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MANAGERIAL DECISION-MAKING IN TRAFFIC

ABSTRACT

Decision-making is defined as a selection of a certain action among several alternatives. It is the essence of planning, as in the managerial sense there is no plan until a decision of engagement of resources, reputation and direction of activities is made. Decision-making is, in fact, only a step in planning, even when it is performed quickly and without special consideration. It is what we all experience every day. It is one of the most fascinating biological activities and the subject of frightening implications for the whole human race. Since various techniques improve the system and the quality of managerial decision-making, they are classified into three assumptions: risk analysis, decision-making trees, and the theory of revealed preference. All of these are based on the interaction of a certain number of important variables out of which many contain the elements of uncertainty, but maybe also high level of probability.

KEY WORDS

managerial decision-making, theory of revealed preference (efficiency), theory of indifference, consistency, transitivity, map of indifference

1. INTRODUCTION

Decision-making is defined as a selection of a certain action among several alternatives. It is the essence of planning, as in the managerial sense there is no plan until a decision of engagement of resources, reputation and direction of activities is made. Up to these values there are only studies and analyses. The traffic (and other) managers sometimes consider decision-making to be the core task since they constantly have to choose what to do, who will do it, when, where and how.

Decision-making is, in fact, only a step in planning, even when it is performed quickly and without special consideration. It is a part of our everyday lives.

Decision-making is at the same time one of the most fascinating biological activities and the subject of frightening implications for the whole human race (C. West Curchman, «Management», tenth edition, p. 199).

All the decisions are made in an environment in which at least some uncertainty is present. The level of uncertainty. Risk is therefore present in every decision-making action. In the situation of certainty people are relatively certain of what will happen when and if they make a certain decision. The information that are considered reliable are available, and the cause-effect relations are known.

In the situation of uncertainty, people have just a poor database, they do not know whether these data are reliable and safe, whether there will be a change of the situation or not. They cannot assess the interactions of various variables.

In order to improve the decision-making process, it is possible to assess the objective probabilities of a certain result by using e.g. mathematical models, through probabilities, based on the empirical, etc. which is the topic of this paper.

2. MANAGERIAL APPROACH TO DECISION-MAKING IN CONDITIONS OF UNCERTAINTY

In the advanced approach to decision-making in traffic (and elsewhere) various techniques improve the quality of decision-making. The most significant include: 1) risk analysis, 2) decision-making tree, and 3) theory of revealed preference.

2.1. Risk analysis

All the decision-makers in traffic (and elsewhere, generally), respecting uncertainty, want to know the size and nature of risk which they take by selecting an action.

In fact, every decision is based on an interaction of a certain number of important variables many of which contain elements of uncertainty, and maybe also quite a high level of probability. Thus, e.g. the justification of launching a new product, transport means (aircraft), can depend on the crucial factors: costs of introducing a new product, costs of production, neces-

sary capital investments, price of the product, scope of the actual market, and share which this product will have on the market.

The managers (of higher levels) in the traffic system are used to accepting greater risks than those at lower levels, since the scope of their activities includes greater elements regarding risk.

The general manager is at the same time the owner of the capital, and is ready to accept greater risk, even up to 75% chance of success, which, of course, is not the case with the managers at lower levels.

In other words, the attitudes towards risk-taking vary with events as well as with people and their positions.

2.2. Decision-making tree

The most convincing decision analysis is the usage of the so-called Decision-making tree. It is usually presented as a "tree" with points representing decision-making, opportunities and probabilities related to different directions that are the subjects of our choice.

Traffic managers have to know whether to install expensive long-lasting equipment in order to insure production at the lowest possible expenditures or to undertake less expensive temporary reconstruction of the existing equipment that will mean higher production costs, but certainly lower capital investments, and will result in smaller loss if the product does not sell as well as expected by the plan.

One thing is certain: decision-making trees and similar decision-making techniques replace the general analyses by concentrating on the important elements of decisions, discover assumptions that are often hidden, confirm the process of making conclusions for making decisions in the conditions of uncertainty.

