discussed in Hogarth and Reder (1987). In particular, the reader is encouraged to review the four articles by Arrow, Lucas, Thaler, and Tversky and Kahneman.

Selten (1989) proposes an alternative view of bounded rationality and provides an overview of some of the issues discussed up to the late 1980s. For other views on modeling rational and bounded-rational players, see Binmore (1987, 1988) and Aumann (1996). Lipman (1995a) contains a short survey covering some of the topics discussed in this book.

1

Bounded Rationality in Choice

1.1 The “Rational Man”

In economic theory, a rational decision maker is an agent who has to choose an alternative after a process of deliberation in which he answers three questions:

· “What is feasible?”
· “What is desirable?”
· “What is the best alternative according to the notion of desirability, given the feasibility constraints?”

This description lacks any predictive power regarding a single decision problem, inasmuch as one can always explain the choice of an alternative, from a given set, as an outcome of a process of deliberation in which that outcome is indeed considered the best. Herein lies a key assumption regarding the rational man: The operation of discovering the feasible alternatives and the operation of defining the preferences are entirely independent. That is, if the decision maker ranks one alternative above another when facing a set of options that includes both, he will rank them identically when encountering any other decision problem in which these two alternatives are available.

Formally, the most abstract model of choice refers to a decision maker who faces choices from sets of alternatives that are subsets
of some "grand set" \( A \). A choice problem, \( A \), is a subset of \( A \); the task of the decision maker is to single out one element of \( A \).

To conclude, the scheme of the choice procedure employed by the rational decision maker is as follows:

(P-1) **The rational man** The primitive of the procedure is a preference relation \( \succeq \) over a set \( A \). Given a choice problem \( A \subseteq A \), choose an element \( x^* \) in \( A \) that is \( \succeq \)-optimal (that is, \( x^* \succeq x \) for all \( x \in A \)).

For simplicity, it will be assumed through the rest of this chapter that preferences are asymmetric (i.e., if \( a \succeq b \) then not \( b \succeq a \)). Thus, the decision maker has in mind a preference relation, \( \succeq \), over the set of alternatives \( A \). Facing a problem \( A \), the decision maker chooses an element in the set \( A \), denoted by \( C_x(A) \), satisfying \( C_x(A) \succeq x \) for all \( x \in A \). Sometimes we replace the preference relation with a utility function, \( u: A \to \mathbb{R} \), with the understanding that \( u(a) \geq u(a') \) is equivalent to \( a \succeq a' \). (Of course, some assumptions are needed for establishing the equivalence between the existence of preferences and the existence of a utility function).

Let us uncover some of the assumptions buried in the rational man procedure:

- **Knowledge of the problem** The decision maker has a clear picture of the choice problem he faces: he is fully aware of the set of alternatives from which he has to choose (facing the problem \( A \), the decision maker can choose any \( x \in A \), and the chosen \( x^* \) cannot be less preferred than any other \( x \in A \)). He neither invents nor discovers new courses of actions (the chosen \( x^* \) cannot be outside the set \( A \)).

- **Clear preferences** The decision maker has a complete ordering over the entire set of alternatives.

- **Ability to optimize** The decision maker has the skill necessary to make whatever complicated calculations are needed to discover his optimal course of action. His ability to calculate is unlimited, and

he does not make mistakes. (The simplicity of the formula \( \max_{a \in A} u(a) \) is misleading; the operation may, of course, be very complex.)

- **Indifference to logically equivalent descriptions of alternatives and choice sets** The choice is invariant to logically equivalent changes of descriptions of alternatives. That is, replacing one "alternative" with another "alternative" that is "logically equivalent" does not affect the choice. If the sets \( A \) and \( B \) are equal, then the choice from \( A \) is the same as the choice from \( B \).

