

Assignment 1 – Due 7/2/2017

Part II. Exercise Set 2.2 [11, 13b, 15, 20, 43, 45]

11. Q: Construct truth tables for the statement forms in 5-11

$$(p \rightarrow (q \rightarrow r)) \leftrightarrow ((p \wedge q) \rightarrow r)$$

A:

p	q	r	$q \rightarrow r$	$p \wedge q$	$p \rightarrow (q \rightarrow r)$	$(p \wedge q) \rightarrow r$
T	T	T	T	T	T	T
T	T	F	F	T	F	F
T	F	T	T	F	T	T
T	F	F	T	F	T	T
F	T	T	T	F	T	T
F	T	F	F	F	T	T
F	F	T	T	F	T	T
F	F	F	T	F	T	T

$p \rightarrow (q \rightarrow r)$ and $(p \wedge q) \rightarrow r$ always have the same truth values (see highlighted columns). This proves the biconditional $(p \rightarrow (q \rightarrow r)) \leftrightarrow ((p \wedge q) \rightarrow r)$.

13b. Q: Use truth tables to verify the following logical equivalences. Include a few words of explanation with your answers.

$$\sim (p \rightarrow q) \equiv p \wedge \sim q$$

A:

p	q	$p \rightarrow q$	$\sim (p \rightarrow q)$	$\sim q$	$p \wedge \sim q$
T	T	T	F	F	F
T	F	F	T	T	T
F	T	T	F	F	F
F	F	T	F	T	F

$\sim (p \rightarrow q)$ and $p \wedge \sim q$ always have the same truth values (see highlighted columns). This proves that they are logically equivalent.

15. Q: Determine whether the following statement forms are logically equivalent:
 $p \rightarrow (q \rightarrow r)$ and $(p \rightarrow q) \rightarrow r$

A:

p	q	r	$(q \rightarrow r)$	$(p \rightarrow q)$	$p \rightarrow (q \rightarrow r)$	$(p \rightarrow q) \rightarrow r$
T	T	T	T	T	T	T
T	T	F	F	T	F	F
T	F	T	T	F	T	T
T	F	F	T	F	T	T
F	T	T	T	T	T	T
F	T	F	F	T	T	F
F	F	T	T	T	T	T
F	F	F	T	T	T	F

$p \rightarrow (q \rightarrow r)$ and $(p \rightarrow q) \rightarrow r$ do not always have the same truth values (See highlighted columns).
This means that they are not logically equivalent.

20. Q: Write negations for each of the following statements. (Assume that all variables represent fixed quantities or entities, as appropriate).

A: See highlighted sections.

- If **P** is a square, then **P** is a rectangle.
P is a square and P is not a rectangle.
- If today is New Year's Eve, then tomorrow is January.
Today is New Year's Eve and tomorrow is not January.
- If the decimal expansion of **r** is terminating, then **r** is rational.
The decimal expansion of r is terminating and r is not rational.
- If **n** is prime, then **n** is odd or **n** is 2.
n is prime and both n is not odd and n is not 2.
- If **x** is nonnegative, then **x** is positive or **x** is 0.
x is nonnegative and x is not positive and x is not 0.
- If Tom is Ann's father, then Jim is her uncle and Sue is her aunt.
Tom is Ann's father and either Jim is not her uncle or Sue is not her aunt.
- If **n** is divisible by 6, then **n** is divisible by 2 and **n** is divisible by 3.
n is divisible by 6 and either n is not divisible by 2 or n is not divisible by 3.

Use the contrapositive to rewrite the statements in 42 and 43 in if-then form in two ways.

43 Q: Doing homework regularly is a necessary condition for Jim to pass the course.

A: 1) If Jim passes the course, then he is doing homework regularly.

2) If Jim is not doing his homework regularly, then he will not pass the course.

Note that “a sufficient condition for s is r ” means r is a sufficient condition for s and that “a necessary condition for s is r ” means r is a necessary condition for s . Rewrite the statements in 44 and 45 in if-then form.

45 Q: A necessary condition for this computer program to be correct is that it not produce error messages during translation.

A: If this computer program is correct, then it does not produce error messages during translation.