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Research Article

Core Competitiveness Analysis and Application of Shandong Tobacco Based on the Theory of Complexity

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Abstract: Grey correlation analysis is used to measure the factors affecting tobacco development and find the vital factors. We found that the illegal cases and customer number are the most important factors. Then, by using the grey correlation method to different parts of tobacco enterprises make a horizontal contrast, found that tobacco in Yantai for several ranked the sixth in the tobacco enterprises. Based on double oriented product differentiation strategy, we build the competitiveness ascending method research model. Game analysis is used to analyze the relationship between local government and the tobacco industry. Lastly, use centre of gravity method to calculate the location of the distribution centre, with network planning method to design logistics distribution network.

Keywords: Centre of gravity method, grey correlation analysis, network planning method, tobacco development

INTRODUCTION

There have been many studies on the tobacco industry. Chen and Zhang (2005) made the research on the management of the subsidiary material to tobacco suppliers, Jian (2011) considered the change of economic development mode in tobacco industry. (Junju, 2008) studied the modern mobacco agriculture development. Fucheng (2011) considered the development situation and production requirement in tobacco industry. But there is few studies on economic indicators of the tobacco industry.

In real life, there are many factors that can affect economic indicators (Tang, 2005; He and Xiang, 2004; Liu *et al*., 2010; Gong *et al*., 2011; Li *et al*., 2005). It is difficult to determine the biggest influencing factors on analysis indicators intuitively, so you need to use certain analysis method (Shuangying, 2009; Dongyun and Weizhong, 2010; Jinchang *et al*., 2008). Commonly used methods are regression analysis method, grey correlation method (Liu *et al*., 2010), neural network (Baoan and Hai, 2001), etc. One of the important applications of grey relation method is factor analysis. General regression, correlation method require large amount of data and its accuracy is directly proportional to the amount of data, which clearly are difficult to obtain in practical work, so this method is not good. Of less data requirements and the grey correlation method's principle is very simple, despite the deficiency of the regression method.

In this study, gray relational analysis method can be used to analyze affecting factors on Yantai tobacco development.

MATERIALS AND METHODS

Influence analysis of indicators of China's tobacco based on grey correlation: According to China's tobacco yearbook data from 2005 to 2010, sorting cost of raw data to be analysed: Yantai tobacco 2005-2010 indicators, shown in the Table 1:

According to the data in Table 1, with asset change rate to measure the development of Yantai tobacco each year and define it as a reference sequence $x_0(t)$. Other indicators, such as total employees, illegal cases, taxes and profits, profit, etc, are comparative sequences. Calculate the correlation of these comparisons of asset changing rate, then get the order of the factors which play an important role on the development of Yantai tobacco.

The first step, deal with the dimensional change of original data. Use average method to deal with the raw data. Average is calculated for each index and then each data is divided by the average of the column to get the new data sheet. The second step is to calculate the absolute difference between the columns and the reference column.

The absolute differences in other years are calculated separately, the maximum and the minimum of the absolute differences between the 2005 and 2010 are 3.0912 and 0.0112 respectively. And namely $\Delta(\max) = 3.0912$ and $\Delta(\min) = 0.0112$.

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Table 1: The raw data

	Asset change rate	Total employee	Hired employee	Sales	Tax and profit	Profit	Customer number	Illegal case
2005	0.1542	1358	725	98.5	30102	22329	30710	7149
2006	2.3899	1254	628	111.83	42476	31776	31518	5229
2007	0.4752	1282	631	124.26	63871	49967	32221	3704
2008	0.3756	1381	745	137.52	87137	69239	30780	1139
2009	0.1076	1378	763	145.00	102656	66575	30663	785
2010	0.4077	1327	755	150.78	116228	65604	30982	2138

Table 2: Correlation coefficient

	Total employee	Hired employee	Sales	Tax and profit	Profit	Customer number	Illegal case
2005	0.6681	0.6672	0.7489	0.9066	0.8908	0.6783	0.4528
2006	0.3646	0.3599	0.3588	0.3357	0.3393	0.3706	0.4259
2007	0.8744	0.9115	0.8710	0.9252	0.8659	0.8410	0.8109
2008	0.7755	0.7700	0.7617	0.7238	0.6684	0.7953	0.8733
2009	0.6442	0.6333	0.6194	0.5615	0.5792	0.6583	0.9644
2010	0.8118	0.7836	0.7420	0.6237	0.7049	0.8131	1.0000

Table 3: Correlation tables

	Total employee	Hired employee	Sales	Tax and profit	Profit	Customer number	Illegal case
Correlation	0.6898	0.6876	0.6836	0.6794	0.6748	0.6928	0.7546

The third step, calculate the correlation coefficient, take rho distinguish coefficient is 0.5, calculation formula is:

$$\xi_{0k}(t)=\frac{\Delta(\min)+0.5\Delta(\max)}{\Delta_{0k}(t)+0.5\Delta(\max)}$$

Take "Total employee" for example:

$$\xi_{01}(2005)=\frac{0.0112+0.5\times 3.0912}{0.7845+0.5\times 3.0912}=0.6681$$

In the same way get correlation coefficient respectively for other years (Table 2).

