

critical thinking

deductive argument: categorical logic

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Template for critical analysis of arguments

1. What's the point (claim/opinion/conclusion)?
 - Look for subconclusions as well.
2. What are the reasons/what is the evidence?
 - Articulate all unstated premises.
 - Articulate connections.
3. What exactly is meant by . . . ?
 - Define terms.
 - Clarify all imprecise language.
 - Eliminate or replace “loaded” language and other manipulations.
4. Assess the reasoning/evidence:
 - **If deductive, check for truth/acceptability and validity.**
 - if inductive, check for truth/acceptability, relevance, and sufficiency.
5. How could the argument be strengthened?
 - Provide additional reasons/evidence.
 - Anticipate objections—are there adequate responses?
6. How could the argument be weakened?
 - Consider and assess counterexamples, counterevidence, and counter-arguments.
 - Should the argument be modified or rejected because of the counter-arguments?
7. If you suspend judgment (rather than accepting or rejecting the argument), identify further information required.

1

Categorical logic

As mentioned in Section 2.10, categorical logic (also called **predicate logic**) deals with categories of things.

There are four kinds of statements (traditionally indicated by the letters A, I, E, O) that can be made about whether members of one category of things are or are not included in another category of things:

- | | |
|-----------------------------|---------------------|
| (A) Universal affirmative: | All As are Bs. |
| (I) Particular affirmative: | Some As are Bs. |
| (E) Universal negative: | No As are Bs. |
| (O) Particular negative: | Some As are not Bs. |

Let's consider each of these **categorical statements** in turn.

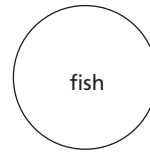
1.1 Universal affirmative

All As are Bs. For example, “All things-that-are-fish are things-that-can-swim.” Or, more simply, “All fish swim.”

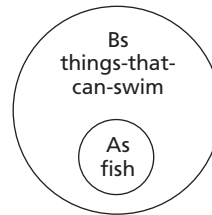
Let's say this is the category of things-that-can-swim:



And this is the category of things-that-are-fish, or more simply, fish.

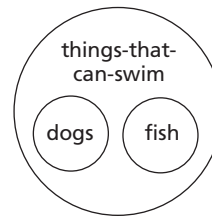


“All fish swim”—“All As are Bs”—would be this:*



This categorical statement is called a **universal affirmative** statement because an *affirmative* statement (“All As *are* Bs”) is made about *all* members of a category (“All As are Bs”).

Note that we’re not saying that *only* fish swim; our diagram doesn’t exclude the possibility that, for example, dogs can also swim:



The following is a list of some other ways of saying “All fish swim.” It can come in handy when you’re translating from “ordinary language” into categorical statements. Take a minute to actually think through each one to assure yourself that it is actually saying “All fish swim”—nothing more and nothing less.

- Every fish swims.
- Each fish swims.
- Anything that’s a fish swims.
- Only things that swim are fish.
- A thing is a fish only if it swims.
- Nothing but things that swim are fish.
- Nothing except things that swim are fish.

* We’ll be using Euler diagrams in this text; another way to diagram categorical statements is to use Venn diagrams.

Nothing is a fish unless it swims.

There is no fish that can't swim. (This form is the legitimate obversion, see Section 1.5.)

All non-swimming things are non-fish. (This form is the legitimate contrapositive, see Section 1.5.)

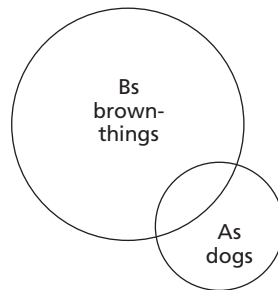
1.1a Practice recognizing universal affirmative statements

Which of the following make a universal affirmative statement? Write the statement in its “All As are Bs” form (or “All A are B” if that seems more appropriate—logically, they’re the same) and diagram it.

1. Anything with a date prior to 2005 is considered an expired file and goes in this box.
2. You're a runner, not a jogger, only if you can do a mile in under 8 minutes.
3. This is an essay that's excellent.
4. If it quacks like a duck . . .
5. Each of the samples in this box is contaminated.

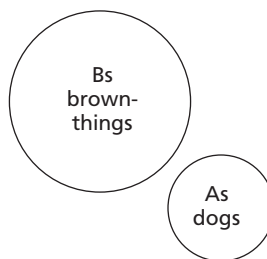
1.2 Particular affirmative

Some As are Bs. For example, “Some dogs are brown.”

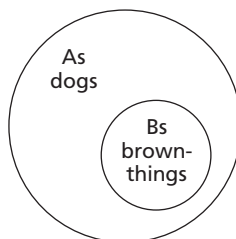


Note that in this case, only part of the A circle is in the B circle, indicating that only some of the things in the dog category are in the brown category: some dogs are brown. Thus, since some As (dogs) are not Bs (brown), it is possible that some dogs are, say, black.

However, if all dogs are brown, then it is indeed the case that some dogs are brown. So the following diagram could also represent “Some dogs are brown.” However, if all we know is that *some* are brown, we don't know which diagram is the correct one: we can't assume that some are not brown (the diagram above), nor can we assume that all are brown (the diagram below).



There is one other way this statement could be drawn:



This too shows that “Some dogs are brown” (the dogs that are in the brown-things circle will be brown), but since this diagram indicates that all brown things are dogs, it’s unlikely we’ll draw the statement this way in this case.

But the point remains, if you use diagrams to determine validity (see Section 4), it’s important to consider all the possibilities, and in the case of particular affirmative statements, there are three possibilities.

This categorical statement is called a **particular affirmative** because it makes an *affirmative* statement (“Some As *are* Bs”) about only *particular* members of a category (“*Some* As are Bs”).

Here are some other ways of saying “Some dogs are brown”:

At least one dog is brown.

A few, or several, or many, or most dogs are brown.

There are dogs that are brown.

Some brown things are dogs. (The legitimate conversion, see Section 1.5.)

Some dogs are not non-brown. (The legitimate obversion, see Section 1.5.)

1.2a Practice recognizing particular affirmative statements

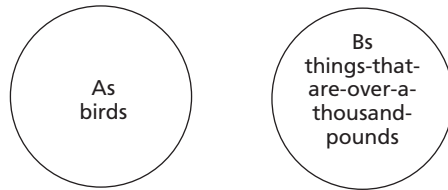
Which of the following make a particular affirmative statement? Write the statement in its “Some As are Bs” form (or, again, “Some A are B”) and diagram it.

1. I’ll agree that some of their music is great.
2. Some days he just doesn’t feel like doing anything.

3. I have examined all of the so-called evidence and find only one item to be relevant to this case.
4. There are ways of making you talk.
5. None of these paperweights is what I'd call beautiful.

1.3 Universal negative

No As are Bs. For example, “No birds are over a thousand pounds.”



Note that the two circles are completely separate from each other; there is no overlap in membership between the one category and the other category.

This categorical statement is called a **universal negative** because a *negative* statement (“All As are *not* Bs”—which is the same as “No As are Bs”) is made about *all* of a category (“All As are not Bs”).

Again, here are some other ways of saying “No birds are over a thousand pounds”:

- Nothing that’s a bird is over a thousand pounds.
- All things over a thousand pounds are non-birds.
- There are no over-a-thousand-pounds birds.
- No bird is over a thousand pounds.
- Nothing that’s over a thousand pounds is a bird. (The legitimate conversion, see Section 1.5.)
- All birds are not over a thousand pounds. (The legitimate obversion, see Section 1.5.)

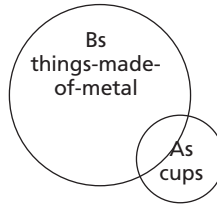
1.3a Practice recognizing universal negative statements

Which of the following make a universal negative statement? Write the statement in its “No As are Bs” form (or “No A are B”) and diagram it.

1. All studies about the ozone layer except this one are incorrect.
2. If its leaves are waxy, the plant does not belong to this species.
3. There is simply no possible way for us to achieve that sales quota.
4. Every potato in the bag is rotten.
5. Not one dance in tonight’s performance was interesting.

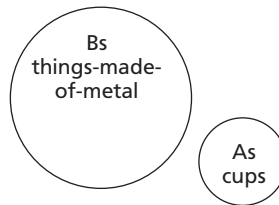
1.4 Particular negative

Some As are not Bs. For example, some cups are not made of metal.

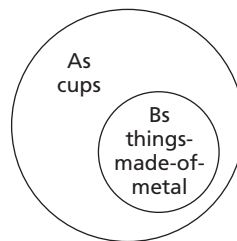


Again, note the overlap: some of the things in the category of cups are *not* in the category of metal things—that is, some cups are not made of metal.

But, again, this next diagram could also illustrate the particular negative: if all cups are not made of metal, it is the case that some of them are not made of metal. Since all we know is that some cups are *not* metal, we can't assume that some are (the diagram above) any more than we can assume that all aren't (the diagram below).



