college professors are entertaining lecturers.

c. No college professors are entertaining lecturers.

d. Some college professors are entertaining lecturers.

Solution: Try yourself.

1.2.5.2 Conversion

Conversion is an inference in which we arrive at a new proposition by interchanging the subject and predicate of the given proposition. If we know that "No students are players" is true, we may validly infer that "No players are students" is true. There is no change in meaning; the former implies the latter. They are both logically equivalent, meaning they share the same truth value. If one is true, the other is also true, and if one is false, the other is also false. However, in everyday life, we often make mistakes when we know that "All students are players" is true and infer that "All players are students" from this. The former does not imply the latter. The valid conversion gives "Some players are students," which becomes limited in quantity. In this case, the proposition and the converse are not logically equivalent to each other. The truth of the former implies the truth of the latter, but the falsity of the former does not imply the falsity of the latter. Interestingly, there is no valid conversion for "Some students are not players." That is, from "Some students are not players," we cannot with certainty arrive at any proposition with "players" as the subject term and "students" as the predicate term. The limitation in quantity of the converse of the universal affirmative proposition, as well as the absence of a valid converse of the particular negative proposition, is due to the condition that no term should be distributed in the inferred proposition if it is undistributed in the given proposition. (More about this condition on the distribution of terms can be understood while dealing with categorical syllogisms in the next unit.) It should also be noted that the quality of a valid converse remains the same as that of the original proposition.

- Conversion arrives at a new proposition by interchanging the subject and predicate of the given proposition

The steps to obtain the valid converse of a given proposition can be stated as follows:

- Interchange the subject term and the predicate term of the given proposition.
- Make no change in the quality of the given proposition.
- Keep the quantity unchanged for 'E' proposition and 'I' proposition. The quantity should be limited to particular in the case of 'A' proposition.
- Note that no valid converse exists for 'O' proposition.

Table 1.2.5 will be useful to remember the rules of conversion

Valid Conversions	
Convertend	**Converse**
A: All S is P	I: Some P is S (by limitation)
E: No S is P	E: No P is S
I: Some S is P	I: Some P is S
O: Some S is not P	No valid conversion

Problems based on conversion

Q4. State the converses of the following propositions.

a. No people who are considerate of others are reckless drivers who pay no attention to traffic regulations.

b. All graduates of West Point are commissioned officers in the U.S. Army.

c. Some European cars are overpriced and underpowered automobiles.

d. No reptiles are warm-blooded animals.

Solution:

a. The given proposition is an E type proposition with "People who are considerate of others" as the subject term and "Reckless drivers who pay no attention to traffic regulations" as the predicate term. From table 1.2.5, we know that the converse of an E type proposition is also an E type proposition with the subject and the predicate terms interchanged. Converse of "No S is P" is "No P is S".

Hence the converse of "No people who are considerate of others are reckless drivers who pay no attention to traffic regulations" is "No reckless drivers who pay no attention to traffic regulations are people who are considerate of others".

b. The given proposition is an A type proposition with "Graduates of West Point" as the subject term and "Commissioned officers in the U.S. Army" as the predicate term. From table 1.2.5, we know that the converse of an A type proposition is an I type proposition with the subject and the predicate terms interchanged. Converse of "All S is P" is "Some P is S".

Hence the converse of "All graduates of West Point are commissioned officers in the U.S. Army" is "Some commissioned officers in the U.S. Army are graduates of West Point".

c. Solve yourself.

d. Solve yourself.

1.2.5.3 Obversion

Obversion is another immediate inference in which we arrive at a new proposition by changing the quality of the given proposition. We infer a negative proposition from an affirmative proposition and vice-versa. However, in order to do so validly without changing the meaning and the subject term, we need to modify the predicate term. For example, the valid obversion for the affirmative proposition "All students are vegetarians" is the negative proposition "No students are non-vegetarians." Similarly, the negative proposition "Some students are not vegetarians" is validly obverted to "Some students are non-vegetarians," which is an affirmative proposition, as "non-vegetarians" is the predicate term here, and the connecting word is affirmative. A proposition and its obverse are logically equivalent. The table 1.2.6 shows the valid obversions.

- Obversion arrives at a new proposition by changing the quality of the given proposition.

The steps to obtain the valid obverse of a given proposition can be stated as follows:

- Change the quality of the given proposition (affirmative to negative or negative to affirmative).
- Replace the predicate term with its complement (e.g., the complement of 'vegetarians' is 'non-vegetarians', and that of 'non-vegetarians' is 'vegetarians').
- Keep the subject term and the quality of the given proposition unchanged.

Table 1.2.6 shows the valid obversions

Valid Obversions	
Obvertend	**Obverse**
A: All S is P	E: No S is non-P
E: No S is P	A: All S is non-P
I: Some S is P	O: Some S is not non-P
O: Some S is not P	I: Some S is non-P

Problem based on obversion

Q5. State the obverses of the following propositions.

a. Some college athletes are professionals.

b. No organic compounds are metals.

c. Some clergy are not abstainers.

d. All objects suitable for boat anchors are objects that weigh at least fifteen pounds.

Solution:

a. The given proposition is an I-type proposition with "college athletes" as the subject term and "professionals" as the predicate term. From table 1.2.6, we know that the obverse of an I-type proposition is an O-type proposition with the same subject term while the predicate term is modified to denote the complementary class. The obverse of "Some S is P" is "Some S is not non-P." The complementary class of "professionals" can be denoted by the term "non-professionals."

Hence, the obverse of "Some college athletes are professionals" is "Some college athletes are not non-professionals."

b. The given proposition is an E type proposition with "organic compounds" as the subject term and "metals" as the predicate term. From Table 1.2.6, we know that the obverse of an E type proposition is an A type proposition with the same subject term, while the predicate term is modified to denote the complementary class. The obverse of "No S is P" is "All S is non-P". The complementary class of "metals" can be denoted by the term "non-metals".

Hence, the obverse of "No organic compounds are metals" is "All organic compounds are non-metals".

c. Solve yourself.

d. Solve yourself.

1.2.5.4 Contraposition

Contraposition is a combination of two obversions with one conversion in between. This involves the modification as well as the interchanging of the subject and predicate terms. With two obversions, the quality remains the same. The contrapositive of "All students are vegetarians" is "All non-vegetarians are non-students". A proposition and its contrapositive are logically equivalent to each other. However, while deriving the contrapositive of a universal negative proposition, the quantity becomes limited. In this case, the proposition and the contrapositive are not logically equivalent to each other. The truth of the former implies the truth of the latter, although the falsity of the former does not imply the falsity of the latter. Additionally, there is no valid contrapositive for the particular affirmative proposition.

- Contraposition = Obversion + Conversion + Obversion

The steps to obtain the valid contrapositive of a given proposition can be stated as follows:

- Replace the subject term with the complement of the predicate term, and the predicate term with the complement of the subject term.
- Make no change to the quality of the given proposition.
- Keep the quantity unchanged for 'A' and 'O' propositions. The quantity should be limited to particular in the case of an 'E' proposition.
- Note that no valid contrapositive exists for the 'I' proposition.

- Contraposition is a combination of two obversions with one conversion in between

Table 1.2.7 shows the valid contrapositions

Valid Contrapositions	
Premise	**Contrapositive**
A: All S is P	A: All non-P is non-S
E: No S is P	O: Some non-P is not non-S (by limitation)
I: Some S is P	Contraposition is not valid
O: Som S is not P	O: Some non-P is not non-S

Problem based on Contraposition

Q6. State the contrapositives of the following propositions.

a. All journalists are pessimists.

b. Some non-citizens are not non-residents.

c. Some soldiers are not officers.

d. All things weighing less than fifty pounds are objects not more than four feet high.

Solution:

a. The given proposition is an A type proposition with "journalists" as the subject term and "pessimists" as the predicate term. From Table 1.2.7, we know that the contrapositive of an A type proposition is an A type proposition with the subject term as the complementary of the original predicate and the predicate term as the complementary of the original subject. The contrapositive of "All S is P" is "All non-P is non-S". The complementary class of "journalists" can be denoted by the term "non-journalists", and that of "pessimists" as "non-pessimists".

Hence, the contrapositive of "All journalists are pessimists" is "All non-pessimists are non-journalists".

b. The given proposition is an O type proposition with "non-citizens" as the subject term and "non-residents" as the predicate term. From Table 1.2.7, we know that the contrapositive of an O type proposition is an O type proposition with the subject term as the complementary of the original predicate and the predicate term as the complementary of the original subject. The contrapositive of "Some S is not P" is "Some non-P is not non-S". The complementary class of "non-citizens" can be denoted by the term "citizens", and that of "non-residents" as "residents".

Hence, the contrapositive of "Some non-citizens are not non-residents" is "Some residents are not citizens".

c. Solve yourself.

d. Solve yourself.

1.2.6 Exercise based on All Kinds of Immediate Inference

Q7. If "No scientists are philosophers" is true, what can be inferred about the truth or falsehood of the following propositions? That is, which can be known to be true, which can be known to be false, and which are undetermined?

a. All philosophers are scientists.

b. All non-scientists are non-philosophers.

c. No non-scientists are non-philosophers.

d. Some scientists are not philosophers.

e. No scientists are non-philosophers.

f. No non-philosophers are scientists.

g. Some non-philosophers are scientists.

Solution: To solve these kinds of problems, we must apply what we have understood from the square of opposition, conversion, obversion, and contraposition. If we know the truth value of a given proposition, then – 1) based on the square of opposition, we can determine the truth value of propositions that differ in structure but have the same subject and predicate terms as that of the given proposition, and 2) based on conversion, obversion, and contraposition, we can determine the truth value of propositions that are logically equivalent to the given proposition. Moreover, applying the same rules further to the above inferred propositions can lead us to determine the truth value of many more propositions.

Here, the E type proposition "No scientists are philosophers" is given as true.

· From Table 1.2.4, we may infer that the corresponding A type proposition is false, the corresponding I type proposition is false, and the corresponding O type proposition is true. Hence, we conclude:

"All scientists are philosophers" is false,

"Some scientists are philosophers" is false,

"Some scientists are not philosophers" is true.

· From Tables 1.2.5 and 1.2.6, we know that the converse and obverse of an E type proposition are logically equivalent to the given proposition. Hence, we conclude:

"No philosophers are scientists" is true,

"All scientists are non-philosophers" is true.

From Table 1.2.7, even though the contrapositive with limited quantity is not logically equivalent to the given E proposition, the truth of the E proposition implies the truth of the contrapositive at least. Hence, we conclude:

"Some non-philosophers are not non-scientists" is true.

Using the above information, we can solve the questions.

a. "All philosophers are scientists" is false.

Since we have already inferred using the rules of conversion that "No philosophers are scientists" is true. Applying the rules of the square of opposition leads us to determine that "All philosophers are scientists" is false.

b. "All non-scientists are non-philosophers" is false.

From (a), we know that "All philosophers are scientists" is false. The given proposition is the contrapositive of the same and is logically equivalent to it. Hence, it is false.

c. The truth value of "No non-scientists are non-philosophers" is undetermined.

From (c), we know that "All non-scientists are non-philosophers" is false. The rules of the square of opposition indicate that from the falsity of an A proposition, the truth value of an E proposition cannot be determined with certainty.

d. Solve yourself.

e. Solve yourself.

f. Solve yourself.

g. Solve yourself.

Summarized Overview

In this unit, we had a brief account of the guidelines that assist us in making valid inferences from a single premise. The square of opposition illustrates the relationships between different types of propositions, while the rules of conversion, obversion, and contraposition demonstrate how propositions can be restructured without altering their meaning and logical value. These concepts are particularly useful when making inferences based on a single proposition. The various problems addressed in this unit can guide in skillfully undertaking immediate inferences in everyday life. They also offer valuable insights for solving similar types of problems that frequently appear in various aptitude tests and other competitive examinations.

Self-Assessment

1. Translate the following into standard-form categorical propositions:
   a. Orchids are not fragrant.
   b. A thing of beauty is a joy forever.
2. If we assume that the first proposition in the following set is false, what can we infer about the truth or falsehood of the remaining propositions in the set?
   a. No animals with horns are carnivores.
   b. Some animals with horns are carnivores.
   c. Some animals with horns are not carnivores.
   d. All animals with horns are carnivores.
3. State the converse of: Some professional wrestlers are elderly persons who are incapable of doing an honest day's work.
4. State the obverse of: No geniuses are conformists.
5. State the contrapositive of: All scholars are non-degenerates.

Assignments

1. Translate the following into standard-form categorical propositions:
   a. Only brave people have ever won the Congressional Medal of Honor.
   b. All that glitters is not gold.
   c. None think the great unhappy but the great.
2. If we assume that the first proposition in the following set is false, what can we infer about the truth or falsehood of the remaining propositions in the set?
   a. Some college professors are not entertaining lecturers.
   b. All college professors are entertaining lecturers.
   c. No college professors are entertaining lecturers.
   d. Some college professors are entertaining lecturers
3. State the converse, obverse, and contrapositive of: No non-saints were martyrs.
4. If "All socialists are pacifists" is true, what may be inferred about the truth or falsehood of the following propositions? That is, which can be known to be true, which can be known to be false, and which are undetermined?
   a. Some socialists are not pacifists.
   b. All pacifists are socialists.
   c. All non-pacifists are nonsocialists.
   d. Some non-pacifists are not nonsocialists.
   e. No non-pacifists are socialists.

Reference

1. Copi, I. M., Cohen, C., & Rodych, V. (2019). *Introduction to Logic*. Routledge.
2. Hurley, Patrick J. (2015). *A Concise Introduction to Logic* (12th ed.). Cengage Learning.
3. Sethy, S. S. (2021). *Introduction to Logic and Logical Discourse.* Springer.

Suggested Reading

1. Copi, I. M., Cohen, C., & Rodych, V. (2019). *Introduction to Logic*. Routledge.

Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.

UNIT 3
Problem solving by Applying the Rules of Mediate Inference

Learning Outcomes

Upon completing this unit, learners will be able to:

- discuss the valid and invalid forms of categorical, hypothetical, and disjunctive syllogisms
- comprehend the formal structure of arguments in the ordinary language
- apply rules of mediate inference to analyse and evaluate various arguments in daily discourse
- solve problems on syllogisms in competitive examinations

Background

We know that all oranges belong to the class of fruits. We also know that all apples belong to the class of fruits. But does it follow that some or all of the oranges are apples too? Given our familiarity with the real-life correspondence of these facts, we might answer "No." Consider this: we conclude the presence of Y at a place when we are given that wherever there is X, there is Y, and that the mentioned place is one where X is present. But what about concluding the absence of Y at a place due to the absence of X at the same place, when we only know that wherever X is present, Y is also present? There are many instances where we experience doubt and make mistakes while deriving conclusions based on two or more statements. Mediate inference, as it is known, has certain principles that determine its validity. Here discusses the principles of deductive reasoning that pertain to mediate inferences and shows how to solve problems involving mediate inferences.