The fourth step, calculate correlation. Here we use average method, get the average of the correlation coefficient of each index of each period and use the average as the correlation of index and reference index. Still with "total employee" index for example, the correlation:

$$r_{01}=\frac{1}{5}\times(0.6681+0.3646+0.8744+0.7755+0.6442+0.8118)=0.6898$$

In this way get the correlation of other indicators are as follows:

Fifth, get the correlation order. From the data in Table 3, correlation with the growth rate of total assets is: illegal cases>customer number>total employee> hired employees>sales>taxes and profits>profits.

We can conclude that in many indicators, the biggest influence on enterprise development is illegal cases, followed by customer number, again is the number of employees, hired employees, sales, taxes and profits and again is profit. So in order to promote the development of Yantai tobacco, the first is to intensify the investigation of the illegal and criminal activities involving tobacco, minimize the amount of the illegal cases, maintain the good image of Yantai tobacco. In addition, promote the growth of customer number, continuously expand the market.

Lateral comparison of the tobacco unit development level based on grey correlation: Using grey correlation can be comprehensive evaluation indicators for tobacco enterprise. While elected index is core competitiveness indicator, the gray correlation can be used to evaluate the core competitiveness of the tobacco. Not only can order the core competencies, also can see where the gap between the target enterprise and benchmarking enterprises.

Similar to the above evaluation method, we need to choose the reference column, deal with the dimensional change of the data and strive for the absolute difference and correlation. The raw data as shown in Table 4.

Competitiveness ascending method research based on double oriented product differentiation strategy model: The so-called double oriented product differentiation strategy model includes two main bodies and the three elements. Two main bodies are competitors and customers, three elements are concept differentiation, attribute differentiation and service differentiation. Competitors and customers are important external factors affecting the differentiation strategy and the concept, properties and service are three directions of differentiation strategy.

The analysis of Yantai tobacco product differentiation strategy should be centered on product hierarchy analysis, with customer needs analysis, competitor analysis as the guidance. After the analysis of customers and competitors, carry on the design of the concept, properties and service, forming favorable difference and innovation, eventually translate into their own brand differentiation, form differentiation advantage within the industry. Therefore, double oriented product differentiation strategy element model as shown in the Fig. 1:

Game analysis of local government and the tobacco industry: The local government protects the local tobacco companies.

Table 4: Raw data

	Increase rate of profit	Asset	Profit	Sales	Employee	A/E
Yantai	1.46	210454	65604	481998	1327	26.29
Qingdao	1.18	298302	82405	568827	1410	24.19
Weihai	8.12	83110	24792	189174	596	24.04
Zhenzhou	18.98	188048	74073	587259	1875	31.05
Kaifeng	0.91	72258	19770	191544	907	44.03
Taiyuan	4.78	134934	52670	349439	744	15.40
Datong	5.79	83342	32597	219855	695	10.80
Yangquan	1.16	32336	9674	74043	221	22.52
Shenyang	3.05	227026	69911	501901	1477	7.720
Anshan	2.87	57045	18806	159657	492	8.110
Fushun	4.61	24982	10937	101331	339	3.330
Jilin	0.96	75071	32597	198629	785	13.51
Siping	1.21	45810	15281	132010	456	20.06
Kunming	9.3	681122	141030	506804	1591	29.68
Yuxi	11.69	526936	105373	145759	958	28.73
Qujing	5.29	840001	155963	343750	2699	38.71
Honghe	15.41	478285	87611	247758	1211	26.56
Changsha	7.32	272839	82174	543610	587	13.84
Zhuzhou	4.81	120359	39813	272440	707	4.660
Xiangtan	8.63	85603	31221	202509	341	6.410

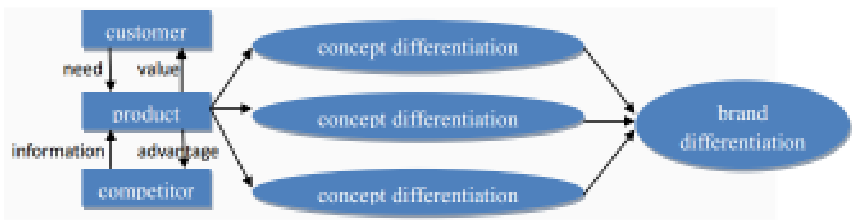

Fig. 1: Double oriented product differentiation strategy model

For tobacco enterprise in a place, facing the competition from tobacco companies in place B and government often have to take some protection measures, such as properly reduce local corporate tax and increase foreign corporate tax. Through revenue function analysis of a tobacco enterprise, tobacco companies and government, specific measures are concluded for government to protect a tobacco enterprise.

