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Module : Mathematcial Logic.
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Tutorial N° 01

Exercise 01: For each three set of formulas, tell which is inconsistent. Otherwise, give a model.

a) $\{p \vee q, p \rightarrow q, \neg q\}$
b) $\{p \rightarrow q, q \rightarrow r, r \rightarrow \neg p\}$
c) $\{p \rightarrow q, q \rightarrow r, r \rightarrow \neg p, p \vee \neg s, s\}$

Exercise 02: Prove using the truth table method that:

a) $p \Leftrightarrow q \models p \rightarrow q$
b) $p \Leftrightarrow \neg q \models p \rightarrow q$
c) $True \models r \rightarrow (s \rightarrow (t \wedge s \rightarrow r)$
d) $\{q \rightarrow (r \wedge s), \neg r \vee \neg s\} \models \neg q$

Exercise 03: Check, using truth tables, the validity of the following reasoning:

a) $p \rightarrow q \models q \rightarrow p$
b) $(p \vee c) \rightarrow q \models \mathrm{p} \vee \mathrm{q}$
c) $\{p \rightarrow \neg q, \neg c \rightarrow p\} \models \mathrm{q} \rightarrow \mathrm{c}$
d) $\{p \rightarrow q, p \rightarrow c, \neg(q \vee c)\} \models \mathrm{r}$
e) $(\neg p \rightarrow \neg q \vee r) \models ((\neg \mathrm{p} \rightarrow \mathrm{q}) \rightarrow (\mathrm{p} \vee \mathrm{r}))$

Exercise 04: Use the truth table method to determine whether the following formulas are tautology or not. If the formula is not tautology, provide an interpretation that makes it false.

:

$$[p \rightarrow (q \rightarrow r)] \rightarrow [(p \rightarrow q) \rightarrow (p \rightarrow r)]$$

$$\neg(p \wedge q) \rightarrow \neg(p \vee q)$$

Prove that this formula:

$$(p \wedge q \wedge r) \vee (\neg p \rightarrow \neg r)$$

is a logical consequence of the set of formula:

$$\Gamma = \{p \rightarrow q, q \rightarrow r, p \vee q \vee \neg r, \neg p \rightarrow \neg r\}$$

If the formula is not a logical consequence, provide a model of the set that is not a model of the formula.

Exercise 05:

Consider the following statements:

(1) If the weather is nice, I go to **swim**.
(2) If the **tide** is low, the **beach** is closed.
(3) If the **beach** is closed, I cannot go to **swim**.
(4) The **tide** is low and the weather is beautiful.

(C) I do not go to **swim**.

a) Translate these statements into propositions.
b) Using the truth table method, determine if this reasoning is valid.