

## *Logic*

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Logic is the study of right or correct thinking. It focuses upon the analysis and construction of arguments. An argument is the reasons given for one's opinion. One's opinion should be supported by statements, sometimes called propositions or premises. The study of logic insures that these statements provide an acceptable inference to the conclusions.

Premise #1 (Reason #1)

Premise #2 (Reason #2)

Conclusion

### **DEDUCTIVE ARGUMENTS**

A deductive argument is one where the conclusion necessarily follows from the premises. It is an argument from a general principle to a specific example. Deductive arguments are said to yield *necessity*. A deductive argument is *valid* when following the correct form. Consider the following example:

#### Example #1:

All men are mortal.

Socrates is a man.

Therefore, Socrates is mortal.

The conclusion (3) necessarily follows from the premises (1 and 2). If all men have the characteristic of mortality and if Socrates is included in the group of men, then he must have the characteristic that the entire group has, namely mortality. The general principle of all men being mortal is applied to the specific example of Socrates. It is very

important that the first premise state a general principle. General principles are indicated by a universal qualifier such as “all,” “any,” “every,” “none,” and “no.”

Upon closer analysis, we find that the conclusion follows necessarily from the premises because it follows this particular form:

Example #2:

All A's = B.

C = A

Therefore, C = B

Again, if all A's are B, and if C is an A, then C must also be a B.

It is interesting to note that this form will produce a logically necessarily conclusion even if the premises are not true. Consider the following example:

Example #3:

All men have brown hair.

Joe is a man.

Therefore, Joe has brown hair.

This conclusion (3) follows necessarily from the premises (1 and 2) even though the premises (1 and 2) and not in fact true. It follows necessarily because of the form. This is a valid deductive argument. You see that it is possible to have a valid deductive argument that is in fact not true, as example #3 demonstrates.

When the premises are true, we say that the deductive argument is *sound*. Example #1 is such an example. It is true, in fact, that all men are mortal and that Socrates is a man, therefore, Socrates must be mortal.

There are four other deductive argument forms that are important to know. They are called *modus ponens*, *modus tollens*, *disjunctive syllogism*, and *reduction ad absurdum*.

### **Modus Ponens (MP)**

*Modus Ponens* means affirming the antecedent. In an “if, then” statement the first term is called the antecedent and the second term is called the consequent. For example:

Example #4:

If A (antecedent), then B (consequent).

The *Modus Ponens* form indicates that if we affirm the antecedent, or if the antecedent is true, then we can affirm the consequent, or the consequent will be true. Consider the following examples:

Example #5:

If P, then Q.  
We have P  
Therefore, we can affirm Q

Example #6:

If Mary is a mother (P), then she must be a woman (Q).  
Mary is a mother (P).  
Therefore, she must be a woman (Q).

Because the previous argument is also naturally true, it provides us an opportunity to see what happens if we affirm the consequent, which is an *invalid* form. Consider the following example:

Example #7:

If Mary is a mother (P), then she must be a woman (Q).  
Mary is a woman (Q).  
Therefore, she must be a mother (P).

We know from experience that this conclusion is not true because not all women are mothers. Therefore the form that was used, affirming the consequent has yielded a false conclusion and is therefore *invalid*.

**Modus Tollens (MT)**

*Modus Tollens* means denying the consequent. The *Modus Tollens* form indicates that if we deny the consequent, or if the consequent is not true, then we must also deny the antecedent, or the antecedent is not true. Consider the following examples:

Example #8:

If P, then Q.  
We do not have Q.  
Therefore, we do not have P.

Example #9:

If Mary is a mother (P), then she must be a woman (Q).  
Mary is not a woman (-Q)  
Therefore she cannot be mother (-P)

Because the pervious argument is also naturally true, it provides us an opportunity to see what happens if we affirm the consequent, which is an *invalid* form. Consider the following example:

Example: #10:

If Mary is a mother (P), then she is a woman (Q).  
Mary is not a mother (-P).  
Therefore, she cannot be a woman (-Q)

Again, we know from experience that this conclusion is not true because not all women are mothers. Therefore the form that was used, affirming the consequent has yielded a false conclusion and is therefore *invalid*.

**Disjunctive Syllogism (DS)**

*Disjunctive syllogism* means deny the disjunct. In an “either / or” statement, each term is called a disjunct. Consider the following examples:

Example #11:

Either P or Q.		1. Either P or Q.
Not P.	or	2. Not Q.
Therefore Q.		3. Therefore P.

Example #12:

I have either \$5 (P) or \$10 in my pocket (Q).  
I don't have \$5 (-P).  
Therefore, I must have \$10 (Q).

**Reductio ad Absurdem (RAA)**

*Reductio ad Absurdem* means reduce to an absurdity. In logic an absurdity is a

contradiction. Therefore, a *reduction* argument reduces an opponent's argument to a contradiction, which renders it illogical and therefore incorrect. Consider the following example:

Example #13:

You have said there is no absolute truth (-A).

But if there is no absolute truth, then no one ever makes a statement that is absolutely true (If -A, then -B).

But if no one ever makes a statement that is absolutely true, then the statement that there is no absolute truth cannot be absolutely true (If -B, then -C).

But you have purported to state a statement that is absolutely true (A), namely that there is no absolute truth.

Therefore, you have said there is no absolute truth (-A) and there is at least one absolute truth (A).

Therefore, your statement that there is no absolute truth is not true because it leads to a logical contradiction (Both A and -A).

The statement "there is no absolute truth," claims to be an absolute truth by asserting that there is absolutely no truth that is absolute. From the *reduction ad absurdum* argument, we can clearly see that this is an inherently false assertion. In other words, there is absolute truth.

