Categorical Syllogisms

I readily own, that all right reasoning may be reduced to Aristotle's forms of syllogism.

John Locke

Some logical arguments contain premises that are intended to provide conclusive support for their conclusions. Such arguments are called deductive arguments, and are the concern of this part of our study. A deductive argument is an argument whose premises are intended to provide conclusive support for its conclusion. In this chapter, we will study a special kind of deductive argument called a syllogism and the six rules which tell us with logical certainty whether or not the argument's form is valid.

VALIDITY

Validity is a formal property of deductive arguments. A deductive argument is valid when it is impossible for its premises to be true and its conclusion false. Put another way: A deductive argument is valid when the relationship between the premises and conclusion is such that if the premises were all true, then the conclusion would have to be true. Let's look at two examples:

A. All chairs are red.
   George Bush is a chair.
   George Bush is red.

and

B. All humans are mortal.
   George Bush is human.
   George Bush is mortal.
<table>
<thead>
<tr>
<th>Categorical Proposition</th>
<th>Designation</th>
<th>Quantity</th>
<th>Quality</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>All $S$ is $P$</td>
<td>$A$</td>
<td>universal</td>
<td>affirmative</td>
<td>subject only</td>
</tr>
<tr>
<td>No $S$ is $P$</td>
<td>$E$</td>
<td>universal</td>
<td>negative</td>
<td>subject and predicate</td>
</tr>
<tr>
<td>Some $S$ is $P$</td>
<td>$I$</td>
<td>particular</td>
<td>affirmative</td>
<td>neither subject</td>
</tr>
<tr>
<td>Some $S$ is not $P$</td>
<td>$O$</td>
<td>particular</td>
<td>negative</td>
<td>predicate only</td>
</tr>
</tbody>
</table>

**EXERCISE 8–3**

Name the form of each of the following propositions and what it distributes.

1. Some children are lovers of ice cream.
2. No revolutionary is a believer in the status quo.
3. All men in combat are soldiers under extraordinary pressure.
4. All noncombatants earning combat pay are shameless individuals.
5. Some film projectionists are not members of a union.
6. Compared with foreign automobile manufacturers, some American automobile manufacturers, despite various pressures, are reluctant observers of the public interest.
7. Some nonmartial arts are not exercises that are lacking in physical courage.
8. All students, some of whom are under twenty-one, are advocates of more tax money spent on education.
9. Some colors of the rainbow are not hues seen anywhere else.
10. Some lives are tragedies that we write, direct, and star in.

**The Simplified Square of Contradiction**

If we compare the diagrams for each of the four standard-form categorical propositions, we observe an interesting pattern. $A$ propositions assert that the class of $S$ and not-$P$ is empty, while $O$ propositions assert that the class of $S$ and not-$P$ contains at least one member:
1. The conclusion determines the major and minor terms of a categorical syllogism.

2. The *major term* is always the *same term as the predicate* of the conclusion.

3. The *minor term* is always the *same term as the subject* of the conclusion.

4. The *middle term* is not in the conclusion but is *common to each premise*.

Remember, look to the conclusion to determine the major and minor term. Once we have identified the components of the syllogism, determining its form is a matter of mechanics.

**EXERCISE 8-5**

In the following syllogisms (1) state the three terms; (2) state the major and minor terms; (3) state the major and minor premises; and (4) order them correctly, assuming the last statements in 1 through 5 are the conclusions.

1. All political candidates are seekers of offices.
   Some political candidates are Republicans.
   Some Republicans are seekers of offices.

2. No true sportsman is a cheater.
   All cheaters are dishonest persons.
   No dishonest person is a true sportsman.

3. Some animals are not endangered species.
   All endangered species are precious creatures.
   Some animals are not precious creatures.

4. Some epicureans are lovers of wine.
   Some epicureans are lovers of women.
   Some lovers of wine are lovers of women.

5. All pollutants are disease carriers.
   All cigarettes are disease carriers.
   All cigarettes are pollutants.

6. All men are equal citizens and all equal citizens are persons entitled to due process.
   Therefore all men are persons entitled to due process.

7. Some countries are belligerents and no belligerents are peace lovers. It follows that some countries are not peace lovers.
trespasser. What if someone says, "No lawbreaker is a good citizen"; does this imply the existence of a lawbreaker? No, it doesn't. But "Some lawbreakers are not good citizens" does logically imply the existence of at least one lawbreaker. Consider this argument:

No lawbreakers are good citizens.
All speeders are lawbreakers.
Some speeders are not good citizens.

