# Categorical Statements: A, E, I, and O

In this lesson, we’ll be starting our study of **categorical logic,** which is a type of formal, deductive logic that deals with relationships between categories of things. The study of categorical logic goes all the way back to the Greek philosopher Aristotle (384-322 BCE), and continues all the way up to the current day. While it isn’t quite as “powerful” as some of the more modern methods of deductive logic we’ll learn later in the class, the rules are much simpler, and it works perfectly well as a tool for analyzing many common types of deductive arguments.

1. What is a **categorical statement**? What does it mean to put categorical statements into **standard form**?
2. What are the component parts of a standard form categorical statement? What are the **quantifier, subject term, copula,** and **predicate term**?
3. What are the four forms of categorical statements? What is the **quality** and **quantity** of each?
4. What does it mean for a term to be **distributed** by a categorical statement? How can you determine whether a particular term has been distributed?

Categorical logic, like other varieties of formal, deductive logic, aims to formulate *rules* for evaluating good (valid) or bad (invalid) arguments. These rules can then be applied in a mechanical fashion, even by people who don’t understand what the argument in question is “about,” or who disagree on the truth of the premises. In the 20th century, the study of formal logic eventually led to the invention of the computer, which is essentially a machine that does *nothing but* process arguments in formal logic. In order to use formal logic at all, however, we need to begin by constructing a new “language” in which to express our premises and conclusions. This language, unlike ordinary English, shouldn’t be open to ambiguity or misinterpretation. With that in mind, we’ll now turn to the language of categorical logic.

## Categorical Statements: Standard Form

A **categorical statement** (or **categorical proposition**)makes a claim about the relationship between two categories of objects.

1. “Many insects are vegetarians.” (The category of insects includes one or more members of the category of vegetarians.)
2. “Reality television shows are not appropriate for children.” (No members of the category of reality TV shows are members of the category of TV shows appropriate for children.)
3. “The 2018 Eagles are Superbowl winners.” (The category of Super-Bowl winning teams includes the category of teams identical to the 2018 Eagles.)

Every **standard form categorical statement** has the form <Quantifier><subject term><copula><predicate term>

* The **quantifier** (“All”, “No”, or “Some”) specifies how much of the subject class is being talked about.
* The **subject term** and **predicate term** are plural noun phrases naming the two classes being related.
* The **copula** (“are” or “are not”) connects the subject term with the predicate term.

In order to apply the methods of categorical logic that we will be learning in future classes, you will need to express both the premises and conclusion as standard form categorical statements.

## Four Types of Categorical Statements

Standard form categorical statements come in just FOUR basic types, each of which is abbreviated by a letter:

|  |  |  |
| --- | --- | --- |
| Statement | Type | Common English Expressions |
| “All S are P” | Universal Affirmative (A) | “Only Ps are Ss”, “Every S is a P”, “Any S is a P”, “Whatever is S is P”, “If something is S, it is P”, “Something is a P if it is S” |
| “No S are P” | Universal Negative (E) | “If S, then not P”, “All Ss are non-Ps”, “Ss are not Ps”, “Nothing S is P” |
| “Some S are P” | Particular affirmative (I) | “There are Ss that are Ps,” “Most Ps are Ss”, “A few Ss are Ps”, “At least one S is P” |
| “Some S are not P” | Particular negative (O) | “Not all Ss are Ps,” “Many Ss are not Ps,” “Ss are not always P”, “A few Ss are not P” |
| “All S are not P” | NOT STANDARD FORM!!! | This is NOT a standard form categorical statement, because it might mean two different things. For example, “all birds are not ravens” means “some birds are not ravens” while “all birds are not mammals” means “no birds are mammals.” Because of this ambiguity, you CANNOT use statements of this form in categorical logic. |

In order to use categorical logic, ALL premises and conclusions must be translated into standard form *A, E, I,* or *O* statements*.*

## Determining the Form: Quantity and Quality

The form of a categorical statement is entirely determined by two properties: *quality* and *quantity*. The **quality** of a categorical statement depends on whether it states that something BELONGS to a class, or whether it states that something does NOT BELONG to a class.

* “All S are P” (A) and “Some S are P” (I) have **affirmative** quality.
* “No S are P” (E) and “Some S are not P” (O) have **negative** quality.

The **quantity** of a categorical statement depends on whether it makes a claim about EVERY member of a class, or just SOME (which means “at least one”) members of a class.

* “All S are P” (A) and “No S are P” (E) have **universal** quantity.
* “Some S are P” (I) and “Some S are not P” (O) have **particular** quantity.

