Clear and Present Thinking

A
handbook
in logic
and
rationality
.

Version 1.1

Northwest Passage Books

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3.5 Some Common Deductive Argument Forms

Earlier we stated that the definition of an argument is "**any two (or more) statements in which one is the reason for the other**". This section will introduce some valid deductive argument forms. In deductive

argumentation, we take some number of premises as given, and from these we are able to make other claims according to certain logical rules of inference. If the conclusion that results comes out of the given premises as a result of applying the accepted rules of inference, then we say that the conclusion follows necessarily from the premises, or that the argument is "valid".

The validity of an argument is determined not by what it says, but by its *form*. That means that when we assess the validity of an argument, we assume that the premises are true. If, on the other hand, we want to question the truth of the premises, we would be evaluating not its validity, but its *soundness*. Consider the following argument:

All Pigs can fly.
Babe is a Pig.
Therefore, Babe can fly.

This argument is valid. That is, assuming that the premises are true, the conclusion necessarily follows. Of course, we can question the *soundness* of the argument. If we can disprove the premise that "All pigs can fly", then the argument would be unsound. We might also question whether we want to consider Babe a pig, rather than a fictional character resembling a pig. In either case, if either one of the premises is not true, then the argument is not sound. But that does not mean it is not valid. An argument can be valid without being sound. Let's look at an example of the same *form*:

All humans are mortal.
Brendan is a human.
Therefore, Brendan is mortal.

This argument is both valid and sound. […]

3.6.1 Modus Ponens or Affirming the Antecedent

Modus Ponens is a valid argument form taking a conditional statement as one premise, and the affirma- tion of its antecedent as another premise. So, if I claim "If something, then another thing" and then affirm "something", I can logically deduce that "another thing". If the conditional statement and the affirmation of its antecedent are both true, the truth of the conclusion is guaranteed.

Let's take an example.

(P1) If the dog is barking, then there's an intruder in the house.
(P2) The dog is barking!
(C) Therefore, there's an intruder in the house!

Of course, there might be other reasons why the dog might bark. But according to Premise 1, the fact that the dog is barking implies that there is definitely an intruder in the house. And we are assuming that P1 is true.

This argument takes the general form:

(P1) If P, then Q.
(P2) P.
(C) Therefore, Q.

Let's look at an example:

(P1) If it is raining, then I will need my umbrella. (P2) It is raining.
(C) Therefore, I will need my umbrella.

There might be other reasons why you might need your umbrella. Perhaps it's to be used as a prop in a theatrical performance. But nothing in this argument tells you that. And besides, whether or not that's the case, the first premise still tells you that you need it when it rains.

Affirming the Consequent: Modus Ponens' Invalid Half Brother

There's a sneaky invalid argument out there that looks a lot like Modus Ponens. What would happen if instead we affirmed the consequent, instead of the antecedent? We would have an argument like this:

(P1) If it is raining, then I will need my umbrella. (P2) I will need my umbrella.
(P3) Therefore, it is raining.

We tend to make this logical leap and equate the fact that we need our umbrella with the fact that it's raining. But though it is not equally likely that we might need the umbrella for a theatrical performance, it is still a possibility. That is, the fact that I need my umbrella does not *absolutely guarantee* that it's raining. This argument form is therefore invalid.

Practical Uses of Modus Ponens:

Every circuit in your computer uses this pattern of ar- gument to make calculations. In effect, the diodes and transistors in your computer CPU are like 'switches', which operate as if they are reasoning like this:

If a signal comes in from direction X, then send it out again in direction Y.
A signal just came in from direction X.
Therefore, the thing to do is send it out in direction Y.

3.6.2 Modus Tollens or Denying the Consequent

Modus Tollens is a valid argument form taking a conditional statement as one premise, and the denial of its consequent as another premise. So, if I claim "If something, then another thing" and then deny "another thing", I can logically deduce that "not something". Here I'm recognizing that if the relation between "something" and "another thing" holds,
and if "another thing" failed to happen, or is false (depending on what that thing is), then "something" must not have happened, or must not be true.

Let's take an example.

(P1) If you gave me a diamond tiara, I'd be the happiest girl in the world!
(P2) I am not the happiest girl in the world.
(C) Therefore, you did not give me a diamond tiara.

This argument takes the general form:

(P1) If P, then Q.
(P2) Not Q.
(C) Therefore, not P.

Like Modus Ponens's evil half brother, there's another bad argument out there attempting at every turn to pass itself off as valid.

Denying the Antecedent: Fallacy!

Again, when we see a conditional statement and a negation, we're immediately tempted to think 'Modus Tollens'. But what happens if we deny the antecedent instead of the consequent? We get an argument like this:

(P1) If you gave me a diamond tiara, I'd be the happiest girl in the world!
(P2) You did not give me a diamond tiara.
(C) Therefore, I am not the happiest girl in the world.

Again, the truth of these premises does not absolutely guarantee the truth of the conclusion. Even if you did not give me a diamond tiara, I might still be the happiest girl in the world for some other reason. I might have been the happiest girl in the world all along, and there's quite possibly nothing you could do to change that. This argument form is invalid.