In this case, A government tax B company. Define the following symbol:

The market demand is Q; P1 and P2 is the market price of A and B; per unit product cost in B place is constant C2, its quality level is established as 1, the consumer consumption tobacco utility for B enterprise is 1r, consumers' B enterprise product consumer surplus for r - P2. Cost of investment level of enterprise A as I, as on the level of investment function C1 (I), the quality is also about the level of investment function Q (I), the utility of consumer spending A tobacco enterprise for Q (I) r, consumer spending A enterprise product consumer surplus for Q (I) r - P1; Q1 represents A enterprise production; Q2 represents exports of enterprises to export to A to B.

A product of inverse demand function is influenced by two enterprises' production, set it as:

$$P_1 = \alpha - \beta Q_1 - kQ_2 = \alpha - \beta Q + (\beta - k)Q_2$$

The inverse demand function B company product is influenced by two enterprises' production, set it as:

$$P_2 = \gamma - mQ_1 - nQ_2 = \gamma - mQ + (m-n)Q_2$$

A、β、γ、k、m、n are constant. When the market is equilibrium:

$$Q(I)*r - P_1 = r - P_2,\ P_2 = [1 - Q(I)]*r + P_1$$

Set of three sides respectively has the following strategy:

- A government decided to tax B corporate, tax rate is:

$$T = \{t \mid t_h, t_m, t_l\}$$

- A companies decide their own investment levels:

$$I = \{i \mid i_h, i_m, i_l\}$$

- B companies decide exports Q_2

Tripartite game order is: first of all A government decides to protect local enterprises, taxes foreign enterprises different levels of tax rates; then A enterprises determine their own investment level I, foreign enterprise B decided exports to export to A.

Above all, A payoff function of enterprise are as follows:

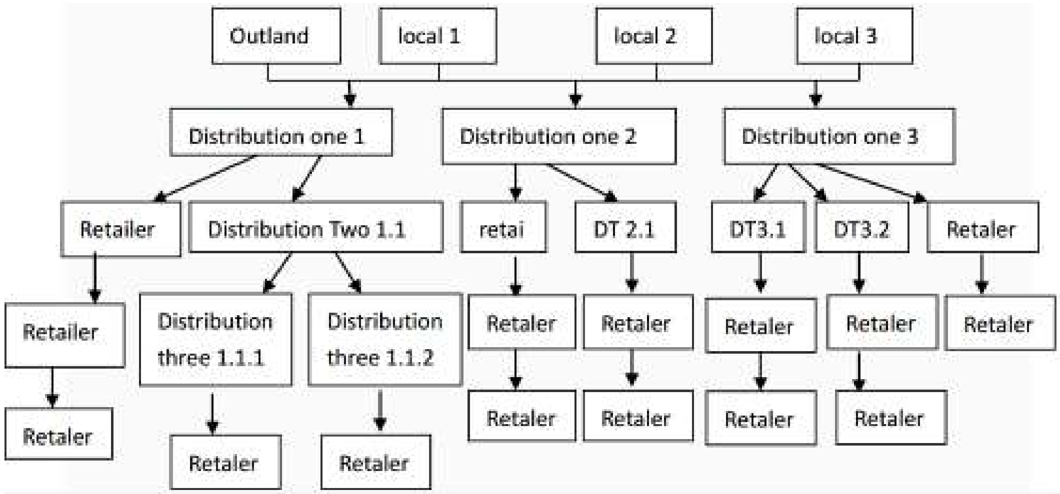

Fig. 2: Logistics distribution network diagram

$$\pi_1 = Q_1[P_1 - C_1(I)] \\ = (Q - Q_2)[\alpha - \beta Q + (\beta - k)Q_2 - C_1(I)]$$

B enterprise pay function is.

$$\pi_2 = Q_2(P_2 - C_2 - t)$$

A government's payoff function is:

$$W = C_s + \lambda \pi_1 + R_t$$

Among them: C_s is net surplus for consumers, π_1 as the producer surplus, R_t as tax revenues.

