

Unit 8

Categorical Syllogism

What is a syllogism?

Inference or reasoning is the process of passing from one or more propositions to another with some justification. This inference when expressed in language is called an argument. An argument consists of more than one proposition (premise and conclusion). The conclusion of an argument is the proposition that is affirmed on the basis of the other propositions of the argument. These other propositions which provide support or ground for the conclusion are called premises of the argument.

Inferences have been broadly divided as deductive and inductive. A deductive argument makes the claim that its conclusion is supported by its premises conclusively. An inductive argument, in contrast, does not make such a claim. It claims to support its conclusion only with some degrees of probability.

Deductive inferences are again divided into Immediate and Mediate.

Immediate inference is a kind of deductive inference in which the conclusion follows from one premise only. In mediate inference, on the other hand, the conclusion follows from more than one premise. Where there are only two premises, and the conclusion follows from them jointly, it is called syllogism.

A syllogism is a deductive argument in which a conclusion is inferred from two premises. The syllogisms with which we are concerned here are called categorical because they are arguments based on the categorical relations of classes or categories. Such relations are of three kinds.

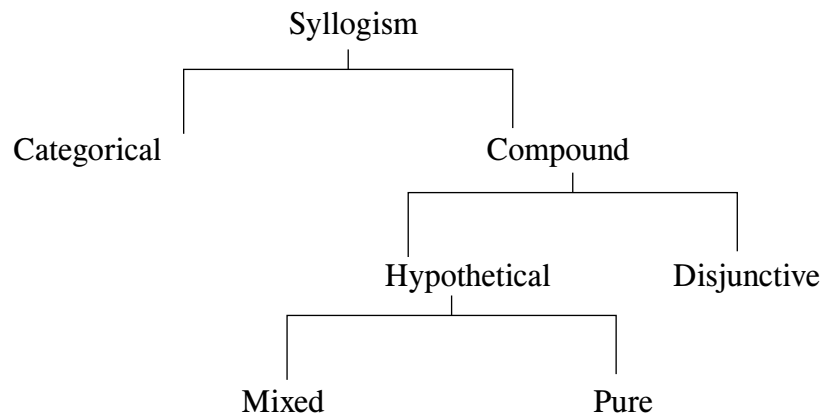
1. The whole of one class may be included in the other class such as
All dogs are mammals.
2. Some members of one class may be included in the other such as
Some chess players are females.
3. Two classes may not have anything in common such as
No man is perfect.

A categorical syllogism, thus, can be defined as a deductive argument consisting of three categorical propositions that together contain exactly three terms each of which occurs twice only.

Types of Syllogism

Before discussing the structure and rules of a valid syllogism, it is necessary to distinguish categorical

sylllogism from various other kinds of syllogism. These different kinds of syllogism can be shown by the following table:-



(Table - 1)

In a categorical syllogism all propositions (both the premises and conclusion) are categorical propositions that is A, E, I and O. For example :

All men are mortal

All players are men

Therefore, all players are mortal

In a compound syllogism one premise or both the premises and conclusion are compound propositions.

If it rains in time, then the crops will be good.

If crops is good, inflation will be controlled.

Therefore, if it rains in time, then inflation will be controlled.

(i) In mixed hypothetical syllogism, the major premise is hypothetical, the minor premise is categorical and the conclusion is also categorical. We have two forms of this kind of syllogism known as Modus Ponens and Modus Tollens. These two kinds can be understood by the following examples:

(i) If you work hard then you will pass.

You are working hard.

Therefore, you will pass.

This is an example of Modus Ponens where by affirming the antecedent we can affirm the consequent.

Symbolically, we can express it as:-

$$p \supset q$$

$$p$$

$$\therefore q$$

(ii) If the car runs, then there is fuel in its tank.

There is no fuel in its tank

Therefore, the car does not run.

The above is an example of Modus Tollens in which by denying the consequent, the antecedent is denied. Symbolically, we can express it as:-

$$p \supset q$$

$$\sim q$$

$$\therefore \sim p$$

In pure hypothetical syllogism all the premises and conclusion are hypothetical propositions. For example :

If there is scandal, then CM will resign

If CM resigns, then there will be mid-term election

Therefore, if there is scandal, then there will be mid-term election.