3.6.3 Categorical Syllogisms

The four standard statements in categorical logic can be combined into 24 possible valid logical argument forms. But we can just look at a few of them; once you get the idea behind how categorical syllogisms are judged as valid or invalid, it's easy to discern the difference.

One valid categorical syllogism was already given in the introduction to this section. That was:

All humans are mortal.
Brendan is a human.
Therefore, Brendan is mortal.

This argument is valid. We can, in general, con- clude that if an entire class of things has some quality, and if something is a member of that class, it has that quality.

But we can also generalize further. If an entire class of things has some quality, and all of the things that have that quality have some other quality, then we can make a valid inference that the entire class also has that other quality.

For example:

All farm animals are cannibalistic.
All cows are farm animals.
Therefore all cows are cannibalistic.

If you accept the validity of the first argument, then you must also accept the validity of this argument. This makes sense, because if every individual cow is a farm animal and therefore cannibalistic, then the whole cow species is cannibalistic.

Now let's try some negative statements.

No human is immortal.
Brendan is a human.
Therefore Brendan is not immortal.

What this argument says is that if none of the members of the class of humans is immortal, then neither is a specific individual of that class. Again, we can generalize. If no specific member of the class is immortal, then the whole class is excluded from immortality.

No human is immortal.
All philosophy professors are humans.
Therefore no philosophy professor is immortal.

These are only some of the possible combinations of categorical statements that result in valid syllogisms. If you can keep track of what thing or what kind of thing belongs to what class, then you're in pretty good shape for evaluating the validity of categorical syllogisms.

3.6.1 Enthymemes

An enthymeme is a categorical syllogism in which one of the premises is missing. People use them all the time, often without realizing it, when they want to get a certain point across quickly, or when they can assume the listeners know what the they are talking about. It's really easy to commit a fallacy called 'undistributed middle' when making an enthymeme, because we aren't always keeping close track of where the premises are. So to analyze an enthymeme, one has to lay out all the propositions in the place where they would stand in a categorical syllogism, fill in the missing proposition, and then determine whether the inferences are valid or invalid.

"Many songs by Justin Timberlake are popular. So this new song will be popular too."

P1. Some Justin Timberlake songs are popular.
P2. This new song is composed by Justin Timberlake.
C. Therefore, this new song will be popular.

"He is a leprous man, for he is unclean." (Leviticus 13)

P1. Leprous men are unclean.
P2. He is unclean.
C. Therefore, he is a leprous man.

"Yond Cassius has a lean and hungry look. He thinks too much. Such men are dangerous." (Shakespeare, Julius Caesar, III.2)

P1. Cassius has a lean and hungry look and thinks too much.
P2. Men who have lean and hungry looks and who think too much are dangerous.
C. Therefore, Cassius is dangerous.

By the way: which of these enthymemes are sound, and which are not?

3.6.2 Hypothetical Syllogism

A hypothetical syllogism is a valid argument form that takes as premises two conditional statements and concludes a third, where the consequent of the first

premise is identical to the antecedent of the second.

For instance, if I make the claim,

(P1) If it gets below freezing outside, I can make ice out there.

And I also make the claim that,

(P2) If I can make ice, my soft drinks will be deliciously refreshing.

Then I can conclude that,

(C) If it gets below freezing outside, my soft drinks will be deliciously refreshing.

Essentially, we are demonstrating the transitive property of conditional statements. That is, if we have two conditional statements where the consequent of one is identical to the antecedent of another, we can eliminate them and mash the rest of the two premises together to get a conclusion that is definitely true.

This argument takes the general form

(P1) If P, then Q
(P2) If Q, then R
(C) If P, then R

But this could all be made clearer by taking a few examples. We can apply the hypothetical syllogism to categorical thinking:

(P1) If Socrates is a man, Socrates is an animal.
(P2) If Socrates is an animal, Socrates is a substance. (C) If Socrates is a man, Socrates is a substance.

We could also apply the hypothetical syllogism to causal relations:

(P1) If I set the house on fire, it will burn down.
(P2) If the house burns down, I'll collect insurance money.
(C) If I set the house on fire, I'll collect insurance money.

In any case, the transitive property of the implication relation that constitutes a conditional statement guarantees that the hypothetical syllogism is valid. That is, the hypothetical syllogism can be proven valid just by the definition of conditional statements.

3.6.1 Disjunctive Syllogism

This argument establishes the truth of some proposi- tion by ruling out all other possibilities until there's just one left still standing.

Form:

> Either P is true, or Q is true. P is false.
> Therefore, Q is true.
>
> Either P is true, or Q is true. Q is false.
> Therefore, P is true.

Examples:

> (P1) This tree is either coniferous or it is deciduous. (P2) I see by its flat leaves that it is not coniferous.
> (C) Therefore, this tree is deciduous.
>
> (P1) One of us is going to die here, Mister Bond. It's either you or me.
> (P2) And it isn't going to be me.
> (C) So it will have to be you!

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