Summer 6-19-2015

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Research on Quality Evaluation of Group Buying Websites Based on DEA and Fuzzy Comprehensive Evaluation

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Abstract: Group buying mode has been one of the hottest business models in the Chinese Internet area in recent years. Though the market competition is intense, the demand of group purchase is still on the rise. Nowadays, the research on comprehensive evaluation of group buying websites in our country is still tiny. The paper used DEA combined with fuzzy comprehensive evaluation to evaluate popular group buying websites. According to the characteristics of group buying websites, we evaluate the quality of group buying websites from three aspects. There are running efficiency, profit ability and promotion quality. Then we got the comprehensive evaluation results of each website. Some suggestions of website building for group purchasing enterprises are proposed.

Keywords: group buying websites; DEA; fuzzy comprehensive evaluation

1. INTRODUCTION

With the rapid development of e-commerce websites, large numbers of group buying model based on the Internet were coming forth. The market is increasing competitive. In 2010, group-buying model which can started with a few million and made a lot of money quickly were extended to China. Then quickly set off a unprecedented dimensions "business battle royal" in the history of Chinese Internet. In the 《group-buying market statistic report in January-February.2014》,it had forecast that the scale of group-buying market will exceed 70 billion in 2014. And by the end of November, a total turnover has realized 658.7 billion throughout the country. According to the average monthly growth rate 5.8% in the previous 11months, we can calculate that it can realizeturnoverof82.2billion in December. But a latest data from Electronic Commerce Research Center in China shows that there are 5376 group-buying websites closed and the failure rate was 86% from the beginning of group-buying to the present. Less than twenty percent Group enterprise are alive, the demand of group purchase are exploded rather than decreased. The cause of this situation is various, so it has important practical significance to evaluate the quality of the group-buying websites with scientific and effective method.

In recent years, the study on e-commerce sites' evaluation has been an important topic in the field of e-commerce. There are many research results of evaluation research of e-commerce sites at home and abroad. Such as the evaluation which based on customer satisfaction, the evaluation which from the perspective of building their own websites evaluation. Utilizing different evaluation methods, AHP, factor analysis, cluster analysis and so on. The evaluation research of group-buying websites at home is still at an early stage. Peng Liang（2011）[1] evaluated group buying websites from the view of the customer trust. Liao Xiaoli（2012）[2]built the ideal model of group shopping websites' information architecture against the existing problems of group shopping websites and explains it. Zhou Beijing and Hou Lun (2012)[3]establish an effective evaluation system of group-buying websites on the basis of the reviewing of the evaluation for E-commerce website, experts interview and customers investigation, and the measurement of the evaluation index was quantified researched by use of the analytic hierarchy process. Xi Li（2012[4]applied link analysis and the measure of web impact

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factors, used search engines Altavista to evaluate the main group-buying websites in China. In conclusion, the evaluation study of group buying websites is still need to deepen. We should establish a scientific appraisal system and use scientific methods further.

This paper selected seven popular group-buying websites. There are Meituan, Dianping, Baidu Nuomi, Lashou, Nest, Manzuo, 58 group. It used DEA combined with fuzzy comprehensive evaluation to compare and evaluate the quality of group buying websites. On one hand, for quantifiable evaluation index, we used DEA to calculate the relative efficiency which can be regard as index of fuzzy comprehensive evaluation. On the other hand, for non-quantitative evaluation index, we used fuzzy evaluation directly. Finally the comprehensive evaluation result is obtained by fuzzy operation.

2. DATA ENVELOPMENT ANALYSIS AND FUZZY COMPREHENSIVE EVALUATION

Data envelopment analysis is a new system analysis method, which to evaluate relative effectiveness or benefit of multi-index input and multi-index output for the same type of units. It proposed by famous operational research experts A.Charnes and W.W.Copper[5] based on the concept of relative efficiency. DEA is a good way to deal with multi-criterion decision problem. It applies mathematical programming model to calculate and compare relative efficiency of decision making units, then evaluate the evaluation objects.