The other kind of compound syllogism is called disjunctive categorical. In this kind of syllogism the major premise is disjunctive, the minor is categorical and the conclusion is also categorical.

The simple rule for disjunction is that by denying one of the disjuncts, we can affirm the other one. It is based on the fact that both the disjuncts cannot be false together. So, if we deny one disjunct, we can thereby affirm the other one but not the other way round. Symbolically, one can express it as :

$$\text{Either } p \text{ or } q \quad p \vee q$$

$$\text{not } p \quad \sim p$$

$$\therefore q$$

After discussing the various kinds of syllogism, now we can turn to the structure of categorical syllogism.

Structure of Syllogism

A syllogism consists of three propositions of which two given propositions are called premises and the third proposition (which is inferred from the given propositions) is called conclusion. Each proposition consists of two terms. Therefore, a syllogism must consist of three terms and each one occurs twice. For example:

All self- confident persons are mentally strong.

No coward is mentally strong.

Therefore, no coward is self- confident person

The three categorical propositions in the above example contain exactly three terms that is 'self-confident person' 'mentally strong' and 'coward'. To identify the terms by name we look at the conclusion. The predicate of the conclusion is called the major term. The subject of the conclusion is called the minor term. The term which occurs in both the premises but not in the conclusion is called the middle term. In the above example, the term 'self-confident' person is the major term 'coward' is the minor term and 'mentally strong' is the middle term.

The premises of a syllogism also have names. Each premise is named after the term that appears in it. The premise that contains the major term is called the major premise. In the example 'self-confident person' is the major term, so the premise "All self-confident persons are mentally strong" is the major premise.

The premise containing the minor term is called the minor premise. In the example, 'coward' is the minor term so "No coward is mentally strong" is the minor premise. It is the minor premise not because of its position but because it is the premise that contains the minor term.

A syllogism is said to be in standard form when its premises are arranged in a specified standard order. In a standard form of syllogism, the major premise is always stated first, the minor premise is second and the conclusion is last. It may be noted that in the accepted usage the symbol M stands for the middle term, S stands for the minor term and P stands for the major term. Now, we can discuss the mood and the figure of a syllogism.

Mood of Syllogism

The mood of a syllogism is determined by the quantity and the quality of its constituent propositions or by the types of (A,E,I,O) standard form categorical propositions it contains. The mood of the syllogism is represented by three letters given in standard form order. The first letter represents the type of major premise, the second letter is for the minor premise and the last letter is for the conclusion.

- A All artists are egoists. (Major premise)
 I Some artists are pampers. (Minor premise)
 I Therefore, some pampers are egoists. (Conclusion)

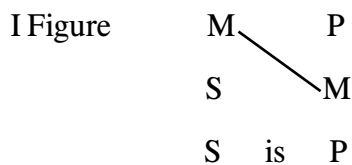
Figure of Syllogism

The mood of a standard form syllogism is not enough by itself to characterize its logical form. The syllogisms having the same mood may differ significantly in their forms depending on the relative positions of their middle terms. To know the form of a syllogism, we must state its mood and its figure.

The figure of a syllogism is determined by the position of the middle term in its premises. The middle term occurs in both the major and the minor premises but the position of the middle term is not the same in all syllogisms. There are four possible arrangements of the middle term in the two premises and, thus, there are four figures of a syllogism:-

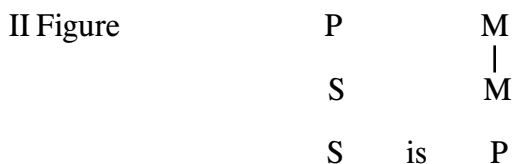
First Figure

In the first figure, the middle term is the subject of the major premise and predicate of the minor premise. Thus,



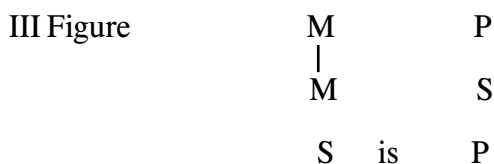
Second Figure

In the second Figure, the middle term is the predicate in both the premises. Thus,