2.3. Theory of preferences

The theory of preferences or utility is based on the understanding that the attitudes of individuals towards risk differ: some are willing to take only risks smaller than those indicated by the probabilities ("risk-averse persons"), whereas others are willing to take greater risks ("risk-seeking" – "gamblers"). Although the theory is called the "theory of preferences", a more classic name is the "theory of utility". Often the statistical probabilities applied to decision-making rely on the assumption that the decision-maker will follow them. In other words, it would seem reasonable that a person would make a certain decision if there was a 60 percent chance that the decision is right. However, this is not always the case, and since there is a 40 percent risk of making an error an individual might decide not to take such a risk. The traffic managers avoid such risks, mainly since the punishment for making such an error may be severe and may result in the loss of money, reputation and job security.

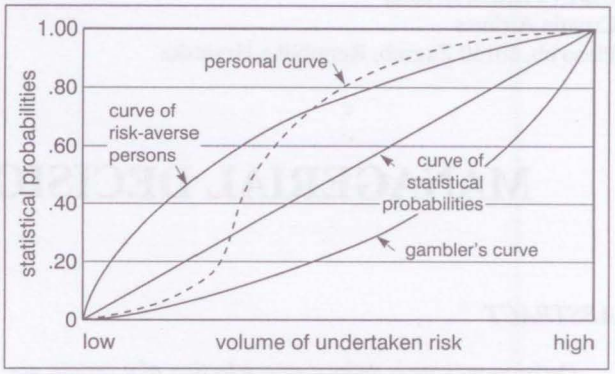

Figure 1 - Preference curve

2.3.1. The basic idea and criteria underlying the theory of revealed preference

One of the key assumptions in the theory of indifference (Latin: indiferens, - entis) uncertain, indifferent, disinterested, unsympathetic), which is the basis of the viability of the assumption about the possibilities of developing a consumer's indifference map, is the assumption about the customers' consistency, i.e. invariability of their tastes and preferences. This assumption is the essence of the theory of revealed preference.

The theory is based on a very simple idea: the customers will make a decision on purchase of a certain combination of items – basket of goods (traffic services) – either because they prefer these over some other service – basket of goods, or because it is less expensive compared to other services – baskets of items. Let us assume that it is known that the consumer prefers to buy basket of goods A and not basket of goods B. This data is not sufficient in order to evaluate whether the consumer prefers A compared to B, since they might not have been able to afford buying the basket of goods B.

Only having the information about the price could we form a more precise opinion. However, only if A is not cheaper than B, and the consumer still prefers to buy A, then it may be concluded that it happens because the consumer likes it more, i.e. has a preference for A rather than for B. In this case it is said that A is a revealed preference compared to B, or that B is revealed inferior to A.

In Figure 2 the points A, B, C and D designate four baskets of goods that represent combinations of various volumes of goods X and Y. All the points on the given limiting budget line PP' designate the baskets of goods that are equally expensive, which means that in this example, the basket of goods A is as expensive as

the basket of goods B. If the consumer's choice was A, then A would be the revealed preference compared to all the other points on the line PP'. Also, C would be revealed inferior to A, since any point below the limiting budget line is revealed inferior compared to the selected point of that line, since they represent less expensive baskets of goods (Figure 3 shows baskets with less expensive goods than A), and logically, any point (such as point D) which lies above the limiting budget line represents a basket of goods more expensive than A and therefore it may be revealed inferior to A.

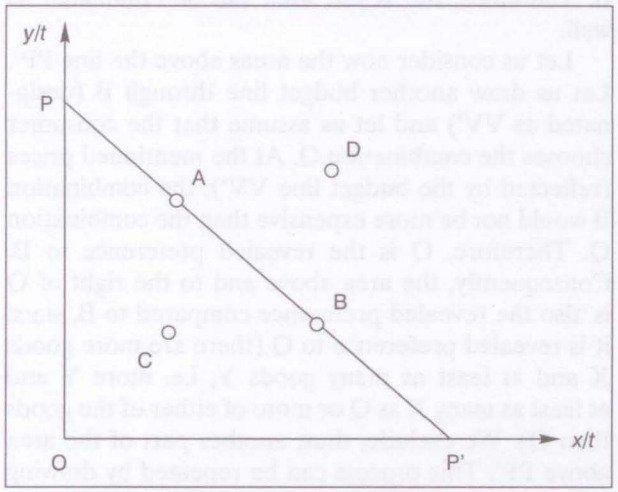

Figure 2 - Indifference as basis for the revealed preference

There are three basic criteria for the theory of revealed preference. They are:

1. **Consistency**

   It is assumed that the consumer will always select the same type of goods at certain prices and income. The consumer will never show such inconsistency to determine first that A is the revealed preference compared to B, and then that B is the revealed preference compared to A. This criterion results from the idea about evaluating the quality through price, since inconsistency may cause an unexpected rise in the price of the B goods, thus rendering B more expensive than A. However, at the given prices and income, it is assumed that when an individual gives preference to one basket of goods over the other, the consumer does not give preference at the same time to the second basket over the first one, i.e. symbolically that A>B implies B>A. Samuelson called this criterion the "weak axiom of consumer's behaviour".

2. **Transitivity**

   It complements in fact the notion of consistency, and on the other hand refers to the mutual position of the initial and final element in a certain series. According to this criterion, it is assumed that if A is the revealed preference compared to B, and B is the revealed preference compared to C, and C is revealed preference compared to D, and thus all the way to Z, then A is the revealed preference compared to the final element in the series (Z). In such cases, Z can never be the revealed preference compared to A.

   This axiom which was called the "strong axiom of consumer's behaviour" has expanded the initial definition of the "revealed preference". It is of special importance in solving the problem of comparing the points located on different limiting budget directions. There are two possibilities, and these are:

   - to find a third point, available to the consumer, which offers the necessary explanation about the required relation between the two points (e.g. point C between points A and B). For instance, if the consumer could have bought C at the level of price and the income, and the consumer actually bought A, and if the consumer bought C, at different condition of price and income, although he could have bought B, it is concluded that A is always the revealed preference compared to C, and C is the revealed preference compared to B, and it may be concluded from this transition relationship that A is always the revealed preference compared to B.
   - the other possibility, if there is no previously described intermediary point, is to find several such points that allow the selection of A rather than of C, C rather than D, ... and finally Z rather than B, assuming that, if such series of points cannot be determined, then according to the earlier definition A is not on the higher curve of indifference than B.

3. **Map of indifference**

   The third basic criterion for this theory is: for any of the mentioned baskets of goods, there is a certain limiting budget trend which makes the consumer select and buy that particular basket.

By applying the mentioned criteria, the consumer's map of indifference can be formed and the consumers' behaviour can be analysed (as believed by the advocates of this theory), freed from excessive assumptions, which in scientific assumptions burdened also the Hick's analysis.

Analogous assumptions can be seen in the traffic system, especially between several buses that are characteristic regarding ergonomic properties, fares, departure times, travelling, arrival times to destinations, and other advantages and drawbacks which characterise the supply and demand of the transport services.

2.3.2. Deriving the consumers' map of indifference

The consumer's map of indifference assumes that the empirically definable volumes of n economic goods are those that a certain individual, faced with prices of these goods and the given level of income, will buy in the unit of time. In Figure 2, the point B designates the combination of goods X and Y that a consumer selected with the limiting budget line PP'. Let us now try to draw a curve of indifference through this point. It is known that B is the revealed preference compared to any point lying on and to the right of B (as point Z) revealed preference compared to B, since there are at least more goods X and at least as many goods Y such as contained in the combination B. Obviously, every such combination (like combination Z) is more expensive than B (at a given pair of prices). Furthermore, the budget line which has made possible the consumer's purchase of combination Z would stretch for the greater or the whole section of its length to the right of the greater part or the whole length of the line PP', which means that every point on or below this budget line is revealed inferior to Z. It follows that B is also revealed inferior to Z, or that Z is revealed preference to B. Therefore, the indifference curve which passes through the point B has to lie below CBD, and above PP'. In extreme cases, this curve will be either a rectangular or a negatively sloped line. The assumption is that the actual form of the indifference curve will be somewhere between these extremes, that is, that it will have the form of a curve declining to the right. Thus, it will be inclined towards the origin, because, were it not convex towards the origin, it would penetrate the OPP' area which has been eliminated.

