

Fact-finding and Legal Subsumption

Standard of Proof and Standard of Correspondence between Fact and Legal Requirement

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Background Inspiration of My Presentation

Cf. Clermont, Kevin M. (2013) *Standards of Decision in Law: Psychological and Logical Bases for the Standard of Proof, Here and Abroad*, Carolina Academic Press.

Clermont uses Fuzzy Logic in both fact-finding and legal subsumption indistinguishably.

This presentation tried to distinguish the logic of decisions in fact-finding (Bayesian probability updating) and legal application to fact (Fuzzy Logic).

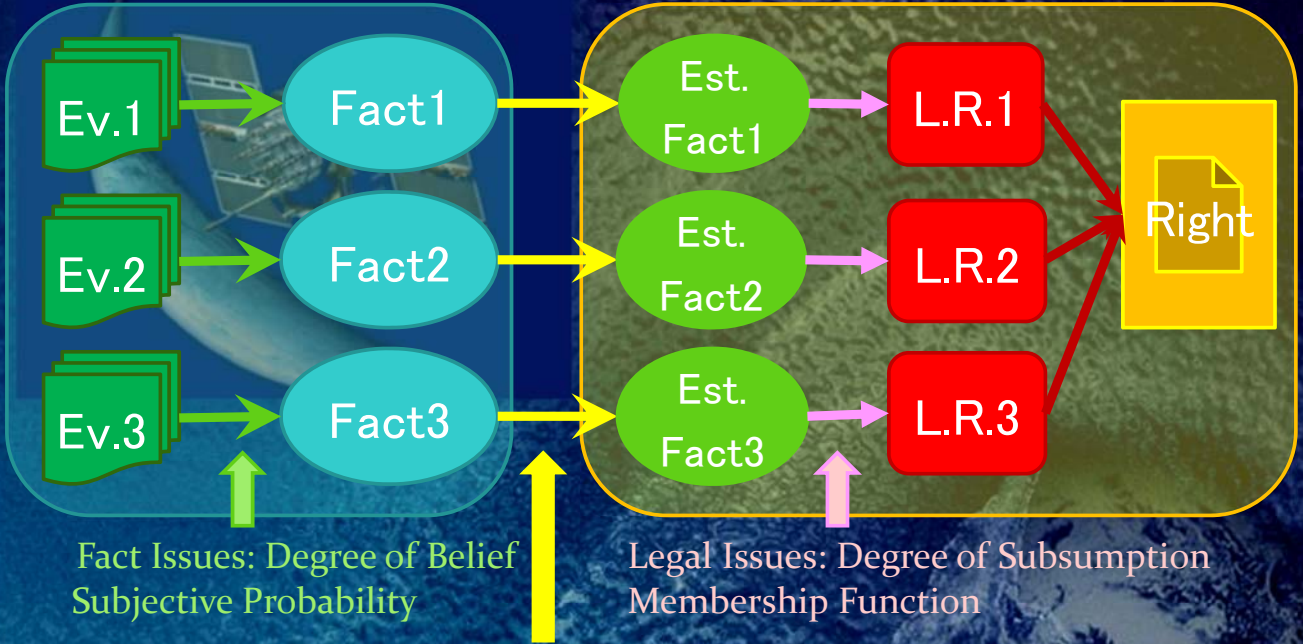
The reason is that Bayesian updating is the established methodology in natural sciences. Confusing fact and law is not appropriate.

Cf. Oaksford, Mike & Chater, Nick (2007) *Bayesian Rationality: The Probabilistic Approach to Human Reasoning*, Oxford U.P.

Oaksford & Chater argue that "probability theory can provide a framework for qualitative reasoning, without using numerical values," and that "much of the power, and the limitations of human reasoning about the everyday world may flow from this qualitative style of reasoning,...such qualitative probabilistic reasoning may allow the cognitive system to reason over domains where precise numerical information is not available."

