

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 goat 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 rob 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	then, 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 ($\sim p \rightarrow \sim q$)
 - ▷ If I am not arrested, then I didn’t rob a bank.

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

“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 $q \rightarrow r$ is true, then $p \rightarrow r$ is true.