Study based on "Situational Rationality" hypothesis for

customer market classification model[∗]

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Abstract: The traditional market segmentation was based on "transcendental rationality" or "Situational Rationality", studies shows that it had disadvantages. This paper states the "Situational" integrated rationality hypothesis and then comes up with the market segmenting models and classification algorithm basing on this hypothesis. This algorithm combined the Rough Set theory and Neural Networks in application, which overcome the dilemma that caused complicated network structure and long training time by only using Neural Networks and influenced the classification precision caused by noise disturbance by only using Rough Set methods. Finally, the paper did a comparison experiment between the traditional method and the method we came up, the results shows that the model and algorithm has its advantage on every aspects.

Key words: segmenting; Situational Rationality; Rough Set; Neural Networks

1. Introduction

Generally speaking, any companies who what to do business in a wide open market can not offer the best product or service for all the customers in the market. It is because that the customers are numerous, the distribution is wide and their needs are different. Under this circumstance, some companies would like to do business for a certain customer market in order to get the advantage market position. So if a company wants to get competitive advantage, it should identify the most attractive segment market that he can serve but not compete everywhere.

Since Segmenting theory was put forward firstly by American marketing expert Wendell. Smith in 1956 (Wendell. R. Smith, 1956), the core of modern marketing can be called as STP marketing (Philip Kotler, 2001), which are Segmenting, Targeting and Positioning. So segmenting is always the focus problem that the marketing experts and company managers cared for more than half century. There are two study views of segmenting now (Tony Lunn, 1986), and it becomes two different schools. One is consumer-oriented segmenting, and it is adopted by the theory study. The other school is product-oriented segmenting, and it is adopted by the marketing managers who making the decisions. The research focus of consumer-oriented segmenting is classifying the needs and

behavior characteristic of consumer, and the consumer is grouped by the standard of general customer characteristic, the experts mainly use the analysis method to segmenting the consumers from three different aspects that are individual psychology (including perceive, acknowledgement, motive personality and preference), social and cultural environment and behavior decision-making process. Product-oriented segmenting is classifying the consumer by different marketing target and the special consumption situation of the product and the classifying index are service rate, pursuing benefit and so on.

These two different study views showed that the marketing theory and practice is separated. Consumer-oriented segmenting is emphasizing the theory study, although it can help the managers understanding the psychological reason behind the consumer's behavior, it is short of the tools or methods that looking into the motivation of the consumer behavior, and the practicality are not good in the marketing practice. Product-oriented segmenting can solve some marketing problems, but it can not explain the deeper requirement motivation of consuming attitude and purchasing behavior that got by the statistics and the psychological changing rules in the future, and it can not predict the future changes of the consumer's behavior so the results can not provide effective proof for the mid long term marketing decision and it also can not adapt the marketing competitive trend of "customer life-long" in the modern society. The problems above are just the problems this paper solved by the combination of Rough Set and neutral network method.

The research documents of customer market segmenting are focused on three aspects: The first one is the hypothetical study of consuming behavior, the second is the study of segmenting index selection and the third one is the algorithm study of segmenting models. The study content of this paper covered all the three aspects and the structure of this paper is studying the hypothesis of consuming behavior. It put forward an integrated hypothesis based on the traditional study that is "Situational-Rationality" hypothesis in the first part. This paper studies the segmenting standard selecting problem in the second part and it approves and adapts the "Personal-Situational" segmenting standard by Peter R. Dickson, this paper studies the algorithm of the segmenting models and puts forward the segmenting models based on the "Situational-Rationality" integrated hypothesis and "Personal-Situational" integrated segmenting standard and the neural network customer classifier that installed the Rough Set sub-system in the third part. In the fourth part a real case was applied on the model and the algorithm and the comparison experiment was carried. It is the study conclusion at last.

