목록

Chapter 0.1 Discussion
Science, Logic, Fallacies

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1. How many reproducible experimental outcomes or observations are needed to disprove a scientific theory? How many are needed to prove a scientific theory? Explain.

only 1 needed to disprove

infinite number needed to prove

2. Suppose a scientific theory has been tested many times with many hypotheses and has not been falsified. Then one experiment falsifies the theory. Should the entire theory be rejected?

yes, only 1 false needed to disprove the theory
depends on circumstances and hypothese.

3. Distinguish between a scientific fact, a hypothesis, a law, and a theory.

Scientific fact : can be contradict or invalidate, close agreement by observers who make series of observation of the same phenomenon again and not contradict

hypothesis : can be tested and falsifiable.

law : usually math behind, also hypotheses among natural quantities tested over.

theory : well tested hypotheses gathered.

4. A logical **statement** (or **proposition**) is a sentence that is either true or false, but not both.

(a) For a statement p, the **negation** of p is "not p" ($\sim p$). Write a truth table for $\sim p$.

p	$\sim p$
T	F
F	T

(b) For statements p and q, the **conjunction** of p and q is "p and q" ($p \wedge q$). It is true when (and only when) both p and q are true. Write a truth table for $p \wedge q$.

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

p	q	$p \wedge q$
F	F	F

(c) For statements p and q, the **disjunction** of p and q is "p or q" ($p \vee q$). It is true when either p is true, or q is true, or both. Write a truth table for $p \vee q$.

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

5. Two statements are **logically equivalent** if they have identical truth tables. Use truth tables to prove the following logical equivalents:

(a) $\sim(\sim p) \equiv p$

p	$\sim p$	$\sim(\sim p)$	$\sim(\sim p) \equiv p$
T	F	T	T
F	T	F	T

(b) $\sim(p \wedge q) \equiv \sim p \vee \sim q$ (one of De Morgan's Laws)

p	q	$p \wedge q$	$\sim(p \wedge q)$	$\sim p \vee \sim q$	$\sim(p \wedge q) \equiv \sim p \vee \sim q$
T	T	T	F	F	T
T	F	F	T	T	T
F	T	F	T	T	T
F	F	F	T	T	T

6. For statements p and q, the **conditional** of q by p is "if p then q" ($p \rightarrow q$). It is false when p is true and q is false; otherwise it is true. We call p the **hypothesis** (or **antecendent**) and q the **conclusion** (or **consequent**).

(a) Write a truth table for $p \rightarrow q$.

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

(b) Write "I am on time for work if I catch the 8:05 bus." in if-then form.

if I catch the 8:05 bus the I will be on time for work

(c) Write "Freeze or I'll shoot!" in if-then form.

if you donot freeze then I'll shoot

7. For the conditional $p \to q$:

- The **converse** is $q \to p$.
- The **inverse** is $\sim p \to \sim q$.
- The **contrapositive** is $\sim q \to \sim p$.

(a) Show that a conditional is logically equivalent to its contrapositive.

p	q	~p	~q	p→q	~q→~p	p→q ≡ ~q→~p
T	T	F	F	T	F→F T	T
T	F	F	T	F	T→F F	T
F	T	T	F	T	F→T T	T
F	F	T	T	T	T→T T	T

(b) Show that the converse and inverse of a statement are logically equivalent.

I've shown that the statement which is in contrapositive relation is logically equivalent

The converse statement which is $q \to p$ and the inverse statement which is $\sim p \to \sim q$

are contrapositive. $q \to p \equiv \sim p \to \sim q$

(c) Read the following excerpt from "A Mad Tea-Party" in *Alice in Wonderland*, by Lewis Carroll:

"Do you mean that you think you can find out the answer to it?" said the March Hare.

"Exactly so," said Alice.

"Then you should say what you mean," the March Hare went on.

"I do," Alice hastily replied; "at least—at least I mean what I say—that's the same thing, you know."