Uncertain World of Facts

Certain World of Law

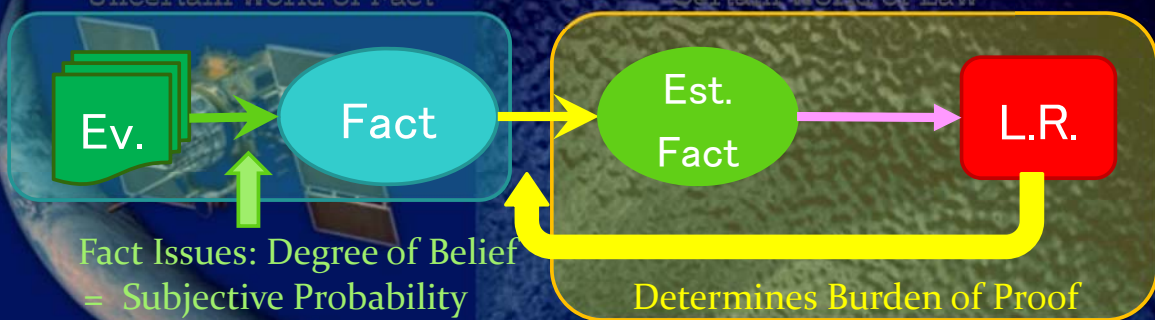


Fact Issues: Scientific Pursuit of Truth, Target Factual Hypotheses have Truth Value. Facts must be established by evidences before legal requirements (e.g., negligence) are applied to them.

Legal Issues: Value Judgment/Policy Decision, which has no Truth Value. Each legal requirement determines the probability required to establish the fact (standard of proof). If the probability is higher than the standard, it is deemed 100% (established).

Uncertain World of Fact

Certain World of Law



Fact-finding is to update the degree of belief (subjective probability) as the evidence accumulates.

$$p(\text{Fact} \mid \text{Evidence}) \propto p(\text{Fact})p(\text{Evidence} \mid \text{Fact}) \quad \dots \text{Bayes' Theorem}$$

Judges use Rules of Thumb, e.g., "Flushed witness may be lying."

Classical logic: "A -> B" $p(A \rightarrow B) = 1.0$

Rules of Thumb: "Flush -> Lying" $p(\text{Flush} \rightarrow \text{Lying}) < 1.0$

=> Bayesian Postulate: $p(A \rightarrow B) \equiv p(B \mid A)$ "Equation" (Oaksford & Chater)

=> "Probabilization" of Classical Logic

$p(p \rightarrow q) = p(q \mid p) = a$, $p(/q) = b$, $p(p) = c$, p_1 : $p(x \mid \dots)$ posteriori probability

Modus Ponens: $[p \rightarrow q, p] \Rightarrow q \Rightarrow p_1(q) = a$

Modus Tollens: $[p \rightarrow q, /q] \Rightarrow /p \Rightarrow p_1(/p) = [b - (1-a)c] / b$

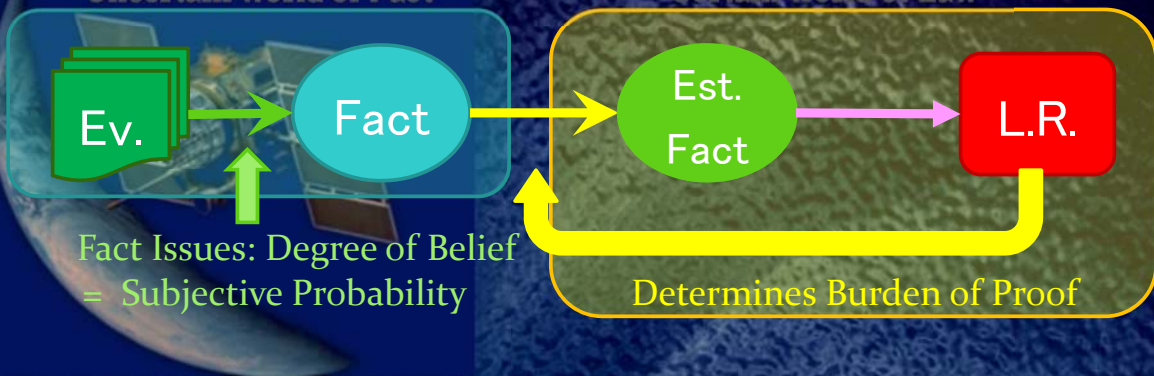
Denying Antecedent: $[p \rightarrow q, /p] \Rightarrow /q \Rightarrow p_1(/q) = [b - (1-a)c] / (1-c)$