The most excellent advantage of Data envelopment analysis is without any weight hypothesis. The weight of each input and output is not identified according to the evaluator's subjective. The optimal weight is obtained from the actual data of DMUs.

The fuzzy comprehensive evaluation is a fuzzy evaluation method which based on fuzzy mathematics. By using the fuzzy theory, some qualitative factors are turned to quantitative factors. The rationale is, first to determine index sets and evaluation sets of judged object. Then determine the weight of each factor and their membership vector, getting fuzzy comprehensive evaluation matrix. Finally we can obtain comprehensive fuzzy evaluation results by making fuzzy operations of fuzzy discrimination matrix and the factors' weight vectors[6].

Data envelopment analysis is a quantitative analysis method, which is strict with the accuracy of the data and has better objectivity. However in reality a lot of index factors of comprehensive evaluation are difficult to express with exact figures. Although it is able to evaluate the effectiveness of inputs, it can't evaluate the overall benefits. Fuzzy comprehensive evaluation need to rely on the knowledge and experience of experts in the evaluation process. Weights are obtained by expert evaluation or other methods. So this method has strong subjectivity. Although it able to evaluate the overall benefits, it can't evaluate the effectiveness of inputs. So you can see that Data envelopment analysis and fuzzy comprehensive evaluation are complementary. The objective and accurate of data envelopment analysis can make up the subjectivity of fuzzy comprehensive evaluation. In this paper, we use the result of data envelopment analysis as the index data of fuzzy comprehensive evaluation to evaluate group-buying websites.

3. EVALUATION INDEX OF GROUP BUYING WEBSITE'S QUALITY

Currently, the evaluation of E-business websites mainly adopted the following four ways: site traffic indicators statistics, expert evaluation, questionnaires, comprehensive evaluation method. Wang Weijun (2003) [7] thought that the website should be evaluated from six parts: (1) Technical indicators, including link availability and the speed of the network. (2) Interface indicators, including visual effects, page layout, ease of use and so on. (3) Information indicators, including the provision of information's quantity, quality, variety, information update frequency, personalized information services. (4) Functional specifications, including website functionality and effectiveness. (5) Customer service indicators, including the level and quality of customer support, the interaction between websites and user and so on. (6) Operating performance indicators,

including site traffic (hits), turnover, profit and other costs. Chen Meimei, Tang Bingyong(2006)[8]judged the quality of business websites on five first class indicator. There is utility business, business information, the design of website, system availability, system efficiency. Fu Lifang(2007) [9]proposed by the number of pages of the site, the average size of the page, the number of references to other Web sites, home average response time, average daily traffic, the average number of daily visitors to the site to evaluate the efficiency. Liu Jinrong(2012)[10] built satisfaction assessment system of 9*-group-buying websites on the basis of products, services and technologies from their own website this three areas according to the real needs of consumers,

In this paper, we synthesize the view of literature, combined with the characteristics of group-buying websites, evaluate the quality of group-buying websites from three aspects, operational efficiency, profitability, and the promotion quality. The main measure of the efficiency of the site is the website traffic. Profitability measures operating performance of the sites, measured by sales. Operational efficiency and profitability indicators are quantifiable indicators, the paper using data envelopment analysis to calculate quantified evaluation, and for data envelopment analysis model, you need to first determine the input and output variables. Operational efficiency, select three-month average click-through rate as output variables, access speed and number of backlinks as input variables, the faster the access speed, the higher the website hits. Number of backlinks, also known as link popularity or linking out, is the votes other sites cast on its site, the more the number of backlinks, the higher the value of the site have, by the search engine the user's attention is also more. Profitability, the total purchase selected as the output variable, the average unit price and the number of open group as input variables, the average price level will affect consumers intuitive, cheap in order to attract consumers to buy, and the number of reactive sites open group product updates speed, the number of open group more to attract more consumers. The operational efficiency and profitability investment selection and data output variables of seven group buying sites are shown in Table 1.