The argument is invalid. It's invalid because the conclusion makes an existential claim that its premises just do not allow; the conclusion states that there exists at least one speeder, but the premises don't contain any such implication. The argument is said to commit the existential fallacy. Any syllogism whose premises consist of universal propositions (A or E) and whose conclusion is a particular proposition (I or O) commits the existential fallacy and is thereby invalid.

Summarizing, the six rules and their accompanying fallacies are

Rule 1: A valid standard-form categorical syllogism must contain three, and no more than three, terms; otherwise it commits the fallacy of four terms.

Rule 2: A valid standard-form categorical syllogism must distribute its middle term at least once; otherwise it commits the fallacy of undistributed middle term.

Rule 3: A standard-form categorical syllogism must not say more in its conclusion than its premises allow. If it distributes its major term (P) in the conclusion but not in the major premise, it commits the fallacy of illicit major term; if it distributes its minor term (S) in the conclusion but not in the minor premise, it commits the fallacy of illicit minor term.

Rule 4: A valid standard-form categorical syllogism must not contain two negative premises; otherwise it commits the fallacy of exclusive premises.

Rule 5: A valid standard-form categorical syllogism must not draw an affirmative conclusion from a negative premise; otherwise it commits the fallacy of drawing an affirmative conclusion from a negative premise.

Rule 6: A valid standard-form categorical syllogism must not draw a particular conclusion from two universal premises; otherwise it commits the existential fallacy.

So much for standard-form categorical syllogisms. At the beginning of our study of the syllogism, we mentioned that the categorical syllogism is only one kind of syllogistic argument and that there are two other kinds as well. These are easy to handle, but they do occur frequently enough for us to be alerted to them. So in Chapter 10 we'll take up validity as it applies to disjunctive and conditional syllogisms. But before that, we must consider the important topic of argument reconstruction.
EXERCISE 8–8*

*A. Determine the validity of the following syllogisms by means of rules and their fallacies. If a syllogism breaks a rule, identify by name the broken rule and the fallacy. Give the form of each syllogism.

1. No refined foods are nutritional foods. So no white flour is a nutritional food because no refined foods are white flour.

2. Some people who believe in astronaut-gods are gullible readers and all gullible readers are fans of the book *Chariots of the Gods*; therefore, some fans of the book *Chariots of the Gods* are people who believe in astronaut-gods.

3. Some extrasensory experiences are not just the products of imagination because some products of imagination are things explained through sense data, and no things explained through sense data are extrasensory experiences.

4. Some professors are not idealists and all professors are college graduates. Therefore some idealists are not college graduates.

5. Since some ministers are not happy men, some ministers are not alcoholics, for no alcoholics are happy men.

6. All good teachers are good administrators because all good teachers are compassionate individuals and all compassionate individuals are good administrators.

7. It follows that some Americans are coffee lovers from the facts that some Americans are not tea lovers and no tea lovers are coffee lovers.

8. All horses are quadrupeds; so, because some horses are faster runners than humans, some quadrupeds are faster runners than humans.

9. Some inventors are people who know how to make money, for all inventors are imaginative individuals and all imaginative individuals are people who know how to make money.

10. All missionaries are altruists and some altruists are women. Thus, some missionaries are women.

11. No professional athletes are welfare recipients because no professional athletes are low-income earners, and all welfare recipients are low-income earners.

12. Some politicians are persons of integrity. Thus some entertainers are politicians, for some entertainers are persons of integrity.
13. All victims of injustice are members of oppressed groups, so, because all blacks are members of oppressed groups, all blacks are victims of injustice.

14. It follows that some American Indians are not exponents of the traditional account of American history because no American Indians are people dealt with fairly in American history books, and no one dealt with fairly in American history books is an exponent of the traditional account of American history.

15. Some explosives are chemicals, from which it follows that some purchasable items are not chemicals because no explosives are purchasable items.

16. Some wealthy people are millionaires because some millionaires are possessors of large sums of money and all possessors of large sums of money are wealthy people.

17. Some persons without sin are ones who should cast the first stone. So no person is one who should cast the first stone because no person is a person without sin.

18. Some newspapers are not true accounts of what’s happened, for all true accounts of what’s happened are complete and accurate sources of information, and some newspapers are not complete and accurate sources of information.

19. Because some movies are films for adults, some movies are not films for children, as no films for adults are films for children.

20. All roads are ways that lead to Rome and all roads are potential dead ends. Thus, all ways that lead to Rome are potential dead ends.