Keywords

Mediate inference, Categorical syllogism, Hypothetical syllogism, Disjunctive syllogism, Enthymeme, Sorites

Discussion

1.3.1 Mediate Inference

In the previous unit, we familiarised ourselves with a few types of immediate inference and practised solving various problems based on them. Now we proceed to mediate inference. In mediate inference, two or more premises are involved; that is, the evidence to arrive at the conclusion is provided by two or more premises together. One of the popular forms of mediate inference is the syllogism, which consists of two premises and a resulting conclusion. The inference proceeds from the first premise to the conclusion through the mediation of the second premise. When the premises and conclusion in the syllogism are categorical propositions, the syllogism is called a categorical syllogism. However, there are propositions in the form of if-then statements and either-or statements, which are respectively called hypothetical and disjunctive propositions. The presence of such propositions in the syllogism results in it being classified as either a hypothetical or a disjunctive syllogism. Understanding the structure of these syllogisms and their valid and invalid forms aids us in our everyday reasoning, where more than one premise is involved.

- In mediate inference, the evidence to arrive at the conclusion is provided by two or more premises together

1.3.2 Categorical Syllogism

A categorical syllogism is a deductive argument that contains three categorical propositions, two of which form the premises and one the conclusion. Each categorical proposition contains two terms – the subject and the predicate. Thus, three categorical propositions must contain a total of six terms. However, in a categorical syllogism, only three terms are present, and each occurs twice. In essence, the syllogism expresses the connection between three terms or three classes of things.

- A categorical syllogism is a deductive argument

The following is an example of a valid categorical syllogism in standard form:

No heroes are cowards. (Premise 1)

Some soldiers are cowards. (Premise 2)

Therefore, some soldiers are not heroes. (Conclusion)

We observe that the above syllogism contains only three terms – heroes, soldiers, and cowards – each occurring twice. The conclusion expresses the relationship between "soldiers" and "heroes." The term "cowards" acts as a link that aids in arriving at the conclusion.

- Minor term, major term, middle term, minor premise, and major premise

In the terminology of categorical syllogisms, the subject term of the conclusion is called the minor term, and the predicate term of the conclusion is called the major term. The middle term has a relationship with both the minor term and the major term, as expressed in the two premises. It serves as the link that facilitates concluding the relationship between the minor and major terms. The major premise contains the major term and expresses the relationship between the major term and the middle term, while the minor premise contains the minor term and expresses the relationship between the minor term and the middle term. In the example above, "soldiers" is the minor term, "heroes" is the major term, and "cowards" is the middle term. Premise 1 is the major premise, and Premise 2 is the minor premise.

We cannot validly derive any conclusion we like from two given premises. A set of rules governs the manner in which a valid categorical syllogism operates.

- Rules of categorical syllogism

1. As we have seen, there should be exactly three terms in the syllogism. Only then we can conclude the relationship between two terms using the third as a link. If more than three terms occur, or more than three classes of things are denoted by the ambiguous use of the three terms, the reasoning becomes fallacious.

2. The middle term must be distributed in at least one of its occurrences. In at least one premise, the middle term should provide certain information about all members of the class it refers to. (Recall the discussion about the distribution of terms from the previous unit.)

3. In case the minor term or the major term is distributed in the conclusion, the respective term must also be distributed in the premise where it occurs. Otherwise, this would mean that the premises do not provide information about all the members of a class, while the conclusion does. This amounts to stating that the conclusion expresses something more than what is warranted by the premises. If the minor term or the major term is undistributed in the conclusion, the distribution status of the same term in the premises is not an issue. The conclusion may express something that is lesser than or equal to the extension warranted in the premises, but never more.

4. If both premises are negative, no conclusion can be reached with certainty. If exactly one of the premises is negative, then the conclusion must also be negative.

5. One rule that did not exist in the traditional system but was formulated by modern logicians is: If both premises are universal, the conclusion cannot be particular.

An overview of all the rules and the popular names of the fallacies that occur when the rules are violated is provided in Table 1.3.1.

Table 1.3.1 Table of Syllogistic Rules and Associated Fallacies

Syllogistic Rules and Associated Fallacies	
Rules	**Associated Fallacy**
Avoid four terms	Fallacy of four terms
Middle term must be distributed in at least one premise	Fallacy of undistributed middle
Any term distributed in the conclusion must be distributed in the premises	Illicit major (if the term is major) and Illicit minor (if the term is minor)
Avoid two negative premises	Exclusive premises
If one premise is negative, the conclusion must be negative	Drawing an affirmative conclusion from a negative premise
No particular conclusion may be drawn from two universal premises	Existential fallacy

1.3.2.1 Translating syllogisms in ordinary language to standard form

The syllogistic arguments that we encounter in everyday life may not be in standard form. Therefore, necessary adjustments need to be made whenever required.

1. The categorical propositions that are not in standard form can be translated into the form mentioned in the previous unit. If the premises and the conclusion are not in the order prescribed in the standard form, they should be understood and rearranged. Familiarity with premise indicators, conclusion indicators, and the definitions of the major term, minor term, middle term, major premise, and minor premise will be useful.

- Syllogisms in ordinary language can be converted to standard form

2. Some syllogisms in ordinary language might appear to have more than three terms. However, terms like "wealthy persons," "rich people," etc., are synonymous and denote the same class. Such terms can be interchanged to reduce the number of terms to three.

3. Similarly, the terms "perfect" and "imperfect" are complementary. We may apply the rules of conversion, obversion, and contraposition to modify terms like these and, accordingly, the premises. For example, the syllogism—All mammals are warm-blooded animals; No lizards are warm-blooded animals; Therefore, all lizards are non-mammals—can be translated into standard form by obverting the conclusion to make it "No lizards are mammals." The number of terms can then be reduced to three.

1.3.3 Problems based on categorical syllogism

Q1. Rewrite each of the following syllogisms in standard form.

a. All juvenile delinquents are maladjusted individuals, and some juvenile delinquents are products of broken homes; hence some maladjusted individuals are products of broken homes.

b. All proteins are organic compounds; hence all enzymes are proteins, as all enzymes are organic compounds.

c. Some evergreens are objects of worship because all fir trees are evergreens, and some objects of worship are fir trees.

d. Some reformers are fanatics, so some idealists are fanatics, because all reformers are idealists.

e. No television stars are certified public accountants, but all certified public accountants are people of good business sense; it follows that no television stars are people of good business sense.

Solution: To translate syllogisms in ordinary language to standard form, first, we should identify the premises and conclusion using the premise indicators and conclusion indicators. Then, from the conclusion, we should identify the subject term, which will be the minor term of the syllogism, and the predicate term, which will be the major term of the syllogism. The premises should then be identified as the major

premise and minor premise based on the presence of the major term and minor term, respectively. Finally, the syllogism should be rewritten in standard order, with the major premise first, the minor premise next, and the conclusion last.

a. The word "hence" is a conclusion indicator. Therefore, "Some maladjusted individuals are products of broken homes" is the conclusion of the given syllogism. The subject term of the conclusion, "maladjusted individuals," is the minor term of the syllogism. The predicate term of the conclusion, "products of broken homes," is the major term of the syllogism. The presence of the major term shows that "Some juvenile delinquents are products of broken homes" is the major premise. The presence of the minor term shows that "All juvenile delinquents are maladjusted individuals" is the minor premise. The syllogism in standard form is as follows:

Some juvenile delinquents are products of broken homes.

All juvenile delinquents are maladjusted individuals.

Therefore, some maladjusted individuals are products of broken homes.

b. The word "hence" is a conclusion indicator, and the word "as" is a premise indicator. Thus, "All enzymes are proteins" is the conclusion of the given syllogism. The subject term of the conclusion, "enzymes," is the minor term of the syllogism. The predicate term of the conclusion, "proteins," is the major term of the syllogism. The presence of the major term indicates that "All proteins are organic compounds" is the major premise. The presence of the minor term indicates that "All enzymes are organic compounds" is the minor premise. The syllogism in standard form is as follows:

All proteins are organic compounds.

All enzymes are organic compounds.

Therefore, all enzymes are proteins.

c. The word "because" is a premise indicator. As there are two statements following "because" without any other indicator interfering, it should be understood that the two premises are written together. The conclusion is the statement written first for which the reasons are given afterwards using the word "because." Therefore,

"Some evergreens are objects of worship" is the conclusion of the given syllogism. The subject term of the conclusion, "evergreens," is the minor term of the syllogism. The predicate term of the conclusion, "objects of worship," is the major term of the syllogism. The presence of the major term indicates that "Some objects of worship are fir trees" is the major premise. The presence of the minor term indicates that "All fir trees are evergreens" is the minor premise. The syllogism in standard form is as follows:

Some objects of worship are fir trees.

All fir trees are evergreens.

Therefore, some evergreens are objects of worship.

d. Solve yourself.

e. Solve yourself.

Q2. Identify the fallacy committed by the following syllogisms.

a. All textbooks are books intended for careful study.

Some reference books are books intended for careful study.

Therefore, some reference books are textbooks.

b. Some good actors are not powerful athletes.

All professional wrestlers are powerful athletes.

Therefore, all professional wrestlers are good actors.

Solution:

a. This syllogism contains exactly three terms - "textbooks", "reference books", and "books intended for careful study", which respectively are the major, minor, and middle terms of the syllogism.

It can be seen that the middle term "books intended for careful study" is undistributed in both premises. The major premise is an A proposition in which the predicate term is undistributed. The minor premise is an I proposition in which the predicate term is undistributed. Hence, the middle term, which is positioned as the predicate term in both premises, remains undistributed. This syllogism commits the fallacy of undistributed middle and is thus invalid.

b. Solve yourself.

Q3. Test the validity of the following syllogistic arguments.

a. No heroes are cowards.

Some soldiers are cowards.

Therefore, some soldiers are not heroes.

b. All people who are most hungry are people who eat most.

All people who eat least are people who are most hungry.

Therefore, all people who eat least are people who eat most.

Solution: The syllogisms should be tested against all the six rules given in Table 1.3.1.

a. This syllogism is in standard form. The major term of the syllogism is "heroes". The minor term is "soldiers", and the middle term is "cowards".

There are exactly three terms, each occurring twice without ambiguity.

The middle term "cowards" is distributed in the major premise, as the major premise is an E-type proposition and the term "cowards" is positioned as the predicate term. We know that the predicate term of an E-type proposition is distributed. The rule that the middle term must be distributed in at least one premise is satisfied.

The conclusion is an O-type proposition which distributes only its predicate term. The minor term "soldiers" is thus not distributed in the conclusion. Therefore, there is no question of the illicit minor fallacy. The major term "heroes" is distributed in the conclusion. In the major premise, the major term is also distributed. Hence, the rule that any term distributed in the conclusion must be distributed in the premises is satisfied.

The major premise, which is an E-type proposition, is negative, and the minor premise, which is an I-type proposition, is affirmative. The premises are not thus exclusive, and the corresponding fallacy is not committed.

Also, as one premise is negative, the conclusion must be negative. Here, the conclusion is an O-type proposition which is negative. Hence, the rule is followed.

The premises are not both universal. Hence, there is no question of the existential fallacy.

Therefore, this syllogism satisfies all rules to be considered a valid syllogism and is thus valid.

b. Solve yourself.

Q4. Convert the following syllogisms into standard form and test their validity.

a. Some non-drinkers are athletes, because no drinkers are persons in perfect physical condition, and some people in perfect physical condition are not non-athletes.

b. Only those who ignore the facts are likely to be mistaken. No one who is truly objective is likely to be mistaken. Hence, no one who ignores the facts is truly objective.

c. All things present are non-irritants; therefore, no irritants are invisible objects, because all visible objects are absent things.

d. Since all knowledge comes from sensory impressions and since there's no sensory impression of substance itself, it follows logically that there is no knowledge of substance.

Solution:

a. The word "because" indicates the premise. The syllogism is as follows:

No drinkers are persons in perfect physical condition.

Some people in perfect physical condition are not non-athletes.

Therefore, some non-drinkers are athletes.

This is not in standard form. We need to modify the terms to eliminate the distinction between "athletes" and "non-athletes", as well as "drinkers" and "non-drinkers".

The converse of the first premise "No drinkers are persons in perfect physical condition" gives "No persons in perfect physical condition are drinkers". If we take the obverse of this converse, we will get "All persons in perfect physical condition are non-drinkers". (Recall Tables 1.2.5 and 1.2.6 on conversion and obversion). The first premise can be replaced by this proposition without any issue, thus eliminating the distinction between "drinkers" and "non-drinkers".

Also, if we take the obverse of the second premise "Some people in perfect physical condition are not non-athletes", we get "Some people in perfect physical condition are athletes". This proposition can replace the second premise. (Note that the complementary term for non-athletes is athletes; recall Table 1.2.6 from the previous unit for clarification on obversion). The distinction between "athletes" and "non-athletes" is thus eliminated.

The syllogism now becomes:

All persons in perfect physical condition are non-drinkers.

Some people in perfect physical condition are athletes.

Therefore, some non-drinkers are athletes.

There are exactly three terms. However, the minor term is "non-drinkers", and the major term is "athletes". The premises need to be rearranged accordingly. The premise that contains "athletes" is the major premise.

The standard form of the syllogism is as follows:

Some people in perfect physical condition are athletes. (Major premise)

All persons in perfect physical condition are non-drinkers. (Minor premise)

Therefore, some non-drinkers are athletes. (Conclusion)

This syllogism has exactly three terms. The middle term "people in perfect physical condition" is distributed in the minor premise. The minor term and major term are not distributed in the conclusion, and there is no scope for illicit fallacies. The premises and conclusion are all affirmative. There is no existential fallacy either. Hence, the given syllogism is a valid syllogism.

b. Solve yourself.

Hint –

"Only those who ignore the facts are likely to be mistaken" can be translated as "All people who are likely to be mistaken are people who ignore the facts".

"No one who is truly objective is likely to be mistaken" can be translated as "No people who are truly objective are people who are likely to be mistaken".

"No one who ignores the facts is truly objective" can be translated as "No people who ignore the facts are people who are truly objective".

c. Solve yourself.

d. Solve yourself.

Q5. Given below are two premises (Premise 1 and Premise 2). Four conclusions are drawn from them (A, B, C, and D). Taking the premises individually or jointly, check which of the conclusions are drawn validly.

Premise 1: Students are always honest.

Premise 2: Most of the girls are students.

Conclusions:

A. Every girl is honest.

B. Most of the honest persons are students.

C. Not all students are girls.

D. Some honest persons are girls.

Solution: It is given that the premises can be taken individually or jointly. This means that both immediate and mediate inference have to be applied here. The conclusions which have the same subject and predicate terms (including the complementary ones) of any of the premises can be examined using the square of opposition properties and the rules of conversion, obversion, and contraposition. The premises, when taken jointly, will behave like the premises of a syllogism with a common middle term. The conclusion that can be validly derived from the syllogism would express the relationship between the other two terms. Thus, from the given conclusions, those that contain such terms can be examined along with the premises using the syllogistic rules.

