Pateicoties šādai "sakrustošanai", algoritms CORA 4.5 atšķirībā no parastā algoritma CORA

1) spēs darboties ar daudzām atribūtu vērtībām, ne tikai binārām;
2) spēs darboties ar nepārtrauktām atribūtu vērtībām;
3) darbosies ar nezināmām atribūtu vērtībām;
4) izmantos *ieguvuma kritēriju* (*gain ratio criterion*) vērtīgāko pazīmju atrašanai.

Atšķirībā no algoritma C4.5 algoritms CORA 4.5, veidojot jēdzienu vispārinājumus, izmantos nevis atsevišķu atribūtu vērtības, bet atribūtu kompleksus jeb pazīmes, kas dziļāk atspoguļo vispārināmās koncepcijas jēgu, tādējādi radot cilvēkam–ekspertam labāk saprotamus secināšanas likumus.

4. Nobeigums

Turpmākajos pētījumos ir paredzēts augstāk minētās teorētiskās idejas realizēt praksē, izveidojot funkcionējošu CORA 4.5 datorprogrammu. Tas dos iespēju empīriski salīdzināt algoritmu CORA 4.5 ar tā priekštečiem – CORA un C4.5, kā arī ar citiem jēdzienu vispārināšanas algoritmiem.

Literatūra

1. Bongard M. (1970). Pattern Recognition, Spartan Books, New York.
2. Quinlan J. R. (1993) C4.5: Programs For Machine Learning. Morgan Kaufmann Publishers.
3. Гладун В. П. (1987). Планирование решений. Киев: Наукова Думка.

ANALYSIS OF THE REASONING LOGIC VIOLATION IN DECISION MAKING
SPRIEDUMU LOĢIKAS PĀRKĀPŠANAS ANALĪZE LĒMUMU PIEŅEMŠANĀ

Oleg Uzhga–Rebrov, Rezekne Higher Educational Instituition, Rezekne, Latvia

Abstract. *This study deals with reasoning logic in decision making. Three major classes of decision making theories are outlined. Possible situations in which preference misrepresentation might take place are analyzed. The reasons for the violation of reasoning logic are examined and possibilities of overcoming it are considered.*

Keywords: *decision making, choice situation, preferences, reasoning logic.*

1. Introduction

Making decisions in any kind of human activity is associated with the evaluation of the outcomes of alternative courses of actions and subjective preferences of the decision maker. Subjective judgements made by human beings can represent actual realities of the external world with different degree of adequacy. Subjective misrepresentation of the real state of things can be due to partialities of various kind. Some kinds of partialities are briefly examined in [Užga–Rebrovs, 2000]. The present paper presents a detailed analysis of the reasons for possible violation of the logic of reasoning in decision making. The paper begins with a brief characteristic of the main classes of the decision making theory. Further sections analyze possible situations in which preference misrepresentation might take place. Based on the analysis, a conclusion is made that the considered reasons for preference misrepresentation cannot make a basis to revise fundamental decision making theories. The existing difficulties

ISBN 9984 - 585 - 36 - 0

can be overcome successfully through a more strict analysis of the initial situations of decision making and the development of additional decision analysis methods so as to take into account the uncertainties of probabilistic evaluations.

2. Analysis of basic decision making theories

Every decision making theory is aimed to develop the rules to choose a decision, optimal in a given sense, from the initial set of alternative decisions. The concept of optimality is related to the preference system of the decision maker in the set of outcomes of alternative decisions.

The whole set of decision making theories can be divided to three large classes: descriptive, normative and prescriptive theories.

A *descriptive theory* tries to describe the world as it is. Its quality is determined by the space over which it accurately characterizes and predicts the behavior of real–world systems. All the theories describing the physical behavior of natural systems are descriptive. The role of descriptive theories in decision making processes is, however, rather limited. Since decision making is a conscious act, the role of descriptive theories is reduced to the description and analysis of common empirical regularities of human being behavior in choice situations.

The main role of normative theories is to establish such rules that would lead to a logically validated and consistent choice of decisions. Normative theories are axiomatic. Based on the system of axioms established, theorems and choice rules are produced. The most widespread is the expected utility theory based on the von Neumann–Morgenstern axioms system [von Neumann and Morgenstern, 1953).

Special role in decision making is played by *prescriptive theories*. These theories try to explain how people make decisions on the basis of the normative theory accepted. In general case, conclusions of prescriptive theories have rather inconsistent nature. On the one hand, they aim to approach strict normative theories. On the other hand, a tendency can be seen to lessen the demands of normative theories when applying them to solve specific problems. Should be regarded as successful the definition of Keeney [Keeney, 1996] stating that descriptive theories are different approximation extents of normative theories.

