Basic Truth Tables You Should Know

(1) **Negation**

p	$\sim p$
T	F
F	T

The truth value of $\sim p$ takes the opposite value of p.

(2) **Conjunction**

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

Only true when both p *and* q are true.

(3) **Disjunction**

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

True when either p *or* q are true.

(4) **Conditional**

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

Always true except for when p is true and q is false

(5) **Biconditional**

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

True only when p and q share the same truth value.

How to Read a Truth Table.

A truth table is essentially a chart of the different possible truth values of a statement given the truth value of the simpler statements. For example, the truth value of $p \vee q$ is true when p is true and q is false, as shown below;

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

This makes sense, since it's an "or" statement, like "It is raining or it is snowing" and thus is true when either part of the statement p: "It is raining" or q: "it is snowing" is true.

Constructing a Truth Table.

We will show by example how to construct a truth table. We construct the truth table for the statement;

$$p \vee \sim q.$$

We first note that the truth value of the above statement depends on the truth value for p and q. So we need both a p column, a q column and a column for the statement itself.

p	q	$p \vee \sim q$

Since we are aiming to make "a chart of the different possible truth values of a statement given the truth value of the simpler statements", we first need to know the possible different truth values for p and q. So we fill this in the chart, as shown below

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

We note, that by filling in the first columns in with this pattern, we get all the possible combinations of truth values for p and q. Also, notice that the statement "$p \vee \sim q$" does not really depend on p and q, but rather it depends on the truth value of p and $\sim q$. So we add a column to show this.

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

From the rule on negation, in section on basic truth tables, we know that the truth value of $\sim q$ takes the opposite value of the truth value of q. We show this below,

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

We now fill in the rest of the column for $\sim q$.

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

So since this statement is overall a disjunction, we note the rule for disjunction;

"True when either p *or* q are true."

and fill in the table accordingly. Consider the first row, p is true, and $\sim q$ is false, so the disjunction $p \vee \sim q$ is true, since at least one is true.

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

We continue on with this in the next row, p is true and $\sim q$ is true so the disjunction $p \vee \sim q$ is true.

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

We continue on and fill in the remainder of the column.

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

One question remains, I said above that "[the] statement is overall a disjunction". How did I decide this? The answer is simple, it is decided by the dominance of connectives. The statement is overall a disjunction since disjunction was the most dominate connective in the statement, the other being negation. We used the type of statement it was, in the case a disjunction, to help us fill out the final column of the chart.