2. "Situational Rationality" hypothesis

Concern to the fundamental theory problem of the functional mechanism between congenital characteristic and acquired psychology, the systematical research framework and positive conclusion has not been put forward by the academic circles. So when the researchers select the segmenting models to carry out the marketing decision, they always make out prior relational hypothesis for the consumer characteristic and the probably marketing reaction, and the hypothesis is always regarded as the standard of the segmenting index and description variable. Wilkie and Cohen divided the segmenting variables into five different layers from the view of behavioral science which are personal general characteristics such as gender, age, profession, income and so on, psychological graphics, customer value, brand value and purchasing behavior Wilkie, William L. & Joel B. Cohen, 1977. Schiffman divided the current segmenting standard and variables into eight aspects which are geographic segmenting, population segmenting, social culture segmenting, usage segmenting, using situation segmenting, and benefit segmenting (Leon G. Schiffman & Leslie Lazar Kanuk, 1995). Further researching the segmenting

standard, we can find that they all established on the basis of "prior hypothesis". The first hypothesis is the "subjective prior rational" hypothesis of consumption, this hypothesis mainly divided the consumers from three different aspects which are personal psychology, social cultural environment and behavioral decision-making process (ZHANG Hong-ji & SANG Yin-feng, 2002), for example, the higher education and income he has, the higher the possibility of buying new product for him. The higher his hierarchy he is, the more shops he will visit and brands he will change. The other one is "objective prior rational" hypothesis, it thinks that the purchasing behavior is decided by the factors of the product, such as the four main factors, product, price, placement and promotion, so it always segments the customer market by the product. The product-oriented market segment is just segmenting the customers from the certain consumption situation and the marketing target, the segmenting variables including the usage of the produce or brand, the pursuing benefit and so on. The further research shows that the first hypothesis is adopted by the theory circles and the other hypothesis is adopted by the practitioners.

The experience of real management world shows that the factors that influencing the consumer decision are in many ways, life modality is a stable psychological behavior model in one period and it centralized reflect the comprehensive effect of the internal and external factors for the customers.

This paper proposed the "Situational Rationality" hypothesis, and it assumes that the customer is the rational consumer that pursuing the maximum of subjective and objective satisfaction, but the satisfaction is determined by the specific consumption situation. This hypothesis requires us to consider both the subjective and the objective factors when selecting the segmenting variables, meanwhile, the unity of the factors is called "situation". For example, the English exulted when entering the huge Chinese market after the Opium War. The Manchester businessman who was in the center city of the textile believed that there were 400 million people in China, if 100 million of them use the nightcap and two for each year when sleeping, all the production the Manchester textile factories produced day and night were still not enough. So a lot of foreign cloths were shipped to China. However, the Chinese did not have the "situation", the unity of subjective and objective, their clothes were also produced by the local silk or cloths, the foreign cloths can not be sold out at all.

The further research for the documents found that the segmenting standard based on the "Situational Rationality" had been proposed by Peter R. Dickson (1982), but he can not put forward the problem of segmenting algorithm, so he can not do any further research and the hypothesis can not be applied.

3. The choice of the market segmenting standard

How to select the market segmenting standard and define the descriptive variables of segmenting market is a problem that the segmenting model should solve. The research emphasis of segmenting model in theory went through the variation phase listed in the Table 1 below.

Table 1　The development of market segmenting standard model

Research period	Segmenting standard	Studding content
Early stage	Consumer's external character	Nature, geography, population statistic
Middle stage	Consumer's psychological difference	Personal psychology school, cognitive psychology school, the education, hierarchy marriage, family and other social background
Later	Consumer's behavior segmenting	The situation of purchasing

In the practical world, managers always adopt the models by task-oriented. In 1984, Ian Fenwick and John A. Quelch concluded it into Table 2 below.
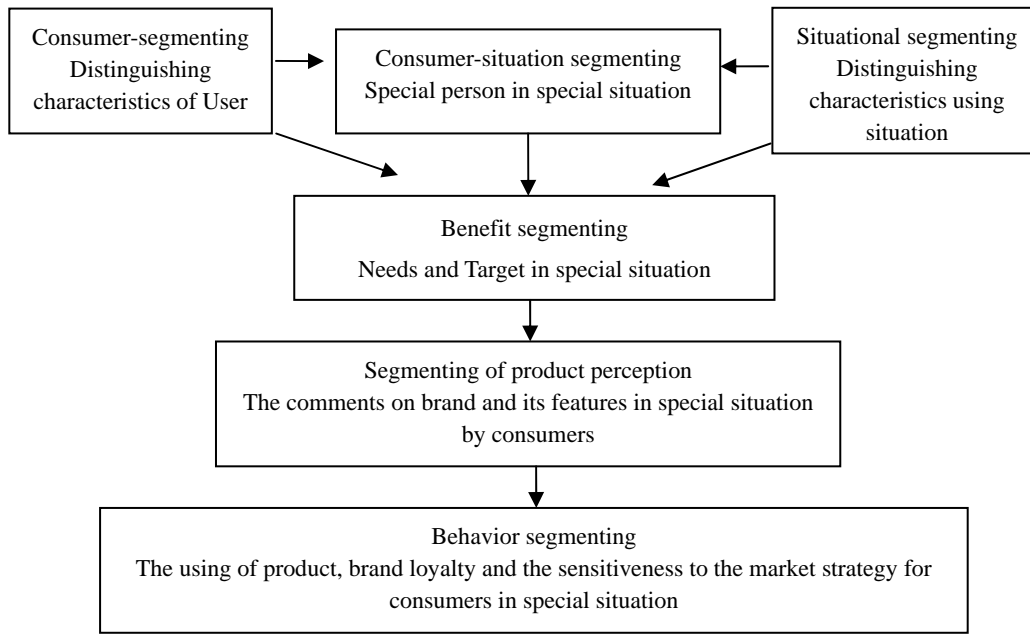
Table 2   The selecting model of management task and segmenting standard

