



*On de Finetti's
Instrumentalist
Philosophy of
Probability*

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1 Introduction



Bruno de Finetti 1906–1985



1 Intro

1.1 The background

- In de Finetti's subjective theory of probability, probabilities are coherent degrees of belief.
- The theory has been very influential.
- But de Finetti's philosophy has been largely misunderstood.
- The aim is to provide a new interpretation of de Finetti.



1 Intro

1.2 The common interpretation of de Finetti

- De Finetti is commonly conceived as providing an operational, behaviorist definition of degrees of belief and accordingly of probabilities.
- Degrees of belief are defined in terms of agents' actual or hypothetical behaviour in betting scenarios.
- Thus, his theory is subject to the objections against operationalism and behaviorism.

1 Intro

1.2 The common interpretation of de Finetti

- De Finetti's concept of probability is conceived as too permissive, licensing imprudent epistemology.

Anything (coherent) goes.



1 Intro

1.2 The common interpretation of de Finetti

- “Orthodox Bayesians in the style of de Finetti recognize no rational constraints on subjective probabilities beyond:
 - (i) conformity to the probability calculus, and
 - (ii) a rule for updating probabilities in the face of new evidence, known as *conditioning*.

...

This is a permissive epistemology, licensing doxastic states that we would normally call crazy.”

(Hájek 2012)



Alan Hájek



1 Intro

1.2 The common interpretation of de Finetti

- There are also various objections to de Finetti's Dutch book argument for the laws/theorems of probability.
- In particular, the common view is that Dutch book arguments provide pragmatic but not epistemic justifications.



1 Intro

1.3 The main arguments

- The objections above are unfounded.
- These objections overlook or misinterpret central aspects of de Finetti's philosophy of probability.
- In particular, they overlook or misinterpret de Finetti's instrumentalist philosophy of probability.



1 Intro

1.3 The main arguments

- There is an analogy between common misconceptions about de Finetti's philosophy of probability and common misconceptions about instrumentalism in the philosophy of science.



The outline

- 2 On the interpretation of de Finetti's theory of probability
- 3 On the definition of probability in de Finetti's theory
- 4 On the ontic and epistemic nature of subjective probability
- 5 On de Finetti's concept of coherence
- 6 On the logical structure of subjective probabilities
- 7 On misconceptions about instrumentalism

2 *On the interpretation of de Finetti's theory*





2 On the interpretation of de Finetti's theory

2.1 Assumption 1

- De Finetti's writings at different periods may sometimes appear to contradict each other.
- Yet, I believe that overall de Finetti was a very consistent thinker who hasn't changed his mind substantially on most of the main issues.
- In particular, I believe that de finetti's philosophy of probability has always been instrumentalist.



2 On the interpretation of de Finetti's theory

2.2 Assumption 2

- The choice between different interpretations should be decided on the basis of how they managed to make sense of most, if not all, of de Finetti's writings.
- In my interpretation, I assume that de Finetti's terminology does not always agree with philosophers' terminology.
- In particular, when de Finetti says that he gives an operational definition, he does not mean by that what philosophers means by operational definition.

3 *On the definition of subjective probability*





3 On the definition of subjective probability

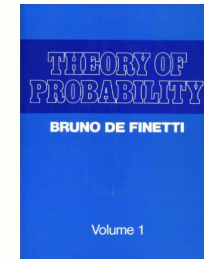
3.1 Is it operational?

- De Finetti assigned a great importance to the measurement of probability.
- He thought that since probability is a guide for life, it should have a meaning that renders it effective as such.
- Being influenced by positivism, he held that “in order to give an effective meaning to a notion – and not only an appearance of such in a metaphysical-verbalistic sense – an operational definition is required.”

3 On the definition of subjective probability

3.1 Is it operational?

- By ‘operational definition’, de Finetti meant “a definition based on a criterion which allows us to measure it”, and he held that



the criterion, the operative part of the definition which enable us to measure it, consists in this case of testing, through the *decisions* of an individual (which are observable), his *opinions* (previsions, probabilities), which are not directly observable (de Finetti, 1974).