Here, first we take Premise 1 – "Students are always honest". It can be translated as "All students are honest persons". We now look for those propositions among the given set of conclusions wherein the subject term and the predicate term are either "students" or "honest persons" or their complementary terms. We see that conclusion (B) "Most of the honest persons are students" is such a proposition. It can be translated as "Some of the honest persons are students". Now, comparing this

with the translated form of Premise 1 and applying the rule of conversion, we get that "Some honest persons are students" is the valid converse of "All students are honest persons". Hence, conclusion (B) is valid upon the individual consideration of Premise 1.

Next, we take premise 2 – "Most of the girls are students." This can be translated as "Some girls are students." Proceeding in the aforementioned manner, we recognise conclusion (C) as having the same subject and predicate terms. "Not all students are girls" gets translated as "Some students are not girls." Comparing this with the translated form of premise 2 and applying the properties of the square of opposition, we find that the truth value of conclusion (C) is undetermined. When an "I" proposition is true, the corresponding "O" proposition can be true or false. Thus, conclusion (C) does not necessarily follow from the corresponding premise.

Now we take both premises jointly. "All students are honest persons" and "Some girls are students" constitute the premises of a syllogism with "students" as the middle term. The valid conclusion, if any, of such a syllogism should contain the terms "honest persons" and "girls." We see conclusion (A) "Every girl is honest" and conclusion (D) "Some honest persons are girls" as satisfying that criterion. The former can be translated as "All girls are honest persons." We need to test the validity of two syllogisms separately: the one with the premises and conclusion (A) and the other with the premises and conclusion (D).

Syllogism 1: *All students are honest persons*. (Premise 1, major premise)

Some girls are students. (Premise 2, minor premise)

Therefore, all girls are honest persons. (Conclusion)

This is in standard form. It has exactly three terms. The middle term "students" is distributed in the major premise. However, the term "girls" distributed in the conclusion is not distributed in the minor premise. Hence, the syllogism is not valid. Thus, conclusion (A) does not logically follow from the joint consideration of the premises.

Syllogism 2: *All students are honest persons*. (Premise 1, major premise)

Some girls are students. (Premise 2, minor premise)

Therefore, some honest persons are girls. (Conclusion)

This is in standard form. It has exactly three terms. The middle term "students" is distributed in the major premise. The minor and major terms are undistributed in the conclusion. There is no scope for the fallacies of illicit minor and major. The premises are both affirmative, and the conclusion is also affirmative. There is no existential fallacy either. Hence, the syllogism is valid. Thus, conclusion (D) logically follows from the joint consideration of the premises.

So, our final answer is that conclusion (B) and conclusion (D) follow from these premises respectively upon individual consideration and joint consideration.

Q6. For the following pairs of premises, deduce a conclusion that does not involve the middle term:

Some eggs are hard boiled; No eggs are uncrackable.

Solution: Solve yourself.

1.3.4 Enthymemes

An enthymeme is an argument that is stated incompletely. The unstated part is taken for granted. The unstated part of an enthymematic argument may be one of its premises or even the conclusion. See the example that follows.

Johann is a native-born American. Therefore, Johann is an American citizen.

It seems that there is only one premise and a conclusion. But the conclusion contains something more than what is stated in the premise. Upon a closer look, we can understand that the premise "All native-born Americans are American citizens" is taken for granted here.

The argument in its complete form is as follows:

All native-born Americans are American citizens. Johann is a native-born American. Therefore, Johann is an American citizen.

- Enthymemes are arguments stated incompletely

Everyday discourse often witnesses enthymemes. We take for granted various kinds of information. Practising the completion of a few enthymematic arguments will improve our skill in uncovering the hidden premise or conclusion.

Problems on enthymemes

Q6. Formulate the plausible premise or conclusion, if any, that is missing but understood.

a. I am an Idealist since I believe that all that exists is spiritual.

b. Only demonstrative proof should be able to make you abandon the theory of Creation; but such a proof does not exist in Nature.

c. Man tends to increase at a greater rate than his means of subsistence; consequently, he is occasionally subject to a severe struggle for existence.

d. Who controls the past controls the future. Who controls the present controls the past.

Solution:

a. The word "since" indicates the premise. The first sentence is the conclusion. One of the premises is missing. The speaker concludes that he is an idealist as he believes that all that exists is spiritual. The premise taken for granted is that "One who believes that all that exists is spiritual is an idealist." The argument in its complete form is:

One who believes that all that exists is spiritual is an idealist.

I believe that all that exists is spiritual.

Therefore, I am an idealist.

b. The two statements given are premises. The conclusion is taken for granted. Since only demonstrative proof should be able to make you abandon the theory of Creation, and as such a proof does not exist in Nature, it follows that you cannot abandon the theory of Creation. The complete argument runs as follows:

Only demonstrative proof should be able to make you abandon the theory of Creation.

Such a proof does not exist in Nature.

Therefore, you cannot abandon the theory of Creation.

c. Solve yourself.

d. Solve yourself.

e. Solve yourself.

1.3.5 Sorites

A sorites is an argument in which the conclusion is derived from the premises through a chain of syllogistic inferences. The conclusion of each such syllogistic inference becomes the premise for the next inference, which finally leads to the conclusion of the whole argument. Consider the following example.

All diplomats are tactful individuals.

Some government officials are diplomats.

All government officials are people in public life.

Therefore, some people in public life are tactful individuals.

The conclusion cannot be arrived at in a single go. In fact, from the first two premises, a valid syllogistic inference results in the conclusion "Some government officials are tactful individuals." Now this proposition acts as a premise along with the third premise given above and implies the final conclusion. The argument with all the statements made explicit looks like the combination of two syllogisms as follows.

Syllogism 1*: All diplomats are tactful individuals.*

Some government officials are diplomats.

Therefore, some government officials are tactful individuals.

- Sorites contains a chain of two or more syllogistic inferences

Syllogism 2*: Some government officials are tactful individuals.*

All government officials are people in public life.

Therefore, some people in public life are tactful individuals.

Sorites, or a pile of syllogisms, is often seen in various books. The authors of such books prefer brevity and assume that their readers possess essential knowledge about logical reasoning. In competitive exams, sorites are also presented as questions to test the logical skills of candidates. Solving a few sorites can aid in understanding the works of great scholars and in succeeding in competitive examinations.

Problems on Sorites

Q7. Test the validity of the following sorites.

All bloodhounds are dogs.

All dogs are mammals.

No fish are mammals.

Therefore, no fish are bloodhounds.

Solution:

The first two premises, considered together, form the premises of a syllogism with "dogs" as the middle term, which is distributed once. The conclusion should thus contain the terms "bloodhounds" and "mammals." As the premises are affirmative, the conclusion should also be affirmative. Since the premises are both universal, in order to avoid the existential fallacy, the conclusion must be universal. Hence, the conclusion should be a universal affirmative A-type proposition with the two terms "bloodhounds" and "mammals." The two possible conclusions are "All bloodhounds are mammals" or "All mammals are bloodhounds." However, we know that the term "mammals" is undistributed in the premises, so it should not be distributed in the conclusion. Therefore, the valid conclusion is "All bloodhounds are mammals," which satisfies all syllogistic rules. The term "bloodhounds" becomes the minor term, and the term "mammals" becomes the major term. The standard form of the first inner syllogism in the sorites is thus:

All dogs are mammals.

All bloodhounds are dogs.

Therefore, all bloodhounds are mammals.

Now, taking the conclusion of the above syllogism, "All bloodhounds are mammals," as a premise along with the next premise, "No fish are mammals," we obtain another premise combination of a syllogism with "mammals" as the middle term, which has been distributed once. A valid conclusion of this syllogism would include the terms "fish" and "bloodhounds." We need to check whether the given conclusion of the sorites, "No fish are bloodhounds," validly follows from the aforementioned syllogism.

The syllogism to be tested is:

All bloodhounds are mammals.

No fish are mammals.

Therefore, no fish are bloodhounds.

This contains exactly three terms. The middle term is distributed in the minor premise. The minor term "fish" and

the major term "bloodhounds" are distributed in the conclusion as well as in the respective premises. The syllogism has one negative premise, resulting in a negative conclusion. There is no existential fallacy, as all propositions are universal. Thus, the syllogism is valid.

Hence, the given sorites, which is a combination of two syllogisms, is valid.

Q8. Test the validity of the following sorites.

Everyone who is sane can do logic.

No lunatics are fit to serve on a jury.

None of your sons can do logic.

Therefore, none of your sons is fit to serve on a jury.

Solution: Solve yourself.

1.3.6 Hypothetical Syllogisms

- A hypothetical syllogism contains one or more propositions in the if-then form

Hypothetical syllogisms contain hypothetical propositions, i.e., propositions in the if-then form. A pure hypothetical syllogism is one in which all three propositions (two premises and a conclusion) are hypothetical propositions. A mixed hypothetical syllogism is one in which the major premise is hypothetical while the minor premise and the conclusion are categorical.

Pure hypothetical syllogism:

If there is fuel in the tank, then there is combustion. (Major premise)

If the car runs, then there is fuel in the tank. (Minor premise)

Therefore, if the car runs, then there is combustion. (Conclusion)

Mixed hypothetical syllogism (Modus Ponens):

If the car runs, then there is fuel in the tank. (Major premise)

The car runs. (Minor premise)

Therefore, there is fuel in the tank. (Conclusion)

Mixed hypothetical syllogism (Modus Tollens):

If the car runs, then there is fuel in the tank. (Major premise)

There is no fuel in the tank. (Minor premise)

Therefore, the car does not run. (Conclusion)

Modus Ponens and Modus Tollens are the only valid forms of mixed hypothetical syllogism. Affirming the first part (antecedent) of the major premise results in the affirmation of the second part (consequent). Denial of the second part of the major premise results in the denial of the first part. Denying the first part to arrive at the denial of the second part and affirming the second part to arrive at the affirmation of the first part are fallacious. We cannot always say with certainty that there is no fuel in the tank when the car is not running; the issue may be something else. Additionally, we cannot always say with certainty that because there is fuel in the tank, the car will run; the car may not be running at all. In everyday reasoning, these mistakes are common.

- Valid and invalid forms of hypothetical syllogism

1.3.7 Disjunctive syllogism

A disjunctive syllogism contains a disjunctive proposition, i.e., a proposition of the form either-or, as the major premise. The minor premise and the conclusion are categorical.

Disjunctive syllogism 1:

Either the child sleeps at night or she sleeps in the daytime. (Major premise)

The child does not sleep at night.(Minor premise)

Therefore, the child sleeps in the daytime. (Conclusion)

Disjunctive syllogism 2:

Either the child sleeps at night or she sleeps in the daytime. (Major premise)

The child does not sleep in the daytime. (Minor premise)

Therefore, the child sleeps at night. (Conclusion)

- There are valid and invalid forms of disjunctive syllogism that contain either-or propositions

The truth of a disjunction implies that at least one of the parts is true; both cannot be false together. Therefore, if one is false, we may certainly conclude that the other is true. However, from the truth of one, we cannot infer anything about the other, as the latter may be true or false.

Problems on hypothetical and disjunctive syllogisms

Q8. Identify the form of each of the following arguments and state whether the argument is valid or invalid.

a. If a man could not have done otherwise than he in fact did, then he is not responsible for his actions. But if determinism is true, it is true of every action that the agent could not have done otherwise. Therefore, if determinism is true, no one is ever responsible for what he does. (From *Determinism and the Ability to Do Otherwise* by Winston Nesbit and Stewart Candlish)

b. If each man had a definite set of rules of conduct by which he regulated his life, he would be no better than a machine. But there are no such rules, so men cannot be machines. (From A. M. Turing's *Computing Machinery and Intelligence*)

c. If it is agreed that things are either the result of coincidence or for an end, and that these cannot be the result of coincidence or spontaneity, it follows that they must be for an end. (From Aristotle's *Physics*)

d. Either wealth is an evil, or wealth is a good; but wealth is not an evil; therefore, wealth is a good. (From Sextus Empiricus' *Against the Logicians*)

e. Total pacifism might be a good principle if everyone were to follow it. But not everyone does, so it isn't. (From Gilbert Harman's *The Nature of Morality*)

Solutions:

a. Once the argument is rewritten using fewer words, the form can be identified easily.

If (a man could not have done otherwise), then (he is not responsible for his actions).

If (determinism is true), then (a man could not have done otherwise).

Therefore, if (determinism is true), then (a man is not responsible for his actions).

It can now be understood that this is a pure hypothetical syllogism with all premises and conclusion as hypothetical propositions. The argument is valid as it follows the accepted form of a valid pure hypothetical syllogism.

b. The argument can be rewritten simply as:

If (a man had a definite set of rules), then (a man would become like a machine).

A man has no such rules.

Therefore, a man cannot be a machine.

It is a mixed hypothetical syllogism with the major premise as a hypothetical proposition and the minor premise and conclusion as categorical. However, in this argument, the first part of the major premise is denied, which leads to the denial of the second part. This is not in valid form.

c. The argument goes like this:

Either (things are the result of coincidence) or (things are for an end).

Things are not the result of coincidence.

Therefore, things are for an end.

This is a disjunctive syllogism. It correctly proceeds by denying one of the disjuncts and affirming the other. This is valid.

d. Solve yourself.

e. Solve yourself.

Summarized Overview

Mediate inference is a form of reasoning in which the conclusion is reached with the help of two or more premises. The most common type is the syllogism, which has two premises and one conclusion. In a categorical syllogism, the premises and conclusion are categorical statements. It contains three terms: the minor term (subject of the conclusion), the major term (predicate of the conclusion), and the middle term (the link between them). A valid categorical syllogism follows certain rules: there must be exactly three terms; the middle term must be distributed at least once; if a term is distributed in the conclusion, it must also be distributed in the premises; two negative premises give no conclusion; and if one premise is negative, the conclusion must also be negative. Other forms include sorites, a chain of syllogisms where one conclusion becomes the premise for the next, hypothetical syllogism using "if-then" statements, and disjunctive syllogism using "either-or" statements. These forms show how reasoning proceeds when more than one premise is involved. A careful study of the examples discussed and a focused attempt to solve the unsolved problems can enhance the reasoning skills, which pays off well in real-life situations as well as academic settings.