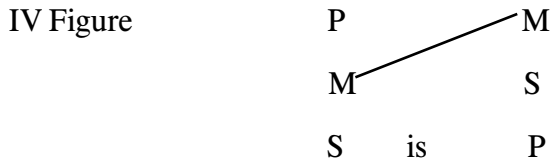
Third Figure

In the third figure, the middle term is the subject in both the premises. Thus,



Fourth Figure

In the fourth figure, the middle term is the predicate in the major premise and subject in the minor premise. It is exactly the opposite of the first figure. Thus,



Any standard form categorical syllogism is described completely when we specify its mood and its figure. If we take an example, we can understand it better. For example, in the following syllogism:-

- E No heroes are cowards.
- I Some soldiers are cowards.
- O Therefore, some soldiers are not heroes.

This syllogism is in the second figure where 'cowards', the middle term, is the predicate in both the premises. Its mood is EIO. It is completely described as a syllogism of the form EIO-2

Now we have to determine the conditions under which an argument is valid. To avoid common errors, the logicians have set forth certain rules. By observing these rules we can avoid the errors commonly made in such arguments. These rules also help in evaluating standard form syllogisms by observing whether any one of these rules has been violated.

We commit a mistake if we violate any one of these rules. Such mistakes are called fallacies. Since these mistakes are there in the form of the arguments, we call them formal fallacies. Now we shall understand the five rules to test the validity of syllogistic arguments.

Rules and Fallacies of Syllogism

- 1 Every syllogism must contain three and only three terms, each of which is used in the same sense throughout the arguments. Any violation of this rule leads to the fallacy of four terms.

For example

No man is made of paper

All pages are men

Therefore, no pages are made of paper.

The above argument commits the fallacy of four terms by using one term (minor term) in two different senses. The term 'page' means 'boy servant' in the minor premise while in the conclusions it means 'pages of a book'. In fact, the definition of categorical syllogism, by itself, indicates that by its nature every syllogism must have three and exactly three terms only.

- 2 According to this rule, the middle term must be distributed at least once in the premises. Otherwise, the connection required by the conclusion cannot be made. For example as in AAA - 2:

All virtuous persons are happy.

All rich men are happy.

Therefore, all rich men are virtuous.

The above arguments violate rule no.2 because the middle term 'happy' is not distributed even once in the premises. Hence, it commits the fallacy of undistributed middle. There is a need to link the minor and the major terms. If they are to be linked by the middle term, either the major or the minor term must be related to the whole class designated by the middle term. If it is not so then both the major and minor terms in the conclusion may be connected to different parts of middle term and thus will not be necessarily connected with each other.

- 3 The third rule again deals with the distribution of terms. According to this rule, no term can be distributed in the conclusion unless it is also distributed in the premise. This rule is based on the fundamental rule of deduction that the conclusion cannot be more general than the premises. It cannot say more than what is said in the premises. We know that a term is distributed when it is taken in its entire denotation. Hence, if a term is distributed in the conclusion without being distributed in the premises, it will say more than what is said in the premises. The premises, thus, will not entail the conclusion or the conclusion will go beyond its premises. The violation of this rule leads to the fallacy of illicit process. There are two different forms of illicit process. If the major term is distributed in the conclusion without being distributed in its premise, the fallacy committed is called the fallacy of illicit major.

For example in the following syllogism AEE-1:

All rational agents are accountable.

No animals are rational agents.

Therefore, no animals are accountable.

Here, in this argument, the major term 'accountable' is distributed in the conclusion without being distributed in the premise. This leads to the fallacy of 'illicit major.' Similarly, if the minor

term is distributed in the conclusion without being distributed in its premise, we commit the fallacy of 'illicit minor' as is apparent in the following AAA-3:

All men are mortal.

All men are rational.

Therefore, all rational beings are mortal.

Here, in this argument, the minor term 'rational being' is distributed in the conclusion without being distributed in the premise. This leads to the fallacy of illicit minor.

Hence we can say that in both kinds of such fallacies, the conclusion goes illicitly beyond what the premises say.