And there is one other way this statement could be drawn—this too shows that some cups are not made of metal:



So, again, if you're using diagrams to determine validity (see Section 4), be sure you consider all the possible ways of diagramming the particular negative statement.

This categorical statement is called a **particular negative** because a *negative* statement (“Some As are *not* Bs”) is made about only *particular* members of a category (“*Some* As are not Bs”).

And, again, here are some other ways of saying “some cups are not made of metal”:

At least one cup is not made of metal.

A few, or several, or many, or most cups are not made of metal.

Not all cups are made of metal.

Some cups are non-metal. (The legitimate obversion, see Section 1.5.)

Some non-metal things are not non-cups. (The contrapositive, see Section 1.5.)

1.4a Practice recognizing particular negative statements

Which of the following make a particular negative statement? Write the statement in its “Some As are not-B” form (or “Some A are not-B”) and diagram it.

1. Several students were late today.
2. Every group follows the same process.
3. Not one car on the lot is in good shape.
4. Some people are not giving up hope!
5. You can’t say that all planets are rocky and small—consider Jupiter!

1.4b More practice translating ordinary language into categorical statements

Each of the following translates correctly into one of the preceding four kinds of categorical statements—write that translation and draw its diagram.

1. My feelings are none of your business!
2. Not one professional skater is over six feet tall.
3. Everything you say may be used against you in a court of law.
4. I think all presidential candidates have a vested interest in gaining that much power; otherwise, they wouldn’t want the position.
5. Not all elderly drivers are bad drivers.
6. Most people who get married haven’t really thought about staying unmarried.
7. I concede that some of the time I want to win too much.
8. Some university students still act like they’re in high school.
9. It’s not that I’m not interested at all in what you think most of the time.
10. Sometimes I think you’re the only one who doesn’t get it!

1.5 Logical equivalence (conversions, obversions, and contrapositives)

There are certain things one can immediately infer from each of the categorical statements. For example, if some dogs are brown, we can infer with certainty that some brown things are dogs—the one statement necessarily implies the other. So the two statements, “Some A are B” and “Some B are A,” are logically equivalent, and either both are true or both are false. There are three kinds of “immediate inferences” we can make: conversions, obversions, and contrapositives.

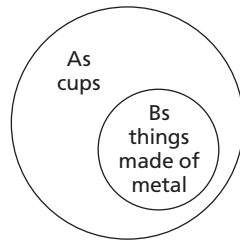
Conversions

As just mentioned, if it is the case that “Some A are B,” its reverse—or more correctly speaking, its converse (the statement that results when you reverse the subject and predicate, A being the subject and B being the predicate)—is also the case; that is, if “Some A are B,” then it must be the case that “Some B are A.” Go back and look at the example and diagram for the particular affirmative statement, “Some dogs are brown” (Section 1.2); if some dogs are brown-things, then some brown-things must be dogs, right? So *you can legitimately infer the converse from a particular affirmative statement.*

Consider, however, the universal affirmative: “All A are B.” All fish-things are swim-things, but it does *not* follow, therefore, that all swim-things are fish-things. Go back and look at the last diagram in that section (1.1): some swim-things are dog-things (that is, dogs, as well as fish, can swim). Consider another universal affirmative statement: “All dogs are mammals.” Is the converse true? Are all mammals dogs? No, some mammals are humans, some are cats, some are horses . . . So you *cannot* legitimately infer the converse from a universal affirmative statement.

Consider next, the universal negative statement: “No A are B.” Does it follow that no B are A? If no birds are over a thousand pounds, then there are no things that are over a thousand pounds that are birds. So yes, it does follow: *the conversion of a universal negative statement is valid*; the two statements are logically equivalent.

Lastly, consider the particular negative: “Some As are not Bs.” If some cups are not made of metal—they’re made of plastic and china—does it follow that some things made of metal are not cups? Not necessarily. It could be that all things made of metal are cups. Remember that the particular negative—some As are not Bs, or some cups are not made of metal—could be drawn thus:



And if that's the case, you see how the converse, that some things made of metal are not cups, would not be true. It *could* be true, but it's not necessarily true—so we can't say the converse is valid.

Consider another example: suppose some women are not logicians (some women are, instead, bankers and dancers and . . .). Does it follow that some logicians are not women? Not necessarily. It could be that all logicians are women (and it would still be true that some women are not logicians).

The following chart summarizes the conversions of the four statements: note that only the conversions of the particular affirmative and the universal negative are valid; the conversions of the universal affirmative and the particular universal are invalid.

Valid

- ✓ Some A are B.
Therefore, some B are A.
- ✓ No A are B.
Therefore, no B are A.

Invalid

- ✗ All A are B.
Therefore, all B are A.
- ✗ Some A are not B.
Therefore, some B are not A.

Obversions

A statement's obverse is a little different from its converse: the obverse is obtained not by reversing subject and predicate, but by negating the predicate (by making the "B" into a "non-B") and changing the statement from affirmative to negative or vice versa. For example, the obversion of "All fish can swim" would be "No fish are non-swimmers." Note that we changed being able to swim to not being able to swim (we made "B" into "non-B") and we changed the affirmative of "All . . ." to the negative of "No . . ."

In all four cases, *the obverse of a categorical statement is logically equivalent to the original categorical statement:*

All A are B.	=	No A are non-B.
Some A are B.	=	Some A are not non-B.
No A are B.	=	All A are non-B.
Some A are not B.	=	Some A are non-B.

Think through each of these, referring to the examples and diagrams above, to assure yourself that the obversion can indeed be legitimately inferred.

Contrapositives

To make a contrapositive of a categorical statement, take its converse (see above) and negate both the subject and the predicate. For example, to determine the contrapositive of “All fish can swim,” first establish its converse, “All things-that-can-swim are fish,” then negate both the subject and the predicate: “All non-things-that-can-swim are non-fish” or “All non-swimmers are non-fish.”

Only the contrapositives of the universal affirmative and the particular negative are valid:

<u>Valid</u>	<u>Invalid</u>
✓ All A are B. Therefore, all non-B are non-A.	✗ Some A are B. Therefore, some non-B are non-A.
✓ Some A are not B. Therefore, some non-B are not non-A.	✗ No A are B. Therefore, no non-B are non-A.

Again, think through each one to assure yourself that the contrapositive is or is not valid. Regarding the contrapositive of the particular affirmative, just because some dogs are brown, it doesn’t mean that some non-dogs are non-brown—maybe everything in the world is brown (that would still mean that some dogs are brown). And with regard to the contrapositive of the universal negative, just because no birds are over a thousand pounds, it doesn’t follow that no non-birds (such as, for example, elephants) are not over a thousand pounds (elephants and other non-birds could be over a thousand pounds).

1.5a Practice recognizing logical equivalence

Which of the following pairs of statements are logical equivalents (valid conversions, obversions, or contrapositives)?

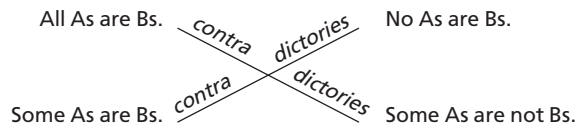
1. All sci-fi novels written by women are discernibly different from sci-fi novels written by men.
No sci-fi novels written by women are indistinguishable from sci-fi novels written by men.
2. Some condoms are defective.
Some condoms are not non-defective.
3. All people who wear make-up are saying that appearance matters more than reality.
All people who don't say appearance matters more than reality don't wear make-up.
4. Some jokes are stupid.
Some stupid things are jokes.
5. No wolves in this forest are sick.
All wolves in this forest are healthy.
6. All rapists are men, so it follows that all men are rapists.
7. Some cats are not pets.
Some non-pets are not non-cats.
8. Some cats are not pets.
Some cats are non-pets.
9. Some of the waste we've dumped into the ocean is radioactive.
Some non-radioactive waste hasn't been dumped into the ocean.
10. No elite athletes are lazy.
No lazy people are elite athletes.
11. No elite athletes are lazy.
No non-lazy people are non-elite athletes.
12. Some part-time jobs are not jobs worth having.
Some jobs worth having are not part-time jobs.
13. All perfumes give me a headache, so it follows that some of my headaches are not caused by perfume.
14. Some pleasurable activities are not, in the long term, good for you.
So not everything that's good for you in the long term is painful.
15. "While it's true that most Muslims or Arabs are not terrorists, almost all the terrorists are Muslims or Arabs."
(Bill Maher, *When You Ride ALONE You Ride with bin Laden*, 2002)

1.6 The square of opposition (contradictories, contraries, and subcontraries)

It will be of value to note that not all four categorical statements can be true at the same time; in fact, they contradict each other in pairs.

