Credences Across Time: Class Task

Belief and its Limits (BaiL); Seminar 4 ANU
Instructor: Joshua Pearson; joshuaedwardpearson@gmail.com 28/10/25

The best way to appreciate the difficulties Bayesianism faces with accounting certain kinds of defeat is to try and model it yourself.

Split into groups.[1] Below are three cases of increasing complexity. For each, I want you to do the following...

1 - Desiderata: Each case will be split into different times, denoted 't_n', and specify a "target proposition" p. Write down what you think are plausible, rational credences for the agent in the case to have in p at each time; i.e. the value of $C_n(p)$.[2]

2 - Evidence: Between any two specified consecutive times, t_n and t_{n+1}, we'll assume the agent gains total evidence 'e_{n+1}'. Write down what you think the relevant content of that evidence roughly is.[3]

3 - Make-it-make-(Bayesian)-sense: Complete a "state-space" with respect to all the specified propositions $\{p, e_1, ..., e_n\}$ and the prior credence function C_0. This is a table specifying the credence assigned to every possible truth-assignment of the propositions.

Why bother? Combined with the **Ratio Formula** and **Conditionalisation**, this state space will tell us exactly what the agent's credences at the later times should be. We can then check we've met the desiderata specified above. That is, we've made (Bayesian) sense of the case!

I've also attempted this—we'll come compare notes after each case.

[1] Let's try to distribute prior knowledge of formal epistemology evenly across them.

[2] This can be precise if you want, but it can also be vague, if you want, like "high"/"middling"/"low" or even "higher than before" or something.

[3] Again, I'm happy for this to be more precise—*the coin landed heads*—or more vague—*the information she gained when X*—

For example, if we just have $\{p, e_1\}$, then the state space might be:

State	$C_0(\cdot)$
$p \wedge e_1$	$\frac{1}{8}$
$p \wedge \neg e_1$	$\frac{1}{4}$
$\neg p \wedge e_1$	$\frac{1}{4}$
$\neg p \wedge \neg e_1$	$\frac{3}{8}$

Tip: as the propositions in a state space form a partition, the values in the second column should add to 1.

Case 1 - Bias Detection.

t_0: Katie is unsure whether the coin in her pocket is fair, or $\frac{3}{4}$ biased towards heads. But she knows for certain that it's one or the other.

t_1: Katie flips the coin and sees it land tails.

Target proposition: F—*the coin is fair*.

1 - Desiderata $C_0(F) =$ ________; $C_1(F) =$ ________

2 - Evidence $e_1 =$ __________

3 - Make-it-make-(Bayesian)-sense

State	$C_0(\cdot)$
$F \wedge e_1$	
$F \wedge \neg e_1$	
$\neg F \wedge e_1$	
$\neg F \wedge \neg e_1$	

Hint: I think the easiest way to answer 3 is to use the **Conjunction** formula on the cheat sheet:

Conjunction: $C(p\&q) = C(p \mid q)C(q)$

It's often much easier to have a clear idea of what a conditional probability should be than a conjunctive one—so you'll mostly be working backwards to specify the state-space.

Case 2 - Questionable Bias Detection

t_0 : Al is unsure whether the coin in his pocket is fair or is $\frac{3}{4}$ biased towards heads. But he knows for certain that it's one or the other.

t_1 : Al flips the coin and sees it lands tails.

t_2 : Josh tells Al that, in order to make the examples in his graduate class vivid and realistic, he spiked Al's morning coffee with a drug that makes Al no better than chance at determining whether a coin lands heads or tails. (In fact, Josh didn't do this, but Al trusts Josh.)

Target Proposition: *F—the coin is fair*

1 - Desiderata $C_0(F) =$ ______; $C_1(F) =$ ______ $C_2(F) =$ ______

2 - Evidence $e_1 =$ ________________________

$e_2 =$ ____________________________

3 - Make-it-make-(Bayesian)-sense

State	$C_0(\cdot)$
$F \& e_1 \& e_2$	
$F \& e_1 \& \neg e_2$	
$F \& \neg e_1 \& e_2$	
$F \& \neg e_1 \& \neg e_2$	
$\neg F \& e_1 \& e_2$	
$\neg F \& e_1 \& \neg e_2$	
$\neg F \& \neg e_1 \& e_2$	
$\neg F \& \neg e_1 \& \neg e_2$	

Hint: For me, it was useful to work out whether any two of these propositions are independent relative to C_0 (see the cheat sheet), and then apply a generalization of the conjunction rule:

$$C(p \& q \& r) = c(p \mid q \& r) c(q \& r)$$

.

Case 3 - Hypoxia.

t_0: Miriam is about to pilot a flight from London to Philidelphia.

t_1: In flight, she's asked whether she has enough fuel to make it to LA. She looks at her coordinates, fuel tank gauge, the aircraft's weight—all the relevant information available. In fact, the information she receives strongly supports the claim that she has enough fuel to get to LA.

t_2: Ground control tell her that, due to an error in the aircraft, the high altitude she's flying at means she's been suffering from Hypoxia. The only effect of hypoxia (let's suppose!) is that it makes her no better at chance at assessing her evidence. (In fact, Miriam isn't suffering from hypoxia, but she trusts ground control.)

Target proposition: *L—There's enough fuel to make it to LA.*

Answer 1, 2 and 3 again — I didn't have enough space to include the questions here....