

Lesson 6: Truth Tables

- Goals:**
- Learn the meaning of various symbols related to truth tables
 - Complete an unfinished truth table

A truth table can be used to determine the truth (or falsehood) of a complex conditional statement, if you know the truth (or falsehood) of the original hypothesis and conclusion. Before we start, there are some important symbols to know:

Symbols	Meaning	Examples
\Rightarrow, \rightarrow	$P \rightarrow Q$ implies; if...then	$P \Rightarrow Q$ $P \rightarrow Q$ means "if P, then Q" Only false if P is true and Q is false.
$\Leftrightarrow, \leftrightarrow$	$P \rightarrow Q \rightarrow \text{True}$ if and only if, biconditional $P \rightarrow Q$ True	$P \Leftrightarrow Q$ $P \leftrightarrow Q$ means "P if and only if Q" Only true if $P \rightarrow Q$ is true AND $Q \rightarrow P$ is also true.
\neg, \sim, P', \bar{P}	negation, 'NOT' (opposite)	$\neg P$ $\sim P$ P' \bar{P} means "not P" or the opposite of P. <u>Reverses the truth value of P.</u>
$\wedge, \&, \cap$	and (Both must be true)	$P \wedge Q$ $P \& Q$ $P \cap Q$ Is only true if both <u>P and Q</u> are true
$\vee, +, \cup$	or only one has to be true	$P \vee Q$ $P + Q$ $P \cup Q$ Is true if P is true, or Q is true, or both are true. \downarrow only 1 (p or q) has to be true

opposite

only 1 (p or q) has to be true

Using these symbols in a **truth table** can help with more difficult examples of verification of the truth of a conditional statement. Below is an example of a truth table showing the basic logical operators in use. Work with your teacher to fill in the blanks in the truth table below.

P	Q	$\neg P$	$\neg Q$	$P \wedge Q$	$P \vee Q$	$P \Rightarrow Q$	$Q \Rightarrow P$	$P \Leftrightarrow Q$
T	T	F	F	T	T	T	T	T
T	F	F	T	F	T	F	T	F
F	T	T	F	F	T	T	F	F
F	F	T	T	F	F	T	T	T

Handwritten annotations for the truth table:

- Arrows pointing from $\neg P$ and $\neg Q$ to the word "opposite".
- An arrow pointing from $P \wedge Q$ to the text "and Both are true".
- An arrow pointing from $P \vee Q$ to the text "one of the 2 is true".
- Handwritten notes above the table: "opp", "opp", "Both must be true", "or", "or $\Rightarrow P \rightarrow \text{True}$ ", "or $P \rightarrow Q$ True".