3 On the definition of subjective probability

3.2 A measurement, not a definition

- The idea here is that if agents strive to maximize their subjective expected utility, one could design decision scenarios in which subjective probabilities could be inferred from their decisions.
- This suggests that de Finetti saw the betting decision-theoretic framework as a method of measuring subjective probabilities, not defining them.



3 On the definition of subjective probability

3.2 A measurement, not a definition

- Further, de Finetti was worried that the non-linear relation between utility and money and the extent to which people care about their bets may render the betting framework inadequate for measuring subjective probabilities.
- These worries make sense if betting scenarios are seen as measurements of probabilities, but not when they are thought of as defining them.

3 On the definition of subjective probability

3.3.1 A measurement and definition? Take 1

- It may be suggested that the operation in operational definition both defines and measures probabilities.
- However, conceptually, this is incoherent.
- In operational definition, the operation constitutes what probability is.
- And the operation cannot both constitute what probability is, and measure it.

3 On the definition of subjective probability

3.3.2 A measurement and definition? Take 2

- Alternatively, it may be suggested that the operation – the betting – *measures* an agent's qualitative probabilities, *which exist independently of the operation*, and also *defines operationally* the agent's math. probabilities, which agree with her qualitative probabilities.
- The idea here is that qualitative probabilities satisfy weaker conditions than math. probabilities.
- Thus, the operation in the operational definition could both define and measure an agent's probabilities.

3 On the definition of subjective probability

3.3.2 A measurement and definition? Take 2

- The problem is that the logical structure of qualitative probabilities may be different from that of the precise probabilities.
- In particular, qualitative probabilities might violate the calculus of probability.
- Accordingly, an agent's qualitative probabilities before the operation need not agree with the math. probabilities that the operation constitutes.

3 On the definition of subjective probability

3.3.2 A measurement and definition? Take 2

- If the logical structure of qualitative probabilities isn't different from that of math. probabilities, the suggestion above is in effect equivalent to the one in Take 1.



3 On the definition of subjective probability

3.4 Input from de Finetti's verificationism

- As we shall later, as part of his instrumental philosophy of probability, de Finetti held that probabilities are assigned only to *verifiable* events.
- The operational definition fails to reflect this essential aspect of de Finetti's philosophy of probability.
- It applies to both verifiable and unverifiable events.



3 On the definition of subjective probability

3.5 Considerations from normativity

- De Finetti conceived his theory of probability as normative, and the operational definition overlooks an important aspect of its normativity.
- De Finetti's theory is normative in two related ways:
 - (1) degrees of belief have to be coherent
 - (2) degrees of belief should be instrumental and accordingly be the outcome of a rigorous inductive reasoning



3 On the definition of subjective probability

3.5 Considerations from normativity

- The operational definition may capture only the first aspect of normativity, but it completely overlooks the second (arguably more important) aspect.



3 On the definition of subjective probability

3.6 Neither behaviourist, nor reductionist

- Finally, the operational definition is reductive, and it is typically situated within a behaviourist philosophy.
- But de Finetti was neither reductionist nor behaviorist.



3 On the definition of subjective probability

3.7 Is it a definition?

- The common presupposition is that de Finetti defines probability.
- However, this presupposition is questionable.
- De Finetti explicates various aspects of his concept of subjective probability.
- But I believe that he never intended to define probability in the sense of giving necessary and sufficient conditions.

