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Evaluation on the Consumer Credit in Returns Reverse Logistics

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Abstract

In buyers' market, the returns reverse logistics caused by consumer credit can increase the management costs that enterprises spend dealing with the reverse logistics, and it can also cause bad community atmosphere. Based on the consumer's gender, age, education, occasion, position and the average monthly income, this paper establishes index system to evaluate consumer credit and uses Fischer discrimination Ⅱ to measure the credit level of consumers, which provides a reference for enterprises to establish a scientific assessment system to evaluate the consumer credit.

Keywords: Returns reverse logistics, Consumer credit, Fisher discrimination Ⅱ

1. Introduction

The return goods are the most common in the reverse logistics, and the returns reverse logistics caused by the consumer credit takes up high proportion, which seriously affects the profits and reputation of enterprises. Therefore, more and more enterprises are beginning to know the importance of evaluating the consumer credit.

2. Constructing the index system of consumer credit evaluation

Constructing the index system of consumer credit must agree with the principles such as scientific, systematic comprehensive, predictable, quantifiable, flexible and operational, and comprehensively consider the factors of credit evaluation. Then based on the classifying, collecting and sorting out, we can determine the input indexes as Table 1.

Insert Table 1 here

3. The questionnaire of consumer credit

This paper uses scoring list to create the score model of qualitative indexes to determine an evaluation criteria program of qualitative indexes. It uses 5-point score to give the score, the greater the score, the smaller the individual credit risk. In addition to the score standard, specific points and division levels refer to the methods in the practice.

Insert Table 2 here

According to the basic request of scoring list, we determine the scoring criteria of each evaluation factor, and then calculate the total score. The greater the total score, the smaller the credit risk and the better the individual credit.

This paper uses questionnaire method to collect the parameters of consumers' credit indexes. Through sorting out, there are 40 valid questionnaires, and good credit's and bad credit's are separately 20. The result of questionnaires is showed as Table 3. The category 1 stands for the consumers of good credit and the category 2 stands for the ones of bad credit. C is short for Category; M is short for Marriage; I is short for Income.

Insert Table 3 here

According to the scoring list, we score the consumer credit evaluation questionnaire to calculate conveniently and the result is showed as Table 4 (C, G, A, E, O, P, M and I are separately short for Category, Gender, Age, Education, Occasion, Position, Marriage and Income.).

Insert Table 4 here

Insert Table 5 here

4. The evaluation model of consumer credit

4.1 The theory basis of fisher discrimination

The basic ideal of Fisher discrimination is to project the multi-dimensional data onto certain direction. The principle of projection is to separate the general as far as possible. The discrimination function is determined according to the principle that the distance between categories is largest and the distance in categories is smallest. Then the type of samples is determined by the linear discrimination equation. Divided by the discrimination equation, the same samples are centered while the different samples are discrete. This paper uses Fisher discrimination II.

(1) The solution of Fisher discrimination II equation

Assuming the samples are divided into A and B, n_1 and n_2 are separately represent the numbers of sample A and sample B. the new discrimination equation is

$$y = c_1x_1 + c_2x_2 + ... + c_px_p \tag{1}$$

K represents the serial number of the variable. The centers of the A and B are separately:

$$\overline{y_k(A)} = \frac{1}{n_1}\sum_{t=1}^{n_1} X_{kt}(A) \tag{2}$$

$$\overline{y_k(B)} = \frac{1}{n_2}\sum_{t=1}^{n_2} X_{kt}(B) \tag{3}$$

According to the basic ideal of Fisher discrimination, we should firstly determine how to express the distance between categories and the distance in categories. Then we use square between categories and Q to represent the distance between categories and square in categories and F to represent the distance in categories. The equations are showed as follows:

$$Q = \left[\overline{y(A)} - \overline{y(B)}\right]^2 \tag{4}$$

$$F = \sum_{t=1}^{n_1}\left[y_t(A) - \overline{y(A)}\right]^2 + \sum_{t=1}^{n_2}\left[y_t(B) - \overline{y(B)}\right]^2 \tag{5}$$

