A Selection Method for Firm' Credit Sale by Optimization Techniques

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Abstract
In this paper, we discuss a selection method for firms' credit sale, and a series of models are designed for selecting retail traders on credit sale by optimization techniques. According to these models the firms will take an order of priority in retail traders from high credit qualities to low. At last, an example is given to analyze its valuable application.

Key words:
credit sale, selection model, optimization techniques

1. Introduction

At present, most of corporation and famous international finance institutions pay serious attention to evaluation of the customers' credit and devoted human and financial resources to delve into the interrelated researches, established respective evaluation systems of customers' credit[1]. Recently, a number of scholars applied the many comprehensive evaluation methods or techniques to establish the synthesis credit-evaluation models based on some assuming conditions[2]~[5]. However, these models depends upon complicated calculate process and be mainly applied in loan of finance institutions. Since Zhou and Tang (2004 、 2005) advance the mathematical frame of credit-evaluation[6]~[8], the process of evaluation on clients comes to clear.

By far, unfortunately, we can't find a simple and effective method for retail trader's selection on credit sale. This paper constructs a simply systematic method to select and evaluation the retail traders on credit sale and a series of selection models are designed, according to these models the firms will take an order of priority in retail traders from high credit qualities to low. At last, a demonstration is given to describe the selection process.

2. The selection model on credit sale

To keep away the credit sale risk, the firms have to select retail traders on credit sale and hope to make the credit sale qualities priority-ranked from *n* retail traders on credit sale for a batch of products.

Now the firm considers *m* crucial credit sale factors (such as: cooperation and trust intensity, repayment abilities, market and sell scale and so on) and *T* times (quarter or more) to evaluate the credit sale qualities of these retail traders. We note that f_{ijt}^{0} (i=1,2,…,n) is the historical status on credit sale of the i-th retail trader on j-th factor (j=1,2,…,m) at time t (t=1,2,…,T), and these factors have been made uniform[4] (if the value is bigger, the credit sale qualities is stronger). $\underline{f}_{ij}$ (i =1,2,…,n; j=1,2,…,m) is the allowable risk low-limit of credit sale qualities of the i-th retail traders at every factor. If $f_{ijt}^{0} \le \underline{f}_{ij}$ for any factor j, the i-th retail trader is declined by firm. So there assumes $f_{ijt}^{0} > \underline{f}_{ij}$ and $d_{ijt} = f_{ijt}^{0} - \underline{f}_{ij}$ >0 is called the superiority dispersion between the historical status and allowable risk low-limit.

Definition 1:

$$CSD_n = \sum_{i=1}^{n} w_i \sum_{j=1}^{m} \alpha_{ij} \sum_{t=1}^{T} \lambda_{ijt} d_{ijt} \tag{1}$$

be called the compositive superiority dispersion of n retail traders on credit sale (abbreviate to CSD_n). Where w_i, α_{ij} and λ_{ijt} i=1,2, …,n; j=1,2,…,m; t = 1,2, …,T are called weights of combined qualities on credit sale, factor weights and time weights respectively, which satisfies:

$\sum_{i=1}^{n} w_i$ =1, w_i ≥0; $\sum_{j=1}^{m} \alpha_{ij}$ =1, $\alpha_{ij} \ge 0$ and $\sum_{t=1}^{T} \lambda_{ijt}$ =1, λ_{ijt} ≥0,i =1,2,…,n; j=1,2,…,m; t = 1,2,…,T.

Definition 2: If combined weight w_i is maximal about CSD_n, w_i^* is called the optimal combined weight based on maximal dispersion for n retail traders on credit sale, i.e.

$$CSD_n^* = \max_{w_i} CSD_n = \sum_{i=1}^{n} w_i^* \sum_{j=1}^{m} \alpha_{ij} \sum_{t=1}^{T} \lambda_{ijt} d_{ijt} \tag{2}$$

The n dimension forward selection optimization model is established as below:

$$\begin{aligned} &\max_{w_i} CSD_n = \sum_{i=1}^{n} w_i \sum_{j=1}^{m} \alpha_{ij} \sum_{t=1}^{T} \lambda_{ijt} d_{ijt} \\ &s.t. \sum_{i=1}^{n} w_i = 1; w_i \ge 0, i = 1,2,\cdots,n \end{aligned} \tag{3}$$

Where α_{ij} and λ_{ijt} have been determined previously[9]. From

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(3) we can get the n dimension optimal combined weights vector $w^* = (w_1^*, \cdots, w_n^*)^T$.

The optimal combined weights vector $w^* = (w_1^*, \cdots, w_n^*)^T$ reflects the qualities of n retail traders on credit sale. Form above optimal combined weights, the firm selects retail traders with first high credit sale qualities that possess the maximal weight. For example, if $w_{i_1}^*$ is maximal, then the retail trader i has the best credit sale qualities.