The system of axioms underlying any normative theory is based on the common and consistent logic of human reasoning. However, due to factors either not considered or misinterpreted, the logic of reasoning might be violated. This yields very unpleasant consequences in choosing decisions. In what follows, the factors disturbing the normal choice of decisions are analyzed.

3. Non–taking into account all the initial information

To demonstrate possible violation of the logic of reasoning in decision making, various specific choice tasks were developed. This section examines one problem of this kind, the Allais problem. Various versions of this problem exist. Here a version suggested in [Howard, 1996] is considered. Suppose an individual has the chance to win a large sum of money under the following conditions. According to the toss of a coin he will receive an opportunity to act either in situation A, or in situation B. If the individual gets in situation A, he will choose between two deals, deal D1 and deal D2. Deal D1 is associated with receiving a sure 1,000,000 conditional monetary unit (c.m.u.). With deal D2 the individual will have a 10% chance of winning 5,000,000 c.m.u., an 89% chance of winning 1,000,000 c.m.u., and a 1 percent chance of winning nothing. If the individual is in situation B, he will have to choose between deal D3 and deal D4. Deal D3 has a 10 percent chance of winning 5,000,000 c.m.u., and a 90 percent

ISBN 9984 - 585 - 36 - 0

chance of winning nothing. Deal D4 has an 11 percent chance of receiving 1,000,000 c.m.u. and a 89 percent chance of winning nothing. Figure 1 shows decision trees for the possibilities arising in both choice situations.

Which action courses will the individual choose in both choice situations? It was found empirically that most of individuals prefer deal D1 in situation A and deal D3 in situation B. Such choices can be regarded as validated from the point of view of risk averse individuals. However, from the viewpoint of the expected utility theory (or in a simplified form, on the

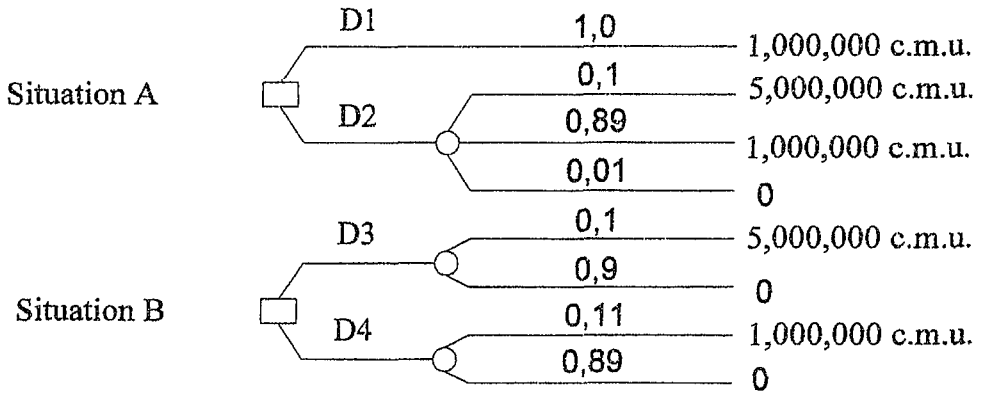

Figure 1. Decision trees representing choice situations in the Allais problem

basis of the expected win maximization) both choices are erroneous. This is because the individuals choose deals given that the choice situation is known. The fact that choosing each situation is a random event is not taken into account. According to any normative decision making theory, the evaluation and choice of actions must be performed on the basis of the complete prior information. A real initial choice situation is presented in Fig.2.

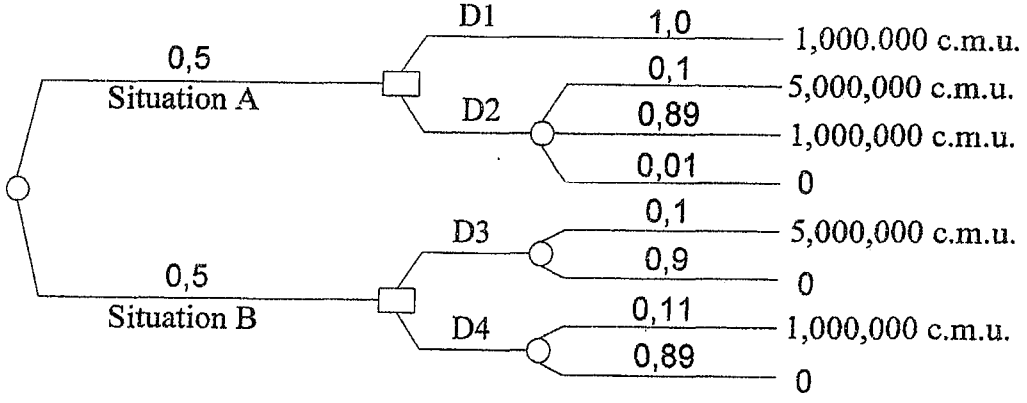

Figure 2. Initial choice situation in the Allais problem

Let us compare in pairs course actions related to different choice situations (see Fig. 3). A simple analysis shows that a pair of deals, D1 and D3, preferred by most individuals gives the same results as a pair of deals, D2 and D4. Common sense let the individuals down because they did not take into account all the initial information.

