Analysis of Product Competitive Factors in Agricultural B2C Platform Based on Factor Analysis

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Keywords: factor analysis; products competitive factors; B2C; evaluation mode.

Abstract. Based on factor analysis, this paper study on the current product competitive factors in agricultural B2C platform. By analyzing the data that is the sales of commodities, price, number of popular, shop credit rating, and evaluation of commodity, and explore the factors of commodity competitiveness, then get commodity competitiveness evaluation model. On one hand, the research results can provide a basis decision for settled sellers in e-commerce platform to improve the competitiveness of their products. On the other hand, the results based on product competitiveness rankings can recommend valuable products to the buyers, the substance is providing recommended service.

Introduction

With the rapid development of the Internet business, a large number of e-commerce platform for all kinds of agricultural products come out, but "information overload" problems have arisen, that disordered information on the internet environment caused users find out the relative information difficult. Therefore, to help users accurately and timely find valuable product information from the Internet, analysis and research of product competitive factors in agricultural e-commerce platform is an important theoretical and practical value, while the results can provide theories to settled sellers who need analyze the selling products in e-commerce and understand the trend of commodity market, for making the right business decisions based on market information [1, 2].

This paper collected agricultural product data from the B2C platform, experimental data record number more than 1,000. Firstly preprocess the product data, and then use factor analysis method to analysis competitiveness of agricultural commodities in B2C platform, and build a commodity competitiveness evaluation model.

Basic Theory of Factor Analysis

Factor analysis is the number of variables with complex relations comes down to a few more variables unrelated to the new integrated statistical factor analysis method. Form the collecting agricultural product raw data, it will get a mass of observational data indicators, there may be some correlations between these data, and there are some difficulties during the parsing process. Factor analysis can resolve the issues of correlation between variables. Without loss of product-related information, factor analysis through the "transformation" to reduce the number of variables, eliminate redundancy of the original information, while eliminating the correlation between variables to

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analyze the competitiveness of products. Thus the objective interpretation of the relationship between commodity competition among these variables, but also eliminate the subjective limitations of the analysis was to obtain scientific analysis conclusions [3].

Factor Analysis Model

Suppose there are p initial variables $x_1 x_2 \dots x_p$, every observations of commodity has p indicators(that means p initial variables). Each initial variable contains m aspects of the competitiveness of products, denoted by $F_1 F_2 \dots F_m (\mathrm{m} < \mathrm{p})$,called m aspects are p principal factors of original variables. The aspects which these principal factors cannot interpret called specific factors of original variables, denoted by $\varepsilon_1 \varepsilon_2 \dots \varepsilon_p$. The factor analysis model is [4]:

$$\begin{cases} x_1 = a_{11}F_1 + a_{12}F_2 + \cdots + a_{1m}F_m + \varepsilon_1 \\ x_2 = a_{21}F_1 + a_{22}F_2 + \cdots + a_{2m}F_m + \varepsilon_2 \\ \qquad \cdots\cdots \\ x_p = a_{p1}F_1 + a_{p2}F_2 + \cdots + a_{pm}F_m + \varepsilon_p \end{cases} \tag{1}$$

$a_{ij}(1 = 1,2 \dots, \mathrm{m}; \mathrm{j} = 1,2 \dots, \mathrm{p})$ is factor loads, means factor load of the i-th variable on the j-th principal factors, that is the extent of explanation by the i-th variable on the j-th aspect of competitiveness.

Factor Analysis Procedure

The process of factor analysis as follows [4,5]:

(1)The raw data were normalized to give a standardized matrix, denoted by X;

(2)Calculated correlation coefficient matrix by standardized matrix, denoted by R; Letbe |R-λE|=0, calculated eigenvalue of matrix R, contribution rate, accumulative contribution rate. Compute by the principle that eigenvalue not less than 1 or the cumulative variance contribution rate of not less than 85% determine the number of principal factors;

(3)Calculated eigenvector of matrix R and original component matrix, denoted by A ;

(4)Estimated factor scores by regression method, variance contribution rate of each factor accounting for the total factor variance contribution ratio as the proportion to get summary calculations ,and to obtain Factor Analysis Model;

(5)If the meaning factors expressed is not obvious, adopt varimax rotation to process initial factor by maximizing variances method, and then obtain the principal factors solution after the rotation[6];

(6)According to factor score of each sample, to build a comprehensive analysis and evaluation model.

