

Categorical Syllogisms

5.1

Standard Form, Mood, and Figure

In the general sense of the term, a **syllogism** is a deductive argument consisting of two premises and one conclusion. Provisionally I will define a *categorical syllogism* as a syllogism consisting of three categorical propositions and containing a total of three different terms, each of which appears twice in distinct propositions. (I will give a more precise definition shortly.) The following argument is a categorical syllogism:

All soldiers are patriots.
 No traitors are patriots.
 Therefore, no traitors are soldiers.

Each of the three terms in a categorical syllogism has its own name depending on its position in the argument. The **major term**, by definition, is the predicate of the conclusion, and the **minor term** is the subject of the conclusion. The **middle term**, which provides the middle ground between the two premises, is the one that occurs once in each premise and does not occur in the conclusion. Thus, for the argument just given, the major term is "soldiers," the minor term is "traitors," and the middle term is "patriots."

The premises of a categorical syllogism also have their own names. The **major premise**, by definition, is the one that contains the major term, and the **minor premise** is the one that contains the minor term. Thus, in the syllogism just given the major premise is "All soldiers are patriots," and the minor premise is "No traitors are patriots." Now that we are supplied with these definitions, we may proceed to the idea of standard form. A **standard-form categorical syllogism** is one that meets the following four conditions:

1. All three statements are standard-form categorical propositions.
2. The two occurrences of each term are identical.
3. Each term is used in the same sense throughout the argument.
4. The major premise is listed first, the minor premise second, and the conclusion last.

The first condition requires that each statement have a proper quantifier, subject term, copula, and predicate term. The second condition is clear. The third rules out the possibility of equivocation. For example, if a syllogism containing the word "men" used that term in the sense of human beings in one statement and in the sense of male human beings in another statement, the syllogism would really contain more than three terms and would therefore not be in standard form. Finally, the fourth condition merely requires that the three statements be listed in the right order.

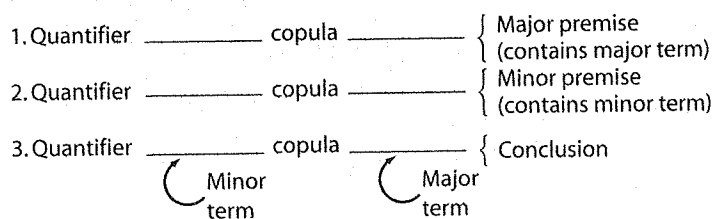
The syllogism about soldiers is in standard form because all four conditions are fulfilled. However, the following syllogism is not in standard form, because the fourth condition is violated:

All watercolors are paintings.
 Some watercolors are masterpieces.
 Therefore, some paintings are masterpieces.

To put this syllogism into standard form the order of the premises must be reversed. The major premise (the one containing "masterpieces," which is the predicate term in the conclusion) must be listed first, and the minor premise (the one containing "paintings," which is the subject term in the conclusion) must be listed second.

Now that we have a definition of standard-form categorical syllogism, we can give a more precise definition of categorical syllogism. A **categorical syllogism** is a deductive argument consisting of three categorical propositions that is capable of being translated into standard form. For an argument to qualify as a categorical syllogism, all three statements need not be standard-form categorical propositions; but if they are, the analysis is greatly simplified. For this reason, all of the syllogisms presented in the first four sections of this chapter will consist of statements that are in standard form. In later sections, techniques will be developed for translating non-standard-form syllogisms into equivalent arguments that are in standard form.

Standard form of a syllogism



After a categorical syllogism has been put into standard form, its validity or invalidity may be determined through mere inspection of the form. The individual form of a syllogism consists of two factors: mood and figure. The **mood** of a categorical syllogism consists of the letter names of the propositions that make it up. For example, if the major premise is an **A** proposition, the minor premise an **O** proposition, and the conclusion an **E** proposition, the mood is **AOE**. To determine the mood of a categorical

syllogism, one must first put the syllogism into standard form; the letter name of the statements may then be noted to the side of each. The mood of the syllogism is then designated by the order of these letters, reading the letter for the major premise first, the letter for the minor premise second, and the letter for the conclusion last.

The figure of a categorical syllogism is determined by the location of the two occurrences of the middle term in the premises. Four different arrangements are possible. If we let *S* represent the subject of the conclusion (minor term), *P* the predicate of the conclusion (major term), and *M* the middle term, and leave out the quantifiers and copulas, the four possible arrangements may be illustrated as follows:

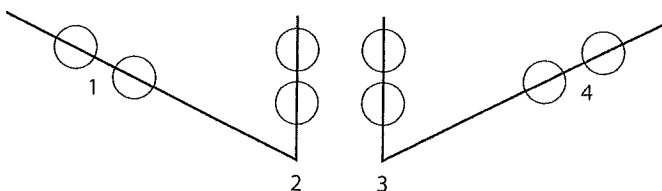
Figure 1	Figure 2	Figure 3	Figure 4
$\begin{array}{cc} \textcircled{M} & P \\ S & \textcircled{M} \\ \hline S & P \end{array}$	$\begin{array}{cc} P & \textcircled{M} \\ S & \textcircled{M} \\ \hline S & P \end{array}$	$\begin{array}{cc} \textcircled{M} & P \\ \textcircled{M} & S \\ \hline S & P \end{array}$	$\begin{array}{cc} P & \textcircled{M} \\ \textcircled{M} & S \\ \hline S & P \end{array}$

In the first figure the middle term is top left, bottom right; in the second, top right, bottom right, and so on. Example:

No painters are sculptors.
 Some sculptors are artists.
 Therefore, some artists are not painters.