3 On the definition of subjective probability

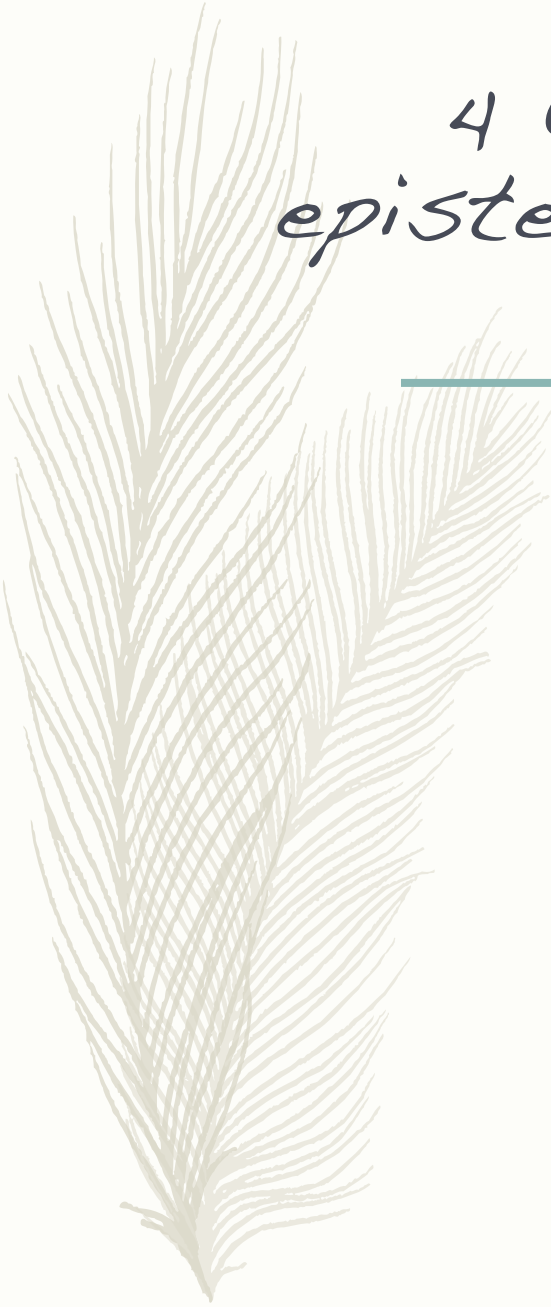
3.7 Is it a definition?

- The notion of probability is too open ended to be defined in such a manner.
- It is supposed to be clear enough to be an effective instrument in various contexts.
- But it is questionable that it is possible to characterize it by a list of necessary and sufficient conditions.

3 On the definition of subjective probability

3.8 A different interpretation

- The upshot is that the *operational interpretation* fails to reflect a number of essential aspects of de Finetti's philosophy probability.
- In what follows, I propose a different interpretation of de Finetti's theory along instrumental lines.
- This interpretation accounts for all these and other essential aspects of de Finetti's philosophy of probability.



4 *On the ontic and
epistemic nature of subjective
probability*



4 On the ontic and epistemic nature of subjective probability

4.1 Permissive, imprudent epistemology?

- De Finetti denied the existence of objective probabilities.
- He also did not impose any formal constraints on the values of subjective probabilities.
- These may have led philosophers to conceive his theory as too permissive, licensing imprudent epistemology.
- But such a conception overlooks de Finetti's instrumentalist philosophy of probability.



4 On the ontic and epistemic nature of subjective probability

4.1 Permissive, imprudent epistemology?

- The view that de Finetti's theory is permissive *conflates* the *ontic status* of subjective probabilities with the *way they are to be determined*.
- While probabilities in this theory are not reducible to objective facts, their evaluation *should* be based on objective facts.
- De Finetti held that the evaluation of probabilities always involves subjective judgments: “it is, in each case, my personal judgment that is responsible for giving a weight to the facts” (DF 1972, p. 21).



4 On the ontic and epistemic nature of subjective probability

4.1 Permissive, imprudent epistemology?

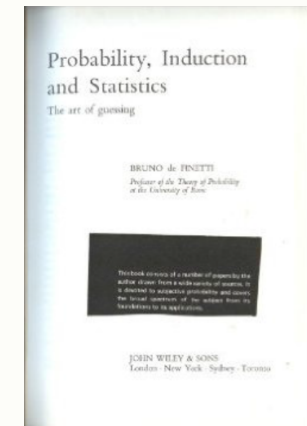
- De Finetti saw his theory of probability as normative, and he held that probabilities should be instrumental.
- To be instrumental, probabilities cannot be permissive.
- Indeed, de Finetti held that the evaluation of probability should involve *rigorous inductive reasoning*.

