The Analysis of Third Party Logistics Based on Cluster Evaluation Mode

Hechun Wang[1,2] ,Jiabin Wang[1]
1 School of Management, Shenyang Normal University, P.R.China,110034
2 School of Management,Dalian University of Technology,P.R.China,116024
whc0818@yahoo.cn ,sywangjiabin@163.com

Abstract

With the development of economy,the logistics outsouring gradually increases.It is an important tache to assess and select third party logistics justly and equitably in the outsourcing process of enterprises.And whether an appropriate third party logistics vendor choosed has become the key to enhance the core competence,low logistics cost,optimize inside and outside resource but whether above aims can be achieved depends on the ability and service of logistics vendors.It is of critical importance to the success of enterprise's outsourcing to choose an appropriate third party logistics vendor.

However,the evaluations currently are carried out by the evaluators manually through analyzing the financial indices of the third paryt logistics,which not only is too objective but also break the relevancies among the indices.The index system used to evaluate the business features of the third part logistics is constructed.A quantitative approach is adopted to assess the third part logistics through cluster method of multivariate statistical analysis.The method can be regarded as an important method for classifying third party logistics. Moreover,this method not only overcomes the above drawbacks but also contributes to the classification of the third party logistics vendors on the basis of some objective information provided by this method.

1. Introduction

For our country logistics industry is being at the start stage, further research is not enough to its theory and method and the content of choosing and evaluating third party logistics to be less[1].Now,the problem has been furrther studied by many literatures but the comprehensive quantitative analysis about third party logistics is less.

The third party logistics plays an important role in enhancing core competition strength of an enterprise,improving added-value service,reducing cost of logistics and optimizing enterprise resources etc,but whether the above aims can be achieved depends on the ability and service of logistics vendors.It is of critical importance to the success of enterprise's outsourcing to choose an appropriate third-party logistics vendor.The classification of third party logistics overall and objectivly brought many advantages for the subsequence cooperation between the third party logistics and enterprises,promoted the entire third party logistics industry development.Conversely,the smooth development of third party logistics may promote damand enterprises to higher level and form virtuous circle and then industry cooperation and society economy development.so,the study of third party logistics evaluation ways and model bear theory and practical significance,regardless of third party logistics and other enterprises.

While currently in China, the evaluating method we adopt are relay on analyzing the financial guideline of third party logistics evaluated by experts so as to ensure the final third party logistics. This method is not only too objective but also dissevers the connection between the biddings. Based on the construction of the index system for third party logistics classification,a method of classifying third party logistics is presented in this paper applying the cluster method of multivariate statistical analysis. it can be regarded as an important method for classifying third party logistics. Moreover, this method not only conquers the above drawbacks but also contributes to the selection of the third party logistics vendors on the basis of some objective information provided by this method.

2. Mathematics model and calculation process

Cluster analysis is the method of multivariate statistical analysis,which study the things Classification ,according to the principle of “Like-

978-0-7695-3435-0/08 $25.00 © 2008 IEEE
DOI 10.1109/ICIII.2008.57

minded people grouped".based on the multi-index value of a group of samples, it can concretely find Statistic which can measure the similar degree of samples and then taked as foundation to decide what type.

The distant samples be congregated a big taxonomical unit and the consanguineous be gathered to a small taxonomical unit.so the different types ba divided in detail.at last, the pedigree figure of ward cluster is came into being which can reflect the difference and relation of object divided(samples and variable) and samples have same similar characters in the same group.cluster analysis can be divided two types:Q type cluster analysis and R type cluster analysis. The fundation of Q type cluster analysis is samples cluster and The fundation of R type cluster analysis is index cluster.the paper aim to cluster sample so select Q type cluster analysis[2][3][4][5][6].