According to the basic idea of Fisher discrimination, we use the mathematical formulas to make the difference between extern-categories discrimination equation great and that between inner-categories discrimination equation small. Here we use I (the ratio that square between categories and Q to F). According to the maximum principle in differential, we make $I = Q/F$ for the partial differential and then make it equal 0. The equations are showed as follows:

$$\frac{\partial I}{\partial C_k} = \frac{F\dfrac{\partial Q}{\partial C_k} - Q\dfrac{\partial F}{\partial C_k}}{F^2} = 0 \tag{6}$$

We make the discrimination function into the partial differential equation and obtain:

$$\begin{cases} s_{11}c_1 + s_{12}c_2 + \ldots + s_{1m}c_m = d_1 \\ s_{21}c_1 + s_{22}c_2 + \ldots + s_{2m}c_m = d_2 \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ s_{m1}c_1 + s_{m2}c_2 + \ldots + s_{mm}c_m = d_m \end{cases}, \text{ and}$$

$$s_{kl} = \sum_{t=1}^{n_1}\left[x_{kt}(A) - \overline{x_k(A)}\right]\left[x_{lt}(A) - \overline{x_l(A)}\right] + \sum_{t=1}^{n_2}\left[x_{kt}(B) - \overline{x_k(B)}\right]\left[x_{lt}(B) - \overline{x_l(B)}\right] \quad (7)$$

$$d_k = \overline{x_k(A)} - \overline{x_k(B)} \quad (8)$$

We adapt the equations into the matrix:

$$S * C = D, \quad C = S^{-1}d$$

$$S = \begin{pmatrix} s_{11}s_{12}\ldots s_{1m} \\ s_{21}s_{22}\ldots s_{2m} \\ \ldots\ldots\ldots\ldots \\ s_{m1}s_{m2}\ldots s_{mm} \end{pmatrix}, \quad C = \begin{pmatrix} c_1 \\ c_2 \\ \ldots \\ c_m \end{pmatrix}, \quad d = \begin{pmatrix} d_1 \\ d_2 \\ \ldots \\ d_m \end{pmatrix}$$

Finally we make the sample data into the above equations to do the solution and we can obtain a group of coefficient values of the equation $y = c_1x_1 + c_2x_2 + \cdots + c_px_p$.

(2) Classifying sample discrimination

To use the discrimination equation to classify the samples, we should firstly construct the threshold y_c:

$$y_c = \frac{n_1\overline{y(A)} + n_2\overline{y(B)}}{n_1 + n_2} = \frac{\sum_{t=1}^{n_1} y_t(A) + \sum_{t=1}^{n_2} y_t(B)}{n_1 + n_2} \quad (9)$$

If $\overline{y(A)} > \overline{y(B)}$ and $y > y_c$, category A will appear, otherwise category B will.

If $\overline{y(A)} < \overline{y(B)}$ and $y > y_c$, otherwise category B will appear, otherwise category A will.

4.2 The basic steps of Fisher discrimination analysis

The credit analysis of Fisher discrimination has four steps:

(1) Classify the original data and achieve the research on the general category of consumer credit;

(2) Analyze the category of the known sample and the record of credit loss and determine whether the sample category has the distinct influence on the lack of credit. If it pass test, we can obtain the estimate of credit loss probability;

(3) Based on the result of the analysis of classifying, do the Fisher discrimination analysis and obtain the discrimination function;

(4) Make the samples into the discrimination function, determine the category of sample according to the discriminating principle, divide the criteria by the known level of consumer credit and determine the credit level of the consumer.

5. An empirical study

According to the scoring result of consumer credit indexes, we use the SPSS 12.0 to do the solution and the result is showed as Table 6.

Insert Table 6 here

From above table we can obtain the sample total is 40 and the valid sample is 40.

Insert Table 7 here

From above table we can obtain the result of classifying statistics including mean, variance, unweighted weight and weighed weight and the category 1 represents the consumer of good credit that the mean of education is 4.15 and the variance is 0.671.

Insert Table 8 here

From above table we can see the result that test whether the mean of the same variable is the same. We can obtain the significant level of age, education, occasion, position and income is 0.000, which is far less than the popular confidence level 0.05. It shows that the mean of age, education, occasion, position and income of different category are all different.

