Reasoning for Humans: Clear Thinking in an Uncertain World

PHIL 171

Eric Pacuit

Department of Philosophy
University of Maryland
pacuit.org

Measuring Arguments

How do we *measure* the strength of an argument?

1. φ evidentially supports ψ
2. φ is positively relevant to ψ.

$Pr(\psi \mid \varphi)$ measures the evidential support of the argument.
But, how do we measure the relevance of φ to ψ?

Confirmation measures

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1. Difference: $d(\varphi, \psi) = Pr(\psi \mid \varphi) - Pr(\psi)$
2. Likelihoods ratio: $\ell(\varphi, \psi) = \frac{Pr(\varphi|\psi) - Pr(\varphi|\neg\psi)}{Pr(\varphi|\psi) + Pr(\varphi|\neg\psi)}$

	P	Q
0.2	T	T
0.3	T	F
0.3	F	T
0.2	F	F

$$d(P, Q) = Pr(Q \mid P) - Pr(Q) = -0.1$$

$$\ell(P, Q) = \frac{Pr(P \mid Q) - Pr(P \mid \neg Q)}{Pr(P \mid Q) + Pr(P \mid \neg Q)} = -0.2$$

Fact. Both confirmation measures make the same qualitative judgements:

$$d(\varphi, \psi) > 0 \text{ if, and only if, } \ell(\varphi, \psi) > 0$$
$$d(\varphi, \psi) = 0 \text{ if, and only if, } \ell(\varphi, \psi) = 0$$
$$d(\varphi, \psi) < 0 \text{ if, and only if, } \ell(\varphi, \psi) < 0$$

So, both measures agree about whether a premise φ is/is not positively/negatively relevant to ψ.

Which measure *d* or ℓ is better?

If $\varphi \models \psi$ *non-trivially*, then the relevance of φ to ψ should be maximal.

If $\varphi \models \neg\psi$ *non-trivially*, then the relevance of φ to ψ should be minimal.

$$d(\varphi,\psi) = \begin{cases} Pr(\neg\psi) & \text{if } \varphi \models \psi,\ Pr(\varphi) > 0,\ 0 < Pr(\psi) < 1 \\ -Pr(\psi) & \text{if } \varphi \models \neg\psi,\ Pr(\varphi) > 0,\ 0 < Pr(\psi) < 1 \end{cases}$$

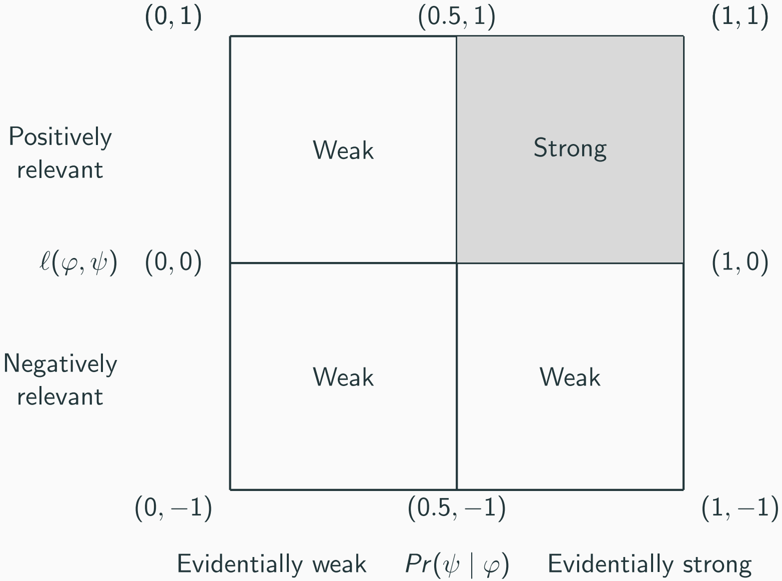
$$\ell(\varphi, \psi) = \begin{cases} 1 & \text{if } \varphi \models \psi,\ Pr(\varphi) > 0,\ 0 < Pr(\psi) < 1 \\ -1 & \text{if } \varphi \models \neg\psi,\ Pr(\varphi) > 0,\ 0 < Pr(\psi) < 1 \end{cases}$$

Evaluating $\varphi \Rightarrow \psi$

Given a stochastic truth table for the argument $\varphi \Rightarrow \psi$, we can assign two numbers to the argument:

$$(Pr(\psi \mid \varphi), \ell(\varphi, \psi))$$

Evaluating $\varphi \Rightarrow \psi$



The Paradox of the Ravens

The Paradox of the Ravens (1)

(IC) A hypothesis of the form "All As are Bs" is confirmed by any positive instance, i.e., any instance that is both A and B.

- A black raven confirms that all ravens are black.
- A green emerald confirms that all emeralds are green.

The Paradox of the Ravens (2)

(EQ) If H and H' are logically equivalent, then if E confirms H, then E confirms H'.

H: All ravens are black.

H': All non-black things are non-ravens.

The Paradox of the Ravens (3)

But, then does a brown jacket confirm H?

1. (IC) implies that a brown jacket confirms that "all non-black things are non-ravens".
2. "all non-black things are non-ravens" is equivalent to "all ravens are black".
3. (EC) implies that a brown jacket confirms that "all ravens are black".

The Paradox of the Ravens (3)

But, then does a brown jacket confirm H?

1. (IC) implies that a brown jacket confirms that "all non-black things are non-ravens".
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3. (EC) implies that a brown jacket confirms that "all ravens are black".

We can run the same argument using a blue jacket, red carpet, white chair,...

But, surely you can't learn something about the color of ravens by looking around your office.