Math 102
Basic Truth Tables

As we mentioned when we first defined statements, a **statement** is a declarative sentence that is either true or false. That is, a statement ends up having one of two possible truth values:

- If a statement is true, we assign it the truth value T. If a statement is false, we assign it the truth value F.
- Often, we will look at simple statements for which the specific truth values of the variables are not known, or where we are using the variables in place of general statements (that is, we are not thinking of any specific simple statements).
- Because of this, we will need to consider all possible ways of assigning a truth value to each of the variables representing a simple statement within the compound statement we are looking at.

Basic Truth Tables:

The truth table for "not" ($\sim$). Given a simple statement p. If p is true, then $\sim p$ is false. Similarly, if p is false, then $\sim p$ is true. Note that the statement p has only two possible truth values, so there are two rows in the truth table. The following table summarizes this information.

p	$\sim p$
T	F
F	T

The truth table for "or" ($\vee$). Given two simple statements p, q, the compound statement $p \vee q$ has four possible truth value assignments: both could be true, both could be false, the first could be true while the second is false, and the first could be false while the second is true. Since $\vee$ always represents an *inclusive or*, the statement $p \vee q$ is true except when p and q are both false. The following table summarizes this information.

p	q	$p \vee q$
T	T	T
T	F	T
F	T	T
F	F	F

The truth table for "and" ($\wedge$). Given two simple statements p, q, as above the compound statement $p \wedge q$ has four truth value assignments. The statement $p \wedge q$ is only true when p and q are both true. The following table summarizes this information.

p	q	$p \wedge q$
T	T	T
T	F	F
F	T	F
F	F	F

The truth table for a conditional ($\rightarrow$). Given two simple statements p, q, as above the compound statement $p \rightarrow q$ has four possible truth value assignments. The statement $p \rightarrow q$ is true except in the case when p is true and q is false. To see this, it is helpful to think about the conditional statement, "If you eat your vegetables then you will get dessert." When is this a false statement? The following table summarizes this information.

p	q	$p \rightarrow q$
T	T	T
T	F	F
F	T	T
F	F	T

The truth table for a biconditional ($\longleftrightarrow$). Given two simple statements p, q, as above the compound statement $p \longleftrightarrow q$ has four possible truth value assignments. The statement $p \longleftrightarrow q$ is true when p and q are both true and when p and q are both false. When p and q have opposite truth values, the statement $p \longleftrightarrow q$ is false. The following table summarizes this information.

p	q	$p \longleftrightarrow q$
T	T	T
T	F	F
F	T	F
F	F	T