

1 Individual decision

In economics, it is traditionally assumed that an agent's behavior can be broken down into a series of parallel or sequential actions, chosen as the result of a process of mental deliberation. The agent thus appears as an autonomous decision-maker who chooses, either consciously or implicitly, in a situation that can be isolated from its context, between the various alternatives presented to him. Furthermore, this decision-making process is assumed to be rational, by virtue of two remarkable properties. Firstly, the agent is "consequentialist" in the sense that he chooses his action solely according to its (foreseeable) consequences; secondly, he is "utilitarian" in the sense that he evaluates the effects of his action by weighing up its costs and advantages. Consequently, such an agent is restricted to a minimal psychological framework, insofar as his choices are governed exclusively by three personal choice determiners: his opportunities (delimiting the space of his possible actions), his representations (enabling him to predict the consequences of his action) and his preferences (inducing a judgment on these consequences). These three determiners are further combined in a choice rule which characterizes more precisely the rationality of the decision-maker.

In the classical approach, the decision-maker is animated by very strong rationality relying on three assumptions. First, given his prior beliefs, he is capable of perfectly anticipating the effects of his actions. Second, he judges his actions on the basis of one unique synthetic criterion, utility, which sums up their costs and advantages. Third, he adopts optimising behaviour, in the sense that he seeks the action that maximises his utility (defined directly on the actions beyond their effects) under certain constraints (those limiting the set of his possible actions). These assumptions have been progressively weakened, but only to a limited degree. When dropping the first assumption, the decision-maker only possesses imperfect information about his environment. The more complex modification of the second assumption gives us a decision maker using multiple, but nevertheless commensurable, criteria of choice. The third assumption is generally kept and assumes that the decision-maker makes his choice without having any real difficulty in calculating what his optimum action is.

In the evolutionary approach, the rationality of the decision-maker is much more limited and is situated within a dynamic perspective. His information is reduced and derives not so much from his prior knowledge as from his past observations, which accumulate and enable him to revise his beliefs. His utility is not necessarily pre-defined, but built as a function of his past experience in analogous situations. Above all, the decision maker's deliberative process is constrained by his limited ability to calculate, and this internal constraint must be added to the external constraints. However, this cognitive limitation can be compensated for by the work of time, at least if the decision maker carries out a succession of repetitive choices. In this case he finds himself involved in a learning process which can, over the long term and in some circumstances, converge towards an optimal action, but the medium term trajectory of this learning process is in itself of interest to the modeler.

This chapter explores precisely the passage from the first approach to the second. The first section reviews the principles of classical decision theory, namely the classically proposed rules of choice, both static (§1.1) and dynamic (§1.2), illustrated by a prototypical example (§1.3), the justifications (axiomatic, operational, evolutionary) that have been presented for it (§1.4) and the criticisms (empirical, theoretical, logical) that have been levelled at it (§1.5). The second section defines the principles of evolutionary behavior, setting out different concepts of rationality (§ 2.1) and then successively examining the processes of prediction (§2.2) and selection (§2.3) carried out by the decision-maker, giving rise to the problem of the value of information (§2.4) and to the exploration-exploitation dilemma (§2.5). The third section describes some recently-developed evolutionary models, firstly models of choice with limited rationality (§3.1), then learning processes applied to repeated decision situations, both static (§3.2) and dynamic (§3.3), possibly simplified (§3.4), these processes being illustrated by the earlier prototypical example (§3.5).

1.1 Background and problems

1.1.1 The choice rules in static situations

In classical decision theory, in its static form, the decision-maker finds himself faced with an environment called “nature”. The decision-maker takes actions and nature assumes states. The instantaneous conjunction of an action and a state results in consequences that are certain. These are of-