Management task	Segmenting standard
Investigate the survey of the market	Variables: benefit, the purchasing and using ways of product, need, brand loyalty and changing models Standard: the mixing of the above variables
Positioning study	Variables: the using, preference and pursuing benefit of product Standard: the mixing of the above variables
Introduction of new product	The reaction of the concept of the new product, the pursuing benefit
The decision of pricing	The sensitiveness of the price, the preference of the sales, the sensitiveness of different using or purchasing ways
The decision of AD	Variables: the pursuing benefit, the using of the media, psychology description and life modality Standard: the mixing of the above variables
The decision of distribution	The loyalty to the shop, the benefit the shop pursued

Source: Consumer behavior for marketing managers, Ian Fenwick, John A. Quelch, Allyn and Bacon, Inc., 1984, pp. 219-243.

Although the segmenting standard used by the theory research can help the managers understanding the psychological reason behind the consumer's behavior, it is short of the tools or methods that looking into the motivation of the consumer behavior, and the practicality are not good in the marketing practice. The management-task-oriented segmenting standard model obeyed the expedient strategy. It is a segmenting standard developed for the different marketing tasks. It seems to be practical but there is a hiding applying hypothesis that is the marketing is the linear-combination of the strategy decision factors such as positioning, development of new product, AD, pricing, placement and so on, and the factors are separated. Actually, as the value carrier between manufacturer and consumer, all the marketing tools affect the consumers as an entirety and consumers make their purchasing decision through the whole feeling and integrated value that showed by the stimulation of marketing activity (Thedore Levitt, 1980). So there is an essential misunderstanding existing in the application of the management-task-oriented segmenting standard model, it can not make systematical analysis on the features that showed by the consumer such as price decision-making, media custom, product function preference and purchasing way. So the marketing segmenting method lack coherence and coordination and it reduced the integrated efficiency of the marketing strategy. It just go against the original purpose of market segmenting that is focusing the limited resource to provide the differential service for the certain customers.

Peter R. Dickson noticed the problems above and he came up a framework called "person-situation" integrated segmenting model, it is showed in the Fig. 1 below. Its disadvantage is that he didn't solve the algorithm problem based on this framework. Dickson believed that the action characteristics of person and situation is the highest segmenting standard, it determined the lower segmenting standard such as benefit segmenting, behavior segmenting and so on, it is the integration of the lower segmenting information. The market segmenting of product development, package design, placement and promotion should choose the situation segmenting model or "person-situation" segmenting model. These segmenting models has the logical coherence with the "subjective and objective rationality" integrated hypothesis this paper put forward, so this paper agreed with and adopted the segmenting standard by Peter R. Dickson. The most important problem is that it is quite difficult to design the segmenting model and the algorithm based on this hypothesis and it is also the reason why Dickson can not do the further research. If the model and algorithm based on this hypothesis can be solved, it can not only make the basis of the hypothesis stronger, but also it can break the separation situation that the theory and the practice world have had.