Insert Table 9 here

From above table we can see the first step is to enter the variable education, the second step is to enter the variable occasion and the third step is to enter the variable position. The statistics value in the column of Extract F is the ratio of Variable Square to error square. The bigger the value, the smaller the value of Sig. when the value of Sig. is smallest, its corresponding variable is entered into the discrimination equation. From the result we can see the stepwise in this example eliminates the variables of gender, age, marriage and income. Only education, occasion and position are entered into the discrimination equation.

Insert Table 10 here

Table 10 shows the condition of priori probability of each category. Because this paper uses the equal probability and divides the samples into 2 categories, the priori probability of each category is 0.5.

Insert Table 11 here

We can get the coefficients from above table and use the data in above table to directly get the discrimination equation. We make a certain sample into the equation to calculate the score of each category, and then tell the category by the score and compare the score. The sample belongs to the bigger one.

The equation of good credit is: y_1 =7.983*education+5.526*occasion+2.856*position-34.927

The equation of good credit is: y_2 =3.839*education+2.564*occasion+0.752*position-7.340

Insert Table 12 here

According to the setting of the discrimination analysis, it can only output the discriminating analysis statistics of the first 10 samples. The “Case number” represents the number of samples; the “Actual Group” represents the actual category of each sample; the “Predicted Group” in the column of “Highest Group” represents the most likely category; the “Group” in the column of “Second Highest Group” represents the second most likely category.

Insert Table 13 here

The table shows the sample numbers of correct classification, ones of wrong classification and the rate of wrong judgment. It also cross-validates the sample numbers of correct classification, ones of wrong classification and the rate of wrong judgment. The result of the correct classification of which all the samples construct the discrimination equation is that the rate of wrong judgment in good credit is 0% and the one in bad credit is 0%. The result of the correct classification that cross-validates the discrimination equation is that the rate of wrong judgment in good credit is 0% and the one in bad credit is 0%.

A new variable is generated named Dis-1 from the original data in the data editing window. Record the result of discriminating classification of each sample generated by the discriminating equation and we can get the conclusion that the result of discriminating classification is the same as the actual category.

6. Conclusion

To evaluate the consumer credit will help the society evaluate the level of consumer credit, help enterprises reduce the cost of the returns reverse logistics and improve the operational efficiency of reverse logistics and the quality of consumers.

References

Abdelkader Sbihi & Richard W. Eglese. (2007). Reverse Logistics-the least used differentiator. UPS Supply Chain Solutions.

H.M. Blance, H.A. Fleuren & H. R.Krikke. (2004). Redesign of a Recycling System for LPG-tanks. OR Spectrum.

Patrick Beullens. (2004). Reverse Logistics in Effective Recovery of Products from Waste Materials. *Reviews in Environment Science and Biotechnology*, 3:283-300.

Xu, Xiaohua & Pan, Xuhua. (2006). The psychology, causes and countermeasures of consumers’ dishonest consumption.

Modern shopping malls.

Yang, Li, Song, Li, et al. (2006). The statistical model methods of credit scoring. Statistics and decision-making.

Zhang, Wenbo & Chen, Hongyan. (2006). The statistics analysis of practical data and SPSS 12.0. Posts & Telecom Press.

Table 1. The index system of consumer credit evaluation

Consumer credit	Qualitative factors	gender
		education
		occasion
		position
		marriage
	Quantitative factors	age
		income

Table 2. Consumer credit index scoring list

Evaluation indexes	Evaluation contents	Score
gender	male	3
	female	2
age	Below 25	1
	25-35	2
	36-45	3
	Above 45	4
education	master	5
	undergraduate	4
	college	3
	high school (secondary)	2
	less than junior	1
occasion	Information technology, high-tech, finance, education, energy monopolies, corporations, hospitals, organizations	5
	Press, publishing, technology-intensive manufacturing	4
	Trade, consulting, architecture	3
	Traffic, transport, tourism	2
	technology-lower industry, catering, construction	1
position	R & D, high-level managers, teachers, doctors and other emerging post	5
	Middle managers, technicians	4
	Sales, general workers	2
	others	0
marriage	married	3
	single	2
income	≤1000 Yuan	1
	1000 Yuan -3000 Yuan (including 3000)	2
	3000 Yuan -5000 Yuan (including 5000)	3
	5000 Yuan-8000 Yuan (including 8000)	4
	≥8000 Yuan	5