"Not the same thing a bit!" said the Hatter. "Why, you might just as well say that 'I see what I eat' is the same thing as 'I eat what I see'!"

The Hatter is right. "I say what I mean" is not the same as "I mean what I say." Rewrite each of these two sentences in if-then form and explain the logical relation between them.

If I mean then I say it // If I say then I mean it

This two sentences are relation of converse. Let's say "mean" part is p and "say" part is q. first statement is $p \to q$, and second is $q \to p$

So they are converse to each other and logically not equivalent

8. An **argument** is a sequence of statements, called **premises** (or **assumptions** or **hypotheses**) followed by a single statement, the **conclusion**. (The symbol for "therefore", $\therefore$, is placed just before the conclusion). An argument is **valid** if, when all the premises are true, then the conclusion is also true.

   An argument with two premises (the **major premise** and the **minor premise**) is called a **syllogism**.

   (a) Use a truth table to show that the following syllogism (**modus ponens**) is a valid argument:

p	p → q	p	q
T	T	T	T

$p \to q$
p
$\therefore q$

When p is True q must be True

q can not be F, only T

$p \to q$

$T \to \square_{q} \equiv T$

   (b) Use a truth table to show that the following syllogism is invalid (this is called the *inverse error* or *fallacy of denying the antecedent*):

p → q	~q → ~p	~p	~q
T	T	T	T, F

$p \to q$
$\sim p$
$\therefore \sim q$

when ~q → ~p is True and ~p is True, $\square \to T \equiv T$ (~q)

~q which is the blank can be both T, F, so its invalid

9. An argument is **sound** if and only if it is valid *and* all its premises are true. Is the argument below valid or invalid? Is it sound or unsound?

   If Canada is north of the U.S., then temperatures in Canada can't rise above freezing.
   Canada is north of the U.S.
   $\therefore$ Temperatures in Canada can't rise above freezing.

$p \longrightarrow q$
p
$\therefore q$

valid but unsound

It's logically valid but It's unsound because of the statement "can't rise above freezing".

Canada is north of the U.S ⇒ p

temperatures in Canada can't rise above freezing ⇒ q

10. For each of the following quotations or arguments, choose the fallacy that is most accurately represented from the following list:

- *Argumentum ad Populum* (Appeal to Emotion) c
- *Argumentum ad Baculum* (Appeal to Force) a
- *Argumentum ad Hominem*
- *Petitio Principii* (Begging the Question) f
- *Post hoc ergo propter hoc* e
- Strawman b
- Red Herring d
- Slippery Slope h
- False Dichotomy
- Hasty Generalization g

(a) After his 2005 State of the Union Address, President George W. Bush's proposals were characterized thus:

> George W. Bush's State of the Union Address, masked in talk of "freedom" and "democracy," was an outline of a brutal agenda of endless war, global empire, and the destruction of what remains of basic social services.
> International Action Center, Feb. 4 2005, http://iacenter.org/folder06/stateoftheunion.htm

(b) In 2009, during the debate over President Obama's healthcare reform bill—the Patient Protection and Affordable Care Act—former vice presidential candidate Sarah Palin took to Facebook to denounce the bill thus:

> "The America I know and love is not one in which my parents or my baby with Down Syndrome will have to stand in front of Obama's 'death panel' so his bureaucrats can decide, based on a subjective judgment of their 'level of productivity in society,' whether they are worthy of health care. Such a system is downright evil."

(c) Michele Bachmann, Republican Congresswoman from Minnesota, was a guest on CNN's Larry King Live in 2009. The topic was "birtherism," the (false) belief among some that Barack Obama was not in fact born in America and was therefore not constitutionally eligible for the presidency. After playing a clip of Senator Lindsey Graham (R, South Carolina) denouncing the myth and those who spread it, King asked Bachmann whether she agreed with Senator Graham. She responded thus:

> "You know, it's so interesting, this whole birther issue hasn't even been one that's ever been brought up to me by my constituents. They continually ask me, where's the jobs? That's what they want to know, where are the jobs?"