Philosophy 201: Critical Thinking
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Unit 1: Deduction and Induction

Once we have established that the passage in question is an argument, we still need to evaluate whether or not it is a good argument. That is, we need to figure out whether or not the argument actually convinces us that some belief is worth holding as true. Before we can get to evaluating arguments, we need to go over some technical terms to describe these argument and we also need to consider what will make an argument a good one.

It turns out that there are two different kinds of arguments. We call them deductive and inductive arguments. All argument have an inferential claim. That means, that each argument uses evidence and reason to infer that some claim (the conclusion) is true. What differs in deductive and inductive arguments is how much we are supposed to believe that the conclusion is true.

Every argument has an inferential claim.

In a **deductive argument** the conclusion necessarily follows from the premises. That is, given the evidence in the premises, we should believe the conclusion to be true for certain.

In an **inductive argument** the conclusion probably follows from the premises. That is, given the evidence in the premises, we should believe the conclusion to be true to some degree of probability.

Here are examples of each type of argument.

Deductive	Inductive
All men are mortal.	This goose is white.
Socrates is a man.	That goose is white.
Socrates is mortal.	All geese are white

For our deductive argument, if it is true the "all men are mortal" and it is also the case that "Socrates is a man" then it just has to be the case that

"Socrates is mortal". The intent here is to convince us that "Socrates in mortal" *for certain*.

Our inductive argument is different. Here I've given you two observations of geese that I found to be white. From that I want to conclude that "all geese are white". Well, seeing two white geese gives me *some* reason to believe that "all geese are white" but it doesn't make it true for certain. In fact, no matter how many white geese I see, the conclusion in this or any other inductive argument will never be true for certain.

With inductive arguments it is possible to add a premise to the argument that would undercut our belief in the truth of the premise.

This goose is white.
That goose is white.
<u>This goose is black.</u>
All geese are white.

With inductive arguments, we can never be sure that the conclusion is true because there is always the possibility that an added piece of information will change our belief in the conclusion.

The example of the inductive argument that I've given you is called a generalization (this is when you take a few examples and then generalize to a larger group) but not all inductive arguments are generalizations.

The next example is also an inductive argument but it is called an analogy. In this case we say something is true about a number of things but then conclude that it will also be true of one additional thing.

Hitler was a dictator and was ruthless.
Stalin was a dictator and was ruthless.
Charles Taylor was a dictator and was ruthless.
<u>Castro is a dictator.</u>
Therefore, Castro is probably ruthless.

Determine whether the following arguments are deductive or inductive.

The sun is coming out, so the rain will probably stop soon.

It's going to rain tomorrow, so it with either rain or be clear tomorrow.

The house is a mess, so Jeff must be home from college.

Evaluating Arguments: Validity, Soundness, Strength and Cogency

It is important to determine whether our arguments are deductive or inductive because each type of argument is evaluated on different grounds.

How do we evaluate these arguments?

Argument Type	How much to believe the conclusion	How we evaluate the argument
Deductive	With certainty	Validity
Inductive	Probably	Strength

Validity

The concept of validity is a bit tricky so don't be frustrated if you don't get it right away. Recall from our first lecture that arguments can be bad in at least two different ways. The premises may be false or irrelevant or the premises might be fine but there is a problem with the pattern of the reasoning. With validity we are considering whether the pattern or the form of the argument is a good one.

Let's reconsider the following argument:

All snakes are reptiles. (T)
All snakes are legless. (T)
Therefore, all reptiles are legless. (F)

Whatever the pattern is in this argument, it doesn't seem like a good one because we have premises that are true and the conclusion turns out to be false.

We can see why it would not be a good idea to use a pattern like this. It would be deceitful to use a pattern of reasoning where I could give you perfectly good premises and in turn convince you of something that turns out to be false.

A pattern will be problematic the premises are true and the conclusion is false.

T
T
F

A pattern that never has this problem is called valid.