**Comment** Often the preferences on a set of alternatives are derived from a more detailed structure. For example, it is often the case that the decision maker bases his preferences, defined on \( A \), on the calculation of consequences yielded from \( A \). That is, he perceives a set of possible consequences, \( C \). He has a preference relation over \( C \) (probably represented by a numerical function, \( V: C \to \mathbb{R} \)). He perceives the causal dependence of a consequence on a chosen alternative, described by a consequence function, \( f: A \to C \). He then chooses, from any set \( A \subseteq A \), the alternative in \( A \) that yields the best consequence—that is, he solves the optimization problem \( \max_{a \in A} V(f(a)) \). In other words, the preference relation on \( A \) is induced from the composition of the consequence function and the preference relation on \( C \).

In order to deal with the situation in which the decision maker assumes that the connection between the action and the consequence has elements of uncertainty, we usually enrich the model. A space of states, \( \Omega \), is added. One element of \( \Omega \) represents the list of exogenous factors that are relevant to the decision maker's interests and are beyond his control. The consequence function is taken to depend on \( \Omega \) as well; that is, \( f: A \times \Omega \to C \). Each action \( a \in A \) corresponds to an "act" (a function that specifies an element in \( C \) for each state in \( \Omega \)) \( a(\omega) = f(a, \omega) \). The preference relation on \( A \) is induced from a preference on "acts." A choice problem now is a
pair \((A, \Omega)\) where \(A \subseteq A\) is the set of alternatives, whereas \(\Omega \subseteq \Omega\) is the set of states not excluded by the information the decision maker receives. Usually, it is taken that the rational man's choice is based on a belief on the set \(\Omega\), a belief he updates by the Bayesian formula whenever he is informed that an event \(\Omega \subseteq \Omega\) happens.

Note that underlying this structure, both with and without uncertainty, is the assumption that the decision maker clearly perceives the action-consequence relationship.

1.2 The Traditional Economist's Position

Economists have often been apologetic about the assumption that decision makers behave like the "rational man." Introspection suggests that those assumptions are often unrealistic. This is probably the reason why economists argued long ago that the rational man paradigm has to be taken less literally.

The "traditional" argument is roughly this: In economics, we are mainly interested in the behavior of the decision maker and not in the process leading to his decision. Even if the decision maker does not behave in the manner described by the rational man procedure, it still may be the case that his behavior can be described as if he follows such a procedure. This is sufficient for the purpose of economics.

A good demonstration of this "as if" idea is given in consumer theory. Imagine a consumer who operates in a world with two goods, 1 and 2, who has budget \(I\), and who faces prices \(p_1\) and \(p_2\). Assume that the consumer allocates the fraction \(\alpha\) of his income to good 1 and \((1 - \alpha)\) of the income to good 2 (for every \(I, p_1\) and \(p_2\)). This behavior rule may be the result of activating a rule of thumb. Nonetheless, it may still be presented as if it is the outcome of the consumer's maximization of the utility function \(x_1^\alpha x_2^{1 - \alpha}\).

Let us return to the general framework. The following argument was designed to support the traditional point of view. Consider a decision maker whose behavior regarding choices from subsets of the set \(A\) is described by a function \(C\) whose domain is the set of all non-empty subsets of \(A\) and whose range is the set \(A\). The element \(C(A)\) is interpreted as the decision maker's choice whenever he confronts the decision problem \(A\). For every \(A\), \(C(A) \in A\). (Note that for simplicity, and in contrast to some of the literature, it is required here that \(C(A)\) is a single element in \(A\) and not a subset of \(A\)).

We now come to an important necessary and sufficient condition for a choice function to be induced by a decision maker who behaves like a rational man. It is said that the decision maker's behavior function \(C\) satisfies the consistency condition (sometimes referred to as the "independence of irrelevant alternatives") if for all \(A_1 \subseteq A_2 \subseteq A\), if \(C(A_2) \in A_1\) then \(C(A_1) = C(A_2)\). That is, if the element chosen from the large set \((A_2)\) is a member of the smaller set \((A_1)\), then the decision maker chooses this element from the smaller set as well. It is easy to see that \(C\) is consistent if and only if there exists a preference relation \(\succeq\) over \(A\) such that for all \(A \subseteq A\), \(C(A)\) is the \(\succeq\)-maximal element in \(A\).