Self-Assessment

1. Rewrite each of the following syllogisms in standard form.
   a. No intellectuals are successful politicians, because no shy and retiring people are
   b. successful politicians, and some intellectuals are shy and retiring people.
   c. Some paediatricians are not specialists in surgery, so some general practitioners are not paediatricians, because some general practitioners are not specialists in surgery.
   d. Some philosophers are mathematicians; hence some scientists are philosophers, because all scientists are mathematicians.
2. Test the validity of the following syllogism.
   a. No one present is out of work. No members are absent. Therefore, all members are employed.
3. Convert the following syllogisms into the standard-form and test their validity.
   a. All things inflammable are unsafe things, so all things that are safe are non-explosives, because all explosives are flammable things.
   b. All mortals are imperfect beings, and no humans are immortals, whence it follows that all perfect beings are nonhumans.
4. For the following pairs of premises, deduce a conclusion that does not involve the middle term:

   All wasps are unfriendly; All puppies are friendly.
5. Formulate the plausible premise or conclusion, if any, that is missing but understood.
   a. Logic is a matter of profound human importance precisely because it is empirically founded and experimentally applied.

Assignments

1. Rewrite the following syllogism in the standard form.
   a. No college graduates are persons having an IQ of less than 70, but all persons who have an IQ of less than 70 are morons, so no college graduates are morons.

2. Identify the fallacy committed in the following syllogism.

   Some diamonds are precious stones.

   Some carbon compounds are not diamonds.

   Therefore, some carbon compounds are not precious stones.

3. Test the validity of the following syllogism.

   a. No valid syllogisms have two negative premises. No syllogisms on this page are invalid. Therefore, no syllogisms on this page have two negative premises.

4. Convert the following syllogisms into the standard-form and test their validity.

   a. All syllogisms having two negative premises are invalid. Some valid syllogisms are sound. Therefore, some unsound arguments are syllogisms having two negative premises.

   b. Not all is gold that glitters, for some base metals glitter, and gold is not a base metal.

5. Given below are two premises (Premise 1 and Premise 2). Four conclusions are drawn from them. (A, B, C and D). Taking the premises individually or jointly, check which of the conclusions are drawn validly.

   Premise 1: No educationists are researchers.

   Premise 2: All teachers are researchers.

   Conclusions:

   A. No teacher is researcher.

   B. No teacher is educationist.

   C. Some researchers are teachers.

   D. Some educationists are not researchers.

6. Test the validity of the following sorites.

   Babies are illogical.

   Nobody is despised who can manage a crocodile.

   Illogical persons are despised.

   Therefore, babies cannot manage crocodiles.

   Hint: try rearranging the premises if needed.

Reference

1. Copi, I. M., Cohen, C., & Rodych, V. (2019). *Introduction to logic*. Routledge.
2. Hurley, Patrick J. (2015). *A concise introduction to logic* (12th ed.). Cengage Learning.
3. Sethy, S. S. (2021). *Introduction to logic and logical discourse.* Springer.

Suggested Reading

1. Copi, I. M., Cohen, C., & Rodych, V. (2019). *Introduction to logic*. Routledge.

Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.

BLOCK 2
Problem Solving in Inductive Logic

UNIT 1
Exercises by Applying Mills' Methods of Causation

Learning Outcomes

Upon completion of this unit, the learner will be able to:

- discuss the informal nature of inductive reasoning
- comprehend causal reasoning as a kind of inductive reasoning
- familiarise themselves with the five methods of causal reasoning formulated by John Stuart Mill
- identify the method used in various real-life causal reasonings
- solve problems based on Mill's methods in competitive examinations

Background

Suppose a few people who attended a birthday party suffer from symptoms of food poisoning, while others who were at the same party do not experience any adverse effects. How do we determine the cause of the disturbances? We can compare the food items that were consumed by both groups. If we find that both groups ate the same set of items, except for one particular dish that those who suffered from food poisoning had eaten while the others did not, we might conclude that this particular dish is the cause of the disturbances. Is this reasoning sound? Is this the only way to establish a cause-effect relationship? Causal reasoning, which seeks to establish cause-effect relationships, exemplifies inductive reasoning, which, unlike deductive reasoning, proceeds from specific observations to arrive at general conclusions. John Stuart Mill formulated five different methods that aid in establishing something as the cause or effect of another, among which the method known as the method of difference is exemplified in the aforementioned inference of identifying the cause of illness. Here, aims to familiarise with Mill's methods through examples and exercises.

Keywords

Informal reasoning, Inductive reasoning, Causal reasoning, Mill's methods of causation

Discussion

2.1.1 Inductive Reasoning

- Inductive reasoning proceeds from particular observations to general conclusions

We have seen that deductive reasoning is primarily discussed in terms of valid and invalid ways of arriving at conclusions based on some premises that are known or assumed to be true. We have also noted that the premises of one deductive argument may serve as the conclusion of another deductive argument. However, no matter how far we extend the chain of deductive arguments, there will be some point where we need to start with premises that are not the product of any deductive reasoning. It is inductive reasoning that leads us to such factual statements. Inductive reasoning is the most popular form of informal logic. Induction proceeds from particular observations to general conclusions that are broader in scope than the premises.

For example, the deductive argument "All humans are mortal; Socrates is a human being; Therefore, Socrates is mortal" relies heavily on the major premise "All humans are mortal." But where does this generalisation come from? It is inductive reasoning in the following form that leads us to such a universal statement:

Socrates is a human being, and he is mortal.

Plato is a human being, and he is mortal.

Aristotle is a human being, and he is mortal.

Therefore, all human beings are mortal.

- Conclusions arrived at through inductive reasoning are only probable and not certain

Unlike deductive reasoning, inductive reasoning cannot claim that the conclusion follows logically from the premises with certainty. In an inductive argument, only probability is claimed. The premises support the conclusion but do not entail it logically. It is not that some information implicit in the premises is made explicit with certainty. The conclusion takes a leap from the evidence at hand and attempts to establish a fact that is broader in scope than the evidence. This kind of reasoning makes it only probable that the conclusion is true. Various factors pertaining to the premises, such as their number,

scope, and relevance, give rise to different degrees of probability in warranting the truth of the conclusion. Inductive reasoning is heavily applied in the sciences. The information obtained through experiments conducted on some samples is then attributed to the whole population through inductive reasoning.

One type of inductive reasoning that we are all familiar with is the manner in which we establish that two events are related to each other as cause or effect of one another. John Stuart Mill precisely formulated five different methods through which a causal connection can be established. These methods help us analyse events carefully, identify patterns, and determine whether one event is the cause of another. They are widely used in science, social studies, and everyday life to make sense of observations and reach reliable conclusions.

2.1.2 Causal Reasoning and Mill's Methods

- Causal reasoning establishes cause-effect relationships between events

Causal reasoning is a kind of inductive reasoning in which some effect is inferred from what is assumed to be its cause, or some cause is inferred from what is assumed to be its effect. John Stuart Mill formulated five different techniques, which he called the "canons of induction." Present-day discoveries in the biological, social, and physical sciences are generally grounded in a methodology that incorporates one or another variant among, or a combination of, these five methods. In all these methods, it can be seen that a cause-effect relationship between two events is established in general terms inductively based on a few observations in particular instances.

The five methods are popularly known as Mill's methods and are as follows:

- Method of agreement identifies a common instance

The Method of Agreement: J. S. Mill states that "If two or more instances of the phenomenon under investigation have only one circumstance in common, the circumstance in which alone all the instances agree is the cause (or effect) of the given phenomenon." The method of agreement is thus a pattern of inductive inference through which it is concluded that some circumstance is the cause or effect of a phenomenon when that circumstance is the only common instance of agreement between two or more occurrences of the phenomenon.

For example, if it is observed that all the children who suffered from food poisoning had consumed only one food item in common, then that food item is the cause of the illness.

The method can be represented as:

A B C D occur together with *w x y z*.

A E F G occur together with *w t u v.*

Therefore, *A*is the cause (or effect) of *w*.

Here A, B, C, D, E, F, and G are different phenomena, and w, x, y, z, t, u, and v are different circumstances. It can be seen that the two occurrences of A have only 'w' as the common circumstance.

The Method of Difference: J. S. Mill states that "If an instance in which the phenomenon under investigation occurs and an instance in which it does not occur have every circumstance in common save one, that one occurring only in the former, the circumstance in which alone the two instances differ is the effect, or the cause, or an indispensable part of the cause, of the phenomenon." The method of difference is thus a pattern of inductive inference through which it is concluded that some circumstance is the cause or effect of a phenomenon when that circumstance is the only difference between an instance where the phenomenon occurs and an instance where the phenomenon does not occur.

- Method of difference identifies the differing factor

For example, if it is observed that the children who became ill and the children who did not become ill have all eaten the same food items except one, then that food item, which was consumed by the children who became ill and was not consumed by the children who did not become ill, is the cause of the illness.

The method can be represented as:

A B C D occur together with *w x y z*.

B C D occur together with *x y z.*

Therefore, *A*is the cause (or effect) of *w*.

It can be seen that the presence and absence of A have only 'w' as the differing circumstance.

The Joint Method of Agreement and Difference: This is a pattern of inductive inference in which the method of agreement and the method of difference are used in combination to give the conclusion a higher degree of probability.

- Method of agreement and method of difference are used in joint method

A B C — x y z. A B C — x y z.

A D E — x t w. B C — y z.

Therefore, *A* is the cause (or effect) of *x*.

The first part shows that the two occurrences of A have only 'x' as the common circumstance. The second part shows that the occurrence and non-occurrence of A have only 'x' as the differing circumstance.

- The remaining portion of the phenomenon is the effect of the remaining circumstances

The Method of Residues: J. S. Mill states the method as follows: "Subtract from any phenomenon such part as is known by previous inductions to be the effect of certain antecedents, and the residue of the phenomenon is the effect of the remaining antecedents." The method of residues is thus a pattern of inductive inference in which, when some portions of a given phenomenon are known to be the effects of certain identified circumstances, we conclude that the remaining portion of the phenomenon is the effect of the remaining circumstances.

For example, all characteristics exhibited by the motion of the planet Uranus, which were previously understood to be the effects of certain factors, were eliminated to isolate a perturbation in Uranus's motion that was hypothesised to be caused by the presence of another planet. This led to the discovery of Neptune.

The method can be represented as:

A B C — x y z.

But *B* is already known to be the cause of *y*.

C is already known to be the cause of *z*.

Therefore, *A* is the cause of *x*.

- John Stuart Mill formulated five methods of causal reasoning

The Method of Concomitant Variation: J. S. Mill states that "Whatever phenomenon varies in any manner whenever another phenomenon varies in some particular manner is either a cause or an effect of that phenomenon or is connected with it through some fact of causation." The method of concomitant variation is thus a pattern of inductive inference through which it is concluded that two phenomena are causally related when each of them shows a variation with respect to the other in some manner. For example, the variation in the yield corresponding to the variation in the amount of fertiliser used enables a farmer to conclude that the fertiliser and the product are causally related.

The method can be represented as:

A B C — x y z.

A+ B C — x+ y z.

Therefore, *A* and *x* are causally connected.

It can be seen that a positive variation in A corresponds to a similar variation in x.

2.1.3 Exercises on Mill's Methods of Causation

Identify the method of causation employed in the reasoning expressed by the following reports and explain your answer.

Q1. It was observed that in cities where the rates of dental decay were unusually low, the one circumstance in common was an unusually high level of fluorine in the water supply. Thus, the scientists concluded from this evidence that fluoride causes teeth to be healthy, and the decision was adopted for the fluoridation of water in developed areas around the globe.

Solution: The phenomenon explained here is the low rate of dental decay. The cities are the instances. The report states that one circumstance that the cities had in common was the high level of fluorine in the water supply. According to the method of agreement formulated by J. S. Mill, if there is one circumstance that is the only common instance of agreement between two or more occurrences of a phenomenon, then that circumstance has a causal connection with the phenomenon. Hence, the scientists' conclusion that the presence of fluoride results in a low rate of dental decay or causes healthy teeth is based on Mill's method of agreement.

Q2. Researchers at the University of California at Irvine have theorised that listening to Mozart's piano music significantly improves performance on intelligence tests. Dr. Frances H. Rauscher and her colleagues reported: "We performed an experiment in which students were each given three sets of standard IQ spatial reasoning tasks; each task was preceded by 10 minutes of a) listening to Mozart's Sonata for Two Pianos in D major, K. 488; or b) listening to a relaxation tape; or c) silence. Performance was improved for those tasks immediately following the first condition compared to the second two."

Solution: Solve yourself.

Q3. A cook left one ingredient out of the usual mix while baking a batch of cookies to determine the importance of that ingredient. The cookies turned out dry and crunchy, and the cook then understood the importance of that ingredient in making the cookies soft, moist, and chewy.

Solution: It is given that the cook used all ingredients from her usual mix except for that particular ingredient while baking the

new batch of cookies. This means that the old batch of cookies and the new batch of cookies differ only in that particular ingredient. The cook observed that the new batch of cookies turned out dry and crunchy, indicating that the old cookies were moist, soft, and chewy. Thus, the presence and absence of moist, soft, and chewy qualities are marked respectively by the presence and absence of that particular ingredient. Hence, the method used in this reasoning is the method of difference formulated by J. S. Mill, which states that if a circumstance is the only difference between an instance where the phenomenon occurs and an instance where the phenomenon does not occur, then that circumstance has a causal connection with the phenomenon.

Q4. The gene MIP-1 alpha, present in mice and humans, was suspected of producing the protein that initiates the process of inflammation. Pathologists at the University of North Carolina at Chapel Hill bred mice that lacked the gene MIP-1 alpha and then infected those mice, as well as a control group of normal mice, with viruses known to cause influenza and other diseases. The normal mice developed extreme inflammation as expected, but mice lacking the MIP-1 alpha gene exhibited only slight inflammation. This represents a significant step toward the development of drugs that will allow humans to fight viral infections without painful and damaging inflammation. Thus, the scientists have been able to identify the gene that causes inflammation - swelling, redness, and pain.

Solution: The phenomenon explained is inflammation. The two instances are the normal mice (control group) and the mice that lacked the gene MIP-1 alpha (experimental group). The phenomenon of inflammation developed in the normal mice but not in the experimental group of mice, where the two instances differed only in the presence and absence, respectively, of the circumstance—the gene MIP-1 alpha. Thus, the conclusion that the gene MIP-1 alpha is the cause of inflammation is based on Mill's method of difference, which states that if a circumstance is the only difference between an instance where the phenomenon occurs and an instance where the phenomenon does not occur, then that circumstance has a causal connection with the phenomenon.

Q5. Researchers at two universities separately conducted experiments in 2003 designed to determine how sleep affects our ability to remember. At the University of Chicago, subjects trained to understand murky speech on a voice synthesiser

could regularly understand more words after a night of sleep than matched counterparts who were tested just hours after the training with no intervening sleep. At Harvard Medical School, one hundred subjects were trained to perform certain finger-tapping sequences that they were later asked, at various intervals, to repeat. The process of memory consolidation required one or two nights of sleep—after which the performance of the subjects improved substantially.

Solution: Solve yourself.