The next step in the analysis is the gradual narrowing of the space between PP' and CBD, i.e. gradual elimination of certain parts of that area. Point A is obviously revealed inferior compared to B.

In accordance with the third basic criterion (see item 2.1.) it is known that there is a limiting budget line, designated as RR', which makes the consumer prefer to buy the combination A. Any other point on the line or below the budget line RR' is revealed inferior compared to A. It has been determined that A is the revealed inferior point compared to B, and that all the points on or below the line RR' are revealed inferior to B. Thus, the AP'R' area is obtained. Of course, it is possible for the budget line (line KK') to pass through A.

However, this line would enter CBD, which is the revealed preference area compared to B. If the consumer selected the combination A, it would be revealed preference compared to some points from CBD. Nevertheless, the limiting budget line PP' shows that A is revealed inferior to B and that the CBD area is revealed preference to B. This is obviously inconsistent, since the combination A of the line KK' is revealed preference compared to some points from CBD.

Let us look now at the point F on the limiting budget line PP'. Its budget line is UU'. All the points on the line or below UU' are the revealed inferior to F, and F is the revealed inferior to B. Therefore, the PUF area is eliminated. Let us look at point E. Its limiting budget line is TT'. Therefore, any other point on or below TT' is revealed inferior to E, and E is revealed inferior compared to A, and A is revealed inferior to B. Therefore, the R'ET' area can be eliminated as well.

Let us consider now the areas above the line PP'. Let us draw another budget line through B (designated as VV') and let us assume that the consumer chooses the combination Q. At the mentioned prices (reflected by the budget line VV'), the combination B would not be more expensive than the combination Q. Therefore, Q is the revealed preference to B. Consequently, the area above and to the right of Q is also the revealed preference compared to B, since it is revealed preference to Q (there are more goods X and at least as many goods Y, i.e. more Y and at least as many X as Q or more of either of the goods than Q). We exclude, thus, another part of the area above PP'. This process can be repeated by drawing the other budget line, such as line LL', which passes through point B and can analyse the consumer's behaviour in that case. Assuming that the consumer chooses the combination G rather than B, we will find that G has to be revealed preference to B, since at that pair of prices B is not more expensive than G.

Furthermore, the area above and to the right of G is revealed preference to B, since B is the revealed preference compared to G. This makes it possible to

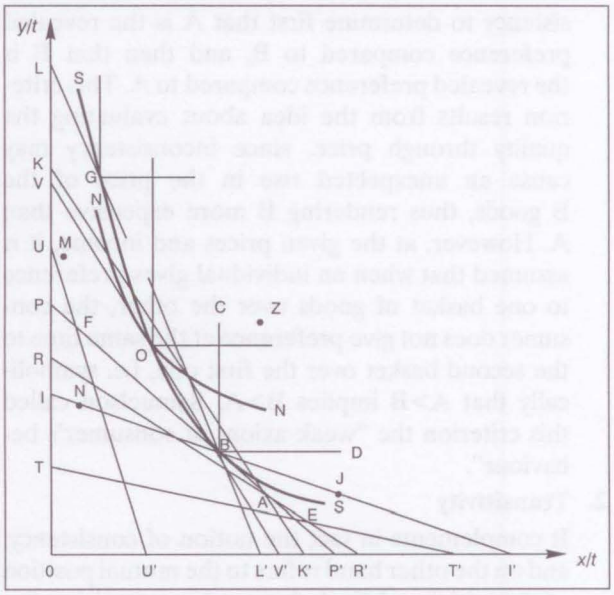

Figure 3 - Consumer's map of indifference[1]

eliminate yet another part of the area above PP' and finally to draw the curve SS which shows that all the points above or to the right of it are the revealed preference to B. Of course, the line LL' can also pass through the point, such as point M, which lies to the left from VV'. Therefore, if combination M were chosen, all the combinations to the right or above it would be revealed preference to M. Therefore, this area may be eliminated as well.