Table 3. The table of consumer credit questionnaire

No.	C	gender	age	education	occasion	position	M	I
1	1	female	37	undergraduate	press	High-manager	married	5500
2	1	male	29	undergraduate	petrochemical	technician	single	3600
3	2	male	31	High school	food-manufacturing	worker	single	1000
4	1	female	48	undergraduate	hospital	doctor	married	4000
5	2	female	23	junior	restaurants	waitress	married	850
6	2	male	26	High school	construction	worker	single	1800
7	1	male	41	graduate	metallurgical-manufacturing	engineer	married	8700
8	1	female	46	undergraduate	trade	Middle-manager	single	4100
9	2	female	24	secondary	transport	worker	married	900
10	2	male	27	college	trade	sale	single	1500
11	2	female	30	High school	Textile manufacturing	worker	married	1000
12	1	male	36	undergraduate	Information technology	R&D	single	6000
13	1	female	39	Graduate	press	editor	married	3500
14	2	female	25	High school	Tourism	record	single	2000
15	2	female	20	secondary	Restaurants	Cash register	single	950
16	1	male	49	undergraduate	consulting	analyst	married	4800
17	1	female	26	undergraduate	Electronic manufacturing	Middle-manager	single	3200
18	1	male	42	Graduate	petrochemical	worker	married	3000
19	2	male	19	junior	construction	Temporary-worker	single	800
20	1	female	37	undergraduate	education	executive	single	6000
21	2	female	18	junior	Construction-installation	worker	single	1100
22	2	female	30	High school	traffic	worker	married	1000
23	1	male	44	graduate	Finance	High-manager	married	8800
24	1	female	32	college	publishing	Middle-manager	married	3500
25	2	female	26	college	cosmetics	sale	single	2800
26	2	female	39	High school	restaurants	Waitress	married	1000
27	1	male	46	undergraduate	petrochemical	High-manager	single	10000
28	1	female	38	graduate	agency	section	married	4800
29	1	male	40	college	consulting	Analyst	married	3700
30	1	male	29	undergraduate	Equipment-manufacturing	Sale	single	5200
31	2	male	22	High school	traffic	Worker	single	1000
32	1	female	37	college	Electronic-manufacturing	Technician	married	3600
33	2	female	24	primary	agriculture	farming	married	600
34	2	female	25	college	transport	Worker	married	2000
35	2	male	41	High school	construction	Worker	married	1800
36	2	female	22	secondary	department	Sale	single	1000
37	1	male	43	undergraduate	Electronic power	Engineer	married	7000
38	1	female	52	graduate	education	executive	married	3500
39	2	female	27	junior	consulting	Worker	single	1400
40	2	male	36	High school	manufacturing	worker	single	1000

Table 4. The result of consumer credit score

No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
C	1	1	2	1	2	2	1	1	2	2	2	1	1	2	2	1	1	1	2	1
G	2	3	3	2	2	3	3	2	2	3	2	3	2	2	2	3	2	3	3	2
A	3	2	2	4	1	2	3	4	1	2	2	3	3	2	1	4	2	3	1	3
E	4	4	2	4	1	2	5	4	2	3	2	5	4	2	2	4	4	5	1	4
O	4	5	1	5	1	3	4	3	2	3	1	5	4	2	1	3	4	5	3	5
P	5	4	2	4	0	2	5	4	2	2	2	4	5	2	0	4	4	2	0	5
M	3	2	2	3	3	2	3	2	3	2	3	2	3	2	2	3	2	3	2	2
I	4	3	1	3	1	2	5	3	1	2	1	4	3	2	1	3	3	2	1	4