4 On the ontic and epistemic nature of subjective probability

4.1 Permissive, imprudent epistemology?

- Thus, such evaluation should not be considered “as a result of a capricious psychological reaction, but as a mental process susceptible of an analysis, interpretation and justification.”

(DF 1972)





4 On the ontic and epistemic nature of subjective probability

4.1 Permissive, imprudent epistemology?

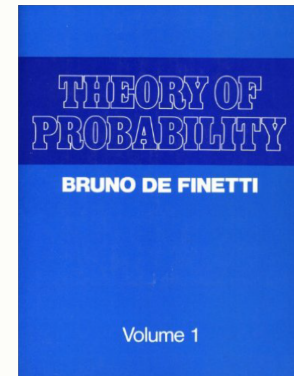
- De Finetti warned against superficiality in evaluating probabilities – an attitude that is frequently associated with subjective probability.
- In particular, he warned against *two* common patterns of superficiality.

4 On the ontic and epistemic nature of subjective probability

4.1 Permissive, imprudent epistemology?

- Thus, *On the one hand* You may think that the choice, being subjective, and therefore arbitrary, **does not require too much of an effort** in pinpointing one particular value rather than a different one;

on the other hand, it might be thought that **no mental effort is required**, since it can be avoided by the **mechanical application of some standardized procedure** (DF 1974).

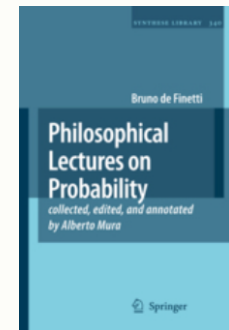


4 On the ontic and epistemic nature of subjective probability

4.2 Instrumentalism

- De Finetti held that probabilities and probabilistic theories should be interpreted along instrumental lines.

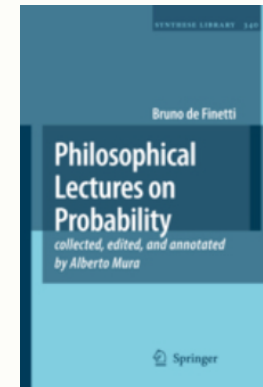
“If one takes science seriously, then one always considers it *also* as an instrument. Otherwise, what would it amount to? Building up houses of cards, empty of any application whatsoever!” (DF 2008)



4 On the ontic and epistemic nature of subjective probability

4.2 Instrumentalism

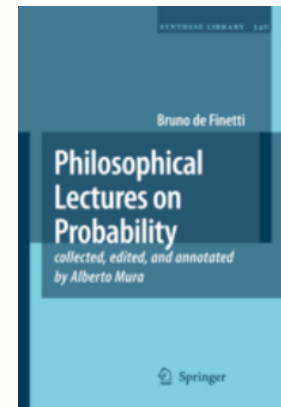
- DF: By looking at the outcome of a phenomenon we could be driven to formulate a rule by virtue of which, in each case, things would blend in that way, as if it were a necessary law of nature.



4 On the ontic and epistemic nature of subjective probability

4.2 Instrumentalism

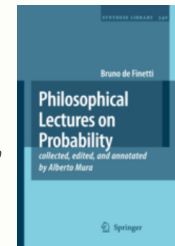
- AM: You say: from a deterministic theory like classical mechanics, one can obtain, by means of certain reasonable assumptions, **laws which are formulated in terms of subjective probabilities.** Therefore, **those laws are not objective laws of nature.** Rather, **they are rules to give ...** reasonable probability evaluations.
- DF: This is, more or less, my position.