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┌─────────────────────┐                                              ┌─────────────────────┐
│ Consumer-segmenting │      ┌──────────────────────────────┐        │ Situational segmenting │
│ Distinguishing      │ ───▶ │ Consumer-situation segmenting │ ◀───  │ Distinguishing       │
│ characteristics of User │  │ Special person in special situation │  │ characteristics using │
└─────────────────────┘      └──────────────────────────────┘        │ situation            │
                                                                      └─────────────────────┘

                             ┌──────────────────────────────┐
                             │ Benefit segmenting           │
                             │ Needs and Target in special situation │
                             └──────────────────────────────┘

                             ┌──────────────────────────────┐
                             │ Segmenting of product perception │
                             │ The comments on brand and its features in special situation │
                             │ by consumers                 │
                             └──────────────────────────────┘

                             ┌──────────────────────────────┐
                             │ Behavior segmenting          │
                             │ The using of product, brand loyalty and the sensitiveness to the market strategy for │
                             │ consumers in special situation │
                             └──────────────────────────────┘
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Fig. 1   Framework of "person-situation" integrated segmenting hypothesis

Source: P. R. Dickson. *Person n situation: Segmentation's missing link, consumer behavior for marketing managers*. Allyn and Bacon, Inc., Newton Massachusetts, 1984, 254-263.

4. The establishment of the model and the design of the algorithm

Summarizing the documents we had, there are several segmenting methods below in the Table 3.

Table 3   The summary of market segmenting methods

Segmenting methods	Theory basis	Introduction
Prior segmenting	Consumer behavior model	The final result of the customer segmenting is depended on the qualitative analysis on the consumer behavior.
Afterwards segmenting	Probability statistical method	Taking the psychological description features and the behavior features as the mixing segmenting variables, using the factor analysis to reduce the dimensions and then using the cluster analysis to get the segmenting group result.
Adaptive segmenting	Conjoint analysis of statistics Computer simulation	Adjusting the consumer selective behavior data in order to get the better segmenting model (Green & Yoram Wind, 1975), including the artificial Neural Networks, fuzzy and overlapping clustering and so on (Neal, William P. & John Wurst, 2001; Wedal, Michel & Wagwr Kamakura, 2000)

We believed that the prior segmenting algorithm is suitable for the "subjective rationality" hypothesis, the afterwards segmenting is suitable for the "Situational Rationality" hypothesis and the adaptive segmenting algorithm is suitable for the "subjective and Situational Rationality" hypothesis, but the segmenting standard based on the "personal-situational" integrated segmenting model should consider many influence factors so the traditional adaptive segmenting algorithm will be less accurate and the calculating time will be much longer. Any more, the traditional customer segmenting methods are almost based on the static descriptive data like demographics and life habits (Hammond K., Ehrenberg A. S. C. & Goodhardt G. J., 1996), for example, using the artificial Neural Networks clustering methods to analyze the relationship between customer category and the data of demographics (Natter M., 1999), and then applying the data of demographics to identify the potential customers

in order to help the company determine the marketing target (CHOU P. B., Grosman E., Gunopulosd, et al, 2000). Once, this method is widely applied, but it has many problems itself. Firstly, the customer has its individualism, so the customers who have the same characteristic in demographics may have the totally different purchasing behavior. Secondly, it is difficult to collect the customers' data because it is always regarded as the private information. This paper proposed the integrated method of Rough Set and Neural Networks to solve the first problem and use the data mining to solve the second problem. Currently, data mining techniques is widely applied in Customer Relationship Management (CRM), and it is build up on the CRM dynamic database so it can solve the problem of static data. The integration of Rough Set and Neural Networks can solve the problem of adaptive segmenting algorithm.

As the important algorithm for calculating the uncertainty, Rough Set theory and BP Neural Networks have lot of advantage in common. For example, they can deal with the uncertain and inaccurate information, they are independent of mathematical models so the input and output are not described by the mathematical function and they are learning based on the samples.

The using way of samples and express way of input and output relationship for samples are the mainly difference of Rough Set theory and BP Neural Networks. BP Neural Networks is a non-linear dynamic system, its correlative information of input and output is stored at the collection weight, but the correlative information of input and output is stored at the decision tables. The relationship mapping of input and output for BP neural network is non-linear mapping based on the data sample, but the Rough Set theory is to establish mapping relationship between condition attribute C and decision attribute D. The calculation of BP Neural Networks includes plus, multiply and exponential operation, its computation is large and the training time is long, sometimes the learning method can not be convergent. The computation of Rough Set is small and the calculation is just comparison and logical operation. When applying the Rough Set theory, the reduction is sensitive to the noise of object of decision tables, but the BP Neural Networks can adapt the noise of the learning sample.

Concern to the above, Neural Networks has good fault-tolerance property and extensibility, and it is widely applied in practice, but Neural Networks can't determine whether the knowledge is redundant or useful. When the sample data is large the requirement for Neural Networks is increased, so the scale of Neural Networks is large and the training time is too long that influenced the practicality of Neural Networks. Rough set theory can define the dependent relationship of condition attribute and decision attribute, so the dimensions is largely reduced.