**Proof** Of course, if for every subset \(A\) the element \(C(A)\) is the \(\succeq\)-maximal element in \(A\), then the choice function \(C\) satisfies the consistency condition. Assume that \(C\) satisfies the consistency condition. Define a preference relation \(\succeq\) by \(a \succeq b\) if \(a = C(\{a, b\})\). We first verify that \(\succeq\) is transitive. If \(a \succeq b\) and \(b \succeq c\), then \(a = C(\{a, b\})\) and \(b = C(\{b, c\})\). Then \(C(\{a, b, c\}) = a\); otherwise, the consistency condition is violated with respect to one of the sets, \(\{a, b\}\) or \(\{b, c\}\). Therefore, by the consistency condition, \(C(\{a, c\}) = a\); that is, \(a \succeq c\).

To verify that for every set \(A\), \(C(A)\) is the \(\succeq\)-maximal element in \(A\), notice that for any element \(a \in A\), \(\{a, C(A)\} \subseteq A\) and because \(C\) satisfies the consistency condition, \(C(\{a, C(A)\}) = C(A)\), therefore by definition of \(\succeq\), \(C(A) \succeq a\).

The conclusion from this simple analysis is that choice functions that satisfy the consistency condition, even if they are not derived
from a rational man procedure, can be described as if they are derived by some rational man. The significance of this result depends on the existence of plausible procedures that satisfy the consistency condition even though they do not belong to the scheme (P-1) of choosing a maximal element. One such classic example is what Simon termed the *satisficing procedure.*

(P-2) The primitives of the procedure are $O$, an ordering of the set $A$, and a set $S \subseteq A$ (as well as a tie-breaking rule; see below). For any decision problem $A$, sequentially examine the alternatives in $A$, according to the ordering $O$, until you confront an alternative that is a member of the set $S$, the set of "satisfactory" alternatives. Once you find such an element, stop and choose it. For the case where no element of $A$ belongs to $S$, use the tie-breaking rule that satisfies the consistency requirement (such as choosing the last element in $A$).

Any procedure within the scheme (P-2) satisfies the consistency condition. To verify this, suppose that $A_1 \subseteq A_2$ and $C(A_2) \in A_1$, that is, $C(A_2)$ is the first (according to the ordering $O$) satisfactory alternative in $A_2$, then it is also the first satisfactory alternative in the subset $A_1$. If $C(A_2) \in S$, then $A_1$ also does not include any element belonging to $S$, and because the tie-breaking rule satisfies the consistency condition, we have $C(A_2) = C(A_1)$.

A special case of (P-2) is one where the set $S$ is derived from two parameters, a function $V$ and a number $v^*$, so that $S = \{ a \in A \mid V(a) \geq v^* \}$. The function $V$ assigns a number to each of the potential alternatives, whereas $v^*$ is the aspiration level. The decision maker searches for an alternative that satisfies the condition that its value be above the aspiration level. For example, in the "finding a worker" problem, the set of alternatives is the set of candidates for a job, the ordering might be the alphabetical ordering of the candidates' names or an enumeration of their social security numbers, $V(a)$ may be the grade that candidate $a$ gets in a test, and $v^*$ is the required minimal grade. Note that instead of having a maximization problem, "max$_{a \in A} V(a),"$ the decision maker who follows (P-2) solves what seems to be a simpler problem: "Find an $a \in A$ for which $V(a) \geq v^*."$

### 1.3 The Attack on the Traditional Approach

The fact that we have found a family of plausible procedures that are not similar to the rational man procedure yet consistent with rationality provides support for the traditional economic position. However, the problem with this position is that it is difficult to propose additional procedures for inducing consistent choice functions.