Analysis of Practical Application

Based on the analysis of agricultural product B2C platform characteristics, summed up the index representative of the merits of competitive products, including the sales of commodities, price, number of popular, shop credit rating, and evaluation of commodity. After crawled items recorded more than 1,000 in agricultural products B2C platform, preprocess these data, content recording some of the products shown in Table 1.And then use SPSS analysis tools, analyze the competitiveness of products according to the procedure described above Factor Analysis.

Table 1 Content Recording Some of the Products in Agricultural Products B2C Platform

name of agricultural products	class of shop	product price	product sales	number of popular	product favorable rate	free shipping (yes/no)
flour of Natural sweet potato	2670	5.9	38	48	1	0
Northeast wild Hericium specialty	40852	36.8	17	121	1	1
Xiangtan dry cored lotus red seed	10460	27.8	1358	1190	0.993137	1
dried lily flower	11920	19.8	13	28	1	1
……	……	……	……	……	……	……

Analysis of Experimental Results

According to the results of the SPSS analysis, KMO value of 0.658 is greater than 0.6, Bartlett's test significant sig value is less than significance level 0.05, as shown in table 2. Therefore rejected the original hypothesis, the original data is suit for factor analysis.

Table 2 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.658
Bartlett's Test of Sphericity	Sig.	0.000

As shown in table 3, from agricultural products data records, extracting the 6 aspects to explain competitiveness of the products, which is 6 principal factors. The cumulative contribution rate of the top 3 principal factors F_1, F_2, F_3 value reached 84.024%(more than 80%), meanwhile the eigenvalue of principal factors F_1, F_2, F_3 greater than 1. That initial information each index of agricultural products lost fewer, the three principal factors can describe these indicators preferably. Notice the 3 principal factors cumulative contribution rate value of 45.386%, 21.357%, 17.282% respectively, these values show equilibrium state, so there is no necessity for rotation factor.

Table 3 Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	total	% of Variance	Cumulative %	total	% of Variance	Cumulative %
1	2.723	45.386	45.386	2.723	45.386	45.386
2	1.281	21.357	66.743	1.281	21.357	66.743
3	1.037	17.282	84.024	1.037	17.282	84.024
4	0.645	10.753	94.778			
5	0.267	4.442	99.220			
6	0.047	0.780	100.000			

On the analysis of the Component Matrix shown in table4, the 1st principal factor have larger load on index of the sales of commodities, number of popular, and class of shop, Most of these factors with shops about tolerance and level, denoted by Store credit factor . The 2nd principal factor have larger load on index of product price and free shipping, these factors related to the price of the product and service , denoted by ratio of performance to price factor. almost The 3rd principal factor have larger load on index of Product favorable rate, Mainly related to quality of user experience, denoted by degree of user approval.

Table 4 Component Matrix

	Component		
	1	2	3
the sales of commodities	0.959		
number of popular	0.954		
Class of shop	0.897		
Free shipping(yes/no)		0.816	
product price(yuan)		0.750	
Product favorable rate			0.947

According to the regression algorithm to calculate the coefficient of factor score, the component score coefficient matrix shown in table 5, the factor score function can be calculated for each principal factor score. The function is:

$$\begin{cases} F_1 = 0.331x_1 + 0.007x_2 + 0.336x_3 + 0.336x_4 - 0.015x_5 + 0.06x_6 \\ F_2 = -0.022x_1 + 0.624x_2 + 0.037x_3 + 0.053x_4 + 0.018x_5 + 0.614x_6 \\ F_3 = 0.001x_1 + 0.248x_2 - 0.022x_3 - 0.005x_4 + 0.918x_5 + 0.234x_6 \end{cases} \quad (2)$$