An argument is **valid** if and only if it is not possible for all its premises to be true when its conclusion is false.

In other words, for a valid argument, when the premises are true the conclusion *has* to be true.

If it is possible for the premises to be true and the conclusion false, then the argument is *invalid*.

Consider the following argument.

All whales are mammals.
All mammals have lungs.
Therefore, all whales have lungs.

If you think about these sentences, it seems that when the premises are true, the conclusion would *have* to be true.

Here is an outline of the pattern or form of the argument. Notice that when we are looking at the pattern we don't really care what the content of the sentence is, just how the content is related to each other.
I have used various underline patterns for the words that are the same.

All _____ are ……
All …… are ,,,,,,,,,,,,,,,
Thus, all _____ are ,,,,,,,,,,,,,,,

Consider another example.

All spiders have ten legs. False
All ten-legged creatures have wings. False
Therefore, all spiders have wings. **False**

All of these sentences are false. However, that doesn't really help us when we are trying to determine if the pattern is valid. We need to pretend that the premises are true and see if the conclusion must be true. Okay, so imagine that you live in a world where it is true that "all spiders have ten legs". It is also the case that in this world "all ten-legged creatures have wings". If those two sentences are true, then it seems like it would just have to be the case that "all spiders have wings". The truth of the premises would guarantee the truth of the conclusion. So this argument, even when all the sentences are false in our world, is valid.

But look! The pattern in the spiders argument is the same as the pattern in the whale argument! The content of the sentences is unimportant. Both of these arguments have the same pattern and they are both valid.

Once you have determined that the argument form is valid, it is always valid. It does not matter what is substituted in the blanks.

Here is another example.

If I owned Facebook then I would be wealthy.
I do not own Facebook.
Therefore, I am not wealthy.

If the premises in this argument are true, is it possible that the conclusion could be false? That is, is T T / F possible?

Here is the pattern for this argument.

If _____ then .....
Not _____
Therefore, not .....

Let's look at the same pattern with slightly different information inserted in the blanks.

If Drake owned Facebook then Drake would be wealthy.
Drake does not own Facebook.
Therefore, Drake is not wealthy.

We can see with this substitution that, when using this argument pattern, it is possible to have true premises and a false conclusion. Thus, this argument pattern in invalid.

The tricky thing to realize here is that this pattern would be invalid no matter what the truth value of the premises and conclusion are. The pattern would be invalid even if the premises and the conclusion all turned out to be true! The pattern is invalid because it is possible to use this pattern and come up with true premises and a false conclusion. That combination just needs to be possible.

Consider this example:

All cats have ears.	True
All kittens have ears.	True
All kittens are cats.	True

In this argument all of the statements are true. Unfortunately, knowing that the statements are all true doesn't actually tell us if the pattern is valid or invalid. What we have to ask ourselves is this: is it possible to use this pattern and end up with all true premises and a false conclusion? Is that possible? I can make

one small change to content to see if that is the case. Let's change 'kittens' to 'dogs'. Now I have:

All cats have ears.	True
All dogs have ears.	True
All dogs are cats.	False

I have used the same pattern and now I have all true premises and a false conclusion. The argument is invalid. What is important to note here is that the argument was also invalid when I was talking about the kittens. The sentences happened to all be true but the pattern was still invalid because T T/F was possible.

So, our invalid arguments can have sentences with many different truth assignments. An invalid argument could present as T T/T, T F/F, F F/F etc. What makes it invalid is that there will be a substitution where we get T T/F. A valid argument can also have multiple truth assignments. The valid argument about the snakes above was F F/F but it was still valid. The only substitution that we won't find with a valid argument is T T/F.

Valid arguments can have any combination of truth values for the premises and the conclusion EXCEPT true premises and a false conclusion.

T	T	T	T	F	F	F	F
T	T	F	F	T	T	F	F
F	T	T	F	T	F	T	F

Invalid arguments can have any combination of truth values for the premises and the conclusion.