Q6. A potential vaccine was tested in a community of Hasidic Jews, Kiryas Joel, in Orange County, New York, a community that was unusual in that it was plagued by yearly epidemics of this infection. Almost no one escaped hepatitis A in Kiryas Joel, and nearly 70 percent of the community members had been infected by the time they were nineteen years old. Dr. Alan Werzberger, of the Kiryas Joel Institute of Medicine, and his colleagues recruited 1,037 children in that community, ages two to sixteen, who had not been exposed to the hepatitis A virus, as determined by a lack of antibodies to the virus in their blood. Half of them (519) received a single dose of the new vaccine, and among those vaccinated children, not a single case of hepatitis A was reported. Of the 518 children who received dummy injections, 25 became infected with hepatitis A soon after. The vaccine for hepatitis A had been found.

Solution: All children who were immune to hepatitis A had only one thing in common—they had all been vaccinated. This means that in all instances where the phenomenon of immunity to hepatitis A is present, the only common circumstance is the vaccine. This calls for the application of Mill's method of agreement. Additionally, the children who were affected by hepatitis A only lacked vaccination compared to the children who were immune to the disease. Mill's method of difference is applicable here. Thus, it is by the joint method of agreement and difference that the causal relation between the vaccine and immunity to hepatitis A has been established as per the report.

Q7. Scientists have long known that severely restricting the number of calories that mice and other organisms consume lengthens their lifespan. Animals on low-calorie diets typically have abnormally cool body temperatures. Does low temperature, in itself, result in longer life? The answer is yes. Bruno Conti, of the Scripps Research Institute in La Jolla, California, genetically engineered mice to have a faulty sense of body temperature. The alteration reduced the animals' temperatures by 0.03 to

0.05°C below normal; they were given as much food as they wanted, maintaining their normal weight. The low-temperature mice lived about 15 percent longer than normal mice did.

Solution: Solve yourself.

Q8. Changes in the sun's output affect global temperatures, but they do not account for the 1.5-degree warming over the last century, two new studies conclude. Scientists from the Climatic Research Unit in Norwich, England, and the University of Illinois at Urbana-Champaign found that variations in the sun's activity help explain some of the changes in the Earth's surface temperature since 1880. However, the sun could not have produced all of the warming, the scientists said. Instead, increased concentrations of greenhouse gases, notably carbon dioxide and methane, are primarily responsible. In the past, global warming sceptics have argued that the sun could account for all of the warming. But the new studies, published last week in the journal Nature, challenge that idea.

Solution: Some part of the phenomenon, i.e. some of the changes in the Earth's surface temperature since 1880, were accounted for by the variations in the sun's activity. However, a 1.5-degree warming in the recent century remained as the part of the phenomenon to be explained. Accordingly, the suggested possible factor, namely the increased concentration of greenhouse gases, was concluded to be the factor that could account for the additional degrees of global warming. This inference exemplifies Mill's method of residues, wherein the portion of the phenomenon left unexplained by previously known circumstances was accounted for by a possible circumstance that remained.

Q9. M. Arago, having suspended a magnetic needle by a silk thread and set it in vibration, observed that it came to a state of rest much sooner when suspended over a plate of copper than when no such plate was beneath it. In both cases, there were two verae causae (antecedents known to exist) that could explain why it should eventually come to rest, namely the resistance of the air, which opposes and ultimately destroys all motions performed in it, and the lack of perfect mobility in the silk thread. However, the effect of these causes was exactly known from the observation made in the absence of the copper; and being thus allowed for and subtracted, a residual phenomenon appeared in the fact that a retarding influence was exerted by the copper itself. This fact, once ascertained, quickly led to the knowledge of an entirely new and unexpected class of relations.

Solution: Solve yourself.

Q10. In attempting to diagnose Mrs. Thompson's high blood pressure, a cardiologist noticed a correlation between fluctuations in blood pressure and certain brain waves. As blood pressure increased, so did the intensity of the brain waves, and as blood pressure decreased, the intensity of the brain waves decreased. The cardiologist concluded that the two conditions were causally related.

Solution: Here, blood pressure and particular brain waves are two phenomena, and each shows a variation with respect to the other in some manner. As the former increased, the latter also increased, and when the former decreased, the latter also decreased. Thus, it is by Mill's method of concomitant variation that the cardiologist concluded that the two conditions are causally related.

Q11. In Finland, heart attacks occur more frequently in the eastern part of the country than in the western and southern parts. Researchers seeking to explain these differences concluded that they "cannot be explained by individual lifestyle or by genetic factors." How, then, can they be explained? A study led by Dr. Anne Kousa of the Geological Survey of Finland examined heart attacks that occurred in 18,946 men, ages 35 to 74, in three different years. The researchers then correlated the incidence of heart attack in these populations with the level of water hardness, as measured by the presence of minerals in the water in their communities. The study found that the degree of water hardness correlated directly with a lowered risk of heart attack. Drinking water rich in minerals appears to play a role in reducing heart disease.

Solution: Solve yourself.

Q12. Stanley Coren sought to explore the connections between sleeplessness and accidents. To do that, he focused on the yearly shift to daylight time in eastern North America, when, because clocks are moved forward one hour, most people lose an hour of sleep. He compared the number of accidents that occurred then with the number on normal days and found that on the day after the time change, there was an 8 percent increase in accidents in Canada. Then, examining the day after the return to standard time, when people gain an hour of sleep, he found a corresponding decrease in accidents.

Solution: Solve yourself.

Summarized Overview

Everyday reasoning encompasses not only formal or deductive reasoning but also the inferences in which the content of the statements is focused more than the structure. Inductive reasoning arrives at conclusions that are not entirely implicit in the premises but are wider in scope, thus leading to new facts. Causal reasoning is a kind of inductive reasoning through which the cause-effect relationship between two events is established in general terms based on observations in a few instances. John Stuart Mill formulated five different methods through which causal reasoning can be carried out: the method of agreement, the method of difference, the method of joint agreement, the method of residues, and the method of concomitant variation. Present-day discoveries in the biological, social, and physical sciences are generally grounded in a methodology that incorporates one or another variant among or a combination of these five methods. This unit aimed to provide the learner with sufficient practice to strengthen their knowledge of Mill's methods and their applications.

Self-Assessment

1. Five people eat dinner in a restaurant. Jack has salad, French fries, a hamburger, ice cream, and mixed vegetables; Bob has salad, French fries, soup, ice cream, fish, and mixed vegetables; Mary has a hamburger, soup, and ice cream; Tim has fish, mixed vegetables, ice cream, salad, and soup; and Gail has mixed vegetables, fish, ice cream, French fries, and salad. Afterwards, all of them became sick from something they ate. What food caused the sickness? How do you arrive at the conclusion?

2. A pair of twins, Jane and Jan, have dinner in a restaurant. The twins have identical susceptibilities to food poisoning. Jane orders soup, salad, chicken, carrots, rice, and ice cream. Jan orders soup, salad, chicken, carrots, rice, and no ice cream. Later, Jane gets sick from something she ate, but Jan does not. What food caused Jane's sickness? How do you arrive at the conclusion?

3. An eighth-grade teacher had five pupils who read very well. These pupils were distinguished by the following features. Tom came from a large family, had professional parents who were not wealthy, had training in phonics, read novels, lived close to a library, and watched educational TV. Andy came from a family that was not large, had wealthy professional parents, watched educational TV, did not live close to a library, did not read novels, and had training in phonics. Cindy did not read novels, lived close to a library, had training in phonics, had wealthy professional parents, came from a large family, and did not watch educational TV. April had training in phonics, read novels, lived close to a library, watched educational TV, came from a large family, and had wealthy parents who were not

professionals. Joe read novels, did not live close to a library, had professional parents who were not wealthy, had training in phonics, watched educational TV, and came from a large family. What can the teacher conclude as the cause that affected the children's reading ability? Explain your answer.

4. Which of Mill's methods of causation is applied to arrive at the conclusion in the following reports? Explain your answer.

   a. To determine the effectiveness of an oil additive, a testing firm purchased two cars of the same make, year, and model, and drove each a distance of 30,000 miles using the same kind of gasoline, the same kind of oil, the same driver, under the same road conditions. The oil in one engine included the additive, whereas the oil in the other engine did not. At the end of the test, the engines of both cars were dismantled, and it was found that the engine that contained the additive had less wear. The testing firm concluded that the oil additive caused the reduced wear.

   b. Whenever the U.S. makes statements that make a military conflict with Iran seem more likely, the price of oil rises, strengthening Iran's regime rather than weakening it. The more we talk about curbing Iranian power, the more difficult it becomes. Thus, cooling down the martial rhetoric, even if we plan to take military action eventually, would likely bring oil prices down, making Iran weaker. Lower oil prices will not, by themselves, topple the mullahs in Iran. However, it is significant that, historically, when oil prices have been low, Iranian reformers have been ascendant and radicals relatively subdued, and vice versa when prices have been high. Talking tough may appear to be a good way of demonstrating U.S. resolve, but when tough talk makes our opponent richer and stronger, we may accomplish more by saying less.

   c. Eighteen healthy men were placed on a low-cholesterol, mixed natural diet. The men were randomly divided into two groups, one of which received twenty percent of its calories in the form of walnuts. After four weeks, researchers found that "With the walnut diet, the mean [average] total cholesterol level was 22.4 mg per decilitre… lower than the mean level with the reference [non-walnut] diet."

Assignments

1. Six people eat dinner in a restaurant. Liz has soup, a hamburger, ice cream, French fries, and mixed vegetables. Tom has salad, soup, fish, mixed vegetables, and ice cream. Andy has salad, a hamburger, French fries, and ice cream. Sue has French fries, a hamburger, and salad. Meg has fish and mixed vegetables. Bill has French fries, a hamburger, and soup. Later, Liz, Tom, and Andy get sick from something they ate, but Sue, Meg, and Bill do not. What food made the first three diners sick? Explain.

2. Explain how Mill's method of difference is applied in the following investigation.

   Dr. Derek Denton, of the University of Melbourne, selected a group of normal chimpanzees, a species biologically very close to humans, in which to conduct the needed trials. A group of chimpanzees in Gabon, with normal blood pressure, were first studied in their natural state. The group was then divided in half, with one half receiving gradually increasing amounts of salt in their diet for twenty months. Normal blood pressure in a chimpanzee is 110/70. In Dr. Denton's experiment, the animals' blood pressure commonly rose as high as 150/90, and in some individuals, much higher. However, among animals in the control group, who received no additional salt, blood pressure did not rise. Six months after the extra salt was withdrawn from their diet, all the chimpanzees in the experimental group had the same low blood pressure they had enjoyed before the experiment. Because there was no other change in the lifestyle of those animals, the investigators concluded that changes in salt consumption caused the changes in blood pressure.

3. Which among Mill's methods of causation is applied to arrive at the conclusion in the following reports? Explain your answer.

   a. A discovery reported in Science in 2007 was that in a small number of persons who had suffered an injury to a particular region of their brains called the insula, the desire to smoke was immediately lost! When statistical analyses of the data were completed, said a lead investigator from the University of Southern California, "it turned out that the likelihood of quitting smoking with ease after insula damage was 136 times higher than for damage anywhere else in the brain." Accordingly, addiction researchers searched for some way to deactivate the insula.

   b. To determine the role of specific genes, mice are bred in which certain genes have been deleted. Such mice are called "knockout mice." When normal mice are placed in a lighted room with dark corners, they go immediately to the dark. In one recent experiment, the mice, upon entering the dark, encounter a mild electric shock and very quickly learn to stay away from those dark regions. Mice who lack a gene called Ras-GRF

learn to be wary just as quickly as do normal mice. But, unlike normal mice, the knockout mice throw caution to the winds the next day and chance the dark corners again and again. It appears that the Ras-GRF gene - probably very much like the analogous gene in humans - plays a critical role in the ability of the mice to remember fear. This gene is almost certainly crucial for the survival of mammals.

c. Potassium in the urine is known to reflect potassium intake from the diet. At the Prosserman Centre for Health Research in Toronto, Dr. Andrew Mente and colleagues analysed urinary potassium as a useful clinical marker of a healthy diet. They collected urine samples from hundreds of patients and separately calculated the quality of their diets. The results were striking: as urinary potassium increased, there was a steady and significant increase in diet quality score, as well as a steady decrease in body mass, blood pressure, and heart rate. "This urinary marker," said Dr. Mente, "is a simple, objective, universally available measure of diet quality."

d. It was thought that among celestial bodies only the sun exerts gravitational force on objects around it. The sun's presence, for sure, accounted for a good part of the observed orbits of the planets, but it could not account for all of those orbits. There was a residual phenomenon to be explained. But what else could explain it? The only bodies left were the planets. This fact led the astronomers to conclude that the planets themselves, including the Earth, exerted gravitational force on each other. When these additional forces were considered and measured, the planetary orbits were completely accounted for.

Reference

1. Copi, I. M., Cohen, C., & Rodych, V. (2019). *Introduction to Logic*. Routledge.
2. Sethy, S. S. (2021). *Introduction to Logic and Logical Discourse.*Springer.

Suggested Reading

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Space for Learner Engagement for Objective Questions

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UNIT 2
Identifying Fallacies of Relevance and Weak Induction

Learning Outcomes

Upon completion of this unit, the learner will be able to:

- differentiate informal and formal fallacies
- familiarise with the fallacies of relevance and fallacies of weak induction
- construct arguments that are not grounded on irrelevant and/or inadequate premises
- identify fallacious arguments in everyday discourse
- solve problems pertaining to informal fallacies in various competitive examinations

Background

Many a time, we conclude that something is the case or not merely because the majority of the people we know believe in the same way. But does this appeal to the multitude provide rational warrant for what we try to prove? Does it not seem that the premise "this is a statement believed by the majority I know" is irrelevant to any sort of conclusion? Now consider another case. An argument in support of the belief that there is an entity called God is grounded on the premise that it has not yet been proved that there is no God. Does it seem rational to conclude something as true merely because its falsity has not been proved yet? Even though the failure to prove its falsity does give some relevant support to accept its truth, it is not at all adequate evidence. However, these arguments cannot be understood using the syllogistic rules and fallacies that are formal in nature. This unit and the next unit introduce the informal fallacies that pertain to the content expressed in the statements and not to their structure. All arguments in which the premises are irrelevant or inadequate to the conclusion commit informal fallacies. The various kinds of informal fallacies are classified into four groups, among which two are discussed in this unit. It is expected that the learner becomes familiar with the identification of fallacies of relevance and fallacies of weak induction through examples and exercises.

Keywords

Informal fallacies, Fallacies of relevance, Fallacies of weak induction

Discussion

2.2.1 Informal Fallacies

- Informal fallacies occur when the premises are irrelevant or inadequate

In the second unit of the previous block, we discussed the fallacies that arise when the rules related to the valid form of a syllogism are violated. Such fallacies are called formal fallacies because they pertain to the form or structure of the statements in an argument. In this unit, we turn to another group of fallacies that are more common in everyday discourse, known as informal fallacies. Unlike formal fallacies, they do not occur due to a deviation in logical form but because the content of the premises is in some way irrelevant or inadequate to support the conclusion. Informal fallacies are generally classified into four groups: (1) fallacies of relevance, which occur when the premises present content that is unrelated to the conclusion, (2) fallacies of weak induction, which occur when the premises are relevant but insufficient, (3) fallacies of presumption, which occur when the premises rely on unjustified assumptions that are treated as the main ground for the conclusion, and (4) fallacies of ambiguity, which occur when the premises use ambiguous language that is then relied upon to reach the conclusion.