Contradictories

Contradictories cannot both be true; they are **logically incompatible**. But nor can they both be false. For example, if “All As are Bs” then it is impossible that also “Some As are not Bs.” And yet one of them must be true: either there’s an A that’s not a B or there’s not. Hence the universal affirmative and the particular negative are contradictories: they cannot both be true, but they cannot both be false. Likewise, if “Some As are Bs,” it is impossible that also “No As are Bs.” But, again, one of them must be true: either there is an A that’s a B or there’s not. Hence the particular affirmative and the universal negative are contradictories: they cannot both be true, but they cannot both be false. These relationships are traditionally shown by the following, which is called the **square of opposition**:



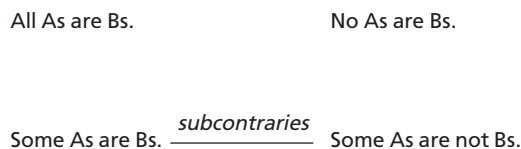
Contraries

Contraries are statements that cannot both be true, but they could both be false. So “All As are Bs” and “No As are Bs” are contraries: they cannot both be true (you can’t say *all* As are Bs and at the same time say *no* As are Bs), but they could both be false (it could be that some As are Bs.)



Subcontraries

Subcontraries are statements that cannot both be false, but they could both be true (they’re **logically compatible**). “Some As are Bs” could be true at the same time as “Some As are not Bs”—but they can’t both be false (some one A is either a B or it is not). So these two statements are subcontraries.



Note that words or phrases or statements often called “opposites” are more often contraries than contradictories. For example, “He is my friend” and “He is my enemy” are not contradictory statements; they are contrary statements. The contradictory of “He is my friend” is “He is not my friend” or “He is my non-friend”: one can’t be both a friend and a non-friend, but one has to be one or the other. However, while one can’t be both a friend and an enemy, one could be neither (perhaps one has no relationship at all toward the other person or perhaps one is just a neutral other)—which is what makes “He is my friend” and “He is my enemy” contraries.

1.6a Practice identifying contradictories, contraries, and subcontraries

Identify each of the following pairs of statements as contradictories, contraries, or subcontraries.

1. All university courses are difficult.
Some university courses are not difficult.
2. The team is not training as often as it should.
The team is training too much.
3. Some competitions are fair.
Some competitions are not fair.
4. Our government’s environmental policies do not indicate an understanding of biochemical principles.
Our government’s environmental policies do not indicate an understanding of biochemical principles.
5. All politicians are good leaders.
No politicians are good leaders.
6. No drunk drivers are safe drivers.
Some drunk drivers are safe drivers.
7. We cannot possibly know God’s will.
But we know that he is on the side of justice.
8. A certain amount of intelligence is required in order to be a good parent.
Some intelligent people do not make good parents.
9. They can’t both be right, although they could both be wrong.
10. Christians believe that only Christians have a place in heaven.
Muslims believe that only Muslims have a place in heaven.

2

Valid forms

Recall (see Section 2.10) that a syllogism is an argument with two premises that together lead to a single conclusion. Using only the four kinds of categorical statements (universal affirmative, particular affirmative, universal negative, and particular negative) as premises and conclusion, one can come up with 256 different arrangements, or 256 different syllogisms, only 15 of which are valid. In this section and the next, we'll cover the more common valid and invalid forms (arrangements). One can determine whether an arrangement is valid using diagrams or rules, which we'll do in the last section of this chapter, but, as is sometimes the case in math, you may not need (or want) to know how to figure out for yourself whether an arrangement is valid; it may be sufficient to just know that it is (or is not).

But first, a word about validity. Recall that in order for a deductive argument to be sound (that is, in order for its conclusion to be necessarily true as a result of the premises), two conditions must be met: (1) the premises must be true, and (2) the form must be valid. We're dealing with that second condition here: we're learning which forms are valid and which are not. (The condition of truth is dealt with in Chapter 6.) Basically, if the form is such that when the premises are true, the conclusion must be true, then the form is a valid one; that is, *if the premises necessarily imply the conclusion, the form is valid.*

For example, consider these two premises:

1. I am a human being.
2. All human beings eventually die.

It should be clear that this conclusion *necessarily follows*:

Therefore, I will eventually die.

The truth of the two premises makes the conclusion necessarily true. So the arrangement we used, the form of this argument, is one of the 15 valid ones.

Now consider another argument, *using exactly the same arrangement or form*:

1. I am a furluvenger.
 2. All furluvengers are blimtsish.
- Therefore, I am blimtsish.

Even though you don't know what furluvengers are or what blimtsish means, you can conclude with absolute certainty that I am blimtsish (as long as the premises are true). We can put *any* two words into the argument, and if the premises are true, the conclusion will also be true—because the arrangement we're using is a valid one.

To underscore that validity is separate from truth, consider the following argument:

1. Some fruit is red.
 2. Apples are fruit.
- Therefore, apples are red.

You might be tempted to accept this argument because, after all, the premises are true and so is the conclusion. But the conclusion is not true *because* of the premises: there is nothing about the facts that some fruit is red and apples are fruit that *makes* apples red. The argument could have just as easily been this:

1. Some fruit is red.
 2. Bananas are fruit.
- Therefore, bananas are red.

You see? In this particular arrangement, the premises do not fit together in such a way as to *make* the conclusion true. If they did, it would be a *valid* argument. That's the definition of validity. But this particular arrangement is *invalid*.

On the other hand, this arrangement *is* valid:

1. All oranges are round.
 2. This object is an orange.
- Therefore, this object must be round.

In this case, the premises *do* fit together in such a way as to make the conclusion true. It's a valid arrangement. And as long as the premises were true, we'd have to accept the conclusion as true even if we hadn't ever seen an orange or didn't really know what "round" meant. See the furluvenger argument above.

But note that second condition: the premises have to be true. Here’s an argument using the same valid form as the preceding argument, but in this case one of the premises is *not* true:

1. All oranges are round.
 2. I am an orange.
- Therefore, I am round.

So we don’t have to accept the conclusion that I am round, because one of the premises is not true. For an argument to be sound—for us to have to accept the conclusion as true—two conditions must be filled: all of the premises must be true, and they must be arranged in a valid form.

Okay, so what are these 15 valid forms? Well, we’ll cover just four. (And we’ll use statements with the conventional placeholders of A, B, and C rather than statements with real words and specific meanings—because, as just explained, it really doesn’t matter what A, B, or C stands for in any given case: as long as your As and Bs and Cs are in the following arrangements, your argument will be valid.) (And if the premises are true, your conclusion will be true.)

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. ✓ All A are B.
<u>C is an A.</u>
Therefore, C is a B. | <ol style="list-style-type: none"> ✓ All A are B.
<u>All C are A.</u>
Therefore, all C are B. |
|--|--|

Notice that the syllogism is valid whether we’re talking about one C being an A or all C being A. (This is true in all cases, by the way, as long as the conclusion matches the premise with respect to talking about one or all.) (You can’t conclude that *all* C are B if your premise is that *one* C is B.)

Note also that it doesn’t matter, ever, what order the two premises are in; these two are just as valid as the preceding two:

- | | |
|---|--|
| <ol style="list-style-type: none"> ✓ C is an A.
<u>All A are B.</u>
Therefore, C is a B. | <ol style="list-style-type: none"> ✓ All C are A.
<u>All A are B.</u>
Therefore, all C are B. |
|---|--|

If we call the Cs As, the As Bs, and the Bs Cs, we get this, which might be easier to remember as the “chain” becomes more evident:

- ✓ All A are B.
All B are C.
Therefore, all A are C.

Here’s an example of an argument with this form:

In order for an article to be classified as a genuine antique, it must be over 100 years old. This chair is a genuine antique, so it must be over 100 years old.

Expressed as a syllogism, the argument is this:

- | | |
|--|----------------------|
| 1. Genuine antiques are over 100 years old. | 1. All A are B. |
| <u>2. This chair is a genuine antique.</u> | <u>2. C is an A.</u> |
| Therefore, this chair is over 100 years old. | Therefore, C is B. |

Since the argument has a valid form, or, put another way, since the argument is valid, if the premises are true, the conclusion must be true. (I made up that bit about genuine antiques being over 100 years old, by the way.)

2a Practice identifying this first valid form

Express each of the following arguments as a syllogism. You'll find that four of the five have the form we've just covered.

- Every kind of infection is serious, and any serious infection should be treated, so of course every infection should be treated!
- Everything that can be made profitable gets corrupted by big business. The internet can be made profitable. Therefore, the internet will be corrupted by big business.
- I can't believe you're going to put an ad in the "Personals" section! That's for losers! You'll certainly never get a good date that way! See? It just proves that losers never get good dates!
- Of course this car was built for speed! It's a race car!
- Student to Professor:* But I need an A!

- | | |
|--------------------------|------------------------|
| 2. ✓ A is a B. | ✓ All A are B. |
| <u>No B are C.</u> | <u>No B are C.</u> |
| Therefore, A is not a C. | Therefore, no A are C. |

Here's an example of an argument with this form:

Lizards are reptiles, and no reptiles are warm-blooded. It follows that no lizards are warm-blooded.