To appreciate the difficulties in finding such examples, note that in (P-2) the ordering in which the alternatives are examined is fixed independent of the particular choice set. However, if the ordering by which the alternatives are examined is dependent on the set, a clash with the consistency condition arises. Consider the following decision procedure scheme:

(P-3) The primitives of the procedure are two different orderings of $A$, $O_1$ and $O_2$, a natural number $n^*$, and a set $S$ (plus a tie-breaking rule). For a choice problem $A$, employ (P-2) with the ordering $O_1$ if the number of elements in $A$ is below $n^*$ and with $O_2$ if the number of alternatives in $A$ is above $n^*$.

It is easy to see that a procedure within the scheme (P-3) will often not satisfy the consistency condition. The fact that an element is the first element, by the ordering $O_2$, belonging to $S$ in a "large" set $A_2$ does not guarantee that it is the first, by the other ordering $O_1$, belonging to $S$ in a "smaller" subset $A_1$.

In the rest of this section, we will refer to three motives often underlying procedures of choice that may conflict with the rational man paradigm: "framing effects," the "tendency to simplify problems," and the "search for reasons." In the next section, we present
evidence from the psychological literature that confirms that these motives systematically appear in human choice situations.

Framing Effects
By framing effects, we refer to phenomena rooted solely in the way that the decision problem is framed, not in the content of the choice problem. Recall that a choice problem is defined as a choice of an element from a set. In practice, this set has to be described; the way that it is described may affect the choice. For example, the model does not allow distinct choices between the lists of alternatives \((a, b, c)\) and \((a, a, b, c)\) because the sets \(\{a, b, c\}\) and \(\{a, a, b, c\}\) are identical. If, however, the language in which the sets are specified is a language of "lists," then the following procedural scheme is well defined:

(P-4) Choose the alternative that appears in the list most often (and apply some rule that satisfies the consistency condition for tie-breaking).

Of course, such a procedure does not satisfy the consistency condition. It does not even induce a well-defined choice function.

The Tendency to Simplify Decision Problems
Decision makers tend to simplify choice problems, probably as a method of saving deliberation resources. An example of a procedure motivated by the simplification effort is the following:

(P-5) The primitives of the procedure are an ordering \(O\) and a preference relation \(\succeq\) on the set \(A\). Given a decision problem \(A\), pick the first and last elements (by the ordering \(O\)) among the set \(A\) and choose the better alternative (by the preference relation \(\succeq\)) between the two.

In this case, the decision maker does not consider all the elements in \(A\) but only those selected by a predetermined rule. From this sample, he then chooses the \(\succeq\)-best alternative. If the alternatives are \(a, b,\) and \(c\), the preference ranking is \(b \succ a \succ c\), and the ordering \(O\) is alphabetical, then the alternative \(a\) will be chosen from among \(\{a, c\}\) and \(b\) from among \(\{a, b\}\), a choice conflicting with the consistency condition. (Try to verify the plausibility of this procedural motive by examining the method by which you make a choice from a large catalog.)

The Search for Reasons
Choices are often made on the basis of reasons. If the reasons are independent of the choice problem, the fact that the decision maker is motivated by them does not cause any conflict with rationality. Sometimes, however, the reasons are "internal," that is, dependent on the decision problem; in such a case, conflict with rationality is often unavoidable. For example, in the next scheme of decision procedures, the decision maker has in mind a partial ordering, \(D\), defined on \(A\). The interpretation given to \(a \triangleq b\) is that \(a\) "clearly dominates" \(b\). Given a decision problem, \(A\), the decision maker selects an alternative that dominates over more alternatives than does any other alternative in the set \(A\).

(P-6) The primitive is a partial ordering \(D\). Given a problem \(A\), for each alternative \(a \in A\), count the number \(N(a)\) of alternatives in \(A\) that are dominated (according to the partial ordering \(D\)). Select the alternative \(a^*\) so that \(N(a^*) \geq N(a)\) for all \(a \in A\) (and use a rule that satisfies the consistency requirement for tie-breaking).

