The Application of Utility Theory in the Decision-Making of Marketing Risk Management

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Abstract: In the increasingly competitive and unpredictable business environment, how to control marketing risk to reduce loss is an important issue in the field of marketing research. On the basis of brief description of marketing risk and basic concept of management, this paper analyzes utility, utility function and utility theory, and illustrates the concrete application of utility theory in marketing risk management decision through an example, and explains some possible problems that may exist in practical application. The conclusion is that utility theory has its theoretical value and advantage in marketing risk management decision, but it still needs further development and improvement in practical application.

Keywords: Marketing Risk; Utility Theory; Risk Management; Decision Making

1 Instruction

Marketing activities are the fundamental way for enterprises to fulfill market value and realize operating income. The effectiveness of marketing directly affects the survival and development prospects of enterprises. In the face of complex and ever-changing internal and external environments, corporate marketing activities often face many uncertain problems and challenges[1], especially in the face of uncertain environmental risks, companies have limited ability to identify[2], such as within corporate marketing. The unpredictability of the external environment, the variability of consumer demand, the complexity of the competitive behavior of competitors, etc., the changes in these market factors make the marketing plan and competition strategy formulated by the enterprise relatively lagging behind, thus hindering the marketing activities of the enterprise. Can not continue, the company expects the realization of marketing objectives can not be discussed. Usually, these uncertainties in the market environment and the effects they cause are called risks[3]. In the field of academic research, most scholars use multiple perspectives to study risk. From the marketing level, the probability of causing losses to the enterprise is the marketing risk. Around the beginning of the 1960s, some marketing scholars began to study marketing risks. Mark R. Greene first used the term Marketing Risk in his article "How to Rationalize Management of Marketing Risks." He pointed out that all marketing decisions and marketing plans always have uncertainties or risk factors to some extent. These factors will lead to a reduction in corporate profits or financial losses[4]. Marketing risk is common to any enterprise. If the company does not take necessary measures in the marketing process, such as the general theory and method of risk identification, quantitative assessment and economic evaluation technology, the marketing risk is effectively prevented. Strong management and control will inevitably have an adverse impact on the realization of corporate marketing objectives[5], which will affect the smooth development of corporate marketing activities and threaten the survival and

development of enterprises. Therefore, in the process of enterprise marketing, it is necessary to estimate the nature and size of risks and take necessary measures to strengthen risk prevention and control.

2 Marketing Risk Management

The intensity of competition in today's market activities has gradually increased, and unpredictable factors in the business environment have emerged in an endless stream. Strengthening the management of marketing risks has been recognized by both industry and academia. Marketing risk management has been paid more and more attention by experts and scholars, and has become a very important research topic in the industry. At present, the theoretical research on marketing risk management by domestic and foreign scholars mainly focuses on the concept of marketing risk, the identification of marketing risk, the evaluation of marketing risk, and the handling of marketing risk[6]. The research of marketing risk management originates from the concept of risk management, and the essence of risk is a kind of uncertainty, and this kind of uncertainty has obvious two-sidedness, which may not only bring losses to the enterprise, but also bring it to the enterprise. High unexpected income[7], that is, risk compensation. The objective existence of risk compensation in marketing activities is to continuously attract more people to brave the "sea" to test the water and the waves. The ultimate goal of enterprises to strengthen marketing activities management is also to control the probability of success in obtaining the largest profit income with the least cost. Therefore, the core of the entire marketing risk management is marketing risk management decision-making. Specifically, under the condition that the decision-making environment is not completely determined, but the probability of marketing risk events is known, based on the scientific analysis of marketing risks, based on marketing risks. The purpose and procedures of management, the rational selection of technical tools for marketing risk management, and the final determination of the overall plan for dealing with marketing risks. However, traditional decision-making techniques ignore the key subjective factors of decision-makers' differences in risk attitudes when making decisions in a risk environment. Because different people may make different choices even in the face of the same risk environment. Therefore, it is attempted to link traditional decision-making techniques with utility theory organically to analyze decision-makers' decision-making psychology and behavior, and to help decision-makers make more scientific and rational decisions in a risk environment.