ISBN 9984 - 585 - 36 - 0

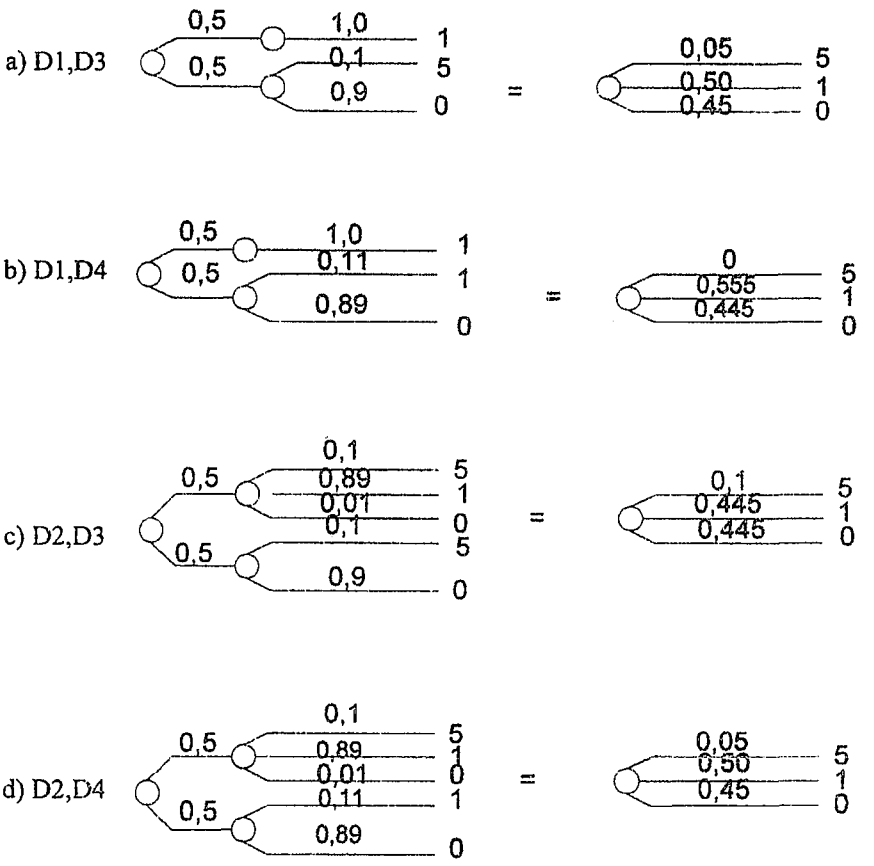

Figure 3. Possible choice strategies in the Allais problem

4. The Ellsberg problem

This famous problem requires people to express preferences for the case when the chances of events are uncertain. An urn B contains 90 balls of which 30 are red and 60 are either blue or yellow. The proportion of balls of each color is unknown. An individual is presented the following choice situation. According to the toss of a coin, one of two choice situations, A or B, is determined. After that a ball is drawn from the urn. The payoff schemes are shown in Fig.4.

Which scheme will the individual prefer in each situation? It was found experimentally that most people prefer to play with payoff schemes A1 and B1. This happens because the proportion of blue and yellow balls in the urn is uncertain.

A strict analysis of the conditions of the task provides very interesting results. Regarding the composition of blue and yellow balls in the urn, different suggestions can be made. For example, it can be assumed that all the balls are blue or all the balls are yellow. It can also be assumed that the number of yellow and blue balls is equal. In the general case it can be shown that any reasonable suggestion about the distribution of blue balls produces the mean number of those balls equal to 30. From this it follows that the probability of a blue ball must be equal to 1/3. Then the probability of a yellow ball is also 1/3.

ISBN 9984 - 585 - 36 - 0

		Ball drawn		
		Red	Blue	Yellow
Situation A	A1	100 c.m.u.	0	0
	A2	0	100 c.m.u.	0

		Ball drawn		
		Red	Blue	Yellow
Situation B	B1	0	100 c.m.u.	100 c.m.u
	B2	100 c.m.u.	0	100 c.m.u.