- 4 The fourth rule says that from two negative premises no conclusion follows. A negative proposition states that the predicate is denied of the subject. If both premises are negative that means there is exclusion of both extremes from the middle term, no connection between the extremes would be established. This rule follows from the same consideration as rule 2 about distribution of the middle term. Both the premises should refer to the same part of the middle term, either by inclusion in both cases or by inclusion in one case and exclusion in the other. Then only middle term can connect major term with minor term. A violation of this rule leads to the fallacy of exclusive premises. For example OEO in any figure, commits this fallacy.
- 5 The fifth rule states that if one premise is negative, the conclusion must be negative. It also states that if the conclusion is negative one premise must be negative.

A violation of this rule leads to the fallacy of drawing an affirmative conclusion from a negative premise. For example, AEA in any figure has this fallacy.

The above five rules are supposed to apply to all the standard form categorical syllogisms. They are adequately sufficient to test the validity of any argument. If an argument conforms to all these five rules, it is valid, otherwise invalid. These rules are based on quantity of propositions, distribution of terms (Rule No. 2 and 3) and quality of propositions. (Rule No. 4 and 5). In addition to these general rules there are certain corollaries which are applicable to all categorical syllogisms irrespective of their figures.

Corollaries

- 1 From two particular premises no conclusion follows:

This rule may be explained as:

If both the premises are particular then the possible combinations are II, IO, OI and OO. Now we can examine them one by one.

- II - If both the premises are II then no terms will be distributed then the result will be violation of rule no. 2 because the middle term will remain undistributed. This will lead to the fallacy of undistributed middle.
- OO - If both the premises are OO then both the premises will be negative. This will be violation of rule no. 4 according to which both the premises cannot be negative. It will lead to the fallacy of exclusive premises.
- OI&IO - In these two combinations, only one term will be distributed, the predicate of O proposition. Since one premises is negative the conclusion will also be negative. Being a negative conclusion it must distribute its predicate, i.e., the major term. According to rule no. 3 this major term should also be distributed in its premise to avoid the fallacy of illicit major. In the two premises, only one term is distributed. Hence, in attempting to draw a conclusion, we either commit the fallacy of illicit major or the fallacy of undistributed middle.

Thus, two particular premises yield no valid conclusion.

2. If one premise is particular the conclusion must be particular

This corollary can be understood by taking into consideration the wider rule of deduction which says that the conclusion must be implied by the premises. In other words the conclusion cannot be more general than the premises. Hence, if one premise is particular the conclusion has to be particular or violation of some rules of syllogism will make the argument fallacious.

3. If both premises are affirmative, the conclusion must be affirmative and vice-versa, if the conclusion be affirmative, both the premises must be affirmative

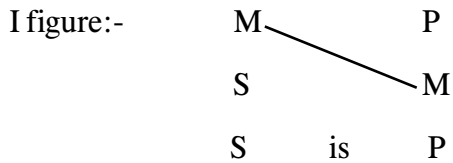
If both the premises be affirmative it means that the middle term has a connection with both the major and the minor term. From this, if we have to have a valid syllogism then in the conclusion the major term and the minor term must have some connection with each other i.e., the conclusion must be affirmative.

4. From a particular major and a negative minor no conclusion follows:

If the minor premise be negative, the major premise must be affirmative and the conclusion must be negative as per rules. The conclusion being negative, it will distribute its predicate i.e. the major term but the major premises being a particular affirmative does not distribute any term. Hence, all this will lead to the violation of rule no. 3 which clearly states that no term can be distributed in the conclusion unless it is also distributed in the premises. The result will be that we shall commit the fallacy of illicit major in our attempt to draw conclusion.

Special Rules of the first figure

1. The major premise must be universal :



If the major premise is not universal, it must be particular. If it is particular then the middle term is not distributed there because the middle term is the subject of the major premise. According to rules, the middle term must be distributed at least once in the premises. So, if not in the major premise, the middle term must be distributed in the minor premise. In the first figure the middle term is the predicate in the minor premise. To distribute the middle term the minor premise must be negative because only negative propositions distribute their predicate. Now, if the minor premise is negative the major must be affirmative and the conclusion negative.