The Fig. 2 below shows the integrated method of the Neural Networks and the Rough Set. According to the picture, we can see the great advantages we had talked below clearly.
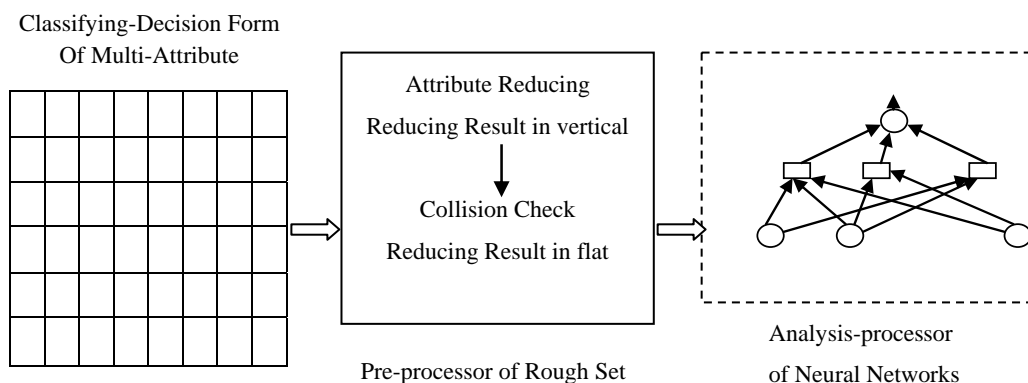
Fig. 2　Integrated model based on the rough set and Neural Network

This paper used the Rough Set method to preprocess the data, which is building up the Rough Set-Neural Network system, and it took the Rough Set as the prior system for Neural Network and integrated the two methods together. The advantage of the Rough Set-Neural Network system is that it can use the Rough Set theory to reduce the attribute and delete the redundant data, and then the neural network methods can classify the data which processed by the Rough Set.

This paper also did a comparative test for both the neural network method and the Rough Set-Neural Network integrated method by using the real case.

5. Case study

5.1 Data collection

An insurance company wanted to promote a life insurance to its customers, and one task is to hand out the guidelines of insurance which cost several dollars. If the company delivers the guidelines to all the customers, it must cost a lot of money and resource. If the company can deliver the guidelines to the customers who have large possibility to accept the life insurance, and do not deliver the guidelines to the customers who are not possible to accept the life insurance, it will save a lot of money and also improve the efficiency and the effect. So the company prepare to classify the customers in order to find the customers who are willing to accept the life insurance and instruct the marketing employees in the market development.

The factors that influence the customers are mainly coming from subjective and objective factors, but the specific factors for each company is different. When selecting the attribute of the relative questions, the specific situation must be considered. According to the experience, we selected six attributes as the condition attributes, they are: (1) Watch promotion, whether the customers have accepted the watch promotion by the insurance company before. (2) Magazine promotion, whether the customers have accepted the magazine promotion by the insurance company before. (3) Credit insurance: whether the customers have the credit insurance. (4) Gender: the customer's gender. (5) Income: the income of the customer. (6) Age: the age of the customers. The first three attributes reflect the subjective factors and the last three reflect the situational factors.

Selecting eight data as example (Table 4):

Table 4   The related data of the case

No.	Watch Prom.	Magazine Prom.	Credit insurance	Gender	Age	Income	Life insurance Prom.
A1	no	yes	no	male	45	40-50,000	not accept
A2	yes	yes	no	female	40	30-40,000	accept
A3	no	no	no	male	42	40-50,000	not accept
A4	yes	yes	yes	male	43	30-40,000	accept
A5	no	yes	no	female	38	50-60,000	accept
A6	no	no	no	female	55	20-30,000	not accept
A7	no	yes	yes	male	35	30-40,000	accept
A8	yes	no	no	male	27	20-30,000	not accept

5.2 BP Neural Networks

When single using the BP Neural Networks to analyze the problems, the steps are as following:

(1) Data standardizing

Selecting the data and standardizing the data in order to make it in the closed interval of zero and one. When standardizing the data by the regular method of extreme value, if there are some outliers in the sample data, the effective sample value may distribute in a small data tape between zero and one and it is not good for the networks' learning. In order to reduce the influence to the result, we defined a function expressed by the sample mean and standard deviation and then we use the extreme value standardizing formula to preprocess the data.