3 Risk preference characteristics and utility theory

3.1 Risk preference characteristics

In marketing activities, managers at all levels of the company face a variety of risks. Based on the different attitudes of decision makers to risk, even in the face of the same risk environment, it is possible to make different or even the opposite decision. Risk attitude is a mental state based on the uncertainty of positive or negative influence on target selection[8], which is the responder's choice of important uncertainty perception, so it is also called risk preference characteristics. In general, people's attitudes toward risk can be roughly divided into three categories. The first category is Risk Lover, who are more inclined to get the expected income in risk, rather than the expected income of risk. They think that the expected utility of risk itself is lower than the expected value[9], and thus the income The response is more sensitive and the response to the loss is slower. In order to obtain higher returns, it is

more willing to take more risks. For the general benefit, they are usually willing to pay the cost lower than the expected value of the loss as the cost of transferring the risk, that is, reducing Loss is equivalent to increasing revenue. The second category is risk neutrals (Risk Neutral). Unlike risk enthusiasts, they do not actively pursue or avoid risks. Regardless of the risk situation, the expected return is the only standard for their choice of assets[10]. Unless the calculated expected return matches the risk, it is unwilling to take the risk, because all assets with the same expected return will give them the same effect, and the utility function of such people has linear characteristics, therefore, the choice The action plan can be fully based on maximization of utility. The third category is Risk Averse. They choose the attitude of assets as opposed to risk enthusiasts. When the expected rate of return is the same, they tend to have low-risk assets. When the risks are the same, they choose high-yield. assets. They respond more to losses than to earnings, preferring to pay more than the expected loss to transfer risk.

From this we can conclude that if the decision maker is a risk-neutral, the expectation criterion can be used for decision making; and the risk averse and risk enthusiasts are suitable to use their utility value as the decision criterion. The utility curve for the three risk attitudes is shown in Figure 1 below:

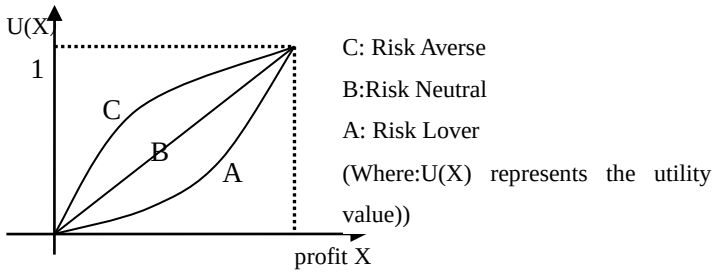

Figure1：Utility curve for three risk attitudes

3.2 Utility Theory and Utility Functions

Utility Theory, also known as consumer behavior theory, was first proposed in 1736 by the famous Swiss mathematician Daniel Bernoulli in the 18th century to analyze the attitudes of decision makers in dealing with risks, that is, to study the consequences of decision-making. An evaluation theory influenced by the decision-maker's psychological choice tendency[11]. Specifically, it can be expressed as: If a person is faced with a decision problem, it must be selected from the known action set A, and the given action consequences are determined by the future natural state S, and the probability of future state occurrence P(S) Knowing or being able to estimate, he must choose the action that will produce the most efficient value. The implicit assumption is that there is a numerical function U on the consequence set X, which represents the decision maker's preference structure[12]. Since then, John.Von Neumann and Oskar. Morgenstern have argued in the book "Theory of Games and Economic Behavior" in 1944 that only the values of decision makers are consistent with "rationality." The assumption of "people", the utility function on action set A will exist.

In view of this, they put forward a new utility point of view - the system's axiomatized expectation utility theory, which holds that when decision makers face any risk decision, they will give subjective utility to each option. This means that after weighing the benefits, losses, advantages and disadvantages, gains and losses of each option, the plan with the highest subjective utility value will be selected by the decision maker. Obviously, decision makers integrate subjective and subjective utility values in a linear combination, and then select the action plan with the most subjective expected utility value[13]. At the same time, they give a standard measure of the utility function and the utility value to set the utility

value for each result of the decision. Among them, the expected utility of the decision is represented by the following function:

$$E[U(X)]= P_1U(x_1) + P_2U(x_2)+\ldots\ldots+ P_nU(x_n) = \sum_{i=1}^{n} P_iU(x_i) \quad \text{（Formula 1）}$$

In the above formula (1), E[U(X)] is the expected utility of the decision; x_1、x_2 … x_n is the possible outcome of the decision; $U(x_i)$ the utility of the possible outcome of the decision; P_n the corresponding probability of the possible outcome of the decision.

