

3.2 Truth Tables for Negation, Conjunction, and Disjunction

Math 120

Math for General Education

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Last Class Review

◆ Connectives

◆ "AND" - \wedge

◆ "OR" - \vee

■ Exclusive

■ Inclusive

◆ Quantifiers

◆ Negation - \sim

◆ "Some", "none", "all"

Last Class Review (cont.)

- ◆ Compound Statements - consisting of 2 or more simple statements.
- ◆ Often use connectives to join 2 simple statements
 - "and"
 - "or"
 - "if ... then ..."
 - "if and only if"
- ◆ Typically use p , q , r , and s to represent simple statements

Last Class Review (cont.)

- ◆ Conditionals - Symbolized by \rightarrow & read "if – then"
 - $p \rightarrow q$ Reads "if p , then q "
 - Antecedent – p – precedes the arrow
 - Consequent – q – follows the arrow
- ◆ Bi-Conditionals – Symbolized by \leftrightarrow & reads "if and only if"
 - $p \leftrightarrow q \Rightarrow$ "p if and only if q"

Truth Tables for Negation, Conjunction and Disjunction

Truth Table – device used to determine when a compound statement is true or false.

5 Basic Truth Tables – used to construct other truth tables

1. Negation
2. Conjunction
3. Disjunction
4. Conditional
5. Biconditional

Truth Table - Negation

If p is a true statement, then the negation of p , "not p " is a false statement.

If p is a false statement, then the negation of p is a true statement.

For a simple statement, there are exactly two true-false cases.

	p	$\sim p$
Case 1	T	F
Case 2	F	T

Truth Table - Negation

If a compound statement consists of 2 simple statements p & q , there are **4 possible cases**.

Ex: "The test is today and the test covers Chapter 5".

Let p : Test is today

q : The test covers Ch. 5

	p	q
Case 1	T	T
Case 2	T	F
Case 3	F	T
Case 4	F	F

Truth Table - Conjunction

You recently bought a new house. You ordered new carpet and new furniture from the same store. You explain to the salesperson that the carpet must be installed before the furniture is delivered. The Salesperson promises that the carpet will be installed on Thursday (p) & the furniture will be delivered on Friday (q).

$(p \wedge q)$

4 possible True-False situations

	p	q	$p \wedge q$
Case 1	T	T	T
Case 2	T	F	F
Case 3	F	T	F
Case 4	F	F	F

$p \wedge q$ is true only when both p & q are true.

Truth Table - Disjunction

Helped Wanted – The applicant must have a 2 year college degree in heating/AC systems or 5 years of related experience.
- Who qualifies for the job?

p: A requirement for the job is a two-year college degree in heating/AC systems.

q: 5 years related experience.

	p	q	$p \vee q$
Case 1	T	T	T
Case 2	T	F	T
Case 3	F	T	T
Case 4	F	F	F

General Procedure for Constructing Truth Tables

1) Study the compound statement and determine whether it is a negation, conjunction, disjunction, conditional, or biconditional statement.

Negation – answer under \sim ;

conjunction – under \wedge ;

disjunction – under \vee ;

conditional – under \rightarrow ;

biconditional – under \leftrightarrow .

2) Complete the columns under the simple statements p, q, r, and their negations within ().

General Procedure for Constructing Truth Tables

- Complete the column under the connective within the (). Use the truth values of the connective in determining the final answer in step 5.
- Complete the column under any remaining **statements and their negations**.
- Complete the column under any remaining connectives. Recall that the answer will appear under the column determined in step 1.

**Be sure to highlight or circle the answer columns and number the columns in the order they are completed.*

Truth Table - Conjunction

"Joe is not an artist and Jose is not a musician."

p: Joe is an artist.

q: Jose is a musician.

	1	2	3	5	4
	p	q	$\sim p$	\wedge	$\sim q$
Case 1	T	T	F	F	F
Case 2	T	F	F	F	T
Case 3	F	T	T	F	F
Case 4	F	F	T	T	T

**Only in Case 4 is the statement true.*

Truth Table Practice

$$(\sim p \vee q) \wedge \sim p$$

Column #	1	2	3	5	4	7	6
Case#	p	q	($\sim p$	\vee	q)	\wedge	$\sim p$
1	T	T	F	T	T	F	F
2	T	F	F	F	F	F	F
3	F	T	T	T	T	T	T
4	F	F	T	T	F	T	T

*Case 3 & 4 produced true results

*Cases 1, 3, 4, 5, & 7 produced true answers.

Truth Table Practice

$$(p \wedge \sim q) \vee r$$

Clmn#	1	2	3	4	6	5	8	7
Case#	p	q	r	(p	\wedge	$\sim q$)	\vee	r
1	T	T	T	T	F	F	T	T
2	T	T	F	T	F	F	F	F
3	T	F	T	T	T	T	T	T
4	T	F	F	T	T	T	T	F
5	F	T	T	F	F	F	T	T
6	F	T	F	F	F	F	F	F
7	F	F	T	F	F	T	T	T
8	F	F	F	F	F	T	F	F

Special Cases



◆ Truth tables are not needed if the truth value is already known of each statement.

◆ Using the picture in the corner:

p: The dog is brown.

q: The girl's shirt is red.

r: The dog is standing up.

Determine the truth value of: $(p \vee q) \wedge \sim r$

$(T \vee F) \wedge T$

$T \wedge T$

T

Practice Problems

◆ Pages 122 – 123

■ #10, 26

◆ Homework:

■ Pages 122 – 123

■ #3 – 42 multiples of 3