2.2.2 Fallacies of Relevance

- Fallacies of relevance occur when the premises are irrelevant to the conclusion

Fallacies of relevance occur when the premises of the argument are irrelevant to the conclusion. They are the ones we most frequently encounter in our everyday discourse. The following are the different kinds of fallacies of relevance.

- Argument based on popular belief

1. **The Appeal to the Populace (also known as argument *ad populum*):** It is an informal fallacy wherein the support offered for some conclusion is an appeal to popular belief. For example: "Why do you think that Mr. X has committed the crime?" "Because many people believe so."

- Argument based on emotions

2. **The Appeal to Emotion:** It is an informal fallacy wherein the argument relies on emotions such as mercy, envy, fear, hatred, etc., rather than reason. For example:

"Why do you think that we should hire him?" "Because he is the only earning member in his family, and if he does not get this job, the whole family will suffer due to poverty." This is an example of the appeal to pity (*ad misericordiam*). Other kinds include the appeal to envy (*ad invidiam*), the appeal to fear (*ad metum*), the appeal to hatred (*ad odium*), and the appeal to pride (*ad superbium*).

3. **The Red Herring:** It is an informal fallacy wherein the attention of the listener or reader is deliberately distracted to some aspect of the discussed topic that is not actually the issue in question. For example: "Global warming is becoming a serious concern. We need to focus on sustainable development and build eco-friendly industries, even if it demands a bit more expenditure from our side." "But this government did not increase our pay scale as it promised before the election. Do you think that is fair?"

- Irrelevant or misleading argument is introduced to distract

4. **The Straw Man:** It is an informal fallacy wherein the position of one's opponent is misrepresented, and that distorted position is made the object of attack. A successful attack on the distorted position would then be claimed as a successful attack on the original one. This fallacy got its name because it is easier to attack a man made of straw than a man made of flesh and blood. It is as if the straw man is attacked and defeated, and the claim is made that the original man has been defeated. For example: Suppose one says, "I think it is good to practice vegetarianism." The opponent distorts the statement to "Those who eat non-vegetarian food are bad people" and then attacks the distorted version.

- Misrepresentation of argument to make it easier to attack

5. **The Attack on the Person (*argumentum ad Hominem*):** It is an informal fallacy wherein the attack is made on the person who puts forward an argument rather than on the content of the argument itself. The attack can be personal abuse in some manner or a consequence of the person's circumstances. For example: Suppose an atheist argues against the existence of God. A believer in God might be tempted to refute the arguments of the atheist by pointing out that the latter is an atheist rather than attempting to address the arguments on their merits. A special case of *ad hominem* occurs when one refutes the objections raised against his conduct or actions

- An individual's argument is dismissed by attacking their character, motive, or other attributes

by saying that the opponent who raised the objections also behaves in the same way. This is called the *tu quoque* fallacy.

6. **The Appeal to Force (*argumentum ad Baculum*):** It is an informal fallacy wherein some threat of force, in open or veiled form, is relied upon to gain approval. For example: A news agency might retract the news published by them regarding some allegation against a politician or even label the allegation as false, not because they obtained some rational evidence but because they were threatened by the politician. The claim of the news agency that the allegation against the politician is false is grounded in the threat they experienced.

- User threats or coercion instead of valid reasoning to force acceptance of a conclusion

7. **Missing the Point (*Ignoratio elenchi*):** It is an informal fallacy wherein one misunderstands the opponent's thesis as something else and arrives at a conclusion based on the mistaken thesis instead of the thesis that the opponent stated. It need not be deliberate. This fallacy is also called an irrelevant conclusion, as the conclusion derived does not logically follow from the original premise. For example: Suppose someone says, "The selfishness and envy among students created by competitive examinations need to be overcome." Deriving the conclusion that "the practice of conducting competitive examinations should be renounced" is an instance of the aforementioned fallacy.

- The premiser support a valid conclusion, but the arguer draws irrelevant conclusion

2.2.3 Problems on Fallacies of Relevance

Identify the fallacy of relevance in the following arguments and explain your answer:

a. Most people believe that Ford is superior to Chevy. Therefore, Ford is superior to Chevy.

Solution: This argument commits the fallacy of relevance known as the appeal to populace. Here, the conclusion that Ford is superior to Chevy is based on the evidence that most people believe so. An appeal to the multitude is made the premise of the argument.

b. The position open in the accounting department should be given to Frank Thompson. Frank has six hungry children to feed, and his wife desperately needs an operation to save her eyesight.

Solution: This argument commits the fallacy of relevance known as the appeal to pity, which is a variety of the appeal to emotion. Here, the conclusion that the job should be given to Frank Thompson relies on evoking the feeling of pity by stating that the person and his family are in desperate need of money due to various problems.

c. Johnny, of course I deserve the use of your bicycle for the afternoon. After all, I am sure you would not want your mother to find out what you did yesterday in school.

Solution: This argument commits the fallacy of relevance known as the appeal to force. Here, for the acceptance of the conclusion that the speaker deserves the use of Johnny's bicycle, a sense of threat is relied upon.

d. Something is seriously wrong with high school education these days. After ten years of decline, SAT scores are still extremely low, and high school graduates are practically incapable of reading and writing. The obvious conclusion is that we should close the schools.

Solution: This argument commits the fallacy of relevance known as missing the point. Here, the conclusion that the schools should be closed is irrelevant with respect to the evidence that the SAT scores of high school graduates are low. The inference is a result of a misunderstanding of the premise.

e. Senator Barrow advocates increased Social Security benefits for the poor. It is regrettable that the senator finds it necessary to advocate socialism. Socialism defeats initiatives, takes away promised rewards, and leads directly to inefficiency and big government. It was tried for years in Eastern Europe, and it failed miserably. Therefore, socialism is not good.

Solution: This argument commits the fallacy of relevance known as the straw man. Here, the senator's argument for increased social security benefits for the poor is distorted and misrepresented as an advocacy for socialism. Then, this distorted version, i.e. the argument for socialism, is attacked and judged as nonsense by raising objections.

2.2.4 Fallacies of Weak Induction

- Fallacies of weak induction occur when the premises are relevant but insufficient to support the conclusion

Fallacies of weak induction or defective induction occur when the premises may be relevant to the conclusion but are not adequate or sufficient. The premises are too weak or ineffective to warrant the conclusion. The different varieties in this group are as follows.

- A claim is true because it has not yet been proven false; false because it has not yet been proven true

1. **The Argument from Ignorance (*Argumentum ad Ignorantiam*):** It is an informal fallacy wherein a proposition is held to be true just because it has not yet been proven false, or false because it has not yet been proven true. For example: "God does not exist because it has not yet been proved that God exists," or "God exists because it has not yet been proved that God does not exist."

- Someone appeals to the testimony of an authority in a field other than their expertise to validate a point

2. **The Appeal to Inappropriate Authority (*Argumentum ad Verecundiam*):** It is an informal fallacy wherein a proposition is held to be true based on the words of some authority who has no expertise on the topic of discussion. This fallacy can also occur when an appeal to authority is relied upon in cases where the topic of discussion is such that no authority has reliable expertise in it. For example: An argument can be set up to conclude that a certain herb is good for the skin based on the words of a celebrity actor.

- Something is mistakenly accepted as the cause of an event

3. **False Cause (*Argumentum non causa pro causa*):** It is an informal fallacy wherein something is mistakenly accepted as the cause of an event. One of its varieties is the attribution of a cause-effect relationship to two events merely because one of them always follows the other closely in time. This is known as the fallacy of *post hoc ergo propter hoc*, meaning "after this, therefore because of this." For example, "Whenever my heartbeat increases, something bad happens to a member of my family." Another variety is the attribution of a cause-effect relationship to two events merely because they both always occur together. This fallacy is called *cum hoc ergo propter hoc*, meaning "with this, therefore because of this." Slippery slope is also considered one form of the false cause fallacy. It occurs when a shift to a particular direction is depicted as necessarily leading to a disastrous extreme in that direction, which actually is a rare possibility.

- Based on few cases, a large-scale generalisation is made about

4. **Hasty Generalisation:** It is an informal fallacy wherein, based on one case or very few cases, a large-scale generalisation is made about most or all cases. It is a generalisation that is done in haste. For example: "I have had bitter experiences with my maths teachers. Hence, I am sure that all teachers who teach mathematics are rude."

2.2.5 Problems on Fallacies of Weak Induction

Identify the fallacy of relevance committed by the following arguments and explain your answer.

a. According to some newspapers, the crime rate in New York has slightly increased in the recent past. New Yorkers are nothing but a bunch of criminals.

Solution: This argument commits the fallacy of weak induction named hasty generalisation. The conclusion that all people in New York are criminals is arrived at on the basis of only a few instances, i.e. the reports given by only some newspapers. It is an unwarranted and sweeping generalisation made in haste.

b. Lester Brown, a universally respected author of the yearly State of the World report, has said that the destruction of tropical rainforests is one of the ten most serious worldwide problems. Thus, it must be the case that this is indeed a very serious problem.

Solution: This argument commits the fallacy of weak induction named the appeal to inappropriate authority. The universally accepted author Lester Brown is not necessarily an expert qualified to speak authentically about phenomena such as deforestation. Therefore, his words cannot be solely relied upon to conclude that the destruction of tropical rainforests is indeed a serious problem.

c. Nobody has proved that UFOs do not exist. So, there is good reason to believe that they do.

Solution: This argument commits the fallacy of weak induction named the argument from ignorance. The conclusion that UFOs exist is based solely on the absence of evidence for the non-existence of UFOs. Such evidence is weak and ineffective.

d. There are more laws on the books today than ever before, and more crimes are being committed than ever before. Therefore, to reduce crime, we must eliminate the laws.

Solution: This argument commits the fallacy of weak induction named false cause. The increase in the number of crimes cannot be considered an effect caused by the increase in the number of laws on the books. Here, something that is not warranted as a cause is declared as the cause in order to arrive at a conclusion.

e. The secretaries have asked us to provide lounge areas where they can spend their coffee breaks. This request will have to be refused. If we give them lounge areas, next they will be asking for spas and swimming pools. Then it will be racquetball courts, tennis courts, and fitness centres. Expenditures for these facilities will drive us into bankruptcy.

Solution: This argument commits the fallacy of weak induction named slippery slope, which can be considered a variety of false cause. The provision of lounges may or may not lead to further requests for spas, swimming pools, etc. When a chain of events is assumed, in which each link is less certain to cause the subsequent link, the fallacy committed is called slippery slope.

Exercises

Identify the informal fallacy committed by the following arguments and explain your answer.

Q1. Friedrich Nietzsche's philosophy is not worth the paper it is printed on. Nietzsche was an immoral reprobate who went completely insane from syphilis before he died.

Q2. Practically everybody believes in life after death. Therefore, you should believe in life after death, too.

Q3. Abuse of the welfare system is rampant nowadays. Our only alternative is to abolish the system altogether.

Q4. Television entertainer Bill Maher argues that religion is just a lot of foolish nonsense. But Maher is an arrogant, shameless, self-righteous pig. Obviously, his arguments are not worth listening to.

Q5. Surely you welcome the opportunity to join our protective organisation. Think of all the money you will lose from broken windows, overturned trucks, and damaged merchandise if you do not join.

Q6. The *Daily News* carried an article this morning about three local teenagers who were arrested on charges of drug possession. Teenagers these days are nothing but a bunch of junkies.

Q7. There must be a God. Belief in God has been a feature of every society at every time in human history. How could all of those people be wrong?

Q8. Secretary of State John Kerry argues that Israel should hold the line on new settlements in Palestine. But Kerry is not Jewish, and he has never had any great affection for Israel. Thus, his arguments are worthless.

Q9. The quality of education in our grade schools and high schools has been declining for years. Clearly, our teachers just are not doing their jobs these days.

Q10. Mr. Goldberg has argued against prayer in public schools. Obviously, Mr. Goldberg advocates atheism. But atheism is what they used to have in Russia. Atheism leads to the suppression of all religions and the replacement of God by an omnipotent state. Is that what we want for this country? I hardly think so. Clearly, Mr. Goldberg's argument is nonsense.

Q11. Probably no life exists on Venus. Teams of scientists have conducted exhaustive studies of the planet's surface and atmosphere, and no living organisms have been found.

Q12. In his History of the American Civil War, Jeffry Noland argues that the war had little to do with slavery. However, as a historian from Alabama, Noland could not possibly present an accurate account. Therefore, his arguments should be discounted.

Q13. Your Honour, I admit that this person declared thirteen children as dependents on his tax return, even though he has only two. But if you convict him of tax evasion, his reputation will be ruined. He will probably lose his job, and his poor wife will not be able to have the operation that she desperately needs, and his kids will starve. Thus, this person should be acquitted.

Q14. Crimes of theft and robbery have been increasing at an alarming rate lately. The conclusion is obvious: We must reinstate the death penalty immediately.

Q15. Professor Conway complains of inadequate parking on our campus. But did you know that last year Conway carried on a love affair with a member of the English Department? The two used to meet every day in the library. Apparently, they did not realise how others watch them. Enough said about Conway.

Summarized Overview

Informal fallacies occur either as conscious sophisms or as overlooked errors. They do not occur when an argument deviates from a prescribed form but when the content in the premises is irrelevant or inadequate to the proposed conclusion. Informal fallacies are generally classified into four categories: fallacies of relevance, fallacies of weak induction, fallacies of presumption, and fallacies of ambiguity. We often fail to recognise that the premises in our argument are irrelevant to the conclusion. The appeal to the populace, the attack against the person, the appeal to emotion, etc., are a few fallacies of relevance commonly observed in our everyday discourse. However, mere relevance is not sufficient. The premises should be adequate too. The various fallacies of weak induction, including the argument from ignorance, the appeal to inappropriate authority, false cause, and hasty generalisation discussed in this unit, appear with high frequency in our daily conversations. We need to try our best to eliminate such fallacious forms of inference.

Self-Assessment

1. Which of the informal fallacies is characterised by the introduction of a distracting element to obscure an opponent's position?

2. Which among the following fallacies involves defective induction?
   a. Appeal to emotion
   b. Irrelevant conclusion
   c. Appeal to populace
   d. False cause

3. Identify the informal fallacy committed by the following arguments and explain your answer.
   a. The Dalai Lama argues that China has no business in Tibet and that the West should do something about it. But the Dalai Lama just wants the Chinese to leave so he can return as leader. Naturally, he argues this way. Therefore, we should reject his arguments.
   b. You should read Irving Stone's latest novel right away. It's sold over a million copies, and practically everyone in the Manhattan cocktail circuit is talking about it.
   c. I have yet to hear a convincing argument that black holes exist, so I am going to remain sceptical of their existence.

d. My lawyer did almost no work on my case and ended up charging me a huge sum of money for the "effort". Lawyers are crooks, I tell you.

e. There are more churches in New York City than in any other city in the nation, and more crimes are committed in New York City than anywhere else. So, if we are to eliminate crime, we must abolish the churches.