Assume that the sample collection has n sample data with m dimension $X_i = \{x_{i1}, x_{i2}, \cdots, x_{im}\}$, i=1,2....n, calculating the mean for the k dimension in the n sample $\overline{x_k} = \frac{1}{n}\sum_{i=1}^{n} x_{ik}$ and the standard deviation $s_k = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_{ik} - \overline{x_k})^2}$. The original data is standardized into $y_{ik} = \frac{x_{ik} - \overline{x_k}}{s_k}$. Let $Y_{k\min} = \min(y_{1k}, y_{2k}, \cdots, y_{nk})$, $Y_{k\max} = \max(y_{1k}, y_{2k}, \cdots, y_{nk})$, using the extreme data standardizing formula to make the data between zero and 1:

$Z_{ik} = \frac{Y_{ik} - Y_{k\min}}{Y_{k\max} - Y_{k\min}} = \frac{x_{ik} - x_{k\min}}{x_{k\max} x_{k\min}}$.

The standardized data is showing in Table 5 below:

Table 5   The standardized data of the case

No.	Watch Prom.	Magazine Prom.	Credit insurance	Income	Gender	Age	Life insurance Prom.
a1	0	1	0	0.3	1	0.72	0
a2	1	1	0	0.2	0	0.58	1
a3	0	0	0	0.3	1	0.64	0
a4	1	1	1	0.2	1	0.67	1
a5	0	1	0	0.4	0	0.53	1
a6	0	0	0	0.1	0	1.00	0
a7	0	1	1	0.2	1	0.44	1
a8	1	0	0	0.1	0	0.22	0

(2) Determining the Neural Network structure

Choosing six characteristic vectors for input layer nod number when classifying by the standardized data. They are watch promotion, magazine promotion, credit insurance, income, gender and age.
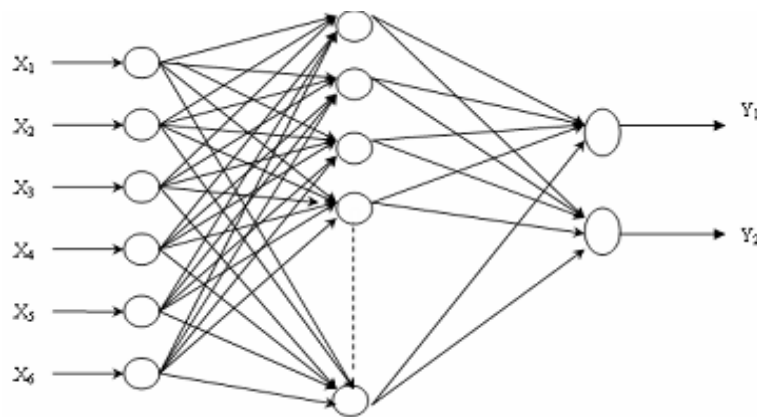
Fig. 3   Structure of the Neural Networks

The nod number of output layer is two. They are the sorts of the customers.

The number of hidden layer and its nod number are choosing by the experience. This paper chose 9 hidden

layer nods.

The structure of the network is showing in Fig. 3.

(3) Determining the back-propagation options

When opening the Neural Networks system based on the Microsoft Excel, there will be a back-propagation menu showing in Fig. 4 as below.
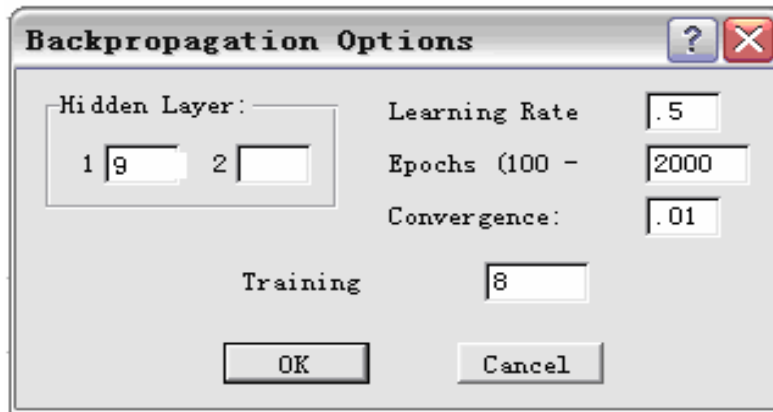
Fig. 4   Original options setting

Our options are 1 hidden layer, 9 nod number, 8 training, the biggest epochs are 20000, the convergence is 0.01 and the learning rate is 0.5.