This syllogism is in standard form. The mood is **EIO** and the figure is four. The form of the syllogism is therefore designated as **EIO-4**.

To remember how the four figures are defined, imagine the four possible arrangements of the middle term as depicting the outline of a shirt collar:



The only problem with this device is that it may lead you to confuse the second figure with the third. To avoid this confusion, keep in mind that for these two figures the *S* and *P* terms go on the same "collar flap" as the middle term. Thus, for the second figure *S* and *P* are to the left of the middle term, and for the third figure they are to the right.

Since there are four kinds of categorical propositions and there are three categorical propositions in a categorical syllogism, there are 64 possible moods ($4 \times 4 \times 4 = 64$). And since there are four different figures, there are 256 different forms of categorical syllogisms ($4 \times 64 = 256$).

Once the mood and figure of a syllogism is known, the validity of the syllogism can be determined by checking the mood and figure against a list of valid syllogistic forms. To do this, first adopt the Boolean standpoint and see if the syllogism's form appears in the following table of unconditionally valid forms. If it does, the syllogism is valid from the Boolean standpoint. In other words, it is valid regardless of whether its terms denote actually existing things.

Figure 1	Figure 2	Figure 3	Figure 4
AAA	EAE	IAI	AEE
EAE	AEE	AII	IAI
AII	EIO	OAO	EIO
EIO	AOO	EIO	

If the syllogism does not appear on the list of unconditionally valid forms, then adopt the Aristotelian standpoint and see if the syllogism's form appears in the following table of conditionally valid forms. If it does, the syllogism is valid from the Aristotelian standpoint on condition that a certain term (the "critical" term) denotes actually existing things. The required condition is stated in the last column.

Conditionally valid forms

Figure 1	Figure 2	Figure 3	Figure 4	Required condition
AAI	AEO		AEO	S exists
EAO	EAO			
		AAI	EAO	M exists
		EAO		
			AAI	P exists

For example, the AAI-1 is valid from the Aristotelian standpoint if the subject of the conclusion (the minor term) denotes actually existing things. The EAO-3 is valid if the middle term denotes actually existing things. Thus, if we are given an AAI-1 syllogism and the minor term is "cats," then the syllogism is valid from the Aristotelian standpoint. But if the minor term is "unicorns," then the syllogism is invalid. On the other hand, if the minor term is "students who failed the exam" and we are not certain if there are any such students, then the syllogism is conditionally valid.

The relationship between the Aristotelian standpoint and the Boolean standpoint is illustrated in the following bar graph:



Information conveyed by premises





The graph shows that when the premises of a syllogistic form are recognized as conveying information about existence, an additional nine forms become valid.

Interestingly, during the Middle Ages logic students used to memorize a little poem that served as a rule of thumb for distinguishing valid from invalid syllogisms. The vowels in the words identified the mood, and the words “prioris,” “secundae,” and so on the figure.

Barbara, Celarent, Darii, Ferioque prioris;
 Cesare, Camestres, Festino, Baroco secundae;
 Tertia, Darapti, Disamis, Datisi, Felapton,
 Bocardo, Ferison habet: quarta insuper addit
 Bramantip, Camenes, Dimaris, Fesapo, Fresison.

For example, the “Barbara” syllogism (this designation is still encountered today) is AAA-1, “Celarent” is EAE-1, and so on. This poem conforms substantially to the two tables given earlier, except that five forms have been left out. The reason these forms were left out is that the logicians of that time considered them weak: They draw a particular conclusion from premises that would support a (stronger) universal conclusion. For example, the weaker AAI-1 is left out in favor of the stronger AAA-1. Needless to say, few students today depend on this poem to distinguish valid from invalid syllogisms.

We have seen how, given the syllogism, we can obtain the mood and figure. But sometimes we need to go in the reverse direction: from the mood and figure to the syllogistic form. Suppose we are given the form EIO-4. To reconstruct the syllogistic form is easy. First use the mood to determine the skeleton of the form:

- E No _____ are _____.
- I Some _____ are _____.
- O Some _____ are not _____.

Then use the figure to determine the arrangement of the middle terms:

- E No _____ are *M*.
- I Some *M* are _____.
- O Some _____ are not _____.

