

Logic and Arguments

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1 Basic Deductive Logic

Logic Logic is the intellectual discipline that distinguishes correct from incorrect reasoning.

Argument An argument is an inference from one or more starting points (truth claims called a ‘premise’ or ‘premises’) to an end point (a truth claim called a ‘conclusion’).

Sentence/Proposition

- A sentence contains sounds (when spoken) or visible marks (when read) which in virtue of linguistic rules and conventions are taken to express beliefs, attitudes, or other mental states of the speaker (or writer).
- A proposition is what is asserted when a person utters a sentence, assertion, claim, etc. It is sometimes defined as the meaning of a declarative sentence.
- Example: Two sentences “My aunt’s pen is green.” and “The pen of my aunt is green.” means the same proposition.
- Logic is about propositions, not sentences.

Deductive Arguments

- In a deductive argument, the truth of the conclusion necessarily follows from its premises so that, if the premises are true, then the conclusion must be true.
- Example:

Elvis Presley lives in a secret location in Idaho.

All people who live in secret locations in Idaho are miserable.

Therefore Elvis Presley is miserable.

Inductive Arguments

- An inductive argument is an argument whose conclusion is claimed to follow from its premises, not with necessity, but only with probability.
- Example:

Almost all elephants like chocolate.

This is an elephant.

Therefore, this elephant likes chocolate.

Validity/Soundness

- Validity is a property of well-formed deductive arguments. A valid deductive argument is one such that if the premises are true, then the conclusion must be true.
- A valid argument can have a false conclusion.
- Example (Valid):

All mammals have wings.

All reptiles are mammals.

Therefore, all reptiles have wings.

- An invalid argument can have a true conclusion.
- Example (Invalid):

Chicago is north of Dallas.(True)

Feinberg is mortal.(True)

Therefore, all birds have wings.(True)

- An argument cannot have true premises and a false conclusion and still be valid. All the other combinations can happen.
- Example (Invalid):

If Rockefeller owned all the gold in Fort Knox, then Rockefeller would be wealthy. (True)

Rockefeller does not own all the gold in Fort Knox. (True)

Therefore Rockefeller is not wealthy. (False)

Logical Necessity/Psychological Certainty

- Rational persons match their psychological certainty to logical necessity, but those two conditions are not the same thing.
- Example: an argument of the form “If p then q; p; therefore q” is valid quite independently of any belief or any degree of certainty in belief any person might have toward it. No rational person could believe both p and not p.

Logical Connectives

- or, \vee
- and, $\wedge(\cdot)$
- negation, $\neg(\sim)$
- if...then..., $\rightarrow (\supset)$, if and only if, \leftrightarrow

Truth Tables

p	q	p · q
T	T	T
T	F	F
F	T	F
F	F	F

p	q	p ∨ q (p or q)
T	T	T
T	F	T
F	T	T
F	F	F

p	~p (not p)
T	F
F	T

1	2	3	4	5	6
p	q	~q	p · ~q	~(p · ~q)	p ⊃ q
T	T	F	F	T	T
T	F	T	T	F	F
F	T	F	F	T	T
F	F	T	F	T	T

Notes about Logical Connectives

- Example: If $x > 0$, then $x^3 \neq 0$. This is a true statement, for in every case for which the hypothesis $x > 0$ holds, the conclusion $x^3 \neq 0$ holds as well.
- Example: If $x^2 < 0$, then $x = 23$. This is also a true statement, because in every case for which the hypothesis holds, the conclusion holds as well. Of course, it happens in this example that there are no cases for which the hypothesis holds. A statement of this sort is sometimes said to be *vacuously true*.

Some Valid Deductive Argument Forms

(a) Modus Ponens

If p then q

p

Therefore q

Example

If this horse's leg is broken, then he will be mercifully shot.

This horse's leg is broken.

Therefore, this horse will be mercifully shot.

(b) Modus Tollens

If p then q

not q

Therefore not p

Example

If this horse's leg is broken, then he will be mercifully shot.

This horse will not be mercifully shot.

Therefore, This horse's leg is not broken.

(c) Hypothetical Syllogism

If p then q

If q then r

If p then r

Example

If Witherspoon wins the next primary election, he will win the nomination.

If Witherspoon wins the nomination, he will win the presidential election.

Therefore, if Witherspoon wins the next primary election, he will win the presidency.

(d) Constructive Dilemma

If p then q and if r then s

p or r

Therefore, q or s

Example

Since those who are already dead, being unconscious, suffer nothing, they do not suffer death, and those who are still living have not suffered death.

Everyone is either living or dead.

Therefore, no one suffers death.

2 Fallacious Reasoning

(a) Affirming the Consequent

If p then q

q

Therefore, p

Example

If Fiona won the lottery last night, she'll be driving a red Ferrari today.

Fiona is driving a red Ferrari today.

Therefore Fiona won the lottery last night.

(b) Denying the Antecedent

If p then q

Not p

Therefore, not q

Example

If Amelia can vote in the United States, then she is 18 years old.

Amelia cannot vote in the United States.

Therefore Amelia is not 18 years old.

(3) Begging the Question

- An argument that assumes in its premises the conclusion it claims to be proving.
- Example

“We can know that God exists,” the argument proceeds, “because the bible tells us so.” “Yes, but how do you know that the bible is true?” asks the critic of this particular argument. “No problem,” the proof-giver replies, “The bible must be true because it is the word of God.” The proof-giver has begged the question.

(4) Genetic Fallacy

1. Confusing an important sufficient condition for a thing with a relatively trivial necessary condition for that thing,

2. Confusing a history of the becoming of a thing with an analysis of the thing it has become;
3. Confusing the thing to be analyzed with a corrupted, defective, or inferior version of the “ancestor” it has evolved from, which is to treat the end (of a long historical process) as “just the beginning in disguise.”

- Example

Action from a sense of duty developed out of action from fear of the ghosts of dead ancestors.

This developed out of action from fear of living chiefs.

Therefore, the sense of duty as it now exists is just a disguised form of fear of punishment by tribal chiefs.

(5) The Fallacy of Division

Notre Dame has a powerful football team. John Doe is a member of the Notre Dame football team. Therefore, John Doe is a powerful man.

(6) The Fallacy of Composition

Socrates is a Greek. Socrates is a philosopher. Therefore, all Greeks are philosophers.

References

- [1] J. Baggini. (2010). *The philosopher’s toolkit: a compendium of philosophical concepts and methods*, 2nd edition. Julian Baggini and Peter S. Fosl.
- [2] J. Feinberg. (2014). *Doing philosophy: a guide to the writing of philosophy papers*, 5th edition. Cengage Learning.