Table 1.   The index data of sites

Websites	Running efficiency			Profit ability		
	Number of backlinks (input)	Access speed （input）	The average click in three months （output）	Average unit price (input)	Number of group open (input)	The total amount of purchase （output）
Meituan	2787	720	17262000	62	1774309	16870067906
Dianping	4136	600	29688000	59	836069	6630556313
Baidu Nuomi	1604	1266	5715000	56	828352	8209967575
Lashou	1829	1140	1800000	26	1863767	178052408803
Nest	1267	1194	675000	74	1544456	16760479408
Man zuo	515	1483	315000	144	330111	13652244190
58 group	10825	1362	57330000	35	1599312	17610495383

As for promote quality, it includes website reputation and customer satisfaction. The indicators mainly reflect the informants' feel of the website which is subjectivity and descriptive indicators, and is quantitative. The evaluation is of strongfuzzinessandneedtoevaluatethroughthefuzzycomprehensiveevaluationmethod.Firstwe use single-factor fuzzy evaluation to evaluate the promotion quality, the factor set of promotion quality is U=(awareness, satisfaction),evaluation set is V=(excellent, good, bad),the data are shown intable2,the data comes from the Tuan 800 sites questionnaire concerning the awareness of sites and consumer satisfaction.

Table 2.The data of popularity and customer satisfaction

websites	promotion quality	
	popularity R_{i31}	customer satisfaction R_{i32}
Meituan	（0.53,0.25,0.22）	（0.52,0.14,0.34）
Dianping	（0.75,0.13,0.12）	（0.75,0.1,0.15）
Baidu Nuomi	（0.62,0.22,0.16）	（0.56,0.13,0.31）
Lashou	（0.52,0.31,0.17）	（0.46,0.15,0.39）
Nest	（0.69,0.17,0.14）	（0.61,0.08,0.31）
Man zuo	（0.71,0.2,0.09）	（0.67，0.1,0.23）
58 group	（0.8,0.11,0.09）	（0.76,0.07,0.17）

4.   EVALUATION OF GROUP BUYING WEBSITES BASED ON DEA AND FUZZY COMPREHENSIVE EVALUATION

The comprehensive evaluation of group-buying websites in this paper is based on two quantifiable index (running efficiency, profit ability) and a non-quantitative evaluation index (promotion quality). For quantifiable evaluation index, we used its input variable and output variable to calculate the relative efficiency of group-buying websites. Because the relative efficiency is only a numerical value, it does not have the form of membership which fuzzy comprehensive evaluation required objectively and perceptual knowledge of "excellent, good, bad" subjectively. So we make use of membership function of fuzzy mathematics to obscure the relative efficiency and evaluate by fuzzy comprehensive evaluation method. Let us assume that the remark set of fuzzy comprehensive evaluation is $V = (v_0, v_1, \cdots, v_n)$ .Then DEA score can be understand as membership degrees of $(v_0, v_1, \cdots, v_n)$ respectively. In this paper, we use isosceles triangle membership function to fuzzy the DEA score. Supposing the membership is $r = (r_0, r_1, \cdots, r_n)$, so

$$r_i = \begin{cases} \dfrac{x - \dfrac{i-1}{n}}{\dfrac{i}{n} - \dfrac{i-1}{n}} & \dfrac{i-1}{n} \le x < \dfrac{i}{n} \\ \dfrac{\dfrac{i+1}{n} - x}{\dfrac{i+1}{n} - \dfrac{i}{n}} & \dfrac{i}{n} \le x < \dfrac{i+1}{n} \qquad i = 0, 1, \cdots, n \\ 0 & others \end{cases}$$

We get the membership degrees from putting the relative efficiency into last formula. Running efficiency's fuzzy membership from DEA score is B_{i1} . Profit ability's fuzzy membership from DEA score is B_{i2} .