Expressed as a syllogism, the argument is as follows:

- | | |
|---|------------------------|
| 1. Lizards are reptiles. | All A are B. |
| <u>2. No reptiles are warm-blooded.</u> | <u>No B are C.</u> |
| Therefore, no lizards are warm-blooded. | Therefore, no A are C. |

If you recall that “No B are C” (the second premise) is logically equivalent to “No C are B” (it’s one of the valid conversions; see Section 1.5), you will see that the following are also valid:

A is a B.
No C are B.
 Therefore, A is not a C.

All A are B.
No C are B.
 Therefore, no A are C.

So the preceding argument would be just as valid if it were presented this way:

1. Lizards are reptiles.
 2. No warm-blooded animals are reptiles.
 Therefore, no lizards are warm-blooded.

All A are B.
No C are B.
 Therefore, no A are C.

Further, since “No A are C” of the conclusion validly converts into “No C are A,” these would also be valid:

✓ All A are B.
No B are C.
 Therefore, no C are A.

✓ All A are B.
No C are B.
 Therefore, no C are A.

That is to say, it doesn’t matter whether our conclusion is “No lizards are warm-blooded” (“No A are C”) or “No warm-blooded animals are lizards” (“No C are A”)—they amount to the same thing.

2b Practice identifying this second valid form

Express each of the following arguments as a syllogism. You’ll find that four of the five have the form we’ve just covered.

1. With today’s technology, you can easily fast-forward through commercials and thus avoid them. You can’t call something harmful if you can avoid it. So I don’t see how you can call television commercials harmful.
2. I don’t think sperm donors or even surrogate mothers should be called parents. After all, they get paid for their services. And real parents don’t get paid.

3. You shouldn't be taking vitamin pills! They're artificially made. I wouldn't put anything artificial into my body—it's not good for you!
4. People should have a say about what happens to the things they own, but they don't own anything once they're dead. So people shouldn't have a say about what happens to their organs once they're dead.
5. A Jewish state cannot be democratic, this argument goes, because a state in which the world's Jewish people and the Jewish religion have exclusive privileges is inherently discriminatory against non-Jewish citizens. (Bernard Avishai, "Saving Israel from Itself," *Harper's Magazine*, January 2005)

3. ✓ All A are B.
Some A are C.
 Therefore, some C are B.

Here's an example of an argument with this form:

Basically, cigarette ads are designed to get you to smoke, and once you start, because cigarettes have nicotine in them, you become addicted. So really, cigarette ads are trying to get you addicted to something. And a lot of cigarette ads these days, I've noticed, are directed toward teenagers. I guess that's because adults are either already smokers or wisely decide not to start. So some of the stuff we teenagers have to deal with, I mean even legal ads on television, are actually enticements to addiction.

Expressed as a syllogism, the argument is as follows:

- | | |
|--|--------------------------|
| 1. All cigarette ads are enticements to addiction. | All A are B. |
| 2. Some cigarette ads are ads that are directed toward teenagers. | <u>Some A are C.</u> |
| Therefore, some ads that are directed toward teenagers are enticements to addiction. | Therefore, some C are B. |

If you recall that "Some A are C" validly converts into "Some C are A," you will see that the following is also valid:

- ✓ All A are B.
Some C are A.
 Therefore, some C are B.

So the preceding argument would be just as valid if it were presented this way:

1. All cigarette ads are enticements to addiction.	All A are B.
2. Some ads that are directed toward teenagers are cigarette ads.	<u>Some C are A.</u>
Therefore, some ads that are directed toward teenagers are enticements to addiction.	Therefore, some C are B.

Similarly, the conclusion in both cases could legitimately convert into “Some B are C,” so these syllogisms would also be valid:

- ✓ All A are B.
Some A are C.
Therefore, some B are C.
- ✓ All A are B.
Some C are A.
Therefore, some B are C.

So the conclusion of the previous arguments could also be “Some enticements to addiction are ads that are directed toward teenagers.”

2c Practice identifying this third valid form

Express each of the following arguments as a syllogism. You’ll find that four of the five have the form we’ve just covered.

1. Only some dogs are terriers, but all dogs are mammals. So it follows that some mammals are terriers.
2. All meat is toxic, at least to some extent, because of the food the animal eats while it’s alive—it’s full of chemical preservatives, growth hormones, and all sorts of yummy stuff. And yet, I know that some meat is good for you. So I guess some things that are good for you are actually or also toxic.
3. Of course all five-year-olds are people, your niece notwithstanding. And we know for a fact that some zepes are five-year-olds—how else do they get from being four-year-olds to being six-year-olds? So it’s what I’ve said all along: some people are zepes.
4. The Heinz dilemma indicates that sometimes stealing is necessary: if Heinz doesn’t steal the drug, his mother will die. So surely sometimes stealing is justified.
5. Rapes increase during the summer months, and so do assaults. So rape is an assault, not sex.

4. ✓ All A are B.
Some C are not B.
 Therefore, some C are not A.

Recall that neither the universal affirmative nor the particular negative has a valid conversion, so this is the only version of this form that's valid.

Here's an example of an argument with this form:

My definition of literature is that it is enlightening: it provides valuable insights into the human condition. And I have to say, a lot of the novels that I've read, even those on course reading lists, well, they simply don't provide any insight, they don't say anything new, hell, often they don't say anything at all. A lot of novels are simply not literature.

Expressed as a syllogism, the argument is as follows:

- | | |
|---|------------------------------|
| 1. All literature is enlightening. | All A are B. |
| <u>2. Some novels are not enlightening.</u> | <u>Some C are not B.</u> |
| Therefore, some novels are not literature. | Therefore, some C are not A. |

Before we leave the valid forms, let me repeat that as long as the premises are true and the form is valid, you must accept the conclusion, no matter how distasteful! That's the beauty of logic: it's immune to our individual prejudices.

Consider this conversation:

Aguiar: What distinguishes people from the other animals is that we know right from wrong. That is, to be a person, a creature with certain rights, is to know right from wrong.

Gysin: So that pretty much excludes babies and young children. Excludes my grandmother too; that last stroke really did a number on her brain.

Well, actually, it's not a complete argument; the conclusion isn't stated. But the conclusion necessarily has to be as indicated below:

- | | |
|---|------------------------------|
| 1. All persons know right from wrong. | All A are B. |
| 2. <u>Some human beings do not know right from wrong.</u> | <u>Some C are not B.</u> |
| Therefore, some human beings are not persons. | Therefore, some C are not A. |

2d Practice identifying this fourth valid form

Express each of the following arguments as a syllogism. You'll find that four of the five have the form we've just covered.

1. It's not good enough to say "I was just doing my job!" That doesn't make it right!
2. All ducks quack. I have a cat. It doesn't quack. Therefore ... some cats are not ducks.
3. Don't be so upset: everyone who lives together is bound to have fights from time to time. Though I know some married couples who don't. Hm. That must mean that some married couples don't live together.
4. I used to be convinced that all my neighbors are aliens. But now that I've taken logic, I see that I was wrong. Because, you see, I figure all aliens will be more intelligent than me; I mean, after all, they've been able to get from their home planet to here; most days I can't even get from here to the corner. And all, okay most, well, some of my neighbors aren't more intelligent than me. So there you have it! Some of my neighbors are *not* aliens!
5. If all hammers are tools, and all screwdrivers are tools, it follows that all hammers are screwdrivers. That's how screwy all this logic is!

2e More practice with valid categorical arguments

Suppose each of the statements in the following pairs is true. What conclusion can—indeed, *must*—you draw? (Two of them are “tricks” . . .)

1. All clones are twins. All twins are individuals.
2. She is an astronaut. No physically unfit people are astronauts.
3. Some pets are cats. Some cats are small.
4. All gamblers are eternal optimists. No eternal optimists are realists.
5. All bananas are yellow. No boats are yellow.
6. All F-rays are dangerous. Some F-rays are pink.
7. All bananas are yellow. Some bananas are ripe.
8. All medical doctors are licensed. Some chiropractors are not licensed.
9. All water contains oxygen. Liquid X contains oxygen.
10. A loan that's not repaid is theft. No theft is morally right.

3

Invalid forms

As you examine the following invalid forms, keep in mind that you are to focus on the *form*; even if the premises are true, and, more, even if the conclusion is true, if the form of the argument is invalid, it provides no reason for you to accept the conclusion. You may agree with the conclusion, and if it is a matter of fact, you may even recognize that it's true—but you cannot do so on the basis of the argument in question, as it's invalid. You must establish the truth of the conclusion by other means—specifically with a sound argument: valid reasoning about true premises.

To review (see the beginning of Section 2), consider the following argument, courtesy Antony Flew:

All Christians believe in a personal god.
Mother Teresa believes in a personal god.
Therefore, Mother Teresa is a Christian.

As it happens, both premises are true, and the conclusion is true. But the form of this argument is invalid (see the first invalid form, below), as you will see by considering this next example, which has exactly the same form:

All broccoli is green.
Grass is green.
Therefore, grass is broccoli.

So for you to accept the claim that Mother Teresa is a Christian *on the basis of the argument given* would be foolish—you'd have to also accept the claim that grass is broccoli.