We assumed in the beginning that the major premise is particular and now we know that it is affirmative. The major term which is distributed in the conclusion (which is negative) will not be distributed in the major premise which is particular affirmative, i.e., I proposition. Thus, our assumption that the major premise is particular leads to the fallacy of 'illicit major'. Thus, we prove that the major premise cannot be particular, it must be universal

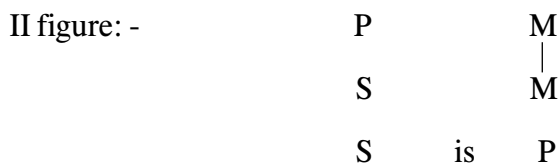
2. The minor premise must be affirmative:

If the minor premise is not affirmative then it must be negative. If the minor premise is negative, the major must be affirmative and the conclusion negative. The conclusion being negative will distribute its predicate, i.e., the major term. The major term in the major premise is the predicate which being affirmative will not distribute its major term.

Thus, if we assume the minor premise as negative we commit the fallacy of illicit major. The minor premise, therefore, must be affirmative.

Special Rules of the second figure

1. The major premise must be universal :



If the major premise is not universal, it must be particular and being particular, it will not distribute its subject which is the major term in the second figure. Since the major term is

undistributed in the major premise, it should not be distributed in the conclusion to avoid the fallacy of illicit major. In that case, the conclusion must be affirmative because only affirmative propositions do not distribute their predicate. Now, if the conclusion is affirmative, both the premises should also be affirmative. If it is so, the middle term will remain undistributed in both the premises because in the second figure, the middle term is the predicate in both the premises and affirmative propositions do not distribute their predicate. This will lead to the fallacy of undistributed middle. Hence, the major premise must be universal, it cannot be particular.

2. One of the premises must be negative :

In the second figure, the middle term is the predicate in both the premises. It is only negative propositions which distribute their predicate. Since the middle term must be distributed at least once in the premises, one of the premises must be negative to avoid the fallacy of undistributed middle.

Special Rules of the third figure

1. The minor premise must be affirmative :

III figure:-

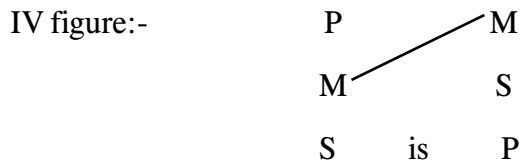
M	P
M	S
S	is
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If the minor premise is not affirmative, it must be negative and then the major premise must be affirmative and the conclusion negative. The conclusion being negative it will distribute its predicate, i.e., the major term. This major term should also be distributed in the major premise to avoid the fallacy of illicit major. The major term in the major premise is its predicate which being affirmative does not distribute its predicate, i.e., the major term. This is violation of rule no. 3 leading to the fallacy of illicit major. Hence, the minor premise must be affirmative in the third figure.

2. The conclusion must be particular:

In the third figure, the minor term is the predicate in the minor premise. As proved in the last special rule, this minor premise must be affirmative. If the minor premise is affirmative, it will not distribute its predicate, i.e., the minor term. This minor term should also be undistributed in the conclusion to avoid the fallacy of illicit minor. The minor term is the subject of the conclusion and will remain undistributed only if the conclusion is particular because universal propositions distribute their subject. The conclusion, thus, must be particular, or, we commit the fallacy of illicit minor.

Special Rules of the fourth figure



1. If the major premise be affirmative, the minor premise must be universal.

In the fourth figure, the middle term is the predicate in the major premise and if this premise is affirmative, the middle term will remain undistributed in the major premise. In the minor premise, the middle term is its subject and since only universal propositions distribute their subject so the minor premise must be universal to get the middle term distributed and thus avoid the fallacy of undistributed middle.

2. If the minor premise be affirmative the conclusion must be particular.

In the fourth figure, the minor term is the predicate in the minor premise. If the minor premise be affirmative, the minor term being its predicate will remain undistributed in the premise and therefore cannot be distributed in the conclusion. The minor term being the subject of the conclusion will be undistributed only if the conclusion is particular because universal propositions must distribute their subject. Therefore, if the minor premise is affirmative, the conclusion must be particular, or, we commit the fallacy of illicit minor.

