Probabilifying the Scenario Approach to Legal Proof

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Outline

Introduction

- The scenario approach is a normative account of legal proof (van Koppen and Mackor, 2020; Mackor, 2021), of the descriptive story-based approach by Pennington and Hastie (1993).
- You should find a defendant guilty iff the best scenario implies that the defendant is guilty *and* the best scenario is much better than any scenario which implies the defendant's innocence.
- Scenario approach provides a set of criteria to evaluate scenarios against.
- It is commonly presented as an incompatible alternative to Bayesian accounts of legal proof (Mackor et al., 2021).

Introduction

- Problem: criteria are not precise.
- Problem: Even if precise criteria available, unclear how to weigh them against each other.
- Solution: Probabilify the scenario approach.
- The most probable scenario is the best.
- Explain which scenario strikes the best balance.
- Upshot: show that Bayesian accounts of legal proofs are not incompatible with the scenario approach.
- Upshot: provide a normative foundation for the scenario approach.

Outline

The Scenario Approach

- A scenario is a story of what might have happened.
- Each story either implies that the defendant is guilty or not guilty.
- A scenario is best among the available scenarios if it strikes the best balance between:
  - (i) explaining the available evidence,
  - (ii) fitting to the general background beliefs, and
  - (iii) exhibiting internal coherence.

Simonshaven case

A Dutch criminal case provided by Mackor (2021). The defendant Ed and his wife Jenny arrived at the Simonshaven forest by car and went for a walk, as eyewitnesses testified. There is evidence that Jenny was hit by a blunt object and died. There are two scenarios. According to the prosecution scenario, Ed killed his wife. On the defense scenario, a madman jumped out of the bushes who beat up both Ed and Jenny. As a result, Ed lost his consciousness for some time and Jenny died.

Comments on the Simonshaven case

- Both scenarios can explain the evidence.
- Both scenarios are internally coherent at least in so far their elements are logically consistent with one another.
- However, the madman scenario fits less well with our background beliefs than a scenario where a husband kills his wife (Mackor, 2021, p. 2414).
- Hence, the prosecution scenario is better than the madman scenario. Or so goes Mackor's plausible assessment.

Comments on the Simonshaven case

- Is the prosecution scenario the best and much better than the madman scenario?
- The scenario approach has difficulties to come to a clear verdict because it does not say what it means that a scenario is 'much better' than another.
- The scenario approach does not explain what it means that a scenario strikes the best balance on the three dimensions.

Again: the Scenario Approach

A scenario is best among the available scenarios if it strikes the best balance between:

(i) explaining the available evidence,

(ii) fitting to the general background beliefs, and

(iii) exhibiting internal coherence.

Outline

Explaining the Available Evidence

- Standard explication of explanation: probability raising (Salmon, 1970).
- Applied to the scenario approach, a scenario S explains the available evidence E iff

$$P(E \mid S) > P(E),$$

where $P(E \mid S)$ is the conditional probability of E given that S and $P(E)$ is the probability of E.

Degree of Explanation

$$Exp(S, E) := \frac{P(E \mid S)}{P(E)}, \text{ if } P(E) > 0.$$

- If S explains E, $Exp(S, E) > 1$.
- If S does not bear on E, $Exp(S) = 1$.

Explaining the Available Evidence: Simonshaven C

- E: available evidence in the Simonshaven case—the eyewitness testimony and the autopsy of Jenny's injuries.
- S_E: scenario in which Ed kills Jenny
- S_M: scenario in which a madman kills Jenny.

$$P(E \mid S_E) \approx P(E \mid S_M).$$

Outline

Fit with General Background Beliefs

The fit of a scenario S with the general background beliefs can be modelled by the probability of S given the background beliefs B.

Fit with General Background Beliefs

$$P_B(S) = P(S \mid B), if P(B) > 0$$

Fit with General Background Beliefs

- That Jenny is killed by their (ex)partners is more plausible in light of our reasonable background beliefs than the belief that Jenny is killed by a madman jumping out of bushes.
- On our model, this comparative plausibility assessment translates into a comparative assessment of probabilities:

$$P(S_E \mid B) > P(S_M \mid B).$$

The Ed scenario fits better to the background beliefs than the madman scenario.