Consider a couple more examples:

My job pays well and has benefits.
My job is fun.

In this case there is no well-defined pattern like we've had with previous examples but we can still determine the validity by following the definition. Is it possible for the premise to be true and the conclusion false? Yes. Just because a job pays well and has benefits, doesn't mean that the job will be fun. Invalid.

Zachary did not make the mess.
April did not make the mess.
Only Zachary, April and Madison were home today.
Thus, Madison made the mess.

If there are only three people who could have made the mess and two of them didn't do it, then it would have to be the case that the third person made the mess. If the premises are true, the conclusion would have to be true. Valid.

Soundness

It is good if our argument pattern is valid but that doesn't guarantee that the conclusion will be true. For example, an argument could be valid and have a false premise so the conclusion could be false as well. A valid argument guarantees us a true conclusion only when all of the premises are true. So, we need our arguments to be more than just valid. Ideally, we want our arguments to be sound.

An argument is **sound** if:
i) it is valid; and,
ii) the premises are true.

If a deductive argument fails on either one (or both) of these conditions then it is unsound.

Determine whether the following arguments are valid or invalid, sound or unsound.

All cats are reptiles.
All reptiles have fur.
Therefore, all cats have fur.

Some Liberals are dentists.
Some Conservatives are not dentists.
Therefore, some Liberals are not Conservatives.

Consider the following two strange cases. Are these arguments valid or invalid?

Sam is a doctor.
Sam is not a doctor.
Therefore, I am Prime Minister.

I am Prime Minister.
The moon is made of green cheese.
Therefore, Sam is Sam.

What we can see from these two examples is that knowing an argument is valid does not mean that the premises will convince us that the conclusion is true. It doesn't even guarantee that the premises are even slightly related to the conclusion. When we know that an argument is valid, all we know is that there will be no instance when we use that argument pattern and come up with all true premises and a false conclusion.

Given the definitions of validity and soundness, are the following statements true or false?

Every argument with a false conclusion is invalid.

Every argument with a false premise is invalid.

Every argument with true premises and a false conclusion is invalid.

Every sound argument has a true conclusion.

Every argument with a true conclusion is sound.

Strength and Cogency

Validity and soundness are ways to evaluate deductive arguments. Inductive arguments are judged on grounds of strength and cogency. Remember that the intent with inductive arguments is different than with a deductive argument. With inductive arguments we are only trying to convince the reader that the conclusion is true to some degree of probability.

An inductive argument is **strong** if and only if:
it is improbable that the conclusion is false given that the premises are true.

Premise (True)
Premise (True)
Conclusion (>= 50% likely to be true)

So, when the premises of an inductively strong argument are true, the likelihood that the conclusion is true is equal to or greater than 50%. If the likelihood that the conclusion will be true (given true premises) is less than 50%, we say that the argument is weak.

Notice, we haven't really set the bar very high when it comes to strong arguments. The conclusion doesn't have to be very likely to be true, just more likely to be true than false.

Consider the following examples:

A vase was found broken on the floor and some money was missing from the safe. Therefore, someone must have burglarized the place.

Given the evidence that the vase has been broken and money is missing from the safe, it seems at least 50% likely that I've been burglarized. That doesn't mean that I've been burglarized for certain, only that it is at least 50% likely that that is what has gone on here.

My father likes fishing so your father will probably like fishing as well.

Now, if the only thing that these two people have in common is that they are fathers, it doesn't seem likely that they will both enjoy the same hobby. The evidence just isn't good enough to convince me that the conclusion is likely to be true.

As we saw with deductive arguments and validity, knowing that your inductive argument is strong doesn't mean that you'll have a conclusion that is likely to be true. What we really want from our inductive arguments is for them to be cogent. Cogency is very similar to soundness but it applies to inductive arguments.

An inductive argument is **cogent** if and only if:
i) it is a strong argument,
ii) it has true premises.