4 On the ontic and epistemic nature of subjective probability

4.2 Instrumentalism

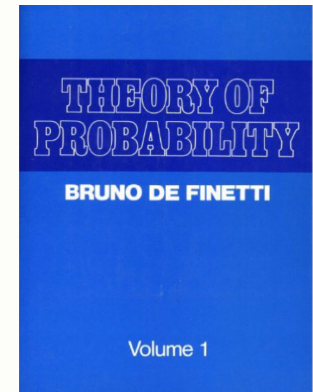
- In line with his instrumental philosophy of probability, de Finetti objected to the idea that probabilistic laws and theories can be falsified.
- He held that “speaking of empirical tests in the field of probability is a contradiction in terms” and that “probabilistic theories are not refutable” (ibid.)
- Rather, probabilistic laws and theories could be considered more or less instrumental.



4 On the ontic and epistemic nature of subjective probability

4.2 Instrumentalism

- Being instrumentalist, de Finetti held that probabilistic reasoning is completely unrelated to general philosophical controversies, such as Determinism versus Indeterminism, Realism versus Solipsism ... (DF 1974).





4 On the ontic and epistemic nature of subjective probability

4.3 The role of intuitions

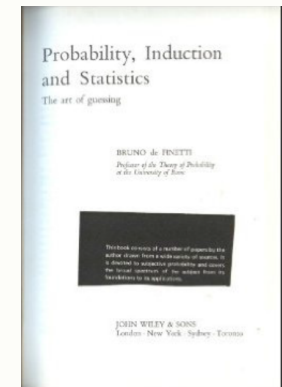
- De Finetti also warned against other misconceptions about the nature of the inductive reasoning that is involved in evaluating probabilities.

4 On the ontic and epistemic nature of subjective probability

4.3 The role of intuitions

- “The tendency to overestimate reason – often in an exclusive spirit – is particularly harmful. **Reason, to my mind, is invaluable as a supplement to the other psycho-intuitive faculties, but never a substitute for them.**

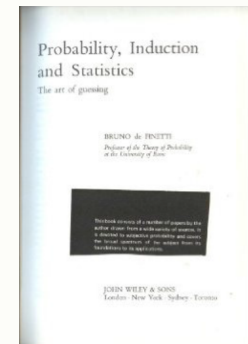
Figuratively, **reason is a pole that may keep the plant of intuitive thought from growing crooked**, but it is not itself either a plant or a valid substitute for a plant.” (DF 1972)



4 On the ontic and epistemic nature of subjective probability

4.3 The role of intuitions

- “A consequence of this distortion is the elevation of deductive reasoning to the status of a standard ... Thus, inductive reasoning is generally considered as something on a lower level, warning caution and suspicion. Worse still, attempts to give it dignity try to change its nature making it seem like something that could almost be included under deductive reasoning (DF 1972, pp. 147-8).





4 On the ontic and epistemic nature of subjective probability

4.3 The role of intuitions

- In order to reduce the risk of error, de Finetti held that it is important “to support intuition with suitable superstructures” (DF 1974).
- One superstructure is the ‘logic of certainty’ (ibid.).
- Another one is the mathematical theory of probability, which guards agents from forming incoherent degrees of expectations.



4 On the ontic and epistemic nature of subjective probability

4.3 The role of intuitions

- The literature has almost entirely focused on the ‘superstructures’ and neglected the important role that de Finetti ascribed to intuitions in evaluating probabilities.
- This focus may explain the misconceptions about de Finetti’s philosophy of probability, especially the idea that his theory offers a permissive epistemology.



4 On the ontic and epistemic nature of subjective probability

4.4 The highlights of the proposed interpretation

- In short, on the proposed interpretation, de Finetti's philosophy of probability presupposes that agents have psycho-intuitive faculties in virtue of which they are capable of forming, with the aid of training and probability theory, instrumental probabilistic opinions.
- These probabilistic opinions are coherent subjective degrees of expectations (which are not reducible to objective facts) that should be the outcome of rigorous inductive reasoning.

5 *On de Finetti's concept of coherence*





5 On de Finetti's concept of coherence

5.1 The analysis of coherence

- The analysis of de Finetti's concept of coherence is a key to understanding his theory of probability.
- Different interpretations of this concept result in different theories of probability.



