Critical Reasoning:
A Romp Through the Foothills of Logic
Lecture Four: Deductive Validity

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Last week we learned:

- **that critical reasoning is normative not descriptive**
- **that there are two types of 'following from'**
- **that deductive arguments are:**
  - **truth preserving (when good)**
  - **such that their being good is an either/or matter**
  - **such that we can determine a priori whether they are good or not**
- **that inductive arguments are:**
  - **not truth preserving**
  - **such that their being good is a matter of degree**
  - **such that we can determine whether they are good or not only a posteriori**

What is it for an argument to be 'truth-preserving'?

Do all deductive arguments preserve the truth?

Why aren't inductive arguments truth-preserving?

What is it for arguments to be 'monotonic'?

Why is it always a matter of degree whether an inductive argument is good or bad?

What is the difference between *a* priori, and *a* posteriori knowledge?

Why is it possible to evaluate deductive arguments a priori?

Why is it possible to evaluate inductive argument only a posteriori?

So we now know what arguments are…

…and we know how to analyse them and set them out logic-book-style…

…and we know the key characteristics of…

…both deductive and inductive arguments

This week we shall learn how to evaluate deductive arguments

When a deductive argument is good it is VALID, and its premises ENTAIL its conclusion

When a deductive argument is bad it is INVALID

A deductive argument is valid…

…and its premises entail its conclusion…

…when and only when there is no logically possible situation…

… in which its premises are true…

…and its conclusion false

And a deductive argument is INVALID…

…whenever its premises fail to entail its conclusion…

…whenever there is a logically possible situation…

… in which its premises are true…

…and its conclusion false

One way in which to determine whether deductive arguments are valid…

… is simply to *learn* which argument forms are always valid…

… and which argument forms are never valid

Argument forms that are always valid include:

- **Modus Ponens: If *P*, then *Q*. *P*. Therefore, *Q*.**
- **Modus Tollens: If *P*, then *Q*. *Not-Q*. Therefore, *Not-P*.**
- **Generalisation: P, therefore P or Q (or Q, therefore P or Q)**
- **Specialisation: P. Q. Therefore P and Q**
  - **etc., etc., etc…**

Argument forms that are never valid include:

- **Denying the Antecedent: If P then Q. Not P. Therefore, not Q.**
- **Affirming the Consequent: If P, then Q. Q. Therefore, P.**
  - **etc., etc., etc…**

They can also be evaluated by means of truth tables (or tableaux):

P	Q	If P then Q	P	⊢	Q
T	T	T	T	✓	T
T	F	F	T	_	F
F	T	T	F	_	T
F	F	T	F	_	F

Try evaluating this argument:

P	Q	P and Q	P	I-	Q
T	T	T	T		T
T	F	F	T		F
F	T	F	F		T
F	F	F	F		F

But both these methods involve…

…learning how to formalise arguments…

…to eliminate the English and replace it with symbols…

…and we are doing *informal* not *formal* logic

In informal logic the best way to evaluate a deductive argument…

… is to set it out logic book style…

…construct the counterexample set…

… and ask whether the sentences of the counterexample set…

… are consistent

The counterexample set consists in the premises of the argument plus the negation of its conclusion

A set of sentences is *consistent* if there is a logically possible situation in which all the sentences are true together

On the LHS is an argument and on the RHS is its counterexample set

Deepak is a banker	Deepak is a banker
All bankers are rich	All bankers are rich
Therefore Deepak is rich	It is not the case that Deepak is rich

On the LHS is another argument and on the RHS is its counterexample set

All bankers are rich	**All bankers are rich**
Deepak is rich	**Deepak is rich**
Therefore Deepak is a banker	**It is not the case that Deepak is a banker**

Exercise One: Can you provide counterexamples to the following arguments:

1. **If anyone is caught cheating they will be sent down. Bill was sent down. So Bill must have been cheating.**

2. **It is not possible to assess the art of Damien Hirst because it would be possible to assess his art only if he were following rules and conventions. But he follows neither rules nor conventions.**

3. **If you live alone or only with someone who is mentally ill you are treated as a single person for the purposes of council tax. Jennifer pays council tax as a single person. Therefore either Jennifer lives alone or with a person who is mentally ill.**

4. **If Higgins was born in Bristol then he is not Cockney. Higgins is either Cockney or an impersonator. Therefore Higgins was born in Bristol.**

For a logician it is a sufficient condition of a deductive argument's being a good argument that it is valid

In every day life we want more of a deductive argument before we will count it as a good argument

Are these arguments valid?

Grass is green

Therefore 2+2=4

2+2=5

Therefore grass is green

Are these arguments 'good'?

These arguments are valid because of the 'paradoxes of entailment' which tell us that:

1. **if a deductive argument has contradictory premises then it is always valid (because there is no logical possibility of its premises being true, so no possibility either of its premises being true AND its conclusion false)**

2. **if an argument has a tautological conclusion then it is always valid (because there is no logical possibility of its conclusion being false, so no possibility either of its premises being true AND its conclusion false)**

The 'paradoxes of entailment' show us…

… that validity is not enough…

… to make an argument 'good' for everyday purposes…

…because for that we also need the premises…

… to be *relevant* to the conclusion

But beware because almost anything…

…can be ‘relevant’ to anything…

…given the right context

For example you might think this couldn't be a good argument:

'The sea is salt' is true

Therefore Melbourne is in Australia

But I can make it one by putting it in context

Context is very important in the evaluation of arguments…

…if my sat-nav tells me 'turn left' one minute….

…then 'turn right' the next minute…

…it is not being inconsistent* is it?