<u>Comparison of Deductive and Inductive Arguments</u>

Deductive and inductive arguments differ on a number of grounds.

1) Evaluation

We judge the pattern of deductive arguments to be valid or invalid. For inductive arguments, we determine if the evidence is sufficient to judge the conclusion to be true to some degree of probability. If the 50% threshold is met, we call the argument strong.

Inductive arguments are not intended to be valid so it is wrong to criticize them for a lack of validity.

2) Adding Premises

Adding premises to an inductive argument can undercut, perhaps completely, the support for the conclusion.

It was sunny two days ago.
It was sunny yesterday.
It will probably be sunny tomorrow.

It was sunny two days ago.
It was sunny yesterday.
It is raining today.
It will probably be sunny tomorrow.

Once we know that it is raining today, our belief in the conclusion decreases drastically.

Adding premises to a valid argument has a different effect. It turns out that once we know we have a valid argument, there are no premises that we can add to make it invalid.

If it is raining then the picnic will be cancelled.
It is raining.
The picnic will be cancelled.

If it is raining then the picnic will be cancelled.
It is raining.
It is not raining.
The picnic will be cancelled.

We may initially think that deductive arguments are actually better than inductive arguments because with deductive arguments you end up believing the conclusion to be true for certain. And who doesn't love certainty?

3) Belief in the Conclusion

However, we should not conclude that inductive arguments are somehow inferior to deductive arguments. Here is an illustration of why.

All geese are white. Deductive
The goose at the zoo will be white.

This goose is white. Inductive
The goose at the zoo will be white.

Consider the preceding arguments. Each argument concludes the same thing but the deductive argument convinces us that the conclusion is true for certain, whereas the inductive argument only convinces us that the conclusion is true to some degree of probability.

So, why don't we prefer the deductive argument? Well, compare the premises. In the deductive argument the premise is that "all geese are white". What would I have to do to know that that statement is true? To know that "all

geese are white" is true, I'd have to look at all geese for all time! Whereas I can easily know that "this goose is white" is true with a simple observation.

Deductive arguments do convince us that the conclusion is true for certain but it can be much harder to determine if the premises in deductive arguments are actually true. That's the tradeoff. In fact, these two kinds of arguments are intimately linked together. Often I know that sentences like "all geese are white" is true but I've seen a lot of geese, they've all been white and I inductively infer that "all geese are white". The deductive argument often depends on inductive reasoning to show that its premises are true.

Exercises – Determine if the following arguments are deductive or inductive and correspondingly valid/invalid and sound/unsound or strong/weak and cogent/uncogent.

Joe and I have similar tastes in food. Joe says that the food in the restaurant is first-rate. So I will find it first-rate.

Social welfare is by definition a handout to people who have not worked for it. But giving people money they have not earned through labour is not helping anyone. It follows then that social welfare does not help anyone.

Bachelors are unmarried. George is a bachelor. Thus, he does not have a wife.

Bachelors are unmarried, and George acts as if he's not married. He's a bachelor for sure.

The Counter Example Method

We have discussed what it means for a deductive argument to be valid or invalid but we have not yet presented a method to determine validity. Our first attempt at this will be by using the counter example method to show that an argument pattern is invalid.

Recall that an argument form, when shown to be valid, will always be valid (independent of the content).

All cats have fur.	All bleebs are goony.
All furry things shed.	All goony things are ript.
All cats shed.	All bleebs are ript.

The second argument has the same pattern as the first argument so if the first argument is valid, so is the second one (even though the words in the second argument do not make sense).

The same can be said for INVALID arguments. As long as both arguments have the same pattern, when we know that first argument is invalid, so must be the second.

All dogs are furry.	All whales like to eat.
All cats are furry.	All mammals like to eat.
All dogs are cats.	All whales are mammals.

Both of these arguments are invalid (even though the one on the right has all true premises).

So, to prove that an argument is INVALID we:

A) determine the form of the argument.
B) substitute content into the argument form that makes the premises obviously true and the conclusion obviously false.