Finally, supply the major and minor terms, using the letters *S* and *P* to designate the subject and predicate of the conclusion. The predicate of the conclusion is always repeated in the first premise, and the subject of the conclusion is repeated in the second premise:

- E No *P* are *M*.
- I Some *M* are *S*.
- O Some *S* are not *P*.

EXERCISE 5.1

- iLrn** I. The following syllogisms are in standard form. Identify the major, minor, and middle terms, as well as the mood and figure of each. Then use the two lists of valid syllogistic forms to determine whether each is valid from the Boolean standpoint, valid from the Aristotelian standpoint, or invalid.

- ★1. All neutron stars are things that produce intense gravity.
All neutron stars are extremely dense objects.
Therefore, all extremely dense objects are things that produce intense gravity.
- 2. No insects that eat mosquitoes are insects that should be killed.
All dragonflies are insects that eat mosquitoes.
Therefore, no dragonflies are insects that should be killed.
- 3. No environmentally produced diseases are inherited afflictions.
Some psychological disorders are not inherited afflictions.
Therefore, some psychological disorders are environmentally produced diseases.
- ★4. No people who mix fact with fantasy are good witnesses.
Some hypnotized people are people who mix fact with fantasy.
Therefore, some hypnotized people are not good witnesses.
- 5. All ozone molecules are good absorbers of ultraviolet rays.
All ozone molecules are things destroyed by chlorine.
Therefore, some things destroyed by chlorine are good absorbers of ultraviolet rays.

II. Put the following syllogisms into standard form, using letters to represent the terms, and name the mood and figure. Then use the two lists of valid syllogistic forms to determine whether each is valid from the Boolean standpoint, valid from the Aristotelian standpoint, or invalid.

- ★1. No Republicans are Democrats, so no Republicans are big spenders, since all big spenders are Democrats.
- 2. Some latchkey children are not kids who can stay out of trouble, for some youngsters prone to boredom are latchkey children, and no kids who can stay out of trouble are youngsters prone to boredom.
- 3. No rent-control proposals are regulations welcomed by landlords, and all regulations welcomed by landlords are measures that allow a free hand in raising rents. Therefore, some rent-control proposals are measures that allow a free hand in raising rents.
- ★4. Some insects that feed on milkweed are not foods suitable for birds, inasmuch as no monarch butterflies are foods suitable for birds and all monarch butterflies are insects that feed on milkweed.
- 5. No illegal aliens are people who have a right to welfare payments, and some migrant workers are illegal aliens. Thus, some people who have a right to welfare payments are migrant workers.
- 6. Some African nations are not countries deserving military aid, because some African nations are not upholders of human rights, and all countries deserving military aid are upholders of human rights.
- ★7. All pranksters are exasperating individuals, consequently some leprechauns are exasperating individuals, since all leprechauns are pranksters.
- 8. Some racists are not people suited to be immigration officials, given that some humanitarians are not people suited to be immigration officials, and no humanitarians are racists.

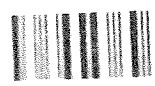


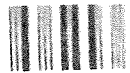
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- 9. No people who respect human life are terrorists, and all airline hijackers are terrorists. Hence, no airline hijackers are people who respect human life.
- ★10. Some silicates are crystalline substances, because all silicates are oxygen compounds, and some oxygen compounds are not crystalline substances.

III. Reconstruct the syllogistic forms from the following combinations of mood and figure.

- ★1. OAE-3
- 2. EIA-4
- 3. AII-3
- ★4. IAE-1
- 5. AOO-2
- 6. EAO-4
- ★7. AAA-1
- 8. EAO-2
- 9. OEI-3
- ★10. OEA-4

IV. Construct the following syllogisms.

- ★1. An EIO-2 syllogism with these terms: *major*: dogmatists; *minor*: theologians; *middle*: scholars who encourage free thinking.
- 2. An unconditionally valid syllogism in the first figure with a particular affirmative conclusion and these terms: *major*: people incapable of objective thought; *minor*: Supreme Court justices; *middle*: lockstep ideologues.
- 3. An unconditionally valid syllogism in the fourth figure having two universal premises and these terms: *major*: teenage suicides; *minor*: heroic episodes; *middle*: tragic occurrences.
- ★4. A valid syllogism having mood OAO and these terms: *major*: things capable of replicating by themselves; *minor*: structures that invade cells; *middle*: viruses.
- 5. A valid syllogism in the first figure having a universal negative conclusion and these terms: *major*: guarantees of marital happiness; *minor*: prenuptial agreements; *middle*: legally enforceable documents.

V. Answer "true" or "false" to the following statements.

- 1. Every syllogism is a categorical syllogism.
- 2. Some categorical syllogisms cannot be put into standard form.
- 3. The statements in a categorical syllogism need not be expressed in standard form.
- 4. The statements in a standard-form categorical syllogism need not be expressed in standard form.
- 5. In a standard-form categorical syllogism the two occurrences of each term must be identical.