Based on the above study, using the training samples and doing the training by study rules S till we get the required network model.

(4) The check-up data analysis by the model

After the training, we use the check-up data to test the model we got from the training, the testing data is showed in Table 6 as below.

Table 6   Testing data collection

No.	Magazine Prom.	Watch Prom.	Credit insurance	Income	Gender	Age	Life insurance Prom.
B1	1	0	0	0.2	1	0.67	0
B2	1	1	0	0.2	0	0.61	1
B3	0	1	0	0.3	0	0.67	1
B4	0	1	0	0.1	1	0.28	1
B5	1	1	0	0.4	0	0.56	1
B6	0	1	0	0.3	1	1.00	0
B7	0	0	1	0.1	0	0.00	1

Input the testing data into the Neural Network, the customer classification result is showed in Table 7 as below.

In the Table 7, "Calculation Results" showed the result calculated by the neural network of decision variable "Life Insurance Promotion", "Life Insurance Promotion" is the real results. Looking into the results, six data group can be classified, and the calculation result of B4 is totally different. The RMS (Rooted Means of Square Errors) and MAE (Mean Absolute Error) of the testing data are 0.350 and 0.14.

Table 7   The classification result of testing data

No.	Magazine Prom.	Watch Prom.	Credit insurance	Income	Gender	Age	Life insurance Prom.	Calculation results
B1	1	0	0	0.2	1	0.67	0	0
B2	1	1	0	0.2	0	0.61	1	0.98
B3	0	1	0	0.3	0	0.67	1	0.985
B4	0	1	0	0.1	1	0.28	1	0.074
B5	1	1	0	0.4	0	0.56	1	0.988
B6	0	1	0	0.3	1	1	0	0.006
B7	0	0	1	0.1	0	0	1	0.993

5.3 The classification of Rough Set-Neural Networks

5.3.1 Attributes reducing by Rough Set

Before operating on the data in the decision table, we should do the discretion and standardization treatment for the data. The result showed in the Table 8.

Table 8   The decision table treated by Rough Set

No.	Watch Prom.	Magazine Prom.	Credit insurance	Income	Gender	Age	Life insurance Prom.
a1	0	1	0	1	1	1	0
a2	1	1	0	0	0	1	1
a3	0	0	0	1	1	1	0
a4	1	1	1	0	1	1	1
a5	0	1	0	1	0	0	1
a6	0	0	0	0	0	1	0
a7	0	1	1	0	1	0	1
a8	1	0	0	1	0	0	0

(1) There are not equivalent set in each tuple, so there are seven equivalent set. A1{a1}, A2{a2}, A3{a3}, A4{a4}, A5{a5}, A6{a6}, A7{a7}, A8{a8}.

①The equivalent set of decision attribute D:

Y1{a1,a3,a6,a8};

Y2{a2,a4,a5,a7}.

②The low approximation set of the equivalent set of decision attribute:

C-Y1={A1,A3,A6,A8}={a1,a3,a6,a8}

C-Y2={A2,A4,A5,A7}={a2,a4,a5,a7}

There are not up approximation set for this sample.

③ Calculating   Pos(C,D) and r(C,D):

Pos(C,D)= C-Y1∪C-Y2={a1,a3,a6, a8,a2,a4,a5,a7}

|Pos(C,D)|=8, |U|=8, r(C,D)=1

(2) Calculating the importance of the attributes:

① the importance calculation of attribute watch promotion

Assuming that delete the watch promotion, the equivalent set of the other attributes are: A1{a1,a3}, A2{a2,a6}, A3{a4}, A4{a5}, A5{a7},A6{a8};

The equivalent set of decision attribute D:

Y1{a1,a3,a6,a8};

Y2{a2,a4,a5,a7}.

The low approximation set of the equivalent set of decision attribute:

C-Y1={A1,A6 }={a1,a3,a8}

C-Y2={A4,A5,A7}={a4,a5,a7}

And Pos(C-{a},D)=C-Y1∪C-Y2={a1,a3,a8, a4,a5,a7}

|Pos(C-{a},D)|=6

|U|=8

r(C-{a},D)=6/8

SGF(C-{a},D)= r(C,D)-r(C-{a},D)=2/8

So the importance of watch promotion is not zero, it can not be deleted.

(3) The importance calculation of attribute magazine promotion

Assuming that delete the magazine promotion, the equivalent set of the other attributes are: A1{a1}, A2{a2}, A3{a3}, A4{a4}, A5{a5}, A6{a6}, A7{a7}, A8{a8}.

