

## Statement Logic

### 1. Translations

Translate the following sentences into statement logic. Use lower-case letters for atomic statements, and give the key to translation. Whenever possible, separate out the logical connectives (i.e., translate "John doesn't sing" as  $\sim s$ , where  $s$ ="John sings"; rather than as  $s$ ="John doesn't sing")

- a. Either John or Mary is in the room (and possibly both)
- b. The fire was set by an arsonist, or there was an accidental explosion.
- c. When it rains, it pours.
- d. Sam wants a dog, but Alice prefers cats
- e. If Steve comes home late and hasn't had any supper, we will reheat the stew.
- f. Clarence is well educated only if he can read Chuvash.
- g. Marsha won't go out with John unless he shaves off his beard and stops drinking.
- h. The stock market advances when public confidence in the economy is rising, and only then.
- i. A necessary, but perhaps not sufficient, condition for negotiations to commence is for Barataria to cease all acts of aggression against Tipitu.

### 2. Truth values

Let  $p$ ,  $q$ , and  $r$  be true, and let  $s$  be false. Find the truth-values of the following statements.

- a.  $((p \wedge q) \wedge s)$
- b.  $(p \wedge (q \wedge s))$
- c.  $p \rightarrow s$
- d.  $s \rightarrow p$
- e.  $((p \wedge q) \leftrightarrow (r \wedge \sim s))$
- f.  $(p \rightarrow (q \leftrightarrow (r \rightarrow s)))$
- g.

### 5. Quick falsification

For each of the following, use "quick-falsification" to find an assignment of truth values to the atomic statements that makes the entire statement false.

- (a)  $(p \vee q)$
- (b)  $((p \vee q) \rightarrow (p \wedge q))$
- (c)  $(\sim(\sim q \vee p) \vee (p \rightarrow q))$
- (d)  $((((p \rightarrow q) \rightarrow r) \rightarrow s) \rightarrow (p \rightarrow q))$
- (e)  $((((p \vee q) \wedge (r \wedge s)) \leftrightarrow (((p \wedge q) \wedge r) \wedge s)))$