1 Euclidean Distance formula

Supposing m samples,n indexes, finally forming m×n matrix

（x_j）, i=1,…,m,j=1,…,n

The index x_j has m observation value and can be show as follows:

$$x_j = (x_{1j}, x_{2j}, x_{3j}, \ldots, x_{mj})^T$$

Now, each index may be taked as one point in m dimension space,n indexes constitute n points in m dimension space.we can naturally judge the close degree for indexes according to the distance among indexes and Similarity factor

Suppose d_{pq} is the distance between p and q ,squater Euclidean Distance d_{pq} formula as follows:

$$d_{pq} = \sum_{i-1}^{m} (x_{ip} - x_{iq})^2 \; i = (1, 2, \ldots, m) \quad (1)$$

2 Standardization

To avoid the index dimension influence. At first, the standardization of originality data is carried on. The formula adopted is as follows:

$$y_i = \frac{x_i - \bar{x}}{[\frac{1}{n-1}\sum_{i=1}^{n} (x_i - \bar{x})^2]^{\vee 2}} \quad (2)$$

y_i is the index X standardization value; x_i is the index x sample i value; n is the number of samples; $\bar{x}$ is the index X mean, so following data is standardization data in cluster part.

3 Ward Method cluster

Ward Method proposed by Ward in 1963,which basic ideal is that deviation sum-of-squares should be smaller in identical kind and bigger in different kind in various cases.the process of solution is that:firstly one case is one kind.secondly with the increase error sum of squares criterion ,the smallest distance two type be incorporated one type until all of case be incorporated one type.D denote type, $\overline{x_G}$ is mean in G,the diameter of G:

$$D_G = \sum_{i=1}^{m} (X_i - \overline{X_G})^2 \quad (3)$$

D_p,$D_q$respectivly denote the diameter of G_p and G_q,D_{p+q}denote the diameter of bigger typeD_pYD_q,D_m（p,q）denote the distance of G_p和 G_q

$$D_m^2(p, q) = D_{p+q} - D_p - D_q \quad (4)$$

3.The evaluation case analysis of third party logistics

3.1. Third party logistics evaluation Index and data

In order to assess and value third party logistics, this paper scores and orders the third party logistics by the following guidelines:（1）Time flexibility F1 which means the delivery time reduced/total time;(2)Complaint Rate F2 which means orders complained/total carrier orders;(3)Timerly rate F3 which means the rapid and timely completion of logistics/total completion of logistics;(4)Attainment rate F4 which means arrival on time/total logistics;(5)Ratio of total assets to Industrial F5 which means (total profit +total taxes+interest expense)/average total assets;(6)Cash ratio F6 which means cash assets/current liabilities;(7)Assets-liability ratio F7 which means total liabilities/total assets;(8)Quick ratio F8 which means liquid assets/current liabilities;(9)Security rate F9 which means security completion of logistics/total logistics completion;(10)Minimum order received rate F10 which means small orders accepted/total small orders;(11)Order received rat F11 which means arrangements for the shipment of orders/total orders;(12)Accuracy rate F12 which means accurate completion of logistics/total logistics output;(13)Circulating rate of fixed assets F13 which means net sales/average net fixed assets;(14)Lobar productivity F14 which means the total logistics during a certain period of time/the average number of employees in the period;(15)Attrition rate F15 which means loss of logistics/ the total completion logistics

In comprehensive evaluation index system,there be three type of index:(1)Positive index,the more value the more practice production.(2)Nagative index: the more value the less practice production.(3)Moderation index:the value in the best course denote the best level.different type index want adopt different ways in the process of non dimension in order to possess the

attribute of positive index.formula adoped:nagative index: $x_i' = 1 - x_i$;moderation index: $x_i' = 1 \Big/ \left| x_i - \overline{x_i} \right|$

3.2.Evaluation principle

1 R^2 Statistic

N samples be divided into k types and marked as G_1, G_2 ,…, G_k,n_t denote the number of Gt type （n_1+ ...+n_k=n）, $\overline{X}^{(t)}$ denote the barycenter of Gt, $X_{(i)}^{(t)}$ denote i samples in G_t （i=1,…,n_t） $\overline{X}$ denote the barycenter in all samples， the dispersion sum-of-squares n_t samples in G_t tpye is

$$W_t = \sum_{i=1}^{n_t} (X_{(i)}^{(t)} - \overline{X}^{(t)})'(X_{(i)}^{(t)} - \overline{X}^{(t)}) \quad (5)$$

$$R^2 = \frac{B_k}{T} \quad (6)$$

$$T = \sum_{t=1}^{k} \sum_{i=1}^{n_t} (X_{(i)}^{(t)} - \overline{X})'(X_{(i)}^{(t)} - \overline{X}) \quad (7)$$

$$B_k = \sum_{t=1}^{k} n_t (\overline{X}^{(t)} - \overline{X})'(\overline{X}^{(t)} - \overline{X}) \quad (8)$$

The bigger R^2 value, which menas the bigger proportion Bk account for T, the better k types can be distinctly divided. B_k is deviation sum-of-squares in k type .we adopt R^2 Statistic to evaluate the cluster effect when samples be merged into k type.the bigger R^2,the better cluster effect.