Table 5 Component Score Coefficient Matrix

	component		
	1	2	3
the sales of commodities	0.331	-0.022	0.001
number of popular	0.007	0.624	0.248
Class of shop	0.366	0.037	-0.022
Free shipping(yes/no)	0.366	0.053	-0.005
product price(yuan)	-0.015	0.018	0.918
Product favorable rate	0.060	0.614	-0.234

Competitiveness of agricultural products affected by 3 factors together, In order to measure the size of the product competitiveness, variance contribution rate of each factor accounting for the total 3 factor variance contribution ratios as the proportion to Calculate composite scores of agricultural products, and then establish commodities competitiveness evaluation model, that is:

$$F=\frac{45.386\%}{84.024\%}F_1+\frac{21.357\%}{84.024\%}F_1+\frac{17.282\%}{84.024\%}F_1 \quad (3)$$

Verification of Competitive Analysis Model

According to the results of agricultural competitiveness analysis, and commodities competitiveness evaluation model, Select 10 information of commodity record to test. According the formula (2), calculate each principal factor score shown in table 6, then based on the formula (3) Calculate the comprehensive composite score of each product sample, and sort them. The result has shown in table 7.

Table 6 Test Sample Data and its Principal Factor Score

number	Name of agricultural products	Class of shop	product price	Product sales	number of popular	Product favorable rate	Free shipping (yes/no)	score of Store credit factor	score of ratio of performance to price factor	score of degrees of user approval
1	Beet root	10177	25.8	79	131	0.996678	1	-0.33	0.161565	-0.08683
2	Peasant straight ladybell	125	32.8	4	0	0	1	-0.26764	0.144109	-5.24911
3	XiangLian centerless white lotus seed	1406918	30.8	12437	39431	0.994244	1	4.289182	0.60552	-0.203964
4	Undaria pinnatifida	98923	15.8	3069	11160	0.999194	0	0.556491	-1.1158	0.331524
5	Auricularia auricula-judae	12289	32.8	4148	2185	0.996946	1	0.351068	0.318506	-0.087977
6	Xiangtan lotus seed dry goods	22373	30.88	1763	1146	0.996936	1	-0.03201	0.25332	-0.076199
7	Wild hericium dry goods	30106	148	252	4460	1	1	-0.06955	1.659218	0.509443
8	Thou farmland ugly ear dry goods	2274461	23.8	7070	19008	0.999125	0	3.041334	-1.011	0.335502
9	dried longan	1058	5.96	1419	188	0.984925	0	-0.2691	-1.33037	0.231425
10	Salted fish dry goods	19786	25.5	209	361	0.995789	0	-0.41875	-1.11208	0.391553

Table 7 Chief Factors Scores of Commodities Competitiveness Evaluation

number	Name of agricultural products	score	ranking	number	Name of agricultural products	score	ranking
1	XiangLian centerless white lotus seed	2.428782	1	6	Xiangtan lotus seed dry goods	0.031425	6
2	Thou farmland ugly ear dry goods	1.454825	2	7	Beet root	-0.15504	7
3	Wild hericium dry goods	0.488949	3	8	Salted fish dry goods	-0.42832	8
4	Auricularia auricula-judae	0.252493	4	9	dried longan	-0.4359	9
5	Undaria pinnatifida	0.085169	5	10	Peasant straight ladybell	-1.18757	10

Conclusions

This research study on the current products competitive factors in agricultural B2C platform, and establish commodities competitiveness evaluation model. The conclusions are product competitiveness was mainly affected by store credit factor, ratio of performance to price factor, and degrees of user approval. From the results on verification of experiment, analysis of competitive factors in agricultural B2C platform is scientific and practical.

Acknowledgement

This research is supported by National Science-technology Support Plan Projects(NO. 2015BAD29B01) and the Fundamental Research Funds for the Central Universities(NO. Yxm2015193).

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