Outline

Internal Coherence

- A scenario S has internal structure.
- $S \equiv S_1, \ldots, S_n$.
- Basic idea: if elements cohere well, they are more likely taken together than individually.
- $P(S_1, S_2) > P(S_1) \cdot P(S_2)$.

Internal Coherence

This idea generalizes to the Shogenji (1999) measure:

Coherence measure

$$Coh(S_1, \ldots, S_n) := \frac{P(S_1, \ldots, S_n)}{P(S_1) \cdot \ldots \cdot P(S_n)}, if P(S_1), \ldots, P(S_n) > 0.$$

- If elements are independent, $Coh(S) = 1$.
- If elements cohere well, $Coh(S) > 1$.
- If elements don't cohere well, $Coh(S) < 1$.

Internal Coherence

- S_{E1}: Ed and Jenny go for a walk.
- S_{E2}: Jenny was attacked and died.
- S_{E3}: Ed killed Jenny in the forest.

$$Coh(S_E) = \frac{P(S_{E1} \cap S_{E2} \cap S_{E3})}{P(S_{E1}) \cdot P(S_{E2}) \cdot P(S_{E3})}.$$

The scenario coheres because the elements of the scenario are more likely to be true together than individually.

- $S_{M1} = S_{E1}$: Ed and Jenny go for a walk in the forest
- $S_{M2} = S_{E2}$: Jenny was attacked and died.
- S_{M3}: A madman jumped out of the bushes and attacked both Ed and Jenny so that Ed lost his consciousness and Jenny died.

$$Coh(S_M) = \frac{P(S_{M1} \cap S_{M2} \cap S_{M3})}{P(S_{M1}) \cdot P(S_{M2}) \cdot P(S_{M3})}.$$

The scenario is again coherent.

- Both scenarios are internally coherent to a similar degree.
- Shogenji measure challenged by Fitelson (2003); Schupbach (2011), further developed by Hartmann and Trpin (forthcoming).

Outline

Putting it all together

Bayes Theorem

$$P_B(S \mid E) = \frac{P_B(E \mid S)}{P_B(E)} \cdot P_B(S).$$

Given that a scenario S consists of elements $S_1, \ldots, S_n$:

Bayes Theorem

$$P_B(S \mid E) = \frac{P_B(E \mid S_1, \ldots, S_n)}{P_B(E)} \cdot P_B(S_1, \ldots, S_n).$$

Putting it all together

And, given our definitions of

- explaining the available evidence,
- fitting to the general background beliefs, and
- exhibiting internal coherence

above:

Posterior Probability of a Scenario S

$$P(S \mid E) = \underbrace{Exp(S, E)}_{\text{Degree of explanation}} \cdot \overbrace{\underbrace{Coh(S_1, \ldots, S_n)}_{\text{Internal coherence}} \cdot P(S_1) \cdot \ldots \cdot P(S_n)}^{\text{Fit with background beliefs}}.$$

Conviction

What does this say about the defendant's guilt and obligation to convict?

- The probability of any best scenario coincides with the probability that the defendant is guilty [extended argument, see paper].
- Convict if the probability of guilt is beyond reasonable doubt
- Standard decision theoretic argument to find threshold.

Conviction

	G	$\neg G$
finding G	TG	FG
finding $\neg G$	FN	TN

Table: Decision matrix for finding guilty (G) or not ($\neg G$).

You should find the defendant guilty iff

$$P_B(G \mid E) > \frac{C(FG)}{C(FG) + C(FG)}.$$

Outline

Summing Up

- We have probabilified the scenario approach to legal proof.
- The most likely scenario is best: it strikes the best balance between explaining the available evidence and fitting to the general background beliefs. Internal coherence is a part of the fit with our background beliefs.
- Our probabilistic account makes precise how the three dimensions of the original scenario approach are to be weighted.
- Our account shows that reconciling the scenario approach and the Bayesian approach is possible.

- Our scenario account inherits the normative justification of Bayesianism in terms of Dutch book arguments (Vineberg, 2022) and epistemic utility arguments (Pettigrew, 2024).
- Further good-making features are that our account avoids confirmation biases as well as the base rate and prosecutor's fallacies (Thompson and Schumann, 1987).
- The most likely scenario, given the evidence, strikes the best balance between explaining the evidence and fit to general background beliefs, including being internally coherent.

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