By (P-6) a reason for choosing an alternative is the "large number of alternatives dominated by the chosen alternative." This is an "internal reason" in the sense that the preference of one alternative over another is determined by the other elements in the set. Of course, (P-6) often does not satisfy the consistency condition.
1.4 Experimental Evidence

Economic theory relies heavily on intuitions and casual observations of real life. However, despite being an economic theorist who rarely approaches data, I have to agree that an understanding of the procedural aspects of decision making should rest on an empirical or experimental exploration of the algorithms of decision. Too many routes diverge from the rational man paradigm, and the input of experimentation may offer some guides for moving onward.

The refutation of the rational man paradigm by experimental evidence is not new. As early as 1955 Simon asserted, “Recent developments in economics . . . have raised great doubts as to whether this schematized model of economic man provides a suitable foundation on which to erect a theory—whether it be a theory of how firms do behave or of how they ‘should’ rationally behave.” Since then, a great deal of additional experimental evidence has been accumulated, mainly by psychologists. Of particular interest is the enormous literature initiated by Daniel Kahneman, Amos Tversky, and their collaborators. We now have a fascinating compilation of experimental data demonstrating the circumstances under which rationality breaks down and other patterns of behavior emerge.

I will briefly dwell on a few examples that seem to me to be especially strong in the sense that they not only demonstrate a deviation from the rational man paradigm, but they also offer clues about where to look for systematic alternatives. The order of the examples parallels that of the discussion in the previous section.

Framing Effects
A rich body of literature has demonstrated circumstances under which the assumption that two logically equivalent alternatives are treated equally, does not hold. A beautiful demonstration of the framing effect is the following experiment taken from Tversky and Kahneman (1986):

Subjects were told that an outbreak of a disease will cause six hundred people to die in the United States. Two mutually exclusive programs, yielding the following results, were considered:

A. two hundred people will be saved.
B. With a probability of 1/3, six hundred people will be saved; with a probability of 2/3, none will be saved.

Another group of subjects were asked to choose between two programs, yielding the results:

C. four hundred people will die.
D. With a probability of 1/3 no one will die; with a probability of 2/3 all six hundred will die.

Although 72 percent of the subjects chose A from [A, B], 78 percent chose D from [C, D]. This occurred in spite of the fact that any reasonable man would say that A and C are identical and B and D are identical! One explanation for this phenomenon is that the description of the choice between A and B in terms of gains prompted risk aversion, whereas the description in terms of losses prompted risk loving.

Framing effects pose the most problematic challenges to the rationality paradigm. Their existence leads to the conclusion that an alternative has to appear in the model with its verbal description. Doing so is a challenging task beyond our reach at the moment.

The Tendency to Simplify a Problem
The following experiment is taken from Tversky and Kahneman (1986). Consider the lotteries A and B. Both involve spinning a roulette wheel. The colors, the prizes, and their probabilities are specified below:
A  Color  white  red  green  yellow  
Probability (%)  90  6  1  3  
Prize ($)  0  45  30  −15  
B  Color  white  red  green  yellow  
Probability (%)  90  7  1  2  
Prize ($)  0  45  −10  −15  

Facing the choice between A and B, about 58 percent of the subjects preferred A.

Now consider the two lotteries C and D:

C  Color  white  red  green  blue  yellow  
Probability (%)  90  6  1  1  2  
Prize ($)  0  45  30  −15  −15  
D  Color  white  red  green  blue  yellow  
Probability (%)  90  6  1  1  2  
Prize ($)  0  45  45  −10  −15  

The lottery D dominates C, and all subjects indeed chose D. However, notice that lottery B is, in all relevant respects, identical to lottery D (red and green in D are combined in B), and that A is the same as C (blue and yellow are combined in A).