Non-quantitative evaluation index (promotion quality) is calculated by fuzzy comprehensive evaluation method. According to expert evaluation to determine weight vector which composed of website popularity and customer satisfaction is $A_{i3} = (0.5, 0.5)$, the corresponding value of the comprehensive evaluation matrix are shown in table 2.So $B_{i3} = A_{i3} \cdot \begin{vmatrix} R_{i31} \\ R_{i32} \end{vmatrix}$, The results show the evaluation results of the group buying site in the respect of promotion of the quality. The corresponding comprehensive evaluation matrix results are shown in Table 3.

Table 3.　The result of quantitative and non-quantitative evaluation index

websites	running efficiency B_{i1}				profit ability B_{i2}				promotion quality B_{i3}		
	DEA score	Fuzzy membership from DEA score			DEA score	Fuzzy membership from DEA score			Fuzzy membership		
		excellent	good	bad		excellent	good	bad	excellent	good	bad
Meituan	86.30%	0.722	0.278	0	54.70%	0.094	0.906	0	0.525	0.195	0.28
Dianping	100%	1	0	0	2.50%	0	0.05	0.95	0.75	0.115	0.135
Baidu Nuomi	49.60%	0	0.992	0.008	1.90%	0	0.038	0.962	0.59	0.175	0.235
Lashou	13.70%	0	0.274	0.726	100%	0	0	1	0.49	0.23	0.28
Nest	7.40%	0	0.148	0.852	7.70%	0	0.154	0.846	0.65	0.125	0.225
Man zuo	8.50%	0	0.17	0.83	12.20%	0	0.244	0.756	0.69	0.15	0.16
58 group	85.10%	0.702	0.298	0	7.90%	0	0.158	0.842	0.78	0.09	0.13

Supposing the weight vector which is composed of running efficiency, profit ability and promotion quality is $A_i = (\frac{1}{3}, \frac{1}{3}, \frac{1}{3})$, The corresponding comprehensive evaluation matrix R_i are shown in Table 4.Then we can get the comprehensive result by the formula

$$B_i = A_i \bullet R_i = (\frac{1}{3}, \frac{1}{3}, \frac{1}{3}) \bullet \begin{vmatrix} B_{i1} \\ B_{i2} \\ B_{i3} \end{vmatrix}$$

Table 4.　Comprehensive evaluation matrix and evaluation result

websites	running efficiency			profit ability			promotion quality			Comprehensive result			Evaluate result
	excellent	good	bad	excellent	good	bad	excellent	good	bad	excellent	good	bad	
Meituan	0.241	0.093	0.000	0.031	0.302	0.000	0.175	0.065	0.093	0.447	0.460	0.093	good
Dianping	0.333	0.000	0.000	0.000	0.017	0.317	0.250	0.038	0.045	0.583	0.055	0.362	excellent
Baidu Nuomi	0.000	0.331	0.003	0.000	0.013	0.321	0.197	0.058	0.078	0.197	0.402	0.402	good
Lashou	0.000	0.091	0.242	0.333	0.000	0.000	0.163	0.077	0.093	0.497	0.168	0.335	excellent
Nest	0.000	0.049	0.284	0.000	0.051	0.282	0.217	0.042	0.075	0.217	0.142	0.641	bad
Man zuo	0.000	0.057	0.277	0.000	0.081	0.252	0.230	0.050	0.053	0.230	0.188	0.582	bad
58 group	0.234	0.099	0.000	0.000	0.053	0.281	0.260	0.030	0.043	0.494	0.182	0.324	excellent