3.3 Utility and utility curves

Utility is a kind of subjective psychological feeling and evaluation of people. It is the unique interest, feeling or trade-off response of decision makers to the expected and expected losses of specific risk events. It can reflect the decision-makers' specific risk events in risk management decisions. Attitude is the performance of decision makers' courage[7]. The measure of utility is called utility value or utility. Generally, the utility index quantifies some qualitatively difficult things that are difficult to quantify, so as to distinguish them. The value of the value is only a relative concept. The value of the utility value ranges between 0 and 1, that is, $0 \leq U \leq 1$. For several outcomes that may arise with a decision problem, if the decision makers think that they are not different, they are considered to have the same utility value[14].

In management problem decisions, different decision makers may often assign different utility values to the same expected profit and loss value due to differences in personal economic conditions, personality temperament, and risk appetite. Therefore, in order to apply utility theory in decision-making, each decision maker's different utility value assignment criteria can be described in the form of a function. Considering the influence of the magnitude of the risk, the utility value can be determined for each possible outcome. The relationship between the choice and the choice forms a utility value function. In the Cartesian coordinate system, the utility curve is formed by plotting the expected benefit loss value on the horizontal axis and the utility value as the vertical axis, and plotting the utility value function[15]. Since utility theory is a qualitative decision theory that reflects the personal psychology and behavior of decision makers, the test and response of decision makers' individual subjective will is the specific performance of their qualitative analysis[16]. Usually, the utility value of the decision maker can be obtained by means of inquiry, questionnaire or psychological test. Assume that only A1 and A2 schemes are available for decision makers to choose. Among them, A1 means that the decision maker can obtain a return R without taking any risk; A2 means that the decision maker can obtain the income S with probability P, or by probability (1) -P) Loss of vested earnings T, and T > R > S. Let U(S), U(R), and U(T) be the utility values of S, R, and T, respectively. If the decision maker judges the utility of the two schemes A1 and A2 according to their own expectations, the utility function can be expressed as:

$$P*U(S)+(1-P)*U(T)=U(R)$$

Set the values of P, S, and T, and repeatedly ask the decision makers, “When you take the value of R, do you think that the schemes A1 and A2 are equivalent?” and so on, you can mark them in the Cartesian coordinate system. The utility value of these gains or losses, and then connecting these points with a smooth curve (or surface), can draw a utility curve that reflects the decision maker's expectations.

4 Feasibility of applying utility theory in marketing decision

Marketing risk management decisions are a typical risk-based decision. Even if the same amount of gains and losses, due to different time and space, or the subjective psychology of different decision makers, will produce different amounts of recognition results, so from a theoretical perspective, the effect theory can be used to analyze all risk-based investment decisions.

Because of the subjective differences in marketing management decision-makers, such as personal personality, talent, literacy, knowledge structure, etc., different decision makers will have different understandings of the same alternative under the same conditions. The difference directly affects its decision-making behavior, which is also based on the choice of individual expectations.

At the same time, because the environment in which the decision makers are located is objectively different, such as the level of management of the enterprise, the level of the industry and the status of the industry, and the "utility value" of the decision makers on the same alternative decision-making plan. Will produce different assertions.

Because of the above differences, utility theory can be applied to marketing risk management decisions to guide decision makers in risk or uncertainty. Of course, whether this decision-making behavior is scientific and reasonable is necessary for further analysis and research.

5 Case analysis

Suppose a company designs two marketing plans for A1 and A2 for its new products. The estimated profit situation is shown in Table 1 below:

Table 1 Marketing plan A1 and expected profit (unit: 10,000 yuan)

Profit	5000	2500	0	-500
Probability	0.15	0.10	0.65	0.10

Table 2 Marketing plan A2 and expected profit (unit: 10,000 yuan)

profit	10000	5000	-500	-800
Probability	0.05	0.20	0.35	0.40

According to the utility function formula, the profit expectations of the above two marketing schemes are:

E(A1)=5000*0.15+2500*0.10+0*0.65+（-500）*0.1=950（10,000 yuan）;

E(A2)=10000*0.05+5000*0.20+（-500）*0.35+（-800）*0.40=1005（10,000 yuan）。

Obviously, according to the expectation criterion, the scheme A2 is superior to the scheme A1.