Assignments

1. Which is the informal fallacy committed when a proposition is held to be true just because it has not been proven false, or false just because it has not been proven true?
2. Which among the following is not a fallacy of relevance?
   a. Ad hominem
   b. Missing the point
   c. Argument from ignorance
   d. Ad misericordiam
3. Identify and explain the informal fallacy committed by the following arguments.
   a. The President continues to have confidence in the Attorney General. I have confidence in the Attorney General, and you ought to have confidence in the Attorney General because we work for the President, and that is the way things are. If anyone has a different view or any different motive, ambition, or intention, he can tell me about it because we will need to discuss your status.
   b. President Barack Obama argues that we should avoid eating junk food. But look at what he eats: greasy cheeseburgers, chilli dogs, French fries, hot dogs, fried cheese puffs, sugary sodas, hot fudge sundaes, cheese steaks, and snow cones. Clearly, Obama's arguments about food are not worth listening to.
   c. I have had two female bosses in my lifetime, and both of them have been incompetent. Women should stay out of management positions.
   d. People have been trying for centuries to disprove the claims of astrology, and no one has ever succeeded. Therefore, we must conclude that the claims of astrology are true.
   e. During the past two months, every time the cheerleaders have worn blue ribbons in their hair, the basketball team has been defeated. Therefore, to prevent defeats in the future, the cheerleaders should get rid of those blue ribbons.

Reference

1. Copi, I. M., Cohen, C., & Rodych, V. (2019). *Introduction to Logic*. Routledge.
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UNIT 3
Identifying Fallacies of Presumption and Ambiguity

Learning Outcomes

Upon completion of this unit, the learner will be able to:

- differentiate various informal fallacies
- familiarise with the fallacies of presumption and fallacies of ambiguity
- construct arguments without presumptions and ambiguities
- identify fallacious arguments in everyday discourse
- solve problems pertaining to informal fallacies in various competitive examinations

Background

Consider the following argument: God exists because the scriptures say so, and the scriptures are trustworthy as they are the words of God. The premise and the conclusion seek support from each other. This argument commits the informal fallacy known as circular argument or begging the question. Arguments of this kind are grouped under fallacies of presumption because the premises presume some unjustified information that is then relied upon to arrive at the conclusion. Now imagine somebody who hears the Upanishadic verse that "I am Brahman, the Supreme Reality" and behaves as if he is the Supreme Power behind everything. However, upon careful study, it will be understood that the word "I" in the verse does not refer to the ordinary physical identity of a person but to his inner true self. The person mistakes the meaning or scope of the word "I." When he bases his conclusion that he is God on the Upanishadic verse, he commits the fallacy of equivocation, wherein the same word is used in one sense in the premise and in a different sense in the conclusion. Fallacies like this occur due to the ambiguous usage of language.

Keywords

Informal fallacies, Fallacies of presumption, Fallacies of ambiguity

Discussion

2.3.1 Fallacies of Presumption

- Fallacies of presumption occur when the conclusion is derived through unjustified assumptions

A fallacy of presumption occurs when the conclusion is derived through unjustified assumptions in the premises, which can be deliberate or an oversight. The premises may be relevant, but that relevance follows from some unwarranted assumption. There are different kinds of fallacies of presumption.

- Generalisation is mistakenly applied to a particular case

1. **Accident:** It is an informal fallacy in which a generalisation is mistakenly applied to a particular case to which the generalisation does not actually apply. Some accidental circumstances can prevent a case from being considered an instance of a general form. A fallacy occurs when the universal application of the generalisation to all cases is unjustifiably assumed. For example: "Anybody who kills a human being should be punished. Soldiers kill human beings. Therefore, they should be punished."

- Here, a question is posed that contains an unproven or unjustified assumption, forcing a simple yes or no answer to commit to a prior point

2. **Complex Question (*Plurium Interrogationum*):** It is an informal fallacy in which a question is asked in such a way that some presupposed truth is buried in the question. For example: "Have you stopped telling lies?" Whatever the answer to this question, it can be concluded that the person has been a liar.

- In this fallacy, the conclusion of the argument is already assumed in the premise

3. **Begging the Question (*Petitio Principii*):** It is an informal fallacy in which the conclusion of the argument is already assumed in the premise. The premise is not self-evident; it needs the support of the conclusion. This fallacy is also called a circular argument as the premise depends on the conclusion, and the conclusion depends on the premise. For example: "God exists because the scriptures say so, and we know that the scriptures are trustworthy as they are the words of God."

4. **False Dichotomy:** It is an informal fallacy committed when a disjunctive (either . . . or . . .) premise presents two unlikely alternatives as if they were the only ones

- Here, an issue is presented as having only two mutually exclusive option, when in reality, more choices exist

available. The arguer then eliminates the undesirable alternative, leaving the desirable one as the conclusion. For example: "Either we adopt a one-world government, or regional wars will continue forever. We certainly cannot tolerate constant war. Therefore, we must adopt a one-world government." Adopting a one-world government and facing regional wars are not exhaustive choices. The fallacy results from presenting the choices with the unjustified presumption that they are exhaustive.

2.3.2 Problems on fallacies of presumption

Identify the fallacy of presumption committed by the following arguments and explain your answer.

a. The maths teacher said that there should be no talking during the test. So, it is fair that Chandni had points deducted for asking to go to the sickroom as she felt sick.

Solution: This argument commits the fallacy of presumption known as accident. It relies on the unjustified assumption that asking to go to the sickroom also falls under the sense in which the term 'talking' is used. However, asking to go to the sickroom is a case with special circumstances that needs to be dealt with specifically.

b. People who lack humility have no sense of beauty because everyone who has a sense of beauty also has humility.

Solution: This argument commits the fallacy of presumption known as begging the question or circular argument. The conclusion associates the lack of humility with the lack of a sense of beauty. The reason given for this is that the sense of beauty is always associated with humility. Clearly, what the premise expresses is not different from the conclusion. Thus, the premise presumes the conclusion within it. The premise and the conclusion depend on each other.

c. Have you stopped cheating on exams?

Solution: This question is an example of the fallacy of presumption known as complex question. Here, it is presumed that the person to whom the question is directed has been cheating on exams. Whether the person answers yes or no, it can thus be concluded that the practice of cheating was present until that moment. The question is loaded.

d. Either we have prayer in our public schools, or the moral fabric of society will disintegrate. The choice should be obvious.

Solution: This argument commits the fallacy of presumption known as false dichotomy. Conducting prayers in public schools and the disintegration of the moral fabric of society are not exhaustive alternatives. The lack of one does not imply the other. Thus, offering a closed choice between them relies on a presumed dichotomy that is false.

e. Anyone who preaches revolution has a vision of the future for the simple reason that if a person has no vision of the future, he could not possibly preach revolution.

Solution: This argument also commits the fallacy of presumption known as begging the question or circular argument. The conclusion associates preaching revolution with a vision of the future. However, the reason given for this is that without a vision of the future, it is impossible to preach revolution. This is synonymous with what is stated in the conclusion, meaning the premise presumes the conclusion within it. The premise and the conclusion depend on each other.

2.3.3 Fallacies of Ambiguity

- Fallacies of ambiguity occur when words or phrases are used with unclear meanings

Fallacies of ambiguity occur due to a shift or confusion in the meaning of words or phrases within an argument. Equivocal use of words, ambiguous grammatical construction of phrases, confusing emphasis, etc., cause fallacious arguments. The following are its different kinds.

- Two or more meanings of a word are used either deliberately or accidentally

1. **Equivocation:** It is an informal fallacy in which two or more meanings of a word are used, either deliberately or accidentally, in different parts of an argument. The word might have one meaning in the premise and another in the conclusion, which clearly affects the soundness of the argument. For example: "The Upanishads say that I am Brahman. So, I am the Supreme Reality behind everything." Equivocation can also occur when terms with relative connotations are used, overlooking their relative nature. For example: The fact that a cat is an animal does not warrant that a large cat is a large animal because the word 'large' takes on different senses with respect to a cat and the group of animals.

2. **Amphiboly:** It is an informal fallacy in which a loose or awkward combination of words results in multiple

- A loose or awkward combination of words results in multiple interpretations

interpretations. The premise expresses one meaning of the phrase, while the conclusion relies on another meaning. For example, the statement "The police officer said that the thief shot the man with the revolver" can be interpreted in at least two ways: either that the thief used a revolver to shoot the man or that the thief shot a man who had a revolver.

- When the meaning of a statement is changed by emphasizing specific words

3. **Accent:** It is an informal fallacy in which the premise contains a possible emphasis on certain words, whereas the conclusion relies on another possible emphasis that gives the words a different meaning. For example: The sentence "We should not speak ill of our friends" can be interpreted in different ways depending on the emphasis placed on different words. With an emphasis on "we", it can be concluded that only a small group of people denoted by the word "we" should not speak ill of their friends, whereas others may do so.

- Certain properties are attributed to a whole because the parts of the whole possess those properties

4. **Composition:** It is an informal fallacy in which certain properties are attributed to a whole because the parts of the whole possess those properties. For example: "All the parts of the machine are light. Therefore, the machine is light." However, there are additive properties, like mass, which can be validly attributed from parts to the whole. It is sound to say that since atoms have mass, whatever is composed of atoms also has mass. The fallacy of composition occurs when certain properties are attributed to a collection because each of the members of the collection possesses those properties. For example: A single bus uses more gasoline than a single automobile. However, it cannot be said that all buses (referring to the collection of all buses) use more gasoline than all automobiles (referring to the collection of all automobiles) because the latter is greater in number than the former. The problem lies in mistaking each among the collective and distributive usages of a term for the other.

- Certain properties are attributed to the parts of a whole because the whole possesses those properties

5. **Division:** It is an informal fallacy in which certain properties are attributed to the parts of a whole because the whole possesses those properties. For example: "The machine is heavy. Therefore, each part of the machine is heavy." Like the fallacy of composition, this fallacy can also occur when some property of a collection is consequently attributed to each of the members of the

collection. For example: Automobiles (referring to the collection of all automobiles) use more gasoline than buses (referring to the collection of all buses) because the latter is greater in number than the former. However, from this, we cannot conclude that a single automobile uses more gasoline than a single bus. The problem lies in mistaking each among the collective and distributive usages of a term for the other.

2.3.4 Problems on Fallacies of Ambiguity

Identify the fallacy of relevance committed by the following arguments and explain your answer.

a. A ship is heavy. Therefore, all parts of the ship are heavy.

Solution: This argument commits the fallacy of ambiguity named division. It mistakenly attributes to the parts of a whole those properties which the whole itself possesses.

b. A line is composed of points. Points have no length. Therefore, a line has no length.

Solution: This argument commits the fallacy of ambiguity named composition. It mistakenly attributes to the whole those properties which the parts of the whole possess.

c. John told Henry that he had made a mistake. It follows that John has at least the courage to admit his own mistakes.

Solution: This argument commits the fallacy of ambiguity named amphiboly. The premise is structured ambiguously, allowing for two possible interpretations. It can mean either that John told Henry that John had made a mistake or that John told Henry that Henry had made a mistake. The conclusion is reached based on one of those interpretations.

d. Any law can be repealed by the legislative authority. But the law of gravity is a law. Therefore, the law of gravity can be repealed by the legislative authority.

Solution: This argument commits the fallacy of ambiguity named equivocation. The word 'law' in the first statement stands for all statutory laws. However, in the second statement, the word 'law' refers to natural law. The word is thus used in multiple senses in the argument, and a conclusion is derived accordingly.

e. An atomic bomb causes more damage than a conventional bomb. Therefore, during World War II, more damage was caused by atomic bombs than by conventional bombs.

Solution: This argument also commits the fallacy of ambiguity named composition. It attributes to the collection of certain things those properties which a particular member of the collection possesses. It is true that a single atomic bomb causes more damage than a single conventional bomb. However, in World War II, the number of conventional bombs used was much higher than that of the atomic bomb, and thus the collective damage caused by all the conventional bombs was higher than that caused by all the atomic bombs.

2.3.5 Exercises

Identify the informal fallacy committed by the following arguments and explain your answer.

Q1. An athlete is a human being. Therefore, a good athlete is a good human being.

Q2. You are a bad journalist because you are a bad woman.

Q3. Freedom of speech is a constitutionally guaranteed right. Therefore, John Q. Radical should not be arrested for his speech that incited the riot last week.

Q4. People who lack arrogance are intelligent because intelligent people do not have arrogance.

Q5. Sodium and chlorine, the atomic components of salt, are both deadly poisons. Therefore, salt is a deadly poison.

Q6. Why is it so difficult for you to reach a decision?

Q7. Professor Johnson said that he will give a lecture about heart failure in the biology lecture hall. It must be the case that a number of heart failures have occurred there recently.

Q8. She says that she loves me, and she must be telling the truth because she certainly would not lie to someone she loves.

Q9. Molecules are in constant random motion. The Statue of Liberty is composed of molecules. Therefore, the Statue of Liberty is in constant random motion.

Q10. Thomas Carlyle said of Walt Whitman that he thinks he is a big poet because he comes from a big country.

Q11. Murder is morally wrong. This being the case, it follows that abortion is morally wrong.

Q12. White sheep eat more than black sheep (because there are more of them). Therefore, this white sheep eats more than that black sheep.

Q13. I would not live forever, because we should not live forever, because if we were supposed to live forever, then we would live forever, but we cannot live forever, which is why I would not live forever.

Q14. The universe is spherical in form... because all the constituent parts of the universe, that is, the sun, moon, and the planets, appear in this form.

Q15. Either we require forced sterilisation of Third World people, or the world population will explode and all of us will die. We certainly do not want to die, so we must require forced sterilisation.

Summarized Overview

Our arguments sometimes contain unjustified assumptions. The questions that we ask each other may be loaded, i.e., the truth of some answers may be already presupposed in our questions. We often assume the universal applicability of some general rule, ignoring the peculiar exceptions of certain individual cases. Moreover, there are instances where the premises and conclusions in our arguments show mutual dependence. All these exemplify the category of informal fallacies known as fallacies of presumption. Fallacies of ambiguity form another category of informal fallacies that arise due to the ambiguous meaning of words or phrases in arguments. The fallacies of equivocation, amphiboly, accent, composition, and division are the various fallacies of ambiguity discussed above. Together, these fallacies show how errors in assumption and language can mislead reasoning. It is expected that solving as many problems that pertain to the identification and explanation of informal fallacies helps to construct arguments devoid of such fallacies as well as point out fallacious aspects of others' arguments. This not only enhances individual reasoning skills but also fosters effective communication and fruitful discourse that leads to the development of humankind in general.