So, here are some of the more common invalid forms.

- | | |
|--|--|
| 1. ✗ All A are B.
<u>C is a B.</u>
Therefore, C is an A. | ✗ All A are B.
<u>All C are B.</u>
Therefore, all C are A. |
|--|--|

Example:

- | | |
|---------------------------------------|-------------------------|
| 1. All murderers have ears. | All A are B. |
| 2. <u>All bunnies have ears.</u> | <u>All C are B.</u> |
| Therefore, all bunnies are murderers. | Therefore, all C are A. |

A noteworthy error of this type is the argument made by Senator Joseph McCarthy and the House Committee on Un-American Activities in order to imprison many people:

- All Communists believe/do X.
You believe/do X.
Therefore, you are a Communist.

The premises may well have been true, but the structure is invalid (and had they thought for a moment and realized that *not only* Communists believe/do X, they would have realized their reasoning was faulty). So their conclusion that any given person was a Communist did not follow.

- | | |
|---|--|
| 2. ✗ All A are B.
<u>C is a B.</u>
Therefore, A is a C. | ✗ All A are B.
<u>All C are B.</u>
Therefore, all A are C. |
|---|--|

Example:

- | | |
|---------------------------------------|-------------------------|
| 1. All murderers have ears. | All A are B. |
| 2. <u>All bunnies have ears.</u> | <u>All C are B.</u> |
| Therefore, all murderers are bunnies. | Therefore, all A are C. |

Note the similarity between these first two invalid forms: when your premises are both universal affirmative statements with the same predicate, you can't conclude with a universal affirmative involving the two subjects, one way or the other.

3. ✗ All A are B. ✗ All A are B.
B is a C. All B are C.
Therefore, C is an A. Therefore, all C are A.

Example:

- | | |
|--|---------------------------|
| 1. All white-collar crime is under-sentenced. | All A is B. |
| 2. <u>All under-sentenced crime is debilitating to society.</u> | <u>All B is C.</u> |
| Therefore, everything that's debilitating to society is
a white-collar crime. | Therefore, all
C is A. |

Note the similarity between this invalid form and the first valid form: in both cases, the premises are universal affirmatives arranged as a chain (All A are B, All B are C), but you can only conclude forward (All A are C); concluding backward (All C is A) is invalid.

4. ✗ All A are B.
All A are C.
Therefore, all B are C.

Example:

- | | |
|---|----------------------------|
| 1. All spaceflight is expensive. | All A are B. |
| 2. <u>All spaceflight yields scientific knowledge.</u> | <u>All A are C.</u> |
| Therefore, all expensive endeavors yield scientific
knowledge. | Therefore,
all B are C. |
5. ✗ All A are B.
All A are C.
Therefore, all C are B.

Example:

- | | |
|--|----------------------------|
| 1. All spaceflight is expensive. | All A are B. |
| 2. <u>All spaceflight yields scientific knowledge.</u> | <u>All A are C.</u> |
| Therefore, all scientific knowledge is expensive
(to obtain). | Therefore,
all C are B. |
6. ✗ All A are B. ✗ All A are B.
A is not a C. No A are C.
Therefore, C is not a B. Therefore, no C are B.

Example:

- | | |
|---|------------------------|
| 1. All pigs have emotions. | All A are B. |
| 2. <u>No pigs are vindictive.</u> | <u>No A are C.</u> |
| Therefore, no vindictive creatures have emotions. | Therefore, no C are B. |

If you recall that “No A are C” validly converts into “No C are A,” you will see that the following is also invalid:

- ✗ All A are B.
No C are A.
 Therefore, no C are B.

Example:

- | | |
|---|------------------------|
| 1. All pigs have emotions. | All A are B. |
| 2. <u>No vindictive creatures are pigs.</u> | <u>No C are A.</u> |
| Therefore, no vindictive creatures have emotions. | Therefore, no C are B. |

Similarly, concluding in either case “No B are C” instead of “No C are B” would also be incorrect.

- ✗ All A are B.
No A are C.
 Therefore, no B are C.

- ✗ All A are B.
No C are A.
 Therefore, no B are C.

7. ✗ All A are B.
Some B are C.
 Therefore, some A are C.

Example:

- | | |
|---|--------------------------|
| 1. All desserts are delicious. | All A are B. |
| 2. <u>Some delicious things are high in calories.</u> | <u>Some B are C.</u> |
| Therefore, some desserts are high in calories. | Therefore, some A are C. |

Calling this invalid might puzzle you but only because you know that the premises and conclusion are true. Consider this example then, which has the very same form:

- | | |
|---|--------------------------|
| 1. All shoes are worn on the feet. | All A are B. |
| <u>2. Some things worn on the feet are socks.</u> | <u>Some B are C.</u> |
| Therefore, some shoes are socks. | Therefore, some A are C. |

The form is invalid because we don't know which "some": if the Bs that are Cs (second premise) are the same Bs that are As (first premise), then the conclusion follows—but we don't know whether that's the case. (There's nothing in the premises that *guarantees* that some of the delicious things that are high in calories are desserts.)

And again, since we can legitimately convert the second premise and the conclusion, there are a few syllogisms that can be derived from this one that are equally invalid. (This time I'll let you figure them out!)

8. ✘ Some A are B.
Some C are A.
 Therefore, some C are B.

Example:

- | | |
|---------------------------------------|--------------------------|
| 1. Some babies are screamers. | Some A are B. |
| <u>2. Some snakes are babies.</u> | <u>Some C are A.</u> |
| Therefore, some snakes are screamers. | Therefore, some C are B. |

Again, this is invalid because we don't know if it's the same "some." That is, some C are A, and if those As are the As that are B (or if at least some of those As are among the As that are Bs), then the conclusion would be okay. If the snakes that are babies (second premise) are among those that are screamers (first premise), then the conclusion necessarily follows: some snakes are screamers. But what if none of the snakes that are babies are among the babies that are screamers? Then the conclusion doesn't necessarily follow at all. Since we don't know which As are B, we can't know for sure whether some Cs are B. Some Cs *might* be B, but in order for a syllogism to be valid, the conclusion *must* be true—"might" be true isn't good enough!

Since each of the three statements in this syllogism has a valid conversion, there are several derivative syllogisms that are equally invalid—you can figure them out!



Leibniz, Boole, and Godel worked with logic . . .

Courtesy <http://www.sciencecartoonsplus.com/galmath2.htm>

3a Practice with invalid categorical arguments

Suppose each of the statements in the following pairs is true. What conclusion can you *not* draw? (Well, except for two of them . . .)

1. Hitler was a vegetarian. Hitler was evil.
2. All fossils are found in rock. All gold is found in rock.
3. A woman is a person. A man is not a woman.
4. Some fatalities are life-changing. Some accidents are fatal.
5. I know what I'm going to do tomorrow. Tomorrow is the future.
6. All Ferengi are schlick. Will Riker is schlick.
7. All Taffi's friends like to wrestle. Anyone who likes to wrestle is welcome at our home.
8. A toaster is a small appliance. No cow is a small appliance.
9. All dreams are significant. All dreams are symbolic.
10. All tooxens are phlatch. Some phlatch are creesh.

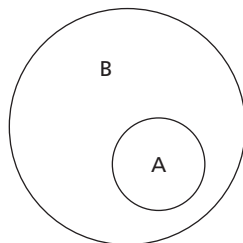
4

Determining validity and invalidity

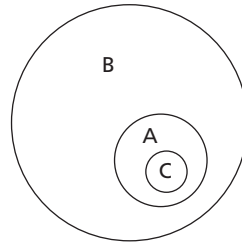
4.1 Using diagrams

One way to determine whether a particular categorical syllogism is valid or not is to draw the diagrams introduced in Section 1. Each categorical statement can be illustrated with one (or more) of three diagrams: two separate circles, one circle inside of another, or two overlapping circles. So you draw the first premise, and then you draw the second premise into the same picture (one of the circles will do “double duty”); then you see whether the conclusion “fits” without further changes to your picture.

Let's start with “All A are B.”



And suppose our second premise was “All C are A.” So we add that to our diagram:

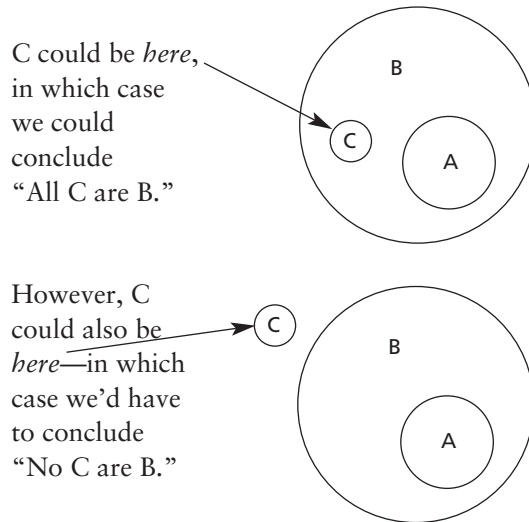


And suppose the conclusion was “All C are B.” Is that a valid conclusion? Is that what we *must* conclude, given our diagram? Yes. So this syllogism

All As are Bs.
All C are A.
 Therefore, all C are B.

