An Alternate Characterization of Expected Value

Causal Decision Theory is a variant of decision theory that is based on Expected Value Maximization but uses an alternate definition of expected value. It holds onto the idea that expected value of an option is a weighted average of the values of the different outcomes that the option might lead to, but does the weighting differently.

The characterization of expected value we have been discussing so far is sometimes called Evidential Decision Theory. As we have seen, it uses *probabilistic dependence* to determine how much weight to give each of the possible outcomes of one's actions. More specifically, it weighs an outcome using the *conditional probability* of the outcome given the relevant action.

Let us review how this plays out in a Newcomb scenario. In calculating the expected value of one-boxing, one weighs an outcome in which you one-box ($1B$) and the large box is full (F) using $p(F|1B)$, and one weighs an outcome in which you one-box and the large box is empty (E) using $p(E|1B)$. And similarly when one calculates the expected value of two-boxing ($2B$). This yields the following familiar results:

$$\begin{aligned} EV(1B) &= v(1B\,F)\cdot p(F|1B) + v(1B\,E)\cdot p(E|1B) \\ EV(2B) &= v(2B\,F)\cdot p(F|2B) + v(2B\,E)\cdot p(E|2B) \end{aligned}$$

Because the probability of an indicative conditional is the probability of the conditional's consequent given its antecedent, these equations could also be written as follows, where "$A \to B$" is the indicative conditional "if A, then B":

$$\begin{aligned} EV(1B) &= v(1B\,F)\cdot p(1B \to F) + v(1B\,E)\cdot p(1B \to E) \\ EV(2B) &= v(2B\,F)\cdot p(2B \to F) + v(2B\,E)\cdot p(2B \to E) \end{aligned}$$

On either version of the equations, Expected Value Maximization delivers the conclusion that one ought to one-box.

Causal decision theorists see things differently. They think that one should use *causal dependence* to determine how much weight to give each of the possible outcomes of one's actions. More specifically, they think that one should weigh an outcome not by using the probability of an indicative conditional, but by using the probability of the corresponding *subjunctive* conditional; specifically the subjunctive conditional *were you to perform the relevant action, the outcome would come about*.

Suppose, for example, that one wishes to calculate the expected value of one-boxing. How should one weigh an outcome in which you one-box and the large box is full? According to causal decision theory, you should use the probability of the following subjunctive conditional: *were you to one-box, a full-box outcome would come about*. In symbols:

$$EV\,(1B) \quad = \quad v\,(1B\,F)\cdot p\,(1B \,\Box\!\!\rightarrow F) + v\,(1B\,E)\cdot p\,(1B \,\Box\!\!\rightarrow E)$$

And similarly for two-boxing:

$$EV\,(2B) \quad = \quad v\,(2B\,F)\cdot p\,(2B \,\Box\!\!\rightarrow F) + v\,(2B\,E)\cdot p\,(2B \,\Box\!\!\rightarrow E)$$

Notice that these are exactly like the equations endorsed by the evidential decision theorists, except that we use subjunctive conditionals instead of indicative conditionals.

As it turns out, the causal decision theorist's equations can be simplified a bit in the present case. For recall that you have no control over the contents of the large box. So under what circumstances will be the case that were you to one box, you would find a full large box? Exactly when the large box is full to begin with. In other words: $p\,(1B \,\Box\!\!\rightarrow F) = p\,(F)$. (And similarly for other cases.) So the equations above reduce to:

$$\begin{aligned} EV\,(1B) \quad &= \quad v\,(1B\,F)\cdot p\,(F) + v\,(1B\,E)\cdot p\,(E) \\ EV\,(2B) \quad &= \quad v\,(2B\,F)\cdot p\,(F) + v\,(2B\,E)\cdot p\,(E) \end{aligned}$$

Since the payoff structure of a Newcomb situation guarantees that $v\,(2B\,F) > v\,(1B\,F)$ and $v\,(2B\,E) > v\,(1B\,E)$, our equations guarantee that the expected value of two-boxing will be higher than the expected value of one-boxing regardless of the values of $p\,(F)$ and $p\,(E)$. So causal decision theory vindicates the idea that the rational thing to do in a Newcomb scenario is two-box.

As the Newcomb case makes clear, causal decision theory can come apart from evidential decision theory when causal and probabilistic dependence come apart. But they always deliver the same results in cases where causal and probabilistic dependence don't come apart.

Problem 1

1/1 point (ungraded)

Consider a variant of the Newcomb scenario in which the predictor decides whether to fill the large box by flipping a coin. Do Causal and Evidential Decision Theory deliver different results?

- Yes, they deliver different results.
- No, they deliver the same result. ✔

Explanation

No. The two versions of decision theory deliver the same result. When the predictor makes her decision by flipping a coin, the contents of the large box are both probabilistically and causally independent of your decision. So we have $p(F|1B) = p(F) = p(1B \mathrel{\Box\!\!\rightarrow} F)$ (and similarly for other cases).

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- Vindicates??? And .. is this a paradox about humility vs. certainty? — 6
  You write that causal decision theory "vindicates" the decision to two-box. But in fact, this is the opp...
- How certain of dominance should you be to 2-box? — 2
  Can't we just put the probability of dominance and causal decision theory being correct right into ou...
- Why Subjunctive Conditionals? — 2
  Why is it that subjunctive conditionals are used to explain the "two boxer theory" if we know that yo...
- Causal dependency not considered — 2
  A) Por subjuntive conditionals on Newcomb's problem we are saying the same as follows (sc = squar...