5 On de Finetti's concept of coherence

5.1 The analysis of coherence

- In de Finetti's theory, subjective probabilities are coherent degrees of expectations.
- The betting decision-theoretic framework was intended as a framework for measuring probabilities and explicating the notion of coherent degrees of expectations.
- In this framework, an agent is subject to various bets by a cunning bookie.



5 On de Finetti's concept of coherence

5.1 The analysis of coherence

- The agent's degrees of expectations determine the odds that the bookie posts for buying and selling the bets, and the bookie determines the directions of the bets.
- The agent's degrees of expectations are coherent if they are not subject to a Dutch book, i.e. a set of bets in which the agent is bound to lose come what may.



5 On de Finetti's concept of coherence

5.1 The analysis of coherence

- Many find the Dutch book argument or its common interpretation defective and propose alternative reading of it, or different arguments for the laws of probability.
- Some authors argue that the Dutch book argument merely dramatizes an inconsistency in the attitudes of an agent whose degrees of belief violate the laws of probability.
- Ramsey (1926/1980) presented the Dutch book argument in this way.

5 On de Finetti's concept of coherence

5.1 The analysis of coherence

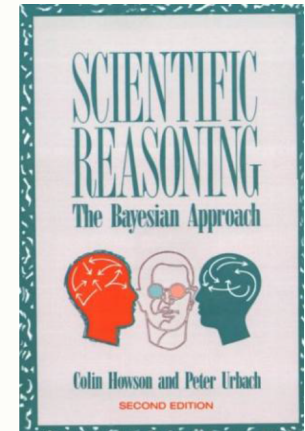
- “Any definite set of degrees of belief which **broke [the laws of probability] would be inconsistent in the sense that it violated the laws of preference between options,** such as that preferability is a transitive asymmetrical relation ... If anyone's mental condition violated these laws, his choice would depend on the precise form in which the options were offered him, which would be absurd. **He could have a book made against him by a cunning bettor and would then stand to lose in any event.**”



5 On de Finetti's concept of coherence

5.1 The analysis of coherence

- Another interpretation of the Dutch book as highlighting inconsistency is due to Howson and Urbach (1993).
- Howson and Urbach propose that the Dutch book argument fundamentally concerns the consistency of an agent's fair betting quotients, i.e. betting quotients that the agent considers fair.





5 On de Finetti's concept of coherence

5.1 The analysis of coherence

- Howson and Urbach identify an agent's degrees of belief with her fair betting quotients and argue that the significance of the Dutch book argument

lies in its corollary that betting quotients that do not satisfy the probability axioms cannot be consistently regarded as fair. ... *if your degrees of belief are measured by the betting quotients you think fair, then consistency demands that they satisfy the probability axioms.*



5 On de Finetti's concept of coherence

5.1 The analysis of coherence

- These and other 'consistency interpretations of coherence' conceive the *incoherence* of degrees of belief in Dutch bookable situations as a symptom of inconsistency of preferences, action-guiding beliefs or degrees of belief.
- The Italian word 'coerenza' that de Finetti used in his writings is ambiguous and could be translated as 'coherence' or 'consistency'.

5 On de Finetti's concept of coherence

5.1 The analysis of coherence

- Howson (2008) proposes that the standard translation of the word 'coerenza' is 'consistency'.
- I will argue that coherence *a la* de Finetti is different from consistency.
- Incoherence *a la* de Finetti is characterized in instrumental terms, whereas inconsistency is not. Accordingly, inconsistent betting quotients need not be incoherent!





5 On de Finetti's concept of coherence

5.2 Coherence and verification

- Consistency interpretations of coherence are inadequate interpretations of de Finetti's notion of coherence because they overlook a very important aspect of de Finetti's philosophy of probability.
- De Finetti attributed a great importance to the verifiability of events and he held that events in probability assignments have to be verifiable.
- Almost all the interpretations of de Finetti's theory either ignore or play down this central aspect of his philosophy.