The equivalent set of decision attribute D:

Y1{a1,a3,a6,a8};

Y2{a2,a4,a5,a7}.

The low approximation set of the equivalent set of decision attribute：C-Y1={A1,A3,A6}={a1,a3,a6,a8}

C-Y2={A2,A4,A5,A7}={a2,a4,a5,a7}

Pos(C-{a},D)= C-Y1∪C-Y2={a1,a2,a3, a4,a5,a6,a7,a8}

|Pos(C-{a},D)|=8

|U|=8

r(C-{a},D)=1

SGF(C-{a},D)= r(C,D)-r(C-{a},D)=0

So the magazine promotion can be deleted because its importance is zero.

We can use the same methods to calculate the importance of the rest attributes, and delete the data which its importance is zero, then we got the simplified data as showed in Table 9.

Table 9   The simplified data

No.	Watch Prom.	Credit insurance	Income	Gender	Age	Life insurance Prom.
a1	0	0	1	1	1	0
a2	1	0	0	0	1	1
a3	0	0	1	1	1	0
a4	1	1	0	1	1	1
a5	0	0	1	0	0	1
a6	0	0	0	0	1	0
a7	0	1	0	1	0	1
a8	1	0	1	0	0	0

5.3.2 Classifying by Neural Networks

Through the reduction by Rough Set, the redundant attributes are deleted. Then we use the new data to train by the Neural Networks as the sample data and get the classification. The analysis steps of BP Neural Networks is the same as section 5.2 showed, after the training, we can use the testing data to check the network model we have got, the check results are showed in the Fig. 5.

Fig. 5   Results of the testing data

In Fig. 5, G2 to G8 are the expecting data of the seven testing data, H2 to H8 are the calculation results by the neural network calculating model. The RMS is 0.026 and the MAE is 0.013.

According to the comparison, the seven data is classified correctly.

Table 10 is the classification results of the two methods we have introduced, and we can get the correctness of these two methods

Table 10   The classification of these two methods

Classification results by the Rough Set-Neural Network method		
The expecting results of the Life Insurance Promotion	Calculation results by the method	The correctness by the method
0	0.001	correct
1	0.978	correct
1	0.995	correct
1	0.996	correct
1	0.999	correct
0	0.065	correct
1	0.999	correct
Classification Results by the BP Neural Networks method		
The expecting results of the Life Insurance Promotion	Calculation results by the method	The correctness by the method
0	0	correct
1	0.98	correct
1	0.985	correct
1	0.074	wrong
1	0.988	correct
0	0.006	correct
1	0.993	correct

5.4 The analysis of the experiment

We have used the Neural Networks method and the Rough Set-Neural Networks method in the same data above, according to the results we have got, the Rough Set-Neural Networks method is better than the Neural Networks method in analyzing the data.

The advantages of the new method are:

(1) Enhancing the accuracy of the classification model

Analyzing from the correctness view, the new method had got the absolutely right classification, however, the Neural Networks method has error.

The RMS and MAE of the new method are 0.026 and 0.013, however, the RMS and MAE of Neural Networks method are 0.350 and 0.14. So the new method has advantage in accuracy.

(2) Improving the calculating speed of the model

The simplification of the data makes the structures of the Neural Networks become simpler and the training time is faster, it can improve the calculating speed of the model obviously. Meanwhile, the effective reduction makes the dimensions of the data simpler. The large the data and the attribute are, the calculating efficiency of the new method is higher.

So the Rough Set-Neural Networks method reduced the redundancy of the attributes and simplified the input of the Neural Networks, the classification of the customers is more correct.

6. Conclusion

In the analysis process of the market segmenting, this paper broke through the traditional "Prior Rationality" Hypothesis and put forward the "Situational Rationality" hypothesis and then introduced the new analysis method based on the new hypothesis. This new method combined the Rough Set and Neural Networks together, using the advantage of each method and avoiding the disadvantages. Rough Set can reduce the redundant attributes but it can not process the noisy data, however, the Neural Networks can process the noisy data but it can not tell the importance of the attributes. According to the comparison of the two theories, they had the good complementarities. Our work is using the Rough Set to reduce the sample data attributes and reduce the range of the sample data. On one hand, it can simplify the sample data for the Neural Networks; one the other hand, it can simplify the structure of the Neural Networks, so the training time and classification correctness can be improved effectively.

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