Name: Richard

QUIZ 5

MATH 300
September 5, 2024

1. Without changing its meaning, write the following sentence in the form of "*If P, then Q.*"

   The quadratic equation has no real solutions provided that the discriminant is negative.

   If the discriminant is negative, then the quadratic equation has no real solutions.

2. Use a truth table to decide if $\sim P \wedge (P \Rightarrow Q)$ and $\sim (Q \Rightarrow P)$ are logically equivalent.

P	Q	$Q \Rightarrow P$	$\sim(Q \Rightarrow P)$	$\sim P$	$P \Rightarrow Q$	$\sim P \wedge (P \Rightarrow Q)$
T	T	T	F	F	T	F
T	F	T	F	F	F	F
F	T	F	T	T	T	T
F	F	T	F	T	T	T

The columns don't quite agree, so the two expressions are not logically equivalent

3. Suppose that $((P \wedge Q) \vee R) \Rightarrow (R \vee S)$ is false. Find the T/F values for P, Q, R and S. (This can be done without writing a truth table.)

This can only be false if $(P \wedge Q) \vee R = T$ and $R \vee S = F$.

For $R \vee S$ to be false, both R and S are false.

But then in order that $(P \wedge Q) \vee R = T$, it must be that $P \wedge Q = T$, so both P and Q are true

Answer: $\begin{cases} P = T \\ Q = T \\ R = F \\ S = F \end{cases}$

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1. Without changing its meaning, write the following sentence in the form of "*If P, then Q.*"

   A geometric series with ratio r converges whenever $|r| < 1$.

   If $|r|<1$, then a geometric series with ratio r converges.

2. Use a truth table to decide if $P \Rightarrow \sim Q$ and $\sim P \vee \sim Q$ are logically equivalent.

P	Q	~Q	P ⇒ ~Q	~P	~P ∨ ~Q
T	T	F	F	F	F
T	F	T	T	F	T
F	T	F	T	T	T
F	F	T	T	T	T

The columns agree, so $P \Rightarrow \sim Q = \sim P \vee \sim Q$, i.e. they are logically equivalent

3. Suppose that $((\sim R \vee P) \Leftrightarrow Q) \wedge (\sim Q)$ is true. Find the T/F values for P, Q and R. (This can be done without writing a truth table.)

For this to be true, both $(\sim R \vee P) \Leftrightarrow Q$ and $\sim Q$ must be true. Therefore Q is false

But then for $(\sim R \vee P) \Leftrightarrow Q$ to be true, $\sim R \vee P$ must be false. Hence both $\sim R$ and P are false, i.e. R is true and P is false.

Answer: P = F Q = F R = T