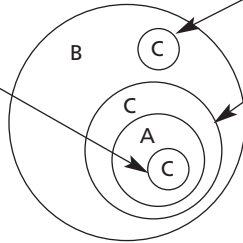
is valid. (And, in fact, you’ll see it is listed as the first valid form in Section 2.)

Okay, what if our second premise were, instead, “No C are A”?

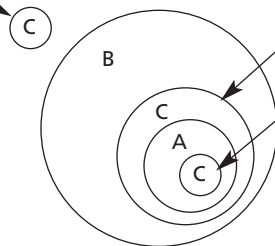


Since we don’t know where exactly C would be (we just know it wouldn’t be inside the A circle), we can’t conclude anything for sure about whether C are B. Concluding either “All C are B” or “No C are B” would be invalid.

What if our second premise is “All C are B”? Then C could be *here* or *here*—or *here*. So we couldn’t conclude that C is an A—it could be, but it could not be. (And you’ll note that that’s the first invalid form listed in Section 3.)

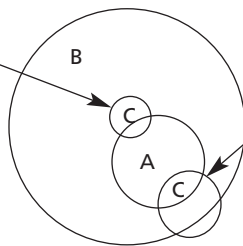


And what if our second premise is “No C are B”? C couldn’t be *here* or *here* because both of those would make Cs Bs; in order for no Cs to be B, C would have to be *here*—so it looks like we could conclude “No C are A.” (And that’s the second valid form listed in Section 2.)



What if our second premise were “Some C are A”?

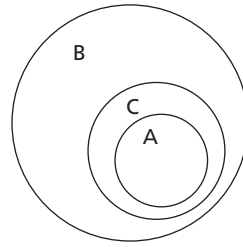
If *this* were the case, we could conclude “All C are B.” But what if *this* were the case?



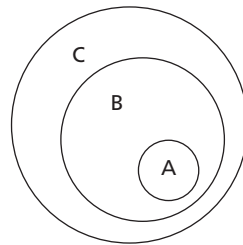
Then some C would *not* be B. Both placements of C fulfill “Some C are A”—but since we don’t know which one is the case, we don’t know whether Cs are Bs or not.

A similar situation arises when our second premise is “Some C are not A.”

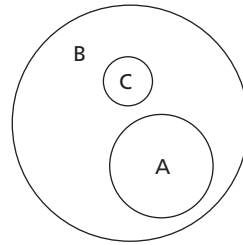
Let’s change direction slightly and say our second premise is “All A are C” (and our first premise is still “All A are B”). That could be this:



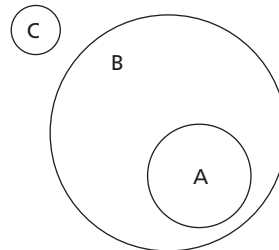
Or it could be this:



So we couldn't conclude for sure that all Cs are Bs or that all Bs are Cs.
 What if our second premise were "No A are C"? That could be this:



Or it could be this:



So, again, we can't conclude anything with certainty about C being B.
 We won't go through every possible combination . . . just remember to draw the first premise as per the diagrams presented in Section 1. Then add the second premise to your diagram, *being sure to check whether there is more than one way*

to add it. There are only a certain number of ways to add, so it might help to memorize them and systematically consider each:

- A circle can be added completely inside one or more existing circles.
- A circle can be added so it completely encloses one or more existing circles.
- A circle can be added so it overlaps one or more existing circles.
- A circle can be added so it's completely separate from existing circles.

(Note that there's a big difference between "one" and "or more" in the first three possibilities.) Then determine whether or not the proposed conclusion is *necessarily* the case, given your finished diagram. If it is, you have a valid argument; if it's not, you have an invalid argument. But keep in mind that if you end up with more than one possible diagram, the proposed conclusion must be true *in every case* if the form is to be considered valid; in other words, if you can draw the premises in just one way that make the proposed conclusion *not* follow, then the form is invalid.

4.1a Practice determining validity and invalidity using diagrams

Diagram the following syllogisms to determine whether or not the argument is valid.

1. 1. People who keep asking questions are impossible to brainwash.
 2. People who know all the answers don't keep asking questions.
 Therefore, people who know all the answers are easy to brainwash.
2. 1. Sexual intercourse is highly overrated.
 2. Nothing that's highly overrated is worth risking your life for.
 Therefore, sexual intercourse is not worth risking your life for.
3. 1. Most Americans are overweight.
 2. Most overweight people are simply greedy.
 Therefore, most Americans are greedy.
4. 1. All Category 5 storms are dangerous.
 2. Some Category 3 storms are dangerous.
 Therefore, some Category 3 storms are actually Category 5 storms.
5. 1. All harmless entertainments should be encouraged.
 2. Not all games are harmless entertainments.
 Therefore, not all games should be encouraged.

4.1b *More practice determining validity and invalidity using diagrams*

Write each of the following arguments into standard syllogism form and then diagram it to determine whether or not the argument is valid.

1. Is it true that prisoners can't vote? I didn't realize that not everyone is entitled to vote. But I guess that's no big deal, because it's not like every vote makes a difference anyway. But it is interesting that we can conclude from that that not everyone is entitled to make a difference.
2. Many of the elk are sick, and of course, many of them are old, so you can expect to see a lot of old elk with a disease or an infection of some kind.
3. You can't say there's equal opportunity employment unless everyone knows about the jobs that are available. If a job ad is in the paper, then everyone knows about it. So all jobs that are advertised in the paper are equal opportunity jobs.
4. Ghosts aren't real! If they were, you could take a photograph of them!
5. I don't care where you live, all tap water contains impurities. And some impurities that are found in water can make you very, very sick. So you're better off with bottled water, and I don't care how much it costs!

4.2 Using rules

Another way to determine whether or not a syllogism is valid is to see whether it follows the rules of validity. If a syllogism violates one or more rules, it's invalid. We'll use the following six rules of validity:

1. The syllogism must have three, and only three, terms.
2. The middle term must be distributed in at least one of the premises.
3. Any term that is distributed in the conclusion must be distributed in the premise in which it occurs.
4. The syllogism can't have two negative premises.
5. If one of the premises is negative, then the conclusion must be negative—and vice versa.
6. If both premises are universal, the conclusion must be universal.

Obviously, we need to cover some terminology before we proceed.

Consider this valid syllogism:

All A are B.
 C is an A. _____
 Therefore, C is a B.

The first premise states the general principle; that premise is called the **major premise**.

The second line presents the specific case in question; that premise is called the **minor premise**.

The last line states the **conclusion**.

(And every syllogism has exactly three statements, two premises leading to a conclusion.)

The term common to both premises is the **middle term**; in this case, A is the middle term.

The subject of the conclusion is the **minor term**; in this case, C is the minor term.

The predicate of the conclusion is the **major term**; in this case, B is the major term.

(And every valid syllogism has exactly three terms, each appearing twice.)

Terms may be distributed or undistributed. A **distributed** term means that the premise tells us something about the *entire* category, not just some members of it. So in “All A are B,” A is a distributed term—*all* As are being talked about. In “No As are Bs,” not only are we being told something about all of A, we are also being told something about all of B (that in all of B, there is not one A); so in that categorical statement, both A and B are distributed. Here’s a list of the four categorical statements, with the distributed terms highlighted:

All **A** are B.
 Some A are B.
 No **A** are **B**.
 Some A are not **B**.

Now, to the rules.

1. The syllogism must have three, and only three, terms.

Consider this syllogism:

All A are B.
 All C are D. _____
 Therefore, all A are D.

This syllogism has four terms (A, B, C, and D) and is therefore invalid (it commits what’s called, surprise, the *fallacy of four terms*).

This error happens more often than you might think because of the error of equivocation (see Section 5.3.4 “Equivocation (an error in reasoning)”): you may think you have only three terms, but if one of your terms is actually being used to mean two different things, it’s actually two different terms—so you’ve got four terms altogether, not three.

Consider this example:

Man is the only species that kills for fun. I think it’s sick to kill for fun! Men are so sick!

Expressed as a syllogism, the argument is this:

1. Man kills for fun.	All A are B.
2. <u>Killing for fun is sick.</u>	<u>All B are C.</u>
Therefore, men are sick.	Therefore, A are C.

But, you may have noticed that “man” in the first premise seems to be referring to the species of *homo sapiens*, whereas “man” in the conclusion probably refers only to the male members of the species, so actually we have four terms:

1. Man kills for fun.	All A are B.
2. <u>Killing for fun is sick.</u>	<u>All B are C.</u>
Therefore, men are sick.	Therefore, D are C.

Since it has four terms, the syllogism violates this rule, and it’s therefore invalid. (The conclusion doesn’t follow from the premises, even if they are true.)