## INDUCTIVE ARGUMENTS

An inductive argument is one where the conclusion follows *probably* from the premises. It is an argument from specific examples to a general principle. Inductive argument are said to yield *probability*. Consider the following example:

Example: #14:

Island A has palm trees.

Island B has palm trees.

Island C has palm trees.

Therefore, all islands have palm trees.

The conclusion (4) does not necessarily follow the premises (1, 2, and 3). It might

be true, give the information in the premises, but it does not *necessarily* have to be true. We speak of *strong* and *weak* inductive arguments based upon the amount of evidence presented in the premises. The more evidence presented in the premises, the stronger the argument.

Given the nature of deductive and inductive arguments, *sound* deductive arguments are always to be preferred. But there are times when a deductive argument simply cannot be used. For example, when General Motors wants to demonstrate the safety of its cars, it can only test a small percentage of the total cars it manufactures because the testing process destroys the cars. It may test only 1% of the total number of cars it has manufactured during the year. But it infers the same safety standards of that 1% to the entire number manufactured. If General Motors wanted to develop a deductive argument for the safety of its cars it would have to test all its cars, which would mean the destruction of all the cars it manufactured. Obviously it cannot do that, therefore an inductive argument is acceptable.

### **ABDUCTIVE ARGUMENTS**

First formulated by the American philosopher Charles S. Peirce (1839-1914), abductive reasoning is better known as “inference to the best explanation.” Like inductive arguments, abductive reasoning yields *probability*. Abductive reasoning is used in evaluating competing explanations or hypotheses.

There are four criteria philosophers use to determine the best explanation of observed phenomena. They are:

- Do any of the competing explanations conflict with established background knowledge?
- Is there more evidence supporting one explanation than the others?
- Is there more evidence against one than the others?
- Which explanation is simpler?

For example, suppose scientists are trying to determine the origin of the great statues on Easter Island. Further suppose that there are only two competing hypotheses. Hypothesis #1 (H1) says that the statues are the product of aliens from another planet. Hypothesis #2 (H2) says that the statues are the product of ancient human beings who were very ingenious in their artistic and construction techniques. How are the scientists to

determine the best explanation? They can apply abductive reasoning to find the inference to the best explanation.

Consider the first criterion; does H1 or H2 conflict with established background knowledge? The answer is yes! H1 conflicts with the established background knowledge that aliens do not exist. Therefore, according to this criterion, H2 is the better explanation.

Consider the second criterion; is there more supporting evidence for one H1 or H2? The answer is yes! There is empirical evidence that ancient human beings designed and constructed extraordinary objects, such as the Pyramids in Egypt and The Mayan Temples in South American. There is no empirical evidence that aliens even exist, let alone designed and built anything on earth. Therefore, according to this criterion, H2 is the better explanation.

Consider the third criterion; is there more evidence against H1 or H2? There is more evidence against H1 because there is no empirical evidence that aliens ever existed on earth and therefore there is no evidence that these non-existent aliens ever designed and built anything on earth. There is evidence that ancient people existed, designed and build objects on earth. Therefore, according to this criterion, H2 is the better explanation.

Consider the fourth criterion; which is the simpler explanation H1 or H2? Here they both seem to be equal. Neither seems to be more complex. So let's say they tie on this criterion.

Considering all the criteria, H2 provides the best explanation for the statues on Easter Island.

## FALLACIES

There are a number of common fallacies of reasoning that you need to be familiar with. A fallacy is an argument that sounds logical but upon closer inspection is found to be unsound.

### *Ad Hominem Argument (Arguing Against the Man):*

This fallacy attacks the person instead of the issue. For example, when two candidates are debating and one candidate attacks the other candidate's morality instead of the issues.

### *Arguing in a Circle (Begging the Question):*

This fallacy occurs when you assume to be true that which you are trying to prove. For example, you believe in God because the Bible tells you so and you believe in the

Bible because it's the Word of God. You have assumed the existence of God as the foundation for the Bible and appealed to the Bible to prove God's existence.

*False Dilemma (Only Two Choices):*

This fallacy occurs when only two choices are offered, when in fact there are several. For example if a young woman gets pregnant and a counselor tells her that her only choices are an abortion or bringing up the child herself. These are not the only two choices because she could have the baby and then give it up for adoption.

*Slippery Slope Fallacy (The Edge of the Wedge Argument):*

This fallacy occurs when it is assumed that if one thing is allowed to happen, another very undesirable thing which inevitably follows. For example, during the Vietnam War it was argued that if Vietnam fell to the communists, all of Southeast Asia would follow. Vietnam did eventually fall to the communists, but all of Southeast Asia did not become communists.

*Straw Man Argument:*

This fallacy occurs when an opponent's position is restated as an inferior position and then this inferior version is argued against. This is an intentional distortion of an opponent's position. For example, a candidate might argue for a reduction in taxes, which most people would like. His opponent restates this position as attacking social programs designed to help the poor because these programs are supported by taxes. Because it is difficult to argue against reducing taxes, this position is intentionally distorted, and then the distorted position is argued against.

*Argument from Ignorance:*

Arguments of this form assume that since something has not been proven false, it is therefore true. Conversely, such an argument may assume that since something has not been proven true, it is therefore false. (This is a special case of a false dilemma since it assumes that all propositions must either be known to be true or known to be false.) As Davis writes, "Lack of proof is not proof."

*Equivocation:*

The same word is used with two different meanings. For example: A plane is a carpenter's tool, and the Boeing 747 is a plane, therefore the Boeing 747 is a carpenter's tool.