What happened? As stated, decision makers try to simplify problems. “Similarity” relations are one of the basic tools they use for this purpose. When comparing A and B, many decision makers went through the following steps:

1. 6 and 7 percent, and likewise 2 and 3 percent, are similar;
2. The data about the probabilities and prizes for the colors white, red, and yellow is more or less the same for A and B, and
3. “Cancel” those components and you are left with comparing a gain of $30 with a loss of $10. This comparison, favoring A, is the decisive factor in determining that the lottery A is preferred to B.

By the way, when I conducted this experiment in class, there were (good!) students who preferred C over D after they preferred A over B. When asked to justify this “strange” choice, they pointed out that C is equivalent to A and D is equivalent to B and referred to their previous choice of A! These students demonstrated another common procedural element of decision making: The choice in one problem is made in relation to decisions made previously in response to other problems.

The Search for Reasons

In the next example (following Huber, Payne, and Puto [1982]), (x, y) represents a holiday package that contains x days in Paris and y days in London, all offered for the same price. All subjects agree that a day in London and a day in Paris are desirable goods. Denote, A = (7, 4), B = (4, 7), C = (6, 3) and D = (3, 6). Some of the subjects were requested to choose between the three packages A, B, and C; others had to choose between A, B, and D. The subjects exhibited a clear tendency to choose A out of the set {A, B, C} and to choose B out of the set {A, B, D}. Obviously, this behavior is not consistent with the behavior of a “rational man.” Given the universal preference of A over C and of B over D, the preferred element out of {A, B} should be chosen from both {A, B, C} and {A, B, D}.

Once again, the beauty of this example is not its contradiction of the rational man paradigm but its demonstration of a procedural element that often appears in decision making. Decision makers look for reasons to prefer A over B. Sometimes, those reasons relate to the decision problem itself. In the current example, “dominating another alternative” is a reason to prefer one alternative over the other. Reasons that involve relationships to other alternatives may therefore conflict with the rational man paradigm.

Another related, striking experiment was conducted by Tversky and Shafir (1992). A subject was shown a list of twelve cards. Each card described one prize. Then the subject was given two cards and asked whether he wanted to pay a certain fee for getting a third
card from the deck. If he did not pay the fee, he had to choose one of the two prizes appearing on the cards in his hand. If he chose to pay the fee, he would have three cards, the two he had originally been dealt and the third he would now draw; he would then have to choose one among the three prizes.

The different configurations of prizes which appeared on the two cards given to the subjects were as follows:

1. Prizes A and B, where A dominates B;
2. Prizes A and C, where A and C are such that neither dominates the other.

A significantly lower percentage of subjects chose to pay the fee in face of (1) than in face of (2). Thus, once the decision maker has an "internal" reason (the domination of one over another alternative) to choose one of the alternatives, he is no longer interested in enriching the set of options. Many subjects, when confronted with conflict while making a choice, were ready to pay a fee for receipt of a reason that would help them to make the choice.

Remark One often hears criticism among economists of the experiments done by psychologists. Critics tend to focus blame on the fact that in the typical experimental design, subjects have no sufficient incentive to make the conduct of the experiment or its results relevant for economics—the rewards given were too small and the subjects were not trained to deal with the problems they faced. I disagree with this criticism for the following reasons:

- The experiments, I feel, simply confirmed solid intuitions originating from our own thought experiments.
- Many of the real-life problems we face entail small rewards and many of our daily decisions are made in the context of nonrecurring situations.
- When considering human behavior regarding "major" decisions, we observe severe conflicts with rationality as well. To illustrate,
assumption of substantive rationality but retain that of procedural rationality.

*Mistakes vs. Bounded Rationality*

Some have claimed that the phenomena demonstrated in the above experiments are uninteresting inasmuch as they express “mistakes” that disappear once the subjects learn of their existence. They contend that economists are not interested in traders who believe that $1 + 1 = 3$; similarly, they should not be interested in agents who are subject to framing affects.