Table 5. Table 4 continuing

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
2	2	1	1	2	2	1	1	1	1	2	1	2	2	2	2	1	1	2	2
2	2	3	2	2	2	3	2	3	3	3	2	2	2	3	2	3	2	2	3
1	2	3	2	2	3	4	3	3	2	1	3	1	2	3	1	3	4	2	3
1	2	5	3	3	2	4	5	3	4	2	3	1	3	2	2	5	4	1	2
3	2	5	4	1	1	5	4	3	4	2	4	1	2	3	2	4	5	3	1
2	2	5	4	2	0	5	4	4	2	2	4	0	2	2	2	5	4	2	2
2	3	3	3	2	3	2	3	3	2	2	3	3	3	3	2	3	3	2	2
2	1	5	3	2	1	5	3	3	4	1	3	1	2	2	1	4	3	2	1

Table 6. The data of discriminating samples

Unweighted Cases		N	Percent
Valid		40	100.0
Excluded	Missing or out-of-range group codes	0	.0
	At least one missing discriminating variable	0	.0
	Both missing or out-of-range group codes and at least one missing discriminating variable	0	.0
	Total	0	.0
Total		40	100.0

Table 7. The result of classification statistics

classification		mean	Variance	weight	
				Unweighted weight	Weighted weight
1	Gender	2.50	.513	20	20.000
	Age	3.05	.686	20	20.000
	Education	4.15	.671	20	20.000
	Occasion	4.25	.716	20	20.000
	Position	4.15	.875	20	20.000
	Marriage	2.65	.489	20	20.000
	Income	3.50	.827	20	20.000
2	Gender	2.35	.489	20	20.000
	Age	1.75	.716	20	20.000
	Education	1.90	.641	20	20.000
	Occasion	1.90	.852	20	20.000
	Position	1.50	.889	20	20.000
	Marriage	2.40	.503	20	20.000
	Income	1.40	.503	20	20.000
Total	Gender	2.42	.501	40	40.000
	Age	2.40	.955	40	40.000
	Education	3.03	1.310	40	40.000
	Occasion	3.08	1.421	40	40.000
	Position	2.83	1.599	40	40.000
	Marriage	2.53	.506	40	40.000
	Income	2.45	1.260	40	40.000

Table 8. The variance analysis of univariate

	F	df1	df2	Sig.
Gender	.895	1	38	.350
Age	34.342	1	38	.000
Education	117.661	1	38	.000
Occasion	89.110	1	38	.000
Position	90.306	1	38	.000
Marriage	2.540	1	38	.119
Income	94.146	1	38	.000

Table 9. Stepwise discrimination variable enter/ eliminate list

Step	Entered	Wilks'Lambda						
		df1	df2	df3	Exact F			
					Statistic	df1	df2	Sig.
1	education	1	1	38.000	117.661	1	38.000	.000
2	occasion	2	1	38.000	91.245	2	37.000	.000
3	position	3	1	38.000	69.028	3	36.000	.000

Table 10. Priori probability

category	Prior	Cases Used in Analysis	
		Unweighted	Weighted
1	.500	20	20.000
2	.500	20	20.000
Total	1.000	40	40.000

Table 11. The coefficients of Fisher linear discrimination equation

	category	
	1	2
education	7.983	3.839
occasion	5.526	2.564
position	2.856	.752
(Constant)	-34.927	-7.340

Table 12. The statistics list of sample classification

Case Number		Actual Group	Highest Group				Second Highest Group	
			Predicted Group	P(D>d| G=g)		P(G=g |D=d)	Group	P(G=g | D=d)
				p	df			
Original	1	1	1	.927	1	1.000000	2	.000
	2	1	1	.783	1	1.000	2	.000
	3	2	2	.797	1	1.000	1	.000
	4	1	1	.783	1	1.000	2	.000
	5	2	2	.041	1	1.000	1	.000
	6	2	2	.312	1	.998	1	.002
	7	1	1	.328	1	1.000	2	.000
	8	1	1	.321	1	.998	2	.002
	9	2	2	.706	1	1.000	1	.000
	10	2	2	.058	1	.887	1	.113

Table 13. The statistics list of classification result

category			Predicted Group Membership		Total
			1	2	
Original	Count	1	20	0	20
		2	0	20	20
	%	1	100.0	.0	100.0
		2	.0	100.0	100.0
Cross-Validated	Count	1	20	0	20
		2	0	20	20
	%	1	100.0	.0	100.0
		2	.0	100.0	100.0