B. Test the validity of these forms:

1. $AAA-4$
2. $IOO-3$
3. $AII-4$
4. $OAO-2$
5. $EOO-1$
6. $OAI-1$
7. $AEE-2$
8. $OIO-3$
9. $IOI-1$
10. $IAI-3$
11. $OAO-2$
12. $EAO-1$
13. $IAA-3$
14. $OEO-4$
15. $AAA-3$
16. $IOO-1$
17. $EEO-3$
18. $AEE-4$
19. $AEO-4$
20. $EIO-3$
1. Since no barbers are qualified to practice medicine, all those qualified to practice medicine have been to college because no barbers have been to college.
2. Since some apples are fruits and some apples are red objects, some red objects are fruits.
3. If some women are college graduates, and all college graduates are high school graduates, then some high school graduates are women.
4. Some professional organizations that charge dues are not organizations worth belonging to. Some organizations worth belonging to are elite clubs. Consequently, some elite clubs are not organizations worth belonging to.
5. Some Chevrolets are overpriced lemons, and some overpriced lemons are selling like hot cakes, so some Chevrolets are selling like hot cakes.
6. If we assume that no signs of forced entry were present at the scene of the crime, we can conclude that the defendant is innocent.
7. All horses are quadrupeds. No humans are horses. Thus no humans are quadrupeds.
8. All horses are quadrupeds. No horses are human. Thus no quadrupeds are human.
9. All flour fit for consumption is ground. All places on which houses are built are ground. Therefore all places on which houses are built are fit for consumption.
10. All Communists are atheists. No atheists are good citizens. So some Communists are not good citizens.
11. AEE-3
12. IOE-2
13. OOI-1
14. IOI-2
15. AAA-4
16. AAA-3
17. AEA-2
18. EAA-2
19. IAI-3
20. EIO-4
In this chapter we'll discuss two of the most common patterns of deductive reasoning—patterns we naturally use as part of our everyday reasoning. We will also reinforce and add to our understanding of the concept of logical form. We will learn to recognize the forms of three nonstandard syllogisms and also how to simplify them. In Chapter 9 we learned how to "translate" or reconstruct syllogisms in ordinary language into standard-form categorical propositions. With the completion of this chapter, we will have a firm grasp on the basics of deductive reasoning and a supply of some basic analytic tools for handy reference.

We'll begin with a look at an argument form we encounter almost daily: the disjunctive syllogism.

**DISJUNCTIVE SYLLOGISMS**

We often find ourselves choosing between alternatives which we express in propositions containing the word or, as in, "Either you’re for me or you’re against me," or "Would you like soup or salad with that tofu, sir?" Notice that the preceding sentence contains alternative examples. In the common understanding of these examples—assuming the second occurs in a restaurant—the choice is between one alternative or the other. Trying to have both is implicitly forbidden. But sometimes alternatives allow for choosing one or the other or both, as in "Is the student a scholar or an athlete?" Both alternatives are possible in this case.

These examples remind us that in English we use the single word or in two senses. For example, in a statement on a restaurant menu such as "Dinner includes soup or salad," or means clearly either soup or salad but not both. This meaning, termed the "exclusive sense of or," is clear to most of us from the context: in this case, the context of a restaurant menu. But in "All those eligible for welfare are unemployed or infirm," or is used in a "weaker" sense known as the inclusive sense. In this example of the "weaker" sense, the statement asserts that one could be either unemployed or infirm and allows for the possibility of being both unemployed and infirm. The inclusive or asserts that at least one of the alternative statements is true. Thus, "All those eligible for welfare are at least unemployed or infirm."

The alternative statements joined by the inclusive or are called disjunctions. The statement including both disjuncts and the inclusive or is called a disjunction. A disjunction is true if either of the disjuncts is true. This is another way of saying that a disjunction is true whenever at least one of its disjuncts is true.

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**Study Hint**

Inclusive or asserts that at least one of the disjuncts is true.

A disjunction is false in only one case: when both disjuncts are false.

Recall that a syllogism consists of two premises and a conclusion. When a disjunction occurs as the premise of a syllogism, the syllogism is called a disjunctive syllogism. Valid disjunctive syllogisms contain a disjunction as one premise, the negation of one of the disjuncts as the second premise, and the affirmation of the
**remaining disjunct as the conclusion.** The basic form of valid disjunctive syllogisms looks like this:

\[
\begin{array}{c}
\text{Either this or that} \\
\text{not this} \\
\text{that}
\end{array}
\quad
\begin{array}{c}
\text{Either this or that} \\
\text{not that} \\
\text{this}
\end{array}
\]

Here’s an example:

Either some students are scholars or they are athletes.
Some students are not scholars.
Then some are athletes.