2. The middle term must be distributed in at least one of the premises.

Consider this syllogism:

All A are B.
<u>All C are A.</u>
Therefore, all C are B.

The middle term, the one in both premises, is A. In the first premise, A is distributed. So it abides by this rule. If it follows the other rules as well, it's a valid syllogism.

Consider this syllogism:

All A are B.
All C are B.
 Therefore, all C are A.

The middle term is B. B is *undistributed* in the first premise; it's also *undistributed* in the second premise. So this syllogism does *not* follow this second rule. This syllogism commits the *fallacy of the undistributed middle*. So it's an invalid syllogism. (All it takes is breaking one rule!)

3. Any term that is distributed in the conclusion must be distributed in the premise in which it occurs.

Consider this syllogism:

All A are B.
No B are C.
 Therefore, no A are C.

In the conclusion, both A and C are distributed. A appears in the first premise—is it distributed there? Yes, it is. So far, so good. C appears in the second premise—is it distributed there? Yes, it is. So, this syllogism follows this third rule. If it follows the other rules as well, it's a valid syllogism.

Consider this syllogism:

Some A are B.
Some C are A.
 Therefore, some C are B.

In the conclusion, neither C nor B are distributed. So, this rule is not applicable. As long as the syllogism doesn't break any of the other rules, it's a valid syllogism.

When the major term is distributed in the conclusion but not in its premise, you have an *illicit major*. When the minor term is distributed in the conclusion but not in its premise, you have an *illicit minor*. (Just in case you wanted more terminology!)

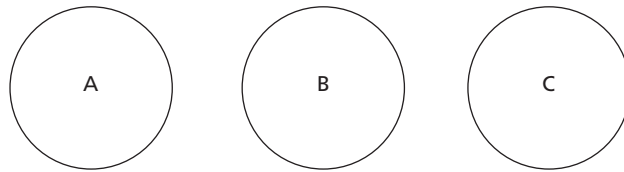
4. The syllogism can't have two negative premises.

Recall that there are two kinds of negative categorical statements: the universal negative and the particular negative.

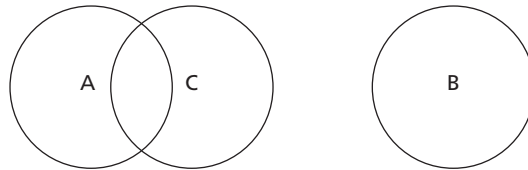
Consider this syllogism:

No A are B.
No B are C.
 Therefore, no A are C.

This syllogism has two negative premises (both are universal negatives) and is therefore invalid. You can check this using the diagram method. The following could illustrate the syllogism:



But so could this:



And in this case, the conclusion doesn't follow. (Remember that all you need is one diagram that correctly shows the two premises and shows something other than the proposed conclusion . . .)

This fallacy is called the *fallacy of exclusive premises*.

5. If one of the premises is negative, then the conclusion must be negative—and vice versa.

Consider this syllogism:

All A are B.
Some A are C.
 Therefore, some C are B.

The conclusion is not negative (it’s a particular affirmative), so again we have a case in which the rule is not applicable. If it doesn’t violate any of the rules, it’s a valid syllogism.

Consider this syllogism:

All A are B.
No C are A.
 Therefore, no C are B.

In this case, the conclusion is negative, so we have to check—is there one, and only one, negative premise? Yes, the second premise is negative (“No C are A” is a universal negative), and the first premise is positive—so there is one, and only one, negative premise. So if this syllogism follows the other rules as well, it’s valid.

A syllogism that breaks this rule commits the *fallacy of drawing an affirmative conclusion from a negative premise*.

6. If both premises are universal, the conclusion must be universal.

Consider this syllogism:

All A are B.
No B are C.
 Therefore, no A are C.

Both premises are universal (the first is the universal affirmative, the second is the universal negative), and the conclusion is, as per the rule, also universal. If the syllogism doesn’t violate any of the other rules either, it is valid.

A syllogism that breaks this rule commits the *existential fallacy* because a particular conclusion (“Some . . .”) would assert the existence of members of a category when, presumably, the universal statements of the premises do not (when we say “All A are B,” we are *not* committing ourselves to there actually being any A). Perhaps an easier version of this rule is that **whenever both premises are universal and the conclusion is particular, all three categories in the syllogism must have at least one member**.

Let’s check the following syllogisms with all six rules.

- | | |
|--|--------------------------|
| 1. All “X” flowers are red. | All A are B. |
| <u>2. No “X” flowers grow on vines.</u> | <u>No A are C.</u> |
| Therefore, some red flowers grow on vines. | Therefore, some B are C. |

Rule 1—The syllogism must have three, and only three, terms. Does it? Yes. ✓

Rule 2—The middle term must be distributed in at least one of the premises. The

- middle term, the one that is common to both premises, is A. Is it distributed in at least one of the premises? Yes, actually it's distributed in both premises. ✓
- Rule 3*—Any term that is distributed in the conclusion must be distributed in the premise in which it occurs. No terms are distributed in the conclusion. n/a
- Rule 4*—The syllogism can't have two negative premises. It doesn't. It has only one negative premise. ✓
- Rule 5*—If one of the premises is negative, then the conclusion must be negative—and vice versa. One of the premises is indeed negative; is the conclusion negative? No. Aha. This rule is broken. ✗ (We don't have to go any further, since as long as a syllogism breaks one rule, it's invalid, but we will anyway, for the learning experience!)
- Rule 6*—If both premises are universal, the conclusion must be universal. Both premises aren't universal. n/a

Let's use the rules with one other example:

I know that all documentaries are seriously informative, and I probably should watch more of them, but so many of them are just so boring! I just have to face it though: boring can nevertheless be seriously informative.

Expressed as a syllogism, the argument is as follows:

- | | |
|---|--------------------------|
| 1. All documentaries are informative. | All A are B. |
| <u>2. Some documentaries are boring.</u> | <u>Some A are C.</u> |
| Therefore, some boring things can be informative. | Therefore, some C are B. |

- Rule 1*—The syllogism must have three, and only three, terms. Does it? Yes. ✓
- Rule 2*—The middle term must be distributed in at least one of the premises. The middle term, the one that is common to both premises, is A. Is it distributed in at least one of the premises? Yes, it's distributed in the first premise. ✓
- Rule 3*—Any term that is distributed in the conclusion must be distributed in the premise in which it occurs. No terms are distributed in the conclusion. n/a
- Rule 4*—The syllogism can't have two negative premises. It doesn't. ✓
- Rule 5*—If one of the premises is negative, then the conclusion must be negative—and vice versa. Neither of the premises is negative. n/a
- Rule 6*—If both premises are universal, the conclusion must be universal. Only one of the premises is universal. n/a

So, none of the rules were broken; this is a valid syllogism. (And if both premises are true, you must accept the conclusion as true.)

4.2a Practice determining validity and invalidity using rules

Use the rules to determine whether or not each of the following syllogisms is valid.

1. 1. No job is worth \$100,000+/year.
 2. No job is worth ignoring what you know to be right.
 Therefore, ignoring what you know to be right is not worth even \$100,000+/year.
2. 1. Some fines are excessive.
 2. No excessive fines should be paid.
 Therefore, all fines should not be paid.
3. 1. Any condition that's fatal and contagious should be subject to mandatory testing and the results available to the public.
 2. AIDS is fatal and contagious.
 Therefore, testing for AIDS should be mandatory and the results available to the public.
4. 1. Sometimes airbags do more harm than good.
 2. Things that do more harm than good shouldn't be mandatory.
 Therefore, airbags shouldn't be mandatory.
5. 1. Any successful business plan requires a loan.
 2. No successful business plan is made overnight.
 Therefore, most business plans hatched overnight require a loan.

4.2b More practice determining validity and invalidity using rules

Write each of the following arguments into standard syllogism form and then use the rules to determine whether or not the argument is valid.

1. Desperate people sometimes lie. It's true. And "I love you" has got to be the most common lie of all. So of course "I love you" is often said just to get sex.
2. Some people are proud of what they don't know, proud of their ignorance. But not knowing something can really limit your choices. So it's real stupid to be proud of your ignorance.
3. Some sprinters are fast, but even some of the fastest sprinters are not faster than a two-year-old terrier. Which just goes to prove that a lot of sprinters can't even outrun a little two-year-old terrier.

4. Because of grade inflation, an “A” no longer means “Excellent.” It means “Good.” That means that a “B” means “Fair.” And fair isn’t good enough for university. You need to be able to read difficult material with comprehension, you need to be able to write correctly and clearly, and you need to be fluent with all basic mathematical operations. So people should need an “A” in high school in order to get into university.
5. Most conservatives don’t believe in working for the public good and social justice, and most university professors do. That’s why most university professors are liberals—or at least not conservatives.

The Barber Paradox

Imagine a village in which a barber (a man) is to shave all and only those men in the village who don’t shave themselves. Does the barber shave himself?