Let's look at the utility value of the decision maker. Suppose that the utility value of 100 million yuan is 1, and the utility value of -8 million yuan is 0. Using the methods of investigation and psychological testing, or asking questions to decision makers, the value of the decision maker's worthy loss for certain profit and loss is calculated. As shown in Table 3 below.

Table 3 Profit, utility value, probability of each scheme (unit: 10,000 yuan)

Profit	10000	5000	2500	0	-500	-800
Utility value	1	0.75	0.40	0.15	0.10	0
Probability	0.05	0.20	0.10	0.65	0.10	0.40

According to this table, the utility curve of the decision maker can be drawn, as shown in Figure 2 below:

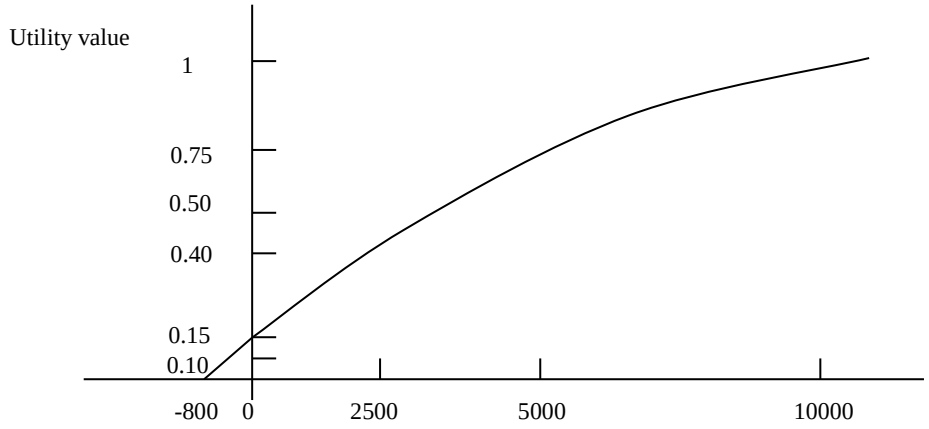

Figure 2: Risk aversive utility curve profit （unit: 10,000 yuan）

The effect function is then calculated using the utility value as a standard.

The utility values for scenarios A1 and A2 are U(A1) and U(A2), respectively:

$$U(A1)=U(5000)*0.15+U(2500)*0.10+U(0)*0.65+U(-500)*0.10$$
$$=0.75*0.15+0.4*0.10+0.15*0.65+0.1*0.1=0.26$$
$$U(A2)=U(10000)*0.05+U(5000)*0.20+U(-500)*0.35+U(-800)*0.40$$
$$=1*0.05+0.75*0.20+0.10*0.35+0*0.4=0.235$$

It can be seen from the utility curve and the expected effect value that this decision maker belongs to the risk aversive. Therefore, with the utility value as the criterion, the plan A1 should be selected in this marketing plan.

6 Conclusion

Based on the above analysis, due to the full consideration of different decision makers' attitudes towards risk based on personal factors such as personality and status, the use of utility theory in marketing risk management is indeed an incomparable advantage of other decision-making techniques. However, due to the application of utility theory for decision analysis, some basic premise needs to be considered, such as the Nobel Prize winner in economics, American management scientist, economist, economic organization decision management master Herbert Alexander Simon in his book "The Cornerstone of Modern Decision Theory" In the conception, the theoretical model of subjective utility is a beautiful work that should occupy a prominent position in the Plato spiritual paradise. However, it is necessary to use it to make practical decisions locally, but it faces many insurmountable difficulties. It is impossible."[17] He pointed out that subjective expectation utility has four basic assumptions: utility function based on cardinal utility theory, complete decision-making alternatives, and each decision alternative in the future possible state The probability distribution, and a strategy that maximizes the expected utility value, obviously, these preconditions are not easy to satisfy in real marketing management. In addition, the personal risk attitude will also be affected by external environmental factors, and the establishment of the utility function will be too difficult. Of course, these do not prevent the utility theory from its incomparable advantages, whether it is in the risk decision of a simple project or in the risk decision of a complex project, or in a large-scale risk decision-making project or a small-scale risk decision-making project. It is true that only in the actual decision-making process, the continuous use and revision in practice, the utility theory can be continuously developed and improved.

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