

Inductive vs Deductive Reasoning

Inductive Reasoning

- specific observation \rightarrow general principle
 - ▷ Two-thirds of the students at Whatsamatta U. take goat herding, therefore $\frac{2}{3}$ of all students everywhere take goad herding.

Deductive Reasoning

- General principle \rightarrow specific instance
 - ▷ All mammals have ears, therefore Mr. Ed (the talking horse; look it up) has ears.

Conditional Statements

- A statement of the form “if p , then q ” ($p \rightarrow q$), where p and q are statements.
 - ▷ If I robbed a bank, then I will be arrested.
 - ▷ Every Tuesday I eat snails for lunch. (i.e., If today is Tuesday, then I’ll eat snails for lunch.)
- p is the *hypothesis*; q is the *conclusion*.
- A *counterexample* is a specific case in which p is true, but q is not.
 - ▷ Today is Tuesday, but I had barbecued water for lunch.

Symbols	
\rightarrow	Implies, leads to
\leftrightarrow	if and only if, iff
$\sim ! \neg$	Not, negation
$\& \wedge \cap$	And, intersection
$ \vee \cup$	Or, union

Derived Statements

- **Converse:** if q , then p ($q \rightarrow p$)
 - ▷ If I am arrested, then I robbed a bank.
- **Inverse:** if not p , then not q ($\sim p \rightarrow \sim q$)
 - ▷ if I didn’t rob a bank, then I won’t be arrested.
- **Contrapositive:** if not q , then not p ($\sim q \rightarrow \sim p$)
 - ▷ If I am not arrested, then I didn’t rob a bank.
- **Biconditional:** p if and only if q ($p \leftrightarrow q$)
 - ▷ Both the statement ($p \rightarrow q$) and its converse ($q \rightarrow p$) are true.
 - ▷ I robbed a bank if and only if I’m arrested.

The contrapositive has the same truth value as the original statement.

“If and only if” is routinely abbreviated “iff”

Laws of Logic

Law of Detachment

- If $p \rightarrow q$ is true, and p is true, then q is true.

Law of Syllogism

- If $p \rightarrow q$ is true and $q \rightarrow r$, then $p \rightarrow r$ is true.