

# Logic

## Aristotelian Syllogistic: Invalidity in Syllogisms

### Invalidity by Counterexample

- The clearest way of showing that a syllogism is invalid is to produce a counterexample—an argument in that form (i.e., mood & figure) with true premises & a false conclusion.
  - E.g., for AAA 2d Figure

Apm	All horses are four-legged.
Asm	All cows are four-legged.
Asp	So, all cows are horses.
- But that requires imagination.
  - There are less clear, but easier ways of knowing that a syllogism is invalid:
  - There are three sets of rules that all valid syllogisms must follow.

### Distribution of Terms

- In order to test syllogisms by rule, one needs the concept of *distribution*.
  - Terms are distributed (or not) in propositions when they refer in that proposition to all of the things the term names. (See next slide.)
  - More technically, when they can be narrowed without risk of making the proposition false. (See second next slide.)
- Distribution is part of a larger medieval theory of language.
  - According to medievals, terms had two basic properties
    - signification, the meaning of terms
    - supposition, the “mode of reference” (Geach) or “substitutive value” (Maritain)
  - Distribution is a part of that theory of language.

### What is Distributed?

- Terms are distributed (or not) in propositions when they refer in that proposition to all of the things the term names
- It is easy to see how this applies to the subjects of propositions:
  - Universal propositions distribute their subjects.
    - “All dogs are mammals” says something about all dogs.
    - As does “No dogs are mammals.”
  - Particular propositions do not distribute their subjects
    - “Some dogs are (or are not) collies” does not say something about all dogs.
- Less clear is its application to predicates:
  - Affirmative propositions do not distribute their predicates.
    - “All (or some) dogs are mammals” does not tell us anything about all mammals.
  - Negative propositions do distribute their predicates.
    - “No dogs are birds” tells us something about all birds, namely that they are not dogs.
    - What about “Some dogs are not collies”?
      - Think of one of the dogs that is not a collie, say Rin Tin Tin.
      - This proposition says of *all* collies that they are not identical to Rin Tin Tin.

### What is Distributed? (cont’d.)

- A term is distributed in a certain kind of proposition if one can always narrow the term without changing a true proposition into a false one.

	All collies are dogs.	Some dogs are friendly animals.	Some dogs are not collies.	No dogs are birds.
Subject	All big collies are dogs, &c. Still true. Distributed.	Some mean dogs are friendly. Not true. Not distributed.	Some collie-dogs are not collies. Not true. Not distributed.	No small dogs are birds, &c. Still true. Distributed.
Predicate	All collies are ugly dogs. Not true. Not distributed.	Some dogs are friendly cat (animals). Not true. Not distributed.	Some dogs are not big collies, &c. Still true. Distributed.	No dogs are big birds, &c. Still true. Distributed.

### Summary

	Distributes the Subject	Does not distribute the Subject
Distributes the Predicate	E	O
Does not distribute the Predicate	A	I

- Each propositional form has its own distribution pattern:
- E distributes *both* the Subject & the Predicate.
  - A distributes the *Subject only*.
  - O distributes the *Predicate only*.
  - I distributes *neither* the Subject nor the Predicate.

### Requirements for Validity

- Constraints on the premises:
  - At least one premise must be universal.
  - At least one premise must be affirmative.
  - The middle term must be distributed at least once.
- Constraints on the conclusion:
  - One cannot get a universal conclusion from a particular premise.
  - One cannot get an affirmative conclusion from a negative premise
    - or a negative conclusion without a negative premise.
  - One cannot distribute in the conclusion what is not distributed in the premises.

### Another Way of Stating the Rules

- Negativity Rules:
  - No syllogism can have two negative premises.
  - Any syllogism with a negative premise must have a negative conclusion.
  - Any syllogism with a negative conclusion must have a negative premise .
- Particularity Rules (Redundant):
  - No syllogism can have two particular premises.
  - Any syllogism with a particular premise must have a particular conclusion.
- Distribution Rules:
  - Any term that is distributed in the conclusion must be distributed in the premises.
  - The middle term must be distributed in at least one premise.