Step 1: Get rid of all the language that is not logically necessary for the argument.

I found it very fascinating that orcas are in fact a kind of dolphin. Dolphins are known to be intelligent. Therefore, it is reasonable to say that orcas are intelligent as well.

All orcas are dolphins.
<u>All dolphins are intelligent.</u>
All orcas are intelligent.

Get rid of all premise and conclusion indicators. E.g. because, since, therefore. The indicator words are useful to help us place the sentences as premises above the line or as the conclusion below the line but once we have the sentences in place, the indicator words are no longer needed.

Keep all logical connectors like 'and', 'or','if … then', 'not', 'if and only if'. For categorical statements include 'all', 'some' and 'no'.

<u>Example</u>

All galaxies are structures that contain black holes in the center, so all galaxies are quasars, since all quasars are structures that contain black holes in the center.

All galaxies are structures that contain black holes in the center.
<u>All quasars are structures that contain black</u> <u>holes in the center.</u>
All galaxies are quasars.

Step 2: Determine the form (i.e. pattern) of the argument. Take out the sentence content and replace with letters.

All G are B.
<u>All Q are B.</u>
All G are Q.

Step 3: Replace the content of the argument so that the premises are obviously true and the conclusion is obviously false.

Hint: Try to make the conclusion false first.

G = ducks, B = swimmers, Q = fish

All ducks are swimmers. (T)
<u>All fish are swimmers.</u> (T)
All ducks are fish. (F)

The argument is invalid (because T T/F is possible). This means that the argument with the galaxies (that has the same pattern) is invalid as well.

What is wrong with the following substitution?

All surfers are good swimmers.
<u>All jet-skiers are good swimmers.</u>
All surfers are jet-skiers.

The substitutions must be made in a way that the premises are OBVIOUSLY TRUE and the conclusion is OBVIOUSLY FALSE.

<u>Exercises</u>

If taxes are increased then consumer spending will decrease.
If consumer spending does not decrease then more people will be employed.
Therefore, if more people are employed then we will increase taxes.

Hint: An if … then is false when the antecedent is true and the consequent is false.

If children fail to eat a good breakfast then they will be unable to concentrate in school.
Children are unable to concentrate in school.
So, children are failing to eat a good breakfast.

Hint: In this case the conclusion doesn't have much logical structure to it (it is just one sentence) so true to make one of the premises true. To make an if ..then statement true pick a necessary relationship between the antecedent and the consequent.

Special Case:

All bachelors are persons.	All B are P.
<u>All unmarried men are persons.</u>	<u>All U are P.</u>
Therefore, all bachelors are unmarried men.	All B are U.

This argument looks like it has an invalid form but the argument pattern is actually valid because the conclusion is always true. What has gone wrong here? The counter example method will work as long as the pattern you write down accurately reflects what is going on in the argument. Our mistake here was giving different letters to "bachelors" and to "unmarried men" when they are actually the same. The argument should have been written as:

All B are P.
All B are P.
All B are B.

There is no substitution that can make the premises true and the conclusion false.

Question: Can we use this method to prove an argument **valid**? That is, if we find a substitution instance that makes the premises and the conclusion obviously true, do we know that the argument is valid?

No. An argument with true premises and a true conclusion may be either valid or invalid. Only an argument with true premises and a false conclusion can be proven invalid. So, the counter example method can only be used to prove that an argument pattern is invalid. We will find a method later on that can help us prove that an argument pattern is valid.

Exercises

Some farm workers are not persons who are paid decent wages, because no illegal aliens are persons who are paid decent wages, and some illegal aliens are not farm workers.

If animal species are fixed and immutable, then evolution is a myth. Therefore, evolution is a myth, since animal species are not fixed and immutable.

All community colleges with low tuition are either schools with large enrollments or institutions supported by taxes. Therefore, all community colleges with low tuition are institutions supported by taxes.