2 Semi-partial R^2 statistic

$$R_K^2 = B_{KL}^2 / T = R_{K+1}^2 - R_K^2 \quad (9)$$

In which, $B_{KL}^2 = W_M - (W_K + W_L)$ denote the increment when G_K and G_L was merged into new G_M type，which can evaluate the combination effect. The thing thatsemi-partial R^2 value become bigger in some step show previous step clustereffect is better.

3 Pseudo F Statistic

Pseudo

$$F_k = \frac{(T - P_k)/(K-1)}{P_k/(n-k)} = \frac{B_k}{P_k}\frac{n-k}{k-1} \quad (10)$$

This Statistic can evaluate the cluster effect of the samples which divided into k type.the bigger Pseudo Fk value get ,the better n samples be divided into k type.

4 Pseudo t^2 Statistic

Pseudo

$$t^2 = \frac{B_{KL}^2}{(W_K + W_L)/(n_K + n_L - 2)} \quad (11)$$

This Statistic can evaluate the effect of G_K and G_L combination type.the bigger value means the dispersion sum-of-squares increment B_{KL}^2 is bigger compared with G_K and G_L . G_K and G_L are incorporated into G_M and the GM dispersion sum-of-squares is B_{KL}^2 .so this prove the formal cluster is efficient[7][8] [9][10] [11].

3.3. The evaluation process

This paper using the most authority software SAS, combining cluster analyzing method of multi-statistics analyzes and assesses eight third party logistics.Using C1-C8 to represent eight third party logistics. Using the SAS software to analyze the original collected data [12][13][14][15][16],which could be ordered to the combining process table of the ward cluster method and the figure of pedigree.the table and figure as follows:

According to table 1, R^2 Statistic（row title RSQ） can evaluate the cluster effect when samples be incorporated NCL type. The bigger R^2 value we get,the better cluster effect we get.the R^2 value is between 0 and 1 and become smaller with NCL number decrease.

From the table,We can see the decrease of R^2 value is gradual and little in the combination process before 3 type (NCL＞3).when be divided 3 type,R^2=0.724.when the next be combined 2 type, R^2 decrease obviously, R^2=0.555.based on analysis ablve,we can draw a conclusion that 3 type is suitability.

According to semi-partial R^2 principle, the biggest and bigger semi-partial R^2 is NCL=2 and 3,so samples incorporated into 3 or 4 type is suitability.

According to Pseudo F principle, the biggest and bigger Pseudo F is NCL=2,3 and 4,o samples incorporated into 2,3 or 4 type is suitability.

According to Pseudo t^2 principle, the biggest and bigger Pseudo t^2 is NCL=1 and 2,o samples incorporated into 2 or 3 type is suitability.

Based on analysis above,contractors divided 3 type is suitability.the finnal result is $G^{(3)}{}_1$=（C1, C6, C2,C5,C8,C7）,$G^{(3)}{}_2$=（C4）,$G^{(3)}{}_3$=（C3）.From analysis above,we can see that the third party logistics can be classified into three groups,different type means different level and ability.

4. Conclusions

The classifying of third party logistics vendors is cruial link of enterprise outsouring.in practice, being short of right classifying methods lead to both sides difficult to work together effectly. The comprehensive theory basis of the cluster method is one of the most important methods in multi-statistics.