Finally, we can consider point Q on the curve SS and draw through it a series of different limiting lines and then derive curve NN in the same way in which we had derived the curve SS. Each point above or to the right of NN is the revealed preference compared to Q, which is revealed preference in the series compared to B. Thus we find out that all the points above and to the right of NQBS are revealed preference to B. Continuing the procedure, one can eventually obtain a certain required curve of indifference through point B. Thus, with a certain number of repeated analyses of the individual's behaviour on the market, and assuming that the consumer's tastes do not change, as well as that the initially mentioned criteria are valid, a map of the consumer's indifference can be derived and an image obtained about the consumer's scale of preference under certain conditions.

The same or similar methodology can be used to follow the managerial decision-making under the conditions of certainty, uncertainty and risk in concrete activities, such as e.g. traffic, where there is a greater number of indicators with different judgement probabilities.

3. CONCLUSION

Managerial decision-making in traffic is a choice of the orientation of activities; it is the core of traffic planning (and other economic activities). Managers have to select the choice based on limited or restricted rationality. This on the other hand means that they have to make decisions within the frames of their knowledge about the situation.

Since there are always alternatives, the managers have to narrow them down to those few which can deal with the limiting factors. These are the factors which block the path to achieving the desired goal. The alternatives are assessed regarding the quantitative and qualitative factors. Other methods of assessing alternatives include the border analysis and the cost efficiency analysis. During decision-making the techniques based on experience, experiments, research and analysis are used.

Programmed and non-programmed decisions do not differ one from the other. The former are adequate for the structured and routine problems. This type of decisions is usually made by managers at lower levels of organisation and by non-managers.

In the advanced approach to decision-making in traffic (and elsewhere), different techniques improve the quality of decision-making. The most important ones include: a) risk analysis, b) decision-making tree, and c) theory of revealed preference.

Each of them is based on the interaction of a certain number of sustainable variables out of which many contain elements of uncertainty, but also a relatively high level of probability.

The decision-making trees and similar decision--making techniques replace the general judgements by concentrating on the important decision elements, bringing to light the assumptions that are often hidden and discover the decision-making process which is used to make decisions under the conditions of uncertainty.

The theory of preference or utility is based on the understanding that the individual's attitudes towards risk differ: some are willing to take only those risks that are smaller than indicated by the probability, ("risk-averse persons"), and others are willing to take greater risks (e.g. "gamblers").

One of the crucial assumptions in the theory of indifference, which is the basis for the assumption about the possibility of deriving the consumer's map of indifference, is the assumption about the consumer's consistency, i.e. the invariability of consumer's tastes and preferences. This assumption forms the core of the theory of revealed preference.

SAŽETAK

MENADŽERSKO ODLUČIVANJE U PROMETU

Odlučivanje se definira kao odabir izvjesnog smjera djelovanja između više alternativa. Ono je bit planiranja, jer u menadžerskom smislu ne postoji plan sve dok nije donesena odluka o angažiranju resursa, ugleda i smjera djelovanja.

Odlučivanje je zapravo samo korak u planiranju čak i onda kad se odvija brzo i s malo razmišljanja. Ono je dio svakidašnjice svakoga.

To je jedna od najfascinantnijih bioloških aktivnosti i predmet zastrašujućih implikacija po cijelu ljudsku vrstu. Budući da razne tehnike poboljšavaju sustav i kvalitetu menadžerskog odlučivanja, svrstane su u tri postavke i to: analizu rizika, stabla odlučivanja i teoriju otkrivene preferencije. Sve se one baziraju na interakciji nekog broja važnih varijabli od kojih mnoge sadržavaju elemente neizvjesnosti, ali možda i prilično visok stupanj vjerojatnosti.

KLJUČNE RIJEČI

menadžersko odlučivanje, teorija otkrivene preferencije (korisnosti), teorija indiferencije, konzistentnost, tranzitivnost, mapa indiferencije

NOTES

1. P. Samuelson: "A Note on Measurement of Utility", Journal "Review of Economic Studies", pp. 155-161 (according to Z. Pjanić: "Teroija cijena", "Suvremena administracija", publ. Štamp. Književna organizacija, Belgrade, 1986

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