Asserting Consequent: $[p \rightarrow q, q] \Rightarrow p \Rightarrow p_1(p) = ac / (1-b)$

Korea-Japan Workshop on Legal Informatics (日韓法情報学ワークショップ)

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Certain World of Law

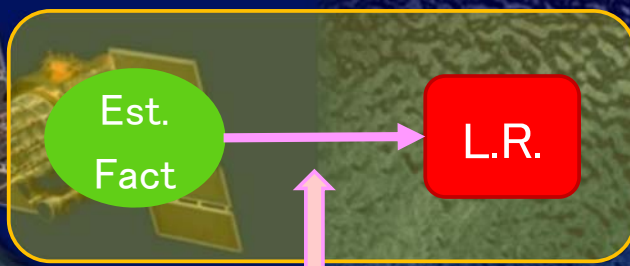


The legal requirement determines the risk of false positive and risk of false negative, and hence the burden of proof ($\equiv p^*$).

$$(1-p^*) \times \delta_{LR} = p^* \times \pi_{LR} \qquad p^* = \frac{\delta_{LR}}{\pi_{LR} + \delta_{LR}}$$

The burden of proof transfer the facts in the Uncertain World of Facts into the Certain World of Law. The application of law on the established facts is done in the Certain World of Law.

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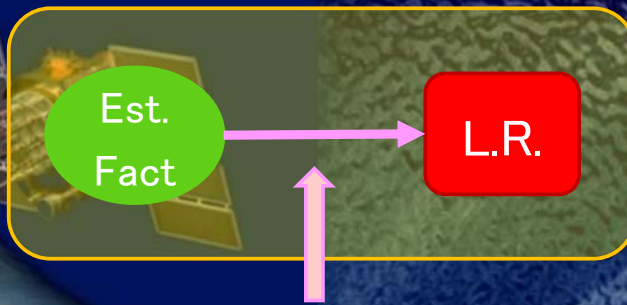
Degree of Subsumption (Est.Fact and Legal Requirement)

The established fact must conceptually correspond to the legal requirement, i.e., the fact should be subsumed by the legal requirement. Therefore, the Subsumption is a conceptual relationship between propositions. The decision of Subsumption is a value/policy judgment.

Easy Cases: Subsumption(Est.Fact, L.R.) is clear and convincing; not controversial.

Hard Cases: Subsumption(Est.Fact, L.R.) is not clear, not convincing, controversial.

=> Policy argument, value discussion, and creative interpretation are needed.



Degree of Subsumption (Est.Fact and Legal Requirement)

The subsumption or the correspondence between the fact and the legal requirement, is modeled by fuzzy logic.

The degree of subsumption/correspondence is defined as a membership function.

E.g., LAW: $LR_1 \wedge LR_2 \wedge LR_3 \Rightarrow \text{Right}$

$\text{Mem}(\text{Est.Fact}_1, LR_1) = \text{Mem}_1 = 0.8$

$\text{Mem}(\text{Est.Fact}_2, LR_2) = \text{Mem}_2 = 0.7$

$\text{Mem}(\text{Est.Fact}_3, LR_3) = \text{Mem}_3 = 0.85$

$\Rightarrow \text{Mem}(\text{Fact}_1 \text{ Est.} \wedge \text{Fact}_2 \text{ Est.} \wedge \text{Fact}_3 \text{ Est.}, LR_1 \wedge LR_2 \wedge LR_3)$

$= \text{MIN}(\text{Mem}_1, \text{Mem}_2, \text{Mem}_3) = 0.7$

Easy Cases: $\text{Mem}(\text{EstFact}, L.R.) = 1.0$ Hard Cases: $\text{Mem}(\text{EstFact}, L.R.) < 1.0$

Thank you very much for your attention!

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