According to the principle of maximum membership degree, we select the maximum value of fuzzy comprehensive evaluation set corresponding level "excellent, good, bad," as the final evaluation results. The above table shows that Dianping, Lashou and 58 group, those comprehensive achievement are excellent, MeiTuan, Baidu Nuomi in just so so, and Nest and Man zuo is relatively bad .The reason why the public comment network performance thanks to its excellent site high efficiency, high-profile sites, customer satisfaction is high, but its profit ability is bad. In the future operation of the process should increase the number of open group, using high visibility, high satisfaction degree increase sales and improve profitability, and maintaining a website running efficiency. Lashou should strengthen the construction of the site itself, improving the efficiency of the site. The profitability of 58groupis poor, although the opening number is more, but the average unit price is low, less corresponding sales. MeiTuan and Baidu Nuomi in operating efficiency, profit ability and promote quality slightly mediocrity, so the overall performance of the general. MeiTuan, Baidu Nuomi should break through itself, to be creative, on the basis of the current to the next level. Nest and Man zuo overall performance is poor because of their poor operational efficiency and profitability is not high. Recommend Nest and Man zuo to concentrate efforts on the key, through the method of Fan out from as an example for the rest of the lot to follow to improve their comprehensive strength.

5.　CONCLUSIONS

The paper used DEA combined with fuzzy comprehensive evaluation to evaluate popular group buying

websites. Regard the results of data envelopment analysis as the fuzzy comprehensive evaluation's index data. Take advantages of data envelopment analysis's intuitive, objective and accurate makes up for subjectivity of fuzzy comprehensive evaluation. Then enhance the objectivity of the fuzzy comprehensive evaluation results.

ACKNOWLEDGEMENT

REFERENCES

[1] Peng Liang. (2011). The fuzzy comprehensive evaluation consumer trustiness degree of the bulk purchasing website based on Groupon model. Business Economic, 02:85-88.

[2] Liao Xiaoli, Hu Yuan. (2012). Model of information architecture of group shopping websites based on user experience. Library and Information Service, 10:138-143.

[3] Zhou Beijing, Hou Lun. (2012). Research on the synthetic evaluating group-buying website. Managerialist (academic version), 02:50-66.

[4] Li Xi. (2012). China's major buy site evaluation of the influence of link analysis based. Information Research,12:46-48.

[5] Chames,A.,Cooper,W.W.and Rhode,E. (1978). Measuring the efficiency of decision making units. European Journal of Operational Research. International Journal of Systems Science,2:429-444.

[6] Tu Dong, Pang Qinghua, WuYan. (2008).Evaluation of modern methods and case selection. Tsinghua University Press.34-48.

[7] Wang Weijun. (2003). Analysis and comment on study and application of EC websites evaluation. Information Science,06:639-642.

[8] Chen Meimei, Tang Bingyong. (2006). Research on quality diagnosis of business website based on fuzzy Comprehensive Evaluation. Mathematics in Practice and Theory, 10:73-78.

[9] Fu Lifang, Feng Yuqiang, Wu Qiufeng. (2007).Evaluation and quality diagnosis of e-commerce website based on DEA model. Natural Science Journal of Harbin Normal University.03:36-40.

[10] Liu Jinrong. (2012). Empirical Study of Consumer Satisfaction buy site evaluation system. China Trade Guide, 09:66-68.

[11] Zheng Hang. (2014). Group-buying purchase website efficiency based on DEA method. Chongqing. Chongqing Normal University.

[12] CharnesA, Cooper W W, Wei Q L, et al. (1989). Cone ratio data envelopment analysis and multi objective programming. International Journal of Systems Science, 20(7):1099-1118.

[13] Banker R D, CharnesA, Cooper W W. (1984). Some models for estimating technical and scale inefficiencies in data enve-lopment analysis. Management Science, 30(9):1078-1092.

[14] Andersen, Petersen. (2003) Congestion and return to scale in data envelopment analysis. European Journal of Operational Research, 145:530-538.

[15] Liu Shun. (2010).DEA –based fuzzy comprehensive evaluation and its applications. Zhejiang. Zhejiang University.

[16] Gefen.D. (2005).Reflections on the dimensions of trust and trust worthiness among online consumers. Database for Advances in Information Systems,33（3）:38．

[17] SaatiS, Memariani.A. (2005).Reducing weight flexibility in fuzzy DEA. Applied Mathematics and computation, 161(2): 611-622.