5 On de Finetti's concept of coherence

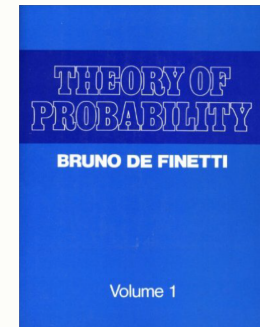
5.2 Coherence and verification

- Interpreters of de Finetti takes his verificationism to be an undesirable residue of the influence of positivism.
- While de Finetti was influenced by positivism, his verificationism is an intrinsic part of his instrumental philosophy of probability.

5 On de Finetti's concept of coherence

5.2 Coherence and verification

In general terms, it will always be a question of examining, if, and in which sense, a statement really constitutes an 'event', permitting in a more or less realistic acceptable form, and in unique way, the 'verification' of whether it is 'true' or 'false' A and B are events (observables), but it is not possible to observe both of them, and, therefore, it is not possible to call the product AB an event (observable). (DF 1974).





5 On de Finetti's concept of coherence

5.2 Coherence and verification

- De Finetti acknowledged that verifiability is “a notion that is often vague and illusive” and thought that it is necessary “to recognize that there are various degrees and shades of meaning attached to it.” (DF 1974)
- He took a pragmatic attitude toward the kind and degree of verifiability that is actually required.
- De Finetti's pragmatism allows for various kinds of verifiability, including cases in which verifiability is highly theoretical or idealized.



5 On de Finetti's concept of coherence

5.2 Coherence and verification

- De Finetti's instrumentalism dictates his verificationism.
- This is clear in the betting decision-theoretic framework.
- There are no Dutch books for unverifiable events.
- In the case of unverifiable events incoherent degrees of belief *a la* consistency interpretations of coherence have no verifiable harmful consequences.



5 On de Finetti's concept of coherence

5.2 Coherence and verification

- Accordingly, radical subjectivists, like de Finetti, who are instrumentalists about probability, have no incentive to avoid such 'incoherent' degrees of belief.
- Thus, unlike consistency interpretations of coherence, de Finetti's concept of incoherent degree of belief does not apply to unverifiable events.
- This conclusion could easily be extended to the Brier scoring-rule decision-theoretic framework, which de Finetti preferred in his later philosophy.



5 On de Finetti's concept of coherence

5.3 Coherence, instrumentalism and knowledge

- Coherence has an instrumental value.
- Incoherent degrees of belief are *less instrumental* than some corresponding coherent degrees of belief, *come what may*; where degrees of belief are corresponding if they are about the same events.
- And no coherent degrees of belief are less instrumental than other corresponding degrees of belief, come what may.



5 On de Finetti's concept of coherence

5.3 Coherence, instrumentalism and knowledge

- Now, according to instrumentalism the knowledge that is embodied in a system of (degrees) beliefs is measured by its instrumental value.
- Thus, in the context of de Finetti's instrumental philosophy, the Dutch book argument demonstrates the epistemic merit of coherent degrees of belief.
- The claims that Dutch book arguments demonstrate the pragmatic rather than the epistemic merits of coherence are *question-begging against instrumentalism*.

6 *On the logical structure of subjective probability*





6 On the logical structure of subjective probability

6.1 On the relation between degrees of belief and probs.

- The proposed interpretation of the concept of coherence has two important implications.
- The first concerns the relation between degrees of belief and probabilities.
- It is common to interpret de Finetti's theory of probability as implying that every event could have a subjective probability.



6 On the logical structure of subjective probability

6.1 On the relation between degrees of belief and probs.

- In the proposed interpretation, coherence entails that while every event could have a degree of belief, only events that are verifiable have subjective probability.



6 On the logical structure of subjective probability

6.2 On the logical structure of subjective probs.

- The second implication of the proposed interpretation concerns the logical structure of subjective probabilities.
- According to this interpretation, probabilities of jointly unverifiable events are less constrained than probabilities of jointly verifiable events.
- Here is a simple example.