3. If either premise be negative, the major premise must be universal.

If either premise be negative, the conclusion will also be negative; distributing at least its predicate i.e. the major term this major term should also be distributed in the major premise to avoid the fallacy of illicit major. In the fourth figure, the major term is the subject in the major premise and can be distributed only if the major premise is universal. Hence, if either premise is negative in the fourth figure, the major premise must be universal.

Questions

1. Test the validity/ invalidity of the following syllogistic forms with the help five rules:

a. IAA - 3	b. IEO - 1	c. AAA- 2
d. OEO - 4	e. AAE - 1	f. EAA - 2
g. EEE - 3	h. IAO - 2	i. AEE - 2
j. OAI - 3		

Solution: - Example:

AAA-2

PM	All P is M
SM	All S is M
\therefore SP	\therefore All S is P

In the second figure the middle term is the predicate in both the premises. Affirmative propositions do not distribute their predicate. So the middle term remains undistributed in both the premises. This is violation of Rule no. 2 according to which the middle term must be distributed at least once in the premises. This leads to the fallacy of undistributed middle.

2. Arrange the following syllogisms into standard form and name figures and moods.
 - a. All musicians are talented people and no musicians are cruel, obviously no talented people are cruel.
 - b. Some philosophers are mathematicians; hence some scientists are philosophers, since all scientists are mathematicians.
 - c. Some mammals are not horses, for no horses are centaurs, and all centaurs are mammals.
 - d. No criminals are pioneers, for criminals are unsavory person and no pioneers are unsavory persons.
 - e. Some women are not strong persons, because all mothers are strong persons but some women are not mothers.

Example :

All supporters of popular government are democrats, so all supporters of popular government are opponents of the Republican party, since all democrats are opponents of the Republican party.

To arrange this syllogism in standard form, we must first recognize the conclusion which will give us the major and the minor terms. This will help us in identifying the major premise and the minor premise. When all this is arranged, we shall know the mood and the figure of this syllogism.

All democrats are opponents of the Republican Party. (Major premise)

All supporters of popular government are democrats. (Major premise)

Therefore, all supporters of popular government are opponents of the Republican Party. (Conclusion)

Now, it is clear that the above argument is in Ist figure with AAA mood, i.e., AAA-I.

3. Determine the validity/invalidity of the following arguments by using the rules of syllogism:
 - a. Some cobras are not dangerous animals, but all cobras are snakes, therefore, some dangerous animals are not snakes.
 - b. Some writers are artists because all artists are sensitive people and some writers are sensitive people.

- c. Some successful men are not Americans, because all Americans are rich, and some rich man are not successful.
- d. Some philosophers are reformers, so some idealists are reformers since all philosophers are idealists.
- e. All proteins are organic compounds; hence all enzymes are proteins, as all enzymes are organic compounds.

Example :

No coal-tar derivatives are nourishing foods, because all artificial dyes are coal-tar derivatives, and no artificial dyes are nourishing foods.

When we arrange this argument in standard form, we get the following:

No artificial dyes are nourishing foods.

All artificial dyes are coal-tar derivatives.

Therefore, no coal-tar derivatives are nourishing foods.

This argument is in the form of EAE-3. When we look at the conclusion, the minor term is distributed there but the same term is not distributed in the minor premise, being the predicate of A proposition. This is in violation of Rule no. 3 according to which no term can be distributed in the conclusion unless it is also distributed in the premise. Hence, this argument is invalid committing the fallacy of illicit minor.

Note : There are certain words which are conclusion indicators such as therefore, hence, so, it follows, consequently, thus, it is implied by etc. There are certain words which are premise indicators like, since, for, because etc.

4. Define syllogism as a form of an argument. Explain different types of syllogism.
5. Write a note on the structure of categorical syllogism. Define and illustrate mood and figure of categorical syllogism.
6. Explain with examples the fallacies of undistributed middle, illicit major and illicit minor.
7. Explain fallacy of four terms.
8. Prove why:
 - a. A valid categorical syllogism cannot have two particular premises.
 - b. From a particular major premise and a negative minor premise no conclusion follows in a valid categorical syllogism.
10. Prove special rules of 1st and 2nd figures.