***A set of sentences is inconsistent if the sentences in the set can't all be true together**

And if I say 'I am hungry'…

… and you say 'I am not hungry'…

… there is no contradiction*

***two sentences are contradictory if they cannot be true together *and* they cannot be false together**

When you are evaluating an argument…

… you should be aware of the context…

… in which the argument is being used…

…(in these lectures we have been assuming that contexts are always constant)

Another thing we need in addition to validity…

…for the purposes of everyday life…

… is *soundness*

The fact that an argument is valid doesn't mean *either…*

… that its premises must be true…

… *or* that its conclusion must be true

A valid argument can have false premises *and* a false conclusion:

All fish have wings

Whales are fish

Therefore whales have wings

This is valid because if its premises *were* true it would be logically impossible for its conclusion to be false (it is truth-preserving)

A valid argument can have some true premises, some false premises and a false conclusion:

All fish have scales

Whales are fish

Therefore whales have scales

This is valid because if its premises *were* both true it would be logically impossible for its conclusion to be false (it is truth-preserving)

A valid argument can have false premises and a true conclusion:

All fish have lungs

Whales are fish

Whales have lungs

This is valid because if its premises *were* true it would be logically impossible for its conclusion to be false (it is truth-preserving)

If a deductive argument is INVALID this will *always* be because…

… its premises do not *entail* its conclusion…

…i.e. because it is *not* truth-preserving…

…in that it is logically possible for its premises to be true…

…*and* its conclusion false

But this doesn't mean that an invalid argument…

….must have false premises…

… *or* a false conclusion

An invalid argument can have false premises and a true conclusion:

All fish have scales

Whales have scales

Whales are not fish

This is invalid because even if its premises *were* true it would be logically possible for its conclusion to be false (it is *not* truth preserving)

An invalid argument can also have true premises and a true conclusion:

All normal cats meow

Dogs are not cats

Dogs don't meow

This is invalid because the truth of its premises do not guarantee that the conclusion is true. The truth of the conclusion is coincidental to the argument

Validity and Truth (i)

	True premises	False premises
True Conclusion	Could be valid or invalid	Could be valid or invalid
False Conclusion	**MUST BE INVALID**	Could be valid or invalid

Exercise two: Are the following statements true or false?

1. **If an argument is invalid it will have a false conclusion.**

2. **If an argument has true premises and a true conclusion it will be valid.**

3. **If the premises of an argument contradict each other the argument will be invalid.**

4. **An argument is valid if its premises are true and its conclusion false.**

If we are interested in the truth of our conclusions…

… as well as the validity of our arguments…

… then we will want our arguments to be *sound*…

… as well as valid

An argument is SOUND if…

… it is valid *and* such that its premises are true…

…given the nature of validity…

… the conclusion of such an argument…

…is logically guaranteed to be true

Validity and Truth (ii)

	True premises	False premises
Valid Argument	**SOUND**	**Unsound**
Invalid Argument	**Unsound**	**Unsound**

So there are two questions we must ask of an argument if we want to know whether its conclusion is true:

1. **is the argument valid?**

2. **are its premises true?**

So although to a logician an argument's being valid…

… suffices for its being good…

…in everyday life we also want…

… the argument's premises to be relevant to its conclusion…

… and we want the premises to be true

But is *this* a good argument?

Whales are mammals

Therefore whales are mammals

This argument is valid, sound and its premises…

… couldn't be more relevant to its conclusion…

…but it isn't in the slightest bit persuasive is it?

An argument is persuasive only if someone might accept the premises and yet deny the conclusion

No-one would accept the premise of this argument and yet deny its conclusion

The argument is *circular*…

…its conclusion is amongst its premises…

…all circular arguments are valid and relevant…

…and many of them are sound

Thanks to the monotonicity of validity, furthermore,…

… such arguments can often be persuasive…

…because we may not notice they are circular if they have lots of other premises

But even if we are persuaded by circular arguments…

…we *shouldn't* be…

…because we will be persuaded by the conclusion…

… if and only if we were antecedently persuaded by the premises…

So in order to evaluate a deductive argument we must ask the following questions:

1. **is it valid?**
2. **is it sound?**
3. **are its premises relevant to its conclusion?**
4. **is it circular?**

Exercise to do at home: Are the following arguments good? If so are they good in the everyday sense of 'good' or only in the logicians' sense of 'good'?

1. **Since many newly emerging nations do not have the capital resources necessary for sustained growth and they need sustained growth, they will continue to need capital resources from industrial nations.**

2. **Economic growth continues to be elusive. If economic growth continues to be elusive it will be necessary to engage in quantitative easing. But luckily the economy is growing. Therefore quantitative easing isn't necessary.**

3. **Premarital sex is wrong because premarital sex is fornication and fornication is a sin.**

4. **There is no-one named 'Bill' here: we have only female students and no female is named 'Bill'.**

This week we have learned:

- how to evaluate deductive arguments from the perspective of a logician
- how to evaluate deductive arguments from the perspective of everyday life
- about the paradoxes of entailment and the importance of context and relevance
- about what it is for an argument to be sound
- why circular arguments should not persuade us of anything despite the fact they are valid

To go with this lecture series, which I gave at the Department For Continuing Education, The University of Oxford (OUDCE) in Michaelmas Term 2012, there is an e-book and a short (ten week) online course run by OUDCE.

Both are entitled: *Critical Reasoning: A Romp Through the Foothills of Logic*

- **The book, by Marianne Talbot, will soon be available from all good e-book providers (follow me on Twitter @oxphil_marianne to find out when it will be released)**

- **Further details of the course can be accessed here: http://www.conted.ox.ac.uk/courses/online/short/subject.php?course_subject=Philosophy**

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That's it for today folks.

Next week we'll be looking at how to evaluate inductive arguments