## Which Terms are Distributed?

In the categorical statements like “All S are P”, “Some S are M”, and “No P are M”, the **terms** are the individual letters S, P, and M. Logicians say that a term is **distributed** by a statement if and only if that statement makes a claim about *every* member of the class denoted by the term. What terms are distributed depends on the type of categorical statement:

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| --- | --- | --- |
| Statement | Distributes | Example |
| “All S are P” (A) | S, but not P | “All rubies are gems” makes a claim about all rubies, but not all gems |
| “No S are P” (E) | Both | “No tires are tulips” makes a claim about every tire AND every tulip. |
| “Some S are P” (I) | Neither | “Some trees are tall things” doesn’t make a claim about every tree, or every tall thing. So, it distributes neither term. |
| “Some S are not P” (o) | P only | “Some novels are not romances” does NOT make a claim about every novel, but it DOES make a claim about every romance. Why? This statement claims that there is at least one thing in the universe (in this case, at least one book) that is NOT a romance. This tells you something about romance: not *everything* is a romance. |

## Summary Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Statement | Letter name | Quantity | Quality | Terms distributed |
| All S are P | A | Universal | Affirmative | S |
| No S are P | E | Universal | Negative | S and P |
| Some S are P | I | Particular | Affirmative | None |
| Some S are not P | O | Particular | Negative | P |

## Translating English Statements

Many English statements don’t have obvious categorical equivalents. Over the years, however, logicians have worked out a number of “tricks” to translating English statements.

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| --- | --- | --- |
| Category | Original | Categorical Translation |
| Active Verbs | Pat ran very quickly. | All persons identical to Pat are persons who ran very quickly. |
| General | Mammals give live birth. | All mammals are beings that give live birth. |
| Individuals | Lincoln was a U.S. president. | All persons identical to Lincoln are former U.S. presidents. |
| Times | It is 12:00 A.M. | All times identical to the present and times identical to 12:00 A.M. |
| Places | I’ll be at the bar soon. | All persons identical to myself are people who will be at the bar soon. |
| “Always”, “Never” | It never rains on the sun. | No places identical to the Sun are places it rains. |
| “Occasionally” | I eat pizza occasionally. | Some times are times I eat pizza. |
| Numbers | Two people drank Coke. | Some people are Coke-drinkers. (Note: In categorical logic, we can’t say “two.” We can only say “at least one”). |

## Solved Problems

Solved Problem 1: Identify the subject term, predicate term, quantity, and quality of the categorical statement. Then, say which terms are distributed.

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| --- | --- | --- | --- | --- |
| Statement | Subject? | Predicate? | Type | Distributes |
| No Vikings are bears. | Vikings | Bears | Universal Negative (E) | S, P |
| Some Vikings who sail ships are not bears that eat people. | Vikings who sail ships | Bears that eat people | Particular Negative (O) | P |
| Some non-bears are non-lions | Non-bears | Non-lions | Particular Affirmative (I) | Neither |
| All Green Bay Packers are football players. | Green Bay Packers | football players | Universal Affirmative (A) | S |

Solved Problem 2: Translate the following into standard form categorical statements.

|  |  |
| --- | --- |
| Statement | Translation |
| “The 2008 stock market crash was caused by a drop in house prices.” | All events identical to the 2008 stock market crash are events caused by drops in house prices. |
| “Not all changes in stock prices have clear causes.” | Some changes in stock prices are not events that have clear causes. |
| “A few people have made a lot of money by digging up gold in their backyards.” | Some people are people who made a lot of money by digging up gold in their backyards. |
| “Americans don’t save enough money.” | No Americans are people who save enough money.” (Note: Categorical logic has problems with claims like this, since the most plausible interpretation is that we are talking about the *average* American, and not ALL or SOME Americans. These sorts of claims often feature in inductive arguments, which categorical logic is not designed to analyze.) |
| “If you want to retire at 55, you need to save a lot of money now.” | All persons wishing to retire at 55 are persons who should save a lot of money now. |
| “Only fools would invest all of their money in tulips.” | All people who invest all of their money in tulips are fools. (Note: This was really a thing!) |
| “I own a house, but don’t own a car.” | All persons identical to me are persons who own a house.  No persons identical to me are person who own a car.  (Note: In many cases, it is best to use two statements, as we did here.) |
| “Stock market crashes can happen at any time.” | All times are times that stock market crashes can happen. |
| “Unless you are a genius, you shouldn’t try to make money by speculating on foreign currency.” | No people who are non-geniuses are people who try to make money… OR  All people who try to make money…are geniuses…  (Note: In general, “unless” is translated as “if not”) |

## Review Questions

1. Identify the subject term, predicate term, quantity, and quality of the categorical statement. Then, say which terms are distributed.
   1. All Slytherins are schemers.
   2. No people sick with the flu are people welcome at work.
   3. Some paintings by Picasso are not good paintings.
   4. Some apparently vicious vampires are innocent vegetarians.
   5. Some events portrayed in movies are events that happened in real life.
   6. No painful experiences are experiences I like to think about.
   7. Some killings during war are not unjustified killings.
2. Translate the following into standard form categorical statements.
   1. Vigorous writing is concise. (W. Strunk)
   2. Creativity can solve almost any problem. (G. Lois)
   3. Honesty is a good thing, but it is not profitable to its possessor unless it is kept under control. (D. Marquis)
   4. College isn't the place to go for ideas. (H. Keller)
   5. The time you enjoy wasting is not wasted time. (B. Russell).
   6. A wise man will make more opportunities than he finds. (F. Bacon)