Notice that the second proposition negates (or denies) one of the disjuncts, and the conclusion affirms the other. Since to assert a disjunction is to assert that at least one of the disjuncts is true, we may validly infer such a conclusion if both premises are treated as being true. In our example, the conclusion “Then some are athletes” must logically follow. Let’s look at another example:

Either the plane has crashed or it’s been delayed.
The plane has not been delayed.
Therefore the plane has crashed.

Here, too, the second premise denies one of the disjuncts and the conclusion affirms the other. This is the same logical pattern—or form—as the first example. It, too, is valid.

On the other hand, consider this argument:

Either the plane has crashed or it’s been delayed.
The plane has been delayed.
Therefore the plane has not crashed.

Notice that the second premise does not deny either disjunct; rather it affirms one of them. Is it possible for both disjuncts to be true? Yes—that’s the meaning of disjunction. It allows for the possibility that the plane has been delayed and has also crashed: Our second premise is merely telling us that at least one of those two disjuncts is true. The meaning of disjunction, as defined above, only says that at least one disjunction must be true—it also always allows for the possibility that both might be. Consequently, the conclusion in this example does not follow from the premises with logical certainty—it goes beyond them. So this example is invalid.

Last, consider this example:

The Senator is qualified to be either President or Vice-President.
The Senator is qualified to be President.
Therefore she’s not qualified to be Vice-President.
As we've already noted, affirming one of the disjuncts does not deny the other. The conclusion, because it does not necessarily follow from the premises, is invalidly drawn. This argument, too, is invalid.

Using \( p \) and \( q \) to represent any two propositions, let's contrast the basic form of valid and invalid disjunctive syllogisms:

<table>
<thead>
<tr>
<th>valid disjunctive syllogism</th>
<th>invalid disjunctive syllogism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Either ( p ) or ( q )</td>
<td>Either ( p ) or ( q )</td>
</tr>
<tr>
<td>not ( p )</td>
<td>( p )</td>
</tr>
<tr>
<td>Therefore, ( q )</td>
<td>Therefore, not ( q )</td>
</tr>
</tbody>
</table>

**EXERCISE 10–1**

Determine the validity of the following disjunctive syllogisms.

1. There's either a fuel shortage or the government is lying.  
   There is a fuel shortage.  
   Therefore the government is not lying.

2. Either the general is guilty of obstructing justice or he's a patriot.  
   The general is no patriot.  
   Then the general is guilty of obstructing justice.

3. The United States either supports the Iraqis or the Kuwaitis in the Middle East.  
   The United States supports the Iraqis.  
   Therefore, the United States does not support the Kuwaitis.

4. Whether we like it or not—and we probably don't—we must either become energy self-sufficient or resign ourselves to international blackmail.  
   We must not resign ourselves to international blackmail.  
   Hence we must become energy self-sufficient.

5. The matter of the universe will continue to expand to extinction, or it will begin to contract, in which case another "big bang" will eventually occur.  
   The matter of the universe will continue to expand.  
   So the matter of the universe will not begin to contract and thus another "big bang" will not eventually occur.

6. Either all \( S \) is \( P \) or no \( S \) is \( P \).  
   Some \( S \) is not \( P \).  
   It follows that no \( S \) is \( P \).

7. Either some \( S \) is \( P \) or some \( S \) is not \( P \).  
   No \( S \) is \( P \).  
   Therefore some \( S \) is not \( P \).
8. Either all $S$ is $P$ or some $S$ is $P$.
   Some $S$ is not $P$.
   So some $S$ is $P$.

9. Either no $S$ is $P$ or some $S$ is not $P$.
   No $S$ is $P$.
   Then some $S$ is not $P$.

CONDITIONAL SYLLOGISMS

We sometimes express the conditions under which something will occur in "if . . . then" form as in, "If I have time, I'll drop your suit off at the cleaners," or "If you love me, you'll be nice to my dog." "If . . . then" statements assert a conditional relationship only. They do not promise or guarantee that those conditions will be met. I may not have time to drop your suit off at the cleaners, or you may not love me.

Certain "if . . . then" statements are called conditionals, hypotheticals, or implications. We'll call the statement that occurs between if and then the antecedent of the conditional, and we'll call the statement that follows then the consequent. This is a special kind of conditional known as a material conditional. (Other kinds of conditionals are logical, definitional, causal, and decisional. We are concerned only with material conditionals.)

Let's see how a material conditional statement is true by considering the following example: "If it's raining, the game is cancelled." This conditional is true provided that "the game is cancelled" is not false at the same time that "it is raining" is true. A conditional statement is true if and only if the consequent is not false and the antecedent true. Every conditional statement—whatever else it may mean—asserts this relationship: It denies that its antecedent is true and its conditional false. Although this may seem odd, remember that we are talking about only one type of conditional statement, the material conditional as logicians call it.