Figure 4. The payoff schemes in the Ellsberg problem

In many real–world decision making tasks it is frequently conditionally assumed that all these probabilities are equal provided that the probabilities of uncertain events are unknown. This assumption is neither worse and nor better than any other assumption in the case of complete lack of information.

For the task in question, the probabilities of balls of each color turn out to be equal. Hence, the individual must be indifferent between A1 and A2 or B1 and B2. A shift in preferences occurred due to the intuitive aversion of the uncertainty about the chances of the events.

5. The problem of the unbiased decision choice

To understand the essence of this problem, let us consider an illustrative example. Suppose a lady has a unique jewelry collection inherited from her grandmother. She has decided to present it to one of her nieces who are twin sisters. The problem is to decide to whom the present should be given, since they both are equally attractive to her. In the long run, the aunt has made the Solomon decision. She decided to flip a coin to determine a candidate for the present. Was she right committing her choice to the blind fate? From the point of view of impartiality her reasoning logic is irreproachable. However, this is not the case from the viewpoint of the nieces. If the mechanism of choice is unknown to the sisters, one of them will feel unfairly offended.

This random mechanism of choice is frequently employed in real–life situations. For example, a candidate for a vacant position can be chosen with the help of this mechanism. The candidates, however, might oppose it seriously. Let us consider an row example. A burglar determines which of two banks to rob according to the toss of a coin. He may consider his choice correct. However, his choice will fairly be regarded as true from the point of view of the bank robbed.

Summing up all the aspects of this kind of choice, the following conclusion has to be made. The random mechanism of choice not based on the decision maker's preferences cannot be regarded as successful. If the ourcome of the choice somehow touches the interests of individuals, certain ethic and other problems can arise. The decision maker may be given

ISBN 9984 - 585 - 36 - 0

recommendations to incorporate additional evaluation criteria on the basis of which a unambiguous and validated choice can be made.

6. Conclusions

Normative decision choice theories, in particular, the expected utility theory, or expected outcome evaluation theory, have proved their validity in numerous case studies. These theories are based on simple and logically validated axioms. The reasoning logic of rationally thinking people in most cases is subject to the demands of those theories.

Certain violations of reasoning logic can be due to different reasons. Some of the reasons are examined in this paper. The Allais problem illustrates visually where ignoring a part of the initial information could lead. In the Ellsberg problem the preferences of the individual are heavily influenced by the uncertainty regarding the chances of random events. Finally, it should be noted that a special class is made of choice tasks in which the decision maker is indifferent with regard to alternatives.

Attempts to develop alternative normative decision choice theories have been made so as to overcome the above difficulties. These theories, however, suffer from conceptual shortcomings [Sarin, 1996]. The difficulties outlined can be overcome by sufficiently simpler techniques. Say in order to avoid the choice situation similar to that considered in the Allais problem, one has to properly account for all the factors of the problem. This is quite a simple task for the experienced analyst.

As regards the uncertainty of the probabilistic evaluations, it cannot be avoided in principle provided the necessary information is missing or is incomplete. It can, however, be concerned correctly with the help of the suitable choice function. Two prescriptive approaches of this kind are examined in [Sarin, 1996].

If the decision maker is indifferent in choosing the alternatives, the problem is not in the decision making theory but in the decision maker himself. The preferences of the individual can always be shifted towards the unambiguous choice by incorporating additional evaluation factors.

From this it follows that the considered problems cannot be a reason to revise the existing normative decision making theories. It is quite enough with the validated corrections of the theories that are of prescriptive nature.

References

1. Howard R.A. (1996). In Praise of the Old Time Religion. Utility Theories: Measurements and Applications. Kluwer Academic Publishers, Boston/ Dordrecht/ London, pp. 27 – 56.
2. Keeney R.L. (1996). On the Foundation of Prescriptive Decision Analysis. Utility Theories: Measurements and Applications. Kluwer Academic Publishers, Boston/ Dordrecht/ London, pp. 57 – 72.
3. Sarin R.K. (1996). Now for Generalized Utility Theory. Utility Theories: Measurements and Applications. Kluwer Academic Publishers, Boston/ Dordrecht/ London, pp. 137 – 164.
4. Užga–Rebrovs O. (2000). Komerclēmumu analīze. – Rēzekne: RA, 175 lpp. (to be published).
5. Von Neumann J. and Morgenstern O. (1953). Theory of Games and Economic Behavior (3rd ed.), Wiley, New York.

ISBN 9984 - 585 - 36 - 0