Self-Assessment

1. Which of the informal fallacies is said to occur when a generalisation is applied to a particular case that it does not govern?
2. Which among the following fallacies does not belong to the fallacies of ambiguity?
    a. fallacy of accident
    b. fallacy of equivocation
    c. fallacy of composition
    d. fallacy of division
3. Identify and explain the informal fallacy committed by the following arguments.
    a. People are obligated to keep their promises. When Jessica married Tyler, she promised to stay with him for life. Therefore, she should stay with him now, even though he has become an abusive spouse addicted to gambling and drugs.
    b. Capital punishment is justified for the crimes of murder and kidnapping because it is quite legitimate and appropriate that someone be put to death for having committed such hateful and inhuman acts.
    c. It is impossible to exist apart from God; it is impossible to be neutral towards Him. He who is not for Him is against Him.
    d. Every sentence in this paragraph is well written. Therefore, the paragraph is well written.
    e. Switzerland is 48 percent Protestant. Heidi Gilsing is a Swiss. Therefore, Heidi Gilsing is 48 percent Protestant.

Assignments

1. Which of the informal fallacies is characterised by the unwarranted attribution of the properties of a whole to the parts of the whole?
2. Which among the following fallacies is a fallacy of ambiguity?
    a. fallacy of false dichotomy
    b. fallacy of accident
    c. fallacy of circular argument
    d. fallacy of composition

3. Choose the correct answer with respect to the following argument.

Atoms have mass. This piece of chalk is composed of atoms. Therefore, this piece of chalk has mass.

a. fallacy of composition is committed here

b. fallacy of division is committed here

c. hasty generalisation is committed here

d. it is a non-fallacious argument

4. Identify and explain the informal fallacy committed by the following arguments.

a. Whoever thrusts a knife into another person should be arrested. But surgeons do precisely this when operating. Therefore, surgeons should be arrested.

b. We know that induction will provide dependable results in the future because it has always worked in the past. Whatever has consistently worked in the past will continue to work in the future, and we know that this is true because it has been established by induction.

c. Each atom in this teacup is invisible. Therefore, this teacup is invisible.

d. Salt is a non-poisonous compound. Therefore, its component elements, sodium and chlorine, are non-poisonous.

Reference

1. Copi, I. M., Cohen, C., & Rodych, V. (2019). *Introduction to Logic*. Routledge.
2. Hurley, P. J. (2015). *A Concise Introduction to Logic*(12th ed.). Cengage Learning.
3. Sethy, S. S. (2021). *Introduction to Logic and Logical Discourse*. Springer.

Suggested Reading

1. Copi, I. M., Cohen, C., & Rodych, V. (2019). *Introduction to Logic*. Routledge.
2. Hurley, P. J. (2015). *A Concise Introduction to Logic* (12th ed.). Cengage Learning.

Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.

MODEL QUESTION PAPER SETS

SREENARAYANAGURU OPEN UNIVERSITY

Model Question Paper (SET A)

QP CODE: ……

Reg. No : …….....

Name: …….....

FOURTH SEMESTER MA PHILOSOPHY EXAMINATION

SKILL ENHANCEMENT COMPULSORY COURSE

M23PH02SC -REASONING AND PROBLEM-SOLVING TECHNIQUES

(CBCS - PG)

2023-24 - Admission Onwards

Time: 3 Hours

Max Marks: 70

SECTION A

Objective Type Questions; Answer any Ten

(10×1=10)

1. Which kind of reasoning derives conclusions with certainty?
2. Write the converse of 'No philosophers are dogmatic thinkers'.
3. Write the obverse of 'Some kings are warriors'.
4. Write the contrapositive of 'All students are eligible candidates'.
5. What is reasoning from particular to general known as?
6. If 'Some rationalists are not believers' is given as true, what can we infer about the truth value of 'All rationalists are believers'?
7. If 'No substances are independent entities' is given as false, what can we infer about the truth value of 'Some substances are independent entities'?
8. Define 'major premise' in a syllogism.
9. Name the major term in the following categorical syllogism.

   No musicians are dancers.

   Some dancers are artists.

   Therefore, some artists are not musicians.
10. Name the middle term of the following syllogism.

All colleges are teaching centres.

All research centres are teaching centres.

Therefore, some research centres are colleges.

11. Identify the fallacy in the argument: 'The movie is bad since many people on social media say so.'
12. Name the fallacy committed by asking a misleading question?
13. Name the process of drawing a conclusion from two or more premises.
14. Which of Mill's methods explains an effect through the remaining unexplained cause?
15. What is the fallacy of generalizing from too few cases called?

SECTION B

Very Short Answer Questions; Answer any Five

(5×2=10)

16. Define 'minor premise' with an example.
17. State the difference between deduction and induction.
18. What is a syllogism?
19. Write the converse and contrapositive of 'No non-citizens are voters'.
20. What is the difference between contrary and contradictory opposition?
21. If 'All perceptions are cognitions' is given as false, what can be inferred about the truth value of 'Some perceptions are cognitions' and 'Some perceptions are not cognitions'?
22. Rewrite the following syllogism in the standard form:

    'Many research papers do not get published since they contain plagiarised data, and research papers with plagiarised data never get published'.

23. What is the fallacy of circular argument?
24. Which of the five methods demonstrated by J S Mill is applied in the reasoning given below?

    An administrator for the Internal Revenue Service noticed that tax revenues for a certain year were down by 14 percent. Of this amount, the administrator attributed 6 percent to an economic slowdown that year, 3 percent to higher interest rates that led to higher write-offs, and 2 percent to changes in the tax code. Unable to attribute the remaining 3 percent to any lawful factor, the administrator concluded that it resulted from increased cheating by the taxpayers.

25. What is the fallacy of ad ignorantiam?

SECTION C

Short Answer Questions; Answer any Five

(5×4=20)

26. Solve the puzzle given below.

    The employees of a small loan company are Mr. Black, Mr. White, Mrs. Coffee, Miss

    Ambrose, Mr. Kelly, and Miss Earnshaw. The positions they occupy are manager, assistant manager, cashier, stenographer, teller, and clerk, though not necessarily in that order. The assistant manager is the manager's grandson, the cashier is the stenographer's son-in-law, Mr. Black is a bachelor, Mr. White is 22 years old, Miss Ambrose is the teller's stepsister, and Mr. Kelly is the manager's neighbour. Who holds each position?

27. Do as directed.
    a. Derive the obverse and contrapositive of 'All integers are real numbers'.
    b. Derive the converse and obverse of 'No non-academicians are researchers'.

28. Identify and describe the fallacies committed in the following categorical syllogism.

    All academicians are philosophers.

    Some psychologists are not academicians.

    Therefore, no psychologists are philosophers.

29. Explain any two informal fallacies with suitable examples.

30. What is the square of opposition? Explain its relevance in logical reasoning with an example.

31. What is meant by conversion, obversion, and contraposition in logic?

32. What are fallacies? Distinguish between formal and informal fallacies with examples.

33. What is the method of concomitant variation, and how is it applied in scientific reasoning?

SECTION D

Essay Type Questions; Answer any Three

(3×10=30)

34. Explain J.S. Mill's methods of experimental inquiry with suitable examples.

35. Assuming that the proposition 'All syllogisms are valid arguments' is false, show which of the following propositions are true, which are false, and which are undetermined.
    a. Some syllogisms are not valid arguments

b. No syllogisms are invalid arguments

c. No valid arguments are syllogisms

d. Some invalid arguments are not non-syllogisms

e. Some syllogisms are invalid arguments

36. Explain the different types of categorical propositions along with their quantity and quality, with suitable examples.

37. What is the difference between the fallacy of ambiguity and the fallacy of presumption? Explain these in detail with suitable examples.

38. Explain immediate inference with the different types of immediate inference.

39. What is a syllogism? Describe the structure, rules, and importance of categorical syllogism in logical reasoning.

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Model Question Paper (SET B)

QP CODE: ……

Reg. No : …….....

Name: …….....

FOURTH SEMESTER MA PHILOSOPHY EXAMINATION

SKILL ENHANCEMENT COMPULSORY COURSE

M23PH02SC -REASONING AND PROBLEM-SOLVING TECHNIQUES

(CBCS - PG)

2023-24 - Admission Onwards

Time: 3 Hours Max Marks: 70

SECTION A

Objective Type Questions; Answer any Ten

(10×1=10)

1. Write the contrapositive of 'No scientists are irrational thinkers'.
2. Name the four types of categorical propositions.
3. If 'Some actions are not perfect' is given as true, what can we infer about the truth value of 'All actions are perfect'?
4. Which informal fallacy occurs in:

   Power tends to corrupt.

   Knowledge is power.

   Therefore, knowledge tends to corrupt.
5. Identify the major term in the following syllogism.

   All teachers are guides.

   Some philosophers are teachers.

   Therefore, some philosophers are guides.
6. Identify the middle term in the following syllogism.

   All artists are creative people.

   Some writers are artists.

   Therefore, some writers are creative people.

7. What kind of reasoning proceeds from general to particular?

8. What fallacy occurs in the sentence, 'Nobody has proved that aliens don't exist, so they must exist'?

9. Which of Mill's methods is applied when one differing circumstance explains the effect?

10. Which fallacy attacks the person instead of the argument?

11. Which informal fallacy is committed in the following argument? 'Have you stopped resorting to malpractice?'

12. Who formulated the five experimental methods of reasoning?

13. What is the process of drawing a conclusion from one premise called?

14. What is the method that studies changes in effect corresponding to changes in cause called?

15. What is another name for contrived problems in logic?

SECTION B

Very Short Answer Questions; Answer any Five

(5×2=10)

16. State the converse, obverse, and contrapositive of 'All voters are citizens'.

17. Identify the fallacy in: 'Thomas Carlyle said Whitman thinks he is a great poet because he comes from a big country.'

18. Define the method of difference with one illustration.

19. Distinguish between necessary and sufficient conditions in reasoning.

20. What is meant by a fallacy of composition?

21. What is the method of residues according to J.S. Mill?

22. Identify the informal fallacy committed by each of the following arguments:
    a. Either you take me on a Caribbean cruise, or I'll have a nervous breakdown. It is up to you.
    b. Power tends to corrupt. Knowledge is power. Therefore, knowledge tends to corrupt.

23. Give an example of hypothetical reasoning.

24. What is the fallacy of hasty generalization?

25. What is a brainteaser in logical reasoning?

SECTION C

Short Answer Questions; Answer any Five

(5×4=20)

26. If 'Some actions are not perfect' is given as true, what can be inferred about the truth value of the following propositions?

    a. All actions are perfect

    b. Some actions are imperfect

    c. Actions are never perfect

    d. Some imperfect things are not non-actions

27. Read the following report and answer the questions.

    A doctor has five patients who suffer from an unusual form of cancer. The patients are distinguished by the following living conditions. Davis, Jones, and Ellis live in smoggy area near high-voltage power lines, and Smith and Frank smoke cigarettes and live downwind from a company that produces chemical defoliants for the military. Frank also lives near the nuclear power plant. Davis, Smith, and Ellis eat red meat every day and live near the nuclear power plant. Jones smokes cigarettes and lives downwind from the chemical defoliant company. Smith lives in a smoggy area, and Davis and Ellis live downwind from the defoliant company.

    What can the doctor conclude as the cause of the cancer? Which one of Mill's methods can be used here? Demonstrate.

28. Analyse each of the following arguments to identify the informal fallacies committed by them.

    a. Nobody has ever proved that using cell phones causes brain tumours. Therefore, using cell phones does not cause brain tumours.

    b. Order is indispensable to justice because justice can be achieved only by means of a social and legal order.

    c. Thomas Carlyle said of Walt Whitman that he thinks he is a big poet because he comes from a big country.

    d. The average height of the first-year undergraduate class is five feet and five inches. So, John, who is a member of that class, must be five feet and five inches tall.

29. What is the difference between mediate inference and immediate inference? Give an example to illustrate the same.

30. Define contrived problems and explain how they help in developing reasoning skills.

31. What is reasoning, and why is it considered central to human life?

32. What is meant by a fallacy? Briefly describe any two informal fallacies.

33. What is a fallacy of relevance, and how does it differ from a fallacy of ambiguity? Illustrate each with an example.

SECTION D

Essay Type Questions; Answer any Three

(3×10=30)

34. Rewrite the following syllogism in the standard form and test its validity.

    'Not all unemployed drink. Only debtors drink. So not all the unemployed are in debt.'

35. Explain the application of Mill's method in each of the following.

    a. A man developed an allergic reaction to an unknown food. His doctor asked him about foods that often cause allergic reactions, and the man replied that he had eaten coconut, chocolate, nuts, milk products, shellfish, peppers, eggs, and wheat products before suffering the reaction. The doctor told him to eliminate all of these foods from his diet; when he had done so, the reaction disappeared. The doctor then told him to introduce each of these foods back into his diet, one at a time. The man did so, and the reaction reappeared only when he ate milk products. The doctor concluded that milk products caused the allergic reaction.

    b. During the first half of the nineteenth century, it was firmly believed that animals were unable to manufacture carbohydrates, fats, or proteins, all of which had to be obtained in the diet preformed from plants. All organic compounds were believed to be synthesised in plants, whereas animals were thought to be capable only of breaking them down. Claude Bernard set out to investigate the metabolism of sugar and, in particular, to find where it is broken down. He fed a dog a diet rich in sugar and then examined the blood leaving the liver to see if the sugar had been broken down in the liver. He found a high sugar content, and then wisely carried out a similar estimation with a dog fed a sugar-free meal. To his astonishment, he found also a high sugar content in the control animal's hepatic blood. He realised that, contrary to all prevailing views, the liver probably did produce sugar from something which is not sugar.

36. Given below are two premises (Premise 1 and Premise 2). Five conclusions are drawn from them. (A, B, C, and D). Taking the premises individually or jointly, check which of the conclusions are drawn validly.

    Premise 1: Every writer is famous.

    Premise 2: Many fools are not famous.

    Conclusions:

    a. Many fools are writers.

b. Writers are hardly fools.

c. Most of the writers are famous.

d. Some famous persons are not fools.

e. Not all fools are writers.

37. Define fallacies. Explain the classification of fallacies into formal and informal, illustrating each type with examples from everyday reasoning.

38. Explain how reasoning and problem-solving techniques help in achieving clarity of thought and precision in judgment. Illustrate your answer with practical examples.

39. Explain the process of mediate inference with reference to categorical, hypothetical, and disjunctive syllogisms. Discuss how these forms contribute to logical reasoning.

സർവ്വകലാശാലാഗീതം

വിദ്യയാൽ സ്വതന്ത്രരാകണം
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കൂരിരുട്ടിൽ നിന്നു ഞങ്ങളെ
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സ്നേഹദീപ്തിയായ് വിളങ്ങണം
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