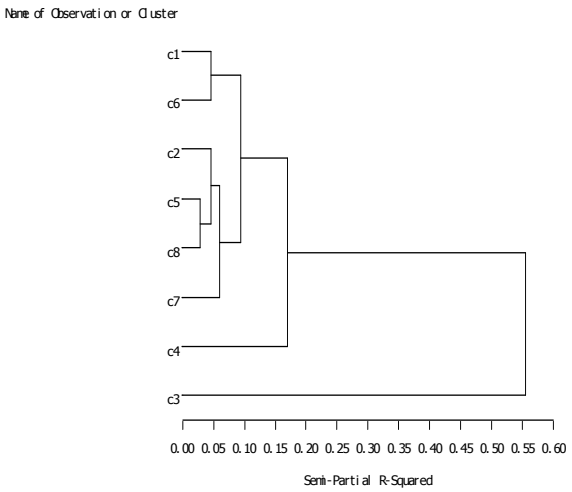

Figure 1 The pedigree of ward cluster

Table 1 The ward cluster process

NCL	Clusters Joined	FREQ	SPRSQ	RSQ	ER.SQ	CCC	PSF	PST2
7	c5 c8	2	0.0287	.971	.	.	5.6	.
6	c1 c6	2	0.0463	.925	.	.	4.9	.
5	c2 CL7	3	0.0467	.878	.	.	5.4	1.6
4	CL5 c7	4	0.0604	.818	.	.	6.0	1.6
3	CL6 L4	6	0.0939	.724	.	.	6.6	2.1
2	CL3 c4	7	0.1694	.555	.	.	7.5	3.1
1	CL2 c3	8	0.5547	.000	.000	0.00	.	7.5

This paper takes the basics on the system of constructing third party logistics' valuation standard, and applies the cluster method to assess the third party logistics. The analysis result can be regarded as one of main foundations for reference.

References

[1]Y.Shen,G.X. Yao,"Comprehensive Evaluation on Carrying Dealer of Supply Chain Logistics Management",*Research on Manufacture Automation*,Beijing Research Institute of Automation for Machine-building Industry,Beijing,Jul.2000,pp.12-15.

[2]Y.T.Zhang,K.T.Fang,*The induction of Multivariate statistical analysis*,Science Press,Beijing,Jun.1982.

[3]X.L.Yu,X.S.Ren,*Multivariate Statistical Analysis*, China Statistics Press,Beijing,Aug.1999.

[4]X.M.Wang,*The Application of Multivariate Analysis*, Shanghai University of Finance & Economics Press, Shanghai,Jan.2004.

[5]Gao Huixuan,*Applied Multivariate Statistical Analysis*,Peking University Press,Beijing,Sep.2002.

[6]D.Y.Zhu,C.O.Wu,W.L.Qin,*Multivariate Statistical Analysis and SAS Software*,Southeast University Publishing House,Nanjing,Aug.1999.

[7]N.Hong,J.Hou,*SAS for Windows Statistics and Analysis Course*,Publishing Hourse of Electronics Industry,Beijing,Jan.2001.

[8]Z.Y.Peng,*The Applied and Exploited Guide to The World Genius Statistics and Analysis SAS System*, Publishing House of Beijing Hope Electronics, Beijing,Jun.2000.

[9]L.P.Hu,*Windows SAS 6.12 & 8.0 Practical Statistical Analysis Course*,Peking: Military Medicine and Science Press,Beijing,Mar.2001.

[10]Q.L.Lei,*Economy Management and Multivariate Statistical Analysis*,China Statistics Press,Beijing,May 2002.

[11]X.C.Pei,H.R.Xue,*The SAS Software and Application*,China Agriculture Press, Beijing,May 1998.

[12]H.X.Gao,*Applied Multivariate Statistical Analysis*,Peking University Press,Beijing,Nov.2005.

[13]Ruan Kuihai,*The Whole of SAS Practical Statistical Analysis*,Tsinghua University Press,Beijing,Jun.2003.

[14]D.J.Dong,*The Application Guides of SAS Statistical Analysis Software*,Peking Publishing House of Electronics Industry,Beijing,Aug.1993.

[15]K.T.Fang,*The Practical Multivariate Statistical Analysis*,East China Normal University Press,Shanghai,Sep.1989.

[16]M.H.Wang,*Mordern Applicationl Statistical Analysis Method*,China Statistics Pres,Beijing,Dec.1999.