Conditional statements can occur as the premises of arguments. Consider the following syllogism:

If we begin recycling efforts immediately, we have a good chance of saving the environment.

We begin recycling efforts immediately.

We have a good chance of saving the environment.

This argument form is called a mixed-conditional syllogism. It is "mixed" because it contains a conditional premise and a second simple premise. If we look carefully at this argument we notice that the second premise affirms the antecedent of the conditional premise and the conclusion affirms the consequent. This form is valid. Such arguments are said to be in the affirmative mood: they are commonly referred to by their Latin name: modus ponens. Any time the second premise of a mixed
conditional syllogism affirms the antecedent of the conditional premise and the conclusion affirms its consequent, the syllogism is valid.

There's a fallacy that superficially resembles modus ponens:

If we begin recycling efforts immediately, we have a good chance of saving the environment.

We have a good chance of saving the environment.

We begin recycling efforts immediately.

Even if this conclusion is, in fact, true, it does not logically follow from the premises. Consider a very simple instance of the same fallacious pattern:

If my car is out of gas, it will not start.

My car will not start.

My car is out of gas.

Even if the conclusion is, in fact, true, the argument upon which it is based is flawed. Based only on the information provided in the premises, the conclusion "my car is out of gas" is too strong for the premises. Other factors may account for my car's not starting: bad battery, failed ignition, and so forth. Since a deductive argument is only valid when the premises entail the conclusion—a condition not met by these last two examples of mixed-conditional syllogisms. Any argument of this form is invalid because the form commits the fallacy of affirming the consequent. Compare modus ponens to affirming the consequent:

<table>
<thead>
<tr>
<th>modus ponens</th>
<th>fallacy of affirming the consequent</th>
</tr>
</thead>
<tbody>
<tr>
<td>If antecedent then consequent</td>
<td>If antecedent then consequent</td>
</tr>
<tr>
<td>antecedent</td>
<td>consequent</td>
</tr>
<tr>
<td>consequent</td>
<td>antecedent</td>
</tr>
</tbody>
</table>

Study Hint

Modus ponens is always valid; affirming the consequent never is.

Besides modus ponens, another valid form—modus tollens—of mixed-conditional syllogism denies the consequent as its second premise and denies the antecedent as its conclusion. Here's an example:

If we begin recycling efforts immediately, we have a good chance of saving the environment.

We don't have a good chance of saving the environment.

We're not beginning recycling efforts immediately.

We can compare the forms of modus ponens and modus tollens as follows:


### modus ponens

<table>
<thead>
<tr>
<th>If antecedent then consequent</th>
<th>antecedent</th>
<th>consequent</th>
</tr>
</thead>
</table>

### modus tollens

<table>
<thead>
<tr>
<th>If antecedent then consequent</th>
<th>not consequent</th>
<th>not antecedent</th>
</tr>
</thead>
</table>

To help see that arguments of this form, known as *modus tollens*, are valid, consider this simple instance:

If my car is safe to drive, then it has good brakes.
My car does not have good brakes.
My car is not safe to drive.

Just as we have to be wary of confusing *modus ponens* with the fallacy of affirming the consequent, we must be careful not to confuse *modus tollens* with the fallacy of denying the antecedent. Here’s an example of the fallacy of denying the antecedent:

If my car is safe to drive, then it has good brakes.
My car is not safe to drive.
My car does not have good brakes.

Based only on the premises, the conclusion “my car does not have good brakes” does not follow. The conditional relationship asserts only that it is not possible for the antecedent to be true and the consequent false. In other words, the occurrence of the antecedent guarantees the occurrence of the consequent. This relationship only goes in one direction. We cannot, for example, reverse the antecedent and consequent and retain the original conditional relationship. “If my car is safe to drive, then it has good brakes” is not equivalent to “If my car has good brakes, then it is safe to drive.” Yet this is exactly what the fallacy of denying the antecedent assumes. Compare *modus tollens* and the fallacy of denying the antecedent to see how these clearly differ:

### fallacy of denying the antecedent

<table>
<thead>
<tr>
<th>If antecedent then consequent</th>
<th>not consequent</th>
<th>not antecedent</th>
</tr>
</thead>
</table>

### Pure Conditional Syllogism

Sometimes, a conditional syllogism contains only conditional propositions, for example:

If Lisa has nightmares, then Nicky wakes up.
If Nicky wakes up, then Lina goes bonkers.
If Lisa has nightmares, then Lina goes bonkers.