6 On the logical structure of subjective probability

6.2 On the logical structure of subjective probs.

- In the standard interpretation of de Finetti's theory, the probabilities of *any* events A and B are subject to the following inequality, independently of whether they are jointly verifiable:

$$P(A \vee B) = P(A) + P(B) - P(A \wedge B)$$

- By contrast, in the proposed interpretation this inequality obtains only for A and B that are jointly verifiable events.



6 On the logical structure of subjective probability

6.2 On the logical structure of subjective probabilities

- More generally, the implication is that, in general, the logical structure of probabilities in de Finetti's theory is different from the way it is commonly portrayed.
- It is particularly interesting to study this structure in the context of quantum theories.



*7 On misconceptions
about instrumentalism*

7 On misconceptions about instrumentalism

7.1 Instrumental value and ontological status

- It is common to evaluate the instrumental value of theoretical terms according to their ontological status.
- For example, it has been argued by Psillos (1999) that the ontological status of theoretical terms and/or relations between them determines the capacity of a theory to make novel predictions.



7 On misconceptions about instrumentalism

7.1 Instrumental value and ontological status

Duhem's point is that the fact that some theories generate novel predictions cannot be accounted for on a purely instrumentalist understanding of scientific theories.



For how can one expect that an arbitrary (artificial) classification of a set of known experimental laws – i.e. a classification based only on considerations of convenience – will possibly be able to reveal unforeseen phenomena in the world?

7 On misconceptions about instrumentalism

7.1 Instrumental value and ontological status

This might happen by chance.

But persistent novel and successful predictions cannot be seriously attributed to mere chance, any more than persistently successful

forecasts of the shown face of a tossed coin can be attributed to pure chance. (Psillos 1999, p. 33)





7 On misconceptions about instrumentalism

7.1 Instrumental value and ontological status

- Similarly, in interpreting de Finetti's theory of probability the common view seems to be that the ontological status of probabilities determines their instrumental value.
- The idea is that since the probabilities in de Finetti's theory neither correspond to nor supervene upon objective properties, probability assignments may be arbitrary and their application to science is questionable.

7 On misconceptions about instrumentalism

7.2 Can probabilities in the hard sciences be subjective?

- Inspired by Ramsey and Jeffrey, Galavotti (2008) suggests that

there is a widely felt need to incorporate into subjectivism a notion of probability endowed with some kind of robustness, in view of its application within ‘hard’ sciences, like physics.



7 On misconceptions about instrumentalism

7.2 Can probabilities in the hard sciences be subjective?

Interestingly, Chapter 5 [of de Finetti's *Philosophical Lectures on Probability*] contains a few remarks to the effect that probability distributions belonging to statistical mechanics could be taken as more solid grounds for subjective opinions. **This suggests that late in life de Finetti must have entertained the idea that a somewhat robust meaning can be attached to those probability assignments deriving from accepted scientific theories.** (Galavotti *ibid.*)





7 On misconceptions about instrumentalism

7.2 Can probabilities in the hard sciences be subjective?

- On the proposed interpretation, de Finetti never changed his mind on this issue.
- His remarks are a natural consequence of his instrumentalist philosophy of probability.
- De Finetti held that the instrumental value of subjective probabilities depends on the quality of the inductive reasoning that is used in their evaluation.

7 On misconceptions about instrumentalism

7.3 Inductive reasoning and ontological status

- De Finetti maintained that the quality of the inductive reasoning that is involved in the evaluation of subjective probabilities is not determined by their ontological status.
- He presupposed that humans have psycho-intuitive capacities that, when developed and properly guarded by probability theory, allow them to choose degrees of belief that are instrumental.
- Surely, realists must share this presupposition.

7 On misconceptions about instrumentalism

7.3 Inductive reasoning and ontological status

- In the realist-instrumentalist debate, the question of the role of psycho-intuitive capacities in inductive reasoning has been largely overlooked.
- An interesting question is whether the effectiveness of such capacities in developing instrumental scientific theories and models could better be accounted under realism.

The End

Thank you!