After the first preference selection, the firm will select hypo-high credit sale qualities retail trader from n-1 remainder retail traders by solving n-1 dimension forward selection optimization model as follows:

$$\begin{cases} \max\limits_{w_i} \ CSD_{n-1} = \sum\limits_{i \neq i_1} w_i \sum\limits_{j=1}^{m} \alpha_{ij} \sum\limits_{t=1}^{T} \lambda_{ijt} b_{ijt} \\ s.t. \sum\limits_{i \neq i_1} w_i = 1; w_i \geq 0, i \neq i_1 \end{cases} \quad (4)$$

After the n-1 dimension optimal combined weights vector

$$w^* = (w_1^*, \cdots, w_{i_1-1}, w_{i_1+1}, \cdots, w_n^*)^T$$

is obtained, the hypo-high credit qualities retail trader is selected from n-1 remainder retail traders.

Repeated above selection process, the firms will establish an order of priority in n retail traders from high credit sale qualities to low credit qualities.

3. An example

An electrical firm will provide electrical products to six retail traders on credit sale. Since the credit sale qualities of retail traders may change along with the time, to decrease the credit risk, five representational important times t_1, t_2, t_3, t_4, t_5 (such as: quarterly and attaching the end of the year) have been selected to review the credit sale qualities of the retail traders. As the current ratio, trust intensity, debt ratio and sell scale that reflect the credit sale qualities are four important credit sale factors, if they take preferable values, the benefits of firm will be protected effectively. Now firm selects four credit sale factors and combines with five times to evaluate credit qualities of six retail traders. The observation values of four factors at five times for six retail traders and allowable risk low-limit have been listed as below tables:

Table1:The observation values and allowable risk low-limit of current ratio at five times

Times / f_{i1t}^0 / Retail traders	t_1	t_2	t_3	t_4	t_5	Allowable risk low-limit $\underline{f}_{i1}$
A	1.28	1.33	1.17	1.98	2.26	1.10
B	1.05	1.19	1.36	1.35	1.26	1.00
C	0.87	1.32	2.15	0.82	1.08	0.80
D	0.66	1.16	1.02	1.43	1.28	0.60
E	0.59	0.97	1.37	0.9	1.3	0.55
F	1.32	1.53	1.43	1.27	1.61	1.20

Table 2 The observation values and allowable risk low-limit of trust intensity at five times

Times / f_{i2t}^0 / Retail traders	t_1	t_2	t_3	t_4	t_5	Allowable risk low-limit $\underline{f}_{i2}$
A	0.77	0.62	0.78	0.75	0.53	0.52
B	0.75	0.65	0.53	0.80	0.71	0.53
C	0.76	0.88	0.55	0.75	0.62	0.55
D	0.91	0.72	0.67	0.70	0.64	0.60
E	0.89	0.64	0.82	0.54	0.69	0.54
F	0.85	0.78	0.82	0.58	0.57	0.57

From the table 1~4, we get the superiority dispersions and resolve the optimization problem (3) to gain the optimal combined weights vector w^* = (1,0,0,0,0,0). Repeated above selection process, we get the other optimal combined weights vector: (0,0,0,1,0); (0,0,0,1); (1,0,0) and (1,0) respectively. The firm will establish an order of priority in six retail traders from high credit sale qualities to low as table 5.

Table3:The observation values and allowable risk low-limit of debt ratio (%) at five times

Times / f_{i3t}^0 / Retail traders	t_1	t_2	t_3	t_4	t_5	Allowable risk low-limit $\underline{f}_{i3}$
A	30.02	60.1	40.91	50.27	44.19	30.02
B	32.95	18.3	22.52	20.25	23.38	18.3
C	65.85	54.37	50.06	50.75	48.14	48.14
D	59.3	55.16	55.35	58.59	54.77	54.77
E	22.87	39.18	31.15	39.96	28.47	22.87
F	29.67	31.33	25.59	40.09	37.54	25.59

Table 4 :The observation values and allowable risk low-limit of sell scale (million) at five times

Times / f_{i4t}^0 / Retail traders	t_1	t_2	t_3	t_4	t_5	Allowable risk low-limit $\underline{f}_{i4}$
A	4.30	7.12	6.84	5.56	1.03	4.30
B	3.41	5.09	8.00	6.46	6.25	3.41
C	2.64	4.70	3.20	3.63	4.49	2.64

D	2.37	1.02	1.64	1.75	3.30	1.02
E	3.87	2.42	4.29	4.75	5.16	2.42
F	4.21	5.02	4.23	4.85	5.32	4.21

Table 5 The result of credit sale qualities order

Credit order	1	2	3	4	5	6
Retail traders	A	E	F	B	C	D

In other words, the electrical firm will take an order of priority in six retail traders from high credit qualities to low: A,E, F, B,C,D.

4. Conclusion

In this paper, we put forth a selection method for credit sale by optimization techniques, and establish the priority-ranked in many retail traders. This method sets some evaluation foundation for firms' credit sale. As an example shows the selection process, that we put forth the method is suppleness and handle. We certainly believe that it can have a great potential of applications. Because of the internal and external circumstance of capital markets and various factors change constantly, the evaluation and selection question on credit obviously has temporal characteristics.

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