(Of unknown and ancient origin, but popularized by Bertrand Russell in *Principia Mathematica* (1927).)

If the barber doesn’t shave himself, then he is a member of the category of men he is to shave—so he does shave himself. But if he does shave himself, then he’s *not* in the category of men he is to shave—so he doesn’t shave himself. Is there something wrong with logic? Or is there something wrong with the scenario as described?

The Barber Paradox is an example of what’s called “the paradox of self-reference.” The logical impossibility arises in both cases because the description, the statement, refers to itself. But why should that be a problem? (Perhaps the problem is one of perspective—perhaps there’s something “illegitimate” about self-reference, something like looking at yourself *from* the mirror.) And, what’s the solution?

Review of terms

Define the following terms:

- categorical logic
- predicate logic
- categorical statement
- universal affirmative
- particular affirmative
- universal negative
- particular negative
- logical equivalence
- conversion
- obversion
- contrapositive
- logical incompatibility
- logical compatibility
- contradictories
- contraries
- subcontraries
- syllogism
- valid syllogism
- invalid syllogism
- major premise
- minor premise
- conclusion
- middle term
- minor term
- major term
- distributed term
- fallacy of four terms
- fallacy of the undistributed middle
- illicit major
- illicit minor
- fallacy of exclusive premises
- fallacy of drawing an affirmative conclusion from a negative premise
- existential fallacy

Thinking critically about what you see

Think critically about each of the following. The first seems to be challenging two statements conventionally thought to be contradictory (or is it contrary?), and in the second, there is something that's logically incompatible with the rest.

1.



2.



Thinking critically about what you hear

The Witch Scene from Monty Python and the Holy Grail

http://www.youtube.com/watch?v=yp_I5ntikaU

Thinking critically about what you read

Think critically about each of the following, paying special attention to deductive validity.

If you can express the argument as a syllogism, you'll be completing steps one and two of the template (which is provided on page 49). Think carefully about step three; in particular, look for the error of equivocation.

If the argument is valid, you might want to consider steps five, six, and seven.

1. Most people profess to be against war. But human history is full of war. So most people must be lying.
2. George W. Bush says that "People who harbor weapons of mass-destruction will be dealt with." We agree. The U.S. harbors weapons of mass-destruction. Therefore, the U.S. will be dealt with.
3. God made us in his image. We lie, punish without proper reason, give no rational reasons for our actions, play favorites, curse those who disobey us, tolerate drunkenness, tolerate slavery, are afraid of the ability of others, and have difficulty with math. Therefore, God lies (Gen 3:2–5), punishes without proper reason (Gen 4:3–11), gives no rational reasons for his actions (Gen 6:6–7), plays favorites (Gen 6:8), curses those who disobey him (Gen 3:14–17), tolerates drunkenness (Gen 9:20–22), tolerates slavery (Gen 9:24–27), is afraid of the ability of others (Gen 11:5–7, and has difficulty with math (Gen 6:30 compared to Gen 9:29).

(Based on Bernard Katz,
The Ways of an Atheist. 1999)

4. It will be impossible [for the Iraqis to write a constitution] in the next six weeks, particularly because, as the price for joining the drafting process, the Sunni delegates demanded that all decisions be made by consensus, not by vote.
(“On Leadership,” Charles Krauthammer.
Daily News July 1/05 p. 41)
5. Those boys who beat up that homosexual last night were just all-American boys.

6. Since these fossils were found in Type 1 rocks but not in Type 2 rocks, and since the fossils are 2,000 years old, we can conclude that Type 1 rocks are 2,000 years old, but Type 2 rocks are not.
7. We know that God created the Earth because everything has to have a cause.
8. It's amazing I won. I was running against peace, prosperity, and incumbency.
(George W. Bush, Jun14/02 speaking to Swedish PM Goran Perrson, unaware that a live television camera was still rolling, as reported in *Stupid White Men*, Michael Moore)
9. "I think, therefore I am," said Descartes. It follows that since I am, I think.
10. Any basis for one's life should be examined before adoption. The Bible is not read carefully, completely, and critically by most people. Therefore, most people should read the Bible carefully, completely, and critically.

Thinking critically about what you write

See your instructor for instructions.

Thinking critically when you discuss

See your instructor for instructions.

Template for critical analysis of arguments

1. What's the point (claim/opinion/conclusion)?
 - Look for subconclusions as well.
2. What are the reasons/what is the evidence?
 - Articulate all unstated premises.
 - Articulate connections.
3. What exactly is meant by . . . ?
 - Define terms.
 - Clarify all imprecise language.
 - Eliminate or replace “loaded” language and other manipulations.
4. Assess the reasoning/evidence:
 - **If deductive, check for truth/acceptability and validity.**
 - If inductive, check for truth/acceptability, relevance, and sufficiency.
5. How could the argument be strengthened?
 - Provide additional reasons/evidence.
 - Anticipate objections—are there adequate responses?
6. How could the argument be weakened?
 - Consider and assess counterexamples, counterevidence, and counterarguments.
 - Should the argument be modified or rejected because of counterarguments.
7. If you suspend judgment (rather than accepting or rejecting the argument), identify further information required.

Reasoning test questions

1. Everyone sitting in the waiting room of the school's athletic office this morning at nine o'clock had just registered for a beginners' tennis clinic. John, Mary, and Teresa were all sitting in the waiting room this morning at nine o'clock. No accomplished tennis player would register for a beginners' tennis clinic.

If the statements above are true, which one of the following must also be true on the basis of them?

- (A) None of the people sitting in the school's athletic office this morning at nine o'clock had ever played tennis.
- (B) Everyone sitting in the school's athletic office this morning at nine o'clock registered only for a beginners' tennis clinic.
- (C) John, Mary, and Teresa were the only people who registered for a beginners' tennis clinic this morning.
- (D) John, Mary, and Teresa were the only people sitting in the waiting room of the school's athletic office this morning at nine o'clock.
- (E) Neither John nor Teresa is an accomplished tennis player.

(The Official LSAT PrepTest XXI, Section 3, #1)

2. Dr. Z: Many of the characterizations of my work offered by Dr. Q are imprecise, and such characterizations do not provide an adequate basis for sound criticism of my work. Which one of the following can be properly inferred from Dr. Z's statement?

- (A) Some of Dr. Q's characterizations of Dr. Z's work provide an adequate basis for sound criticism of Dr. Z's work.
- (B) All of Dr. Q's characterizations of Dr. Z's work that are not imprecise provide an adequate basis for sound criticism of Dr. Z's work.
- (C) All of the characterizations of Dr. Z's work by Dr. Q that do not provide an adequate basis for sound criticism of Dr. Z's work are imprecise.
- (D) If the characterization of someone's work is precise, then it provides a sound basis for criticizing that work.
- (E) At least one of Dr. Q's characterizations of Dr. Z's work fails to provide an adequate basis for sound criticism of that work.

(The Official LSAT PrepTest XXIV, Section 3, #15)

3. *Essayist*: Every contract negotiator has been lied to by someone or other, and whoever lies to anyone is practicing deception. But, of course, anyone who has been lied to has also lied to someone or other.

If the essayist's statements are true, which one of the following must also be true?

- (A) Every contract negotiator has practiced deception.
- (B) Not everyone who practices deception is lying to someone.

- (C) Not everyone who lies to someone is practicing deception.
- (D) Whoever lies to a contract negotiator has been lied to by a contract negotiator.
- (E) Whoever lies to anyone is lied to by someone.

(The Official LSAT PrepTest XXII, Section 4, #25)

4. *Political theorist:* The vast majority of countries that have a single political party have corrupt national governments, but some countries with a plurality of parties also have corrupt national governments. What all countries with corrupt national governments have in common, however, is the weakness of local governments.

If all of the political theorist's statements are true, which one of the following must also be true?

- (A) Every country with weak local government has a single political party.
- (B) Some countries with weak local governments have a plurality of political parties.
- (C) Some countries with weak local governments do not have corrupt national governments.
- (D) The majority of countries with weak local governments have a single political party.
- (E) Fewer multiparty countries than single-party countries have weak local governments.

(The Official LSAT PrepTest XXIII, Section 2, #12)

5. All bridges built from 1950 to 1960 are in serious need of rehabilitation. Some bridges constructed in this period, however, were built according to faulty engineering design. That is the bad news. The good news is that at least some bridges in serious need of rehabilitation are not suspension bridges, since no suspension bridges are among the bridges that were built according to faulty engineering design.

If the statements above are true, then on the basis of those statements, which one of the following must also be true?

- (A) Some suspension bridges are not in serious need of rehabilitation.
- (B) Some suspension bridges are in serious need of rehabilitation.
- (C) Some bridges that were built according to faulty engineering design are in serious need of rehabilitation.
- (D) Some bridges built from 1950 to 1960 are not in serious need of rehabilitation.
- (E) Some bridges that were built according to faulty engineering design are not bridges other than suspension bridges.

(The Official LSAT PrepTest XXIII, Section 2, #10)