I beg to differ. Labeling behavior as “mistakes” does make the behavior uninteresting. If there are many traders in a market who calculate $1 + 1 = 3$, then their “mistake” may be economically relevant. The fact that behavior may be changed after the subjects have been informed of their “mistakes” is of interest, but so is behavior absent the revelation of mistakes because, in real life, explicit “mistake-identifiers” rarely exist.

*Rationalizing on a Higher Level*

As economists raised on the rational man paradigm, our natural response to the idea of describing a decision maker by starting from a decision procedure is akin to asking the question, “Where does the procedure come from?” One method of rationalizing the use of decision procedures inconsistent with the rational man paradigm is by expanding the context to that of a “richer” decision problem in which additional considerations (such as the cost of deliberation) are taken into account. Under such conditions, one may try to argue that what seems to be irrational is actually rational. In regard to the satisficing procedure (P-2), for example, such a question was asked and answered by Simon himself. Simon proposed a search model with costs in order to derive the use of the procedure and to provide an explanation for the determination of the aspiration value.

This is an interesting research program, but I do not see why we must follow it. Alternatively, we may treat the level of aspiration simply as one parameter of the decision maker’s problem (similar to the coefficient in a Cobb-Douglas utility function in standard consumer theory), a parameter that is not selected by the decision maker but is given among his exogenous characteristics. We should probably view rationality as a property of behavior within the model. The fact that having an aspiration level is justifiable as rational behavior in one model does not mean that we can consider that behavior as rational within any other model.

1.6 Bibliographic Notes

The pioneering works on bounded rationality are those of Herbert Simon. See, for example, Simon (1955, 1956, 1972, and 1976). (About the first two papers Simon wrote: “If I were asked to select just two of my publications in economics for transmission to another galaxy where intelligent life had just been discovered, these are the two I would choose.”) All four papers are reprinted in Simon (1982).

For the foundation of choice theory see, for example, Kreps (1988).

1.7 Projects

1. *Reading* Shafir, Diamond, and Tversky (1997) reports on a “framing effect” in the context of economic decisions in times of inflation. Read the paper and suggest another context in which a similar “framing effect” may influence economic behavior.

2. *Reading* Read Benartzi and Thaler (1995) on the decision of real investors to allocate their investments between stocks and bonds. Consider the following “experiment.” Subjects are split into two groups. At each of the two periods of the experiment, each subject gets a fixed income that he must invest immediately in stocks and bonds. At the end of the first period, an investor has access to information about that period’s yields. A subject cashes his investments at the end of the second period.

At every period, a member of the first group is asked to allocate only the income he receives that period, whereas a member of the second group is asked to reallocate his entire balance at that point.

Guess the two typical responses. Can such an experiment establish that investors’ behaviors are not compatible with rationality?

3. *Innovative* Choose one of the axiomatizations of decision making under uncertainty (exclude the original expected utility axiomatization) and examine the axiom from a procedural point of view.

2. Modeling Procedural Decision Making

2.1 Motivation

In the previous chapter, I argued that experimental evidence from the psychological literature demonstrates the existence of common procedural elements that are quite distinct from those involved in the rational man’s decision-making mechanism. In this chapter, we turn to a discussion of attempts to model formally some of these elements.

Note that when we model procedural aspects of decision making, we are not necessarily aiming at the construction of models of choice that are incompatible with rationality. Our research program is to model formally procedures of choice that exhibit a certain procedural element, and then to investigate whether or not such procedures are compatible with rationality. If they are, we will try to identify restrictions on the space of preferences that are compatible with those procedures.

We now return to a motive we mentioned in Chapter 1: Decision makers attempt to simplify decision problems. For simplicity, let us focus on choice problems that contain two alternatives, each described as a vector. One way to simplify such a problem is to apply similarity notions in order to “cancel” the components of the two alternatives that are alike, and thereby to reduce the number of elements involved in the descriptions of the two alternatives. This makes the comparison less cumbersome.