Chapter 10 Bayesian v.s. non-Bayesian decision theory.

Section 10.1 What is Bayesianism?

According to Bradley,

"Bayesian decision theories are formal theories of rational agency: they aim to tell us both what the properties of a rational state of mind are ... and what action it is rational for an agent to perform, given the state of mind ..."

By this definition there are two distinct components:

① what your state of mind ought to be like

② how you ought to act given that state of mind

① = epistemic, ② = deliberative

Epistemic is a claim about what rational agents ought to believe and which combinations of beliefs and desires are rationally permissible.

Or, the theory holds that one is free to believe whatever one wishes as long as one's beliefs can be represented by a subjective probability function, and those beliefs are updated in according with Bayes' theorem.

The theory has no advice on how one ought to go about when exploring the world but provides a set of structural restrictions on what it is permissible to believe, and how one should be permitted to revise those beliefs in light of new information.

Deliberative is supposed to tell us what action is rational for the agent to perform, given their state of mind.

Principles of the Bayesian account of rational action.

1) Subjective degrees of belief can be represented by a probability function defined in terms of the decision maker's preferences over uncertain prospects.
2) Degrees of desire can be represented by a utility function defined in the same way, that is, in terms of preferences over uncertain propects
3) Rational decision makers act if they maximise subjective expected utility.

3 is new.

So what does ≳ even mean.

In short, the decision maker does not prefer an uncertain prospect to another because they judges the utilities and probabilities of the outcomes to be more favourable than those of another.

Instead, the well-organised structure of the agent's preferences over uncertain prospects logically implies that the agent can be described as if her choices were governed by a utility function and a subjective probility function.

Ordering Axiom:

The most fundamental Bayesian preference axiom

It holds that for any two uncertain prospects, the decision maker must be able to state a clear and unambiguous preference and all such preferences must be asymmetric and transitive.

Does not tell the decision maker what to choice though.

If red > white, then white ≯ red.

Examples:

① Measure subjective probability

watch = $1000

If $50 is a fair price for insuring the watch, then subjective probability is about $\frac{50}{1000} = .05$.

② Find utility function if know probability of atleast one event.

p(rain in Cambridge today) = .5

gold watch > steel watch > plastic watch

A - steel watch

B - if rain then gold watch, otherwise plastic watch

If indifferent to A and B, then utility for the outcomes can be represented on a linear scale by

u(gold) = 1

u(steel) = .5

u(plastic) = 0

$.5 = 1(.5) + 0(.5)$

3) ($R, \neg R$ are mutually exclusive events)

If R and $\neg R$ are equally probable,

then indifferent to

(i) 200 units of utility if R and 100 if $\neg R$

(ii) 100 if R and 200 if $\neg R$.

This holds no matter what the attitude of risk is.

10.2 Arguments for and against Bayesianism.

For:

+ Provides an unified answer to many important questions in decision theory, epistemology, and probability theory.

+ Most answer will be based on principles (1)-(3)

+ Avoids a number of potentially hard metaphysical questions. (All that matters is our beliefs and desires)

+ Offers a high degree of precision.
(Every thing can be represented by numbers)

− Useless in real word since no actually existing human being is likely to satisfy all the structural principles imposed by the theory.
+ theoretical ideal

− A decision maker who is able to state a complete preference ordering over uncertain prospects, as required by Bayesian theories, already knows what to do.

4) two decision makers A and B
have exactly the same beliefs and desires
A is able to express their preferences
and B is not able.

Since B's tastes and beliefs are exactly
parallel to those of A, it follows that
every decision, B ought to behave as A.

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the out put of a decision theory based on
the Bayesian approach is a set of probability
and utility function.

Bayesian theory has strictly speaking nothing to tell B
about how to behave. But since B has
access to some of his preferences, but not all, and also
assume that their has partial information about their
utility and probability functions. Then, the Bayesian
representation theorems can, it is sometimes suggested,
be put to "fill the missing gaps" of a preference ordering.

- it is perhaps too optimistic to assume that the
decision maker's initial information always is
sufficiently rich to allow them to fill all the
gaps in the preference ordering.
- This manoeuvre offers no theoretical justification
for the initial preference ordering over risky acts.

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10.3 Non-Bayesian approaches

Two subclasses — extrenalist, internalists

Extrenalist —

- argue that an act is rational not merely by virtue of what the decision maker believes and desires
- the belief-desire model is too narrow
- rationality is also constituted by facts about the external world.

Internalist

- Agree with that the decision maker's beliefs and desires are all that matters when adjudicating whether an act is rational or irrational
- Denies the rational decision makers merely act "as if" they were acting from the principle of maximising expected utility
- Claim that rational decision makers choose an act over another beause its subjective expected utility is optimal.

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