$$C_s = Q_1(Q_r - P_1) + Q_2(r - P_2) = Q(r - P_2)$$

$$\pi_1 = Q_1[P_1 - C_1(I)] \qquad R_t = tQ_2 \\ = (Q - Q_2)[\alpha - \beta Q + (\beta - k)Q_2 - C_1(I)]$$

To sum up:

$$W = Q(r - P_2) + \\ \lambda\{(Q - Q_2)[\alpha - \beta Q + (\beta - k)Q_2 - C_1(I)]\}$$

Logistics distribution network design with network planning:

The structure of distribution network: Tobacco products are different from other common products protected by the monopoly policy, the local government will protect local tobacco companies, making local tobacco and outland tobacco in competition in a dominant position. According to the tobacco circulation policy and the goal of distribution network planning and the characteristics of cigarette in China including many sales networks, small scale, customer changes frequently, set the cigarette distribution system into a multi-level one, expand coverage, increase the flexibility of the scheduling and the corresponding speed, improve the level of customer service.

A new distribution network structure as shown in the Fig. 2.

In which DT is shorthand for Distribution Two. What can be seen from the diagram is that, the cigarette out of the cigarette factories are sent directly to several primary distribution centers, then to their corresponding secondary distribution centers, again by secondary distribution center distribution to tertiary distribution center. Each layer of the distribution center can be delivery directly to retailers.

Distribution center location design:

Node position: In retail location and their demand for certain cases, by using gravity method that determines the location of the distribution center. Assuming that the number of distribution centers to determine, for k, for the distribution center location (x, y). n retailers, each retailer's distribution is Q_j, the coordinates (x_j, y_j), comprehensive weight W_j, among them j = 1, 2, 3, …, n.

Synthesis weights W_j represents delivery frequency G_j of the jth in the proportion of the sum of all retailers, formula is expressed as:

$$W_j = \frac{G_j}{\sum_{j=1}^{n} G_j}$$

Distribution center's coordinates by using gravity method:

$$\begin{cases} x\sum_{j=1}^{n} W_j Q_j = \sum_{j=1}^{n} W_j Q_j X_j \\ y\sum_{j=1}^{n} W_j Q_j = \sum_{j=1}^{n} W_j Q_j Y_j \end{cases}$$

Then we have:

Table 5: Retailer's information

Retail j	Coordinates (x_j, y_j)	Quantity Q_i	Delivery frequency G_j
1	(4, 0.5)	1000	1
2	(5.5, 2.5)	4000	4
3	(3.5, 2)	3600	4
4	(2, 3)	4500	5
5	(5, 5)	1200	2
6	(1, 4)	1700	2

Table 6: Comprehensive weights of retailer

Retail j	Comprehensive weights W_j
1	0.056
2	0.222
3	0.222
4	0.278
5	0.111
6	0.111

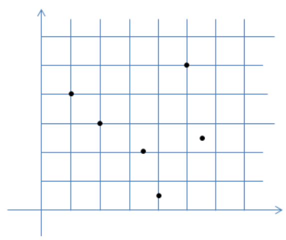

Fig. 3: Retailers in a region

$$\begin{cases} x=\dfrac{\sum_{j=1}^{n} W_j Q_j X_j}{\sum_{j=1}^{n} W_j Q_j} \\ y=\dfrac{\sum_{j=1}^{n} W_j Q_j Y_j}{\sum_{j=1}^{n} W_j Q_j} \end{cases}$$

Suppose there are 6 retailers in a region (Fig. 3):

There were two among them in the city and outside the city there are four, each retailer's information is shown in Table 5:

First of all, according to the delivery frequency we can calculate their comprehensive weights in Table 6.

Then calculate the distribution center coordinates using the formula (3.17, 2.54). Then in the area indicated by the coordinates, according to the specific circumstances, such as land property, surrounding traffic conditions and other information, further develop distribution center location.

Cigarette sales distribution route optimization: When the numbers of retailers, demand, daily delivery, as well as the suppliers' vehicles, transport capacity are known, on the premise of adequate supply, the minimum distance of transportation can be calculated.

Assume distribution center under study were responsible for M retailers, each retailer for demand from the distribution center was q_i, the distribution center has C distribution vehicles, speed for every car was v, load was Q, each shipping routes of distribution tasks need to be finished in time T. Each trading time for retailers was t, the transport distance of retailer i to j was D_{ij}, the transport distance for distribution center to the retailers was D_{oj}.

Assume there are R lines near the distribution center, the number of retailers responsible for the r line is M_r, H_r is the collection of retailers responsible for the r line, $H_r = \{h_{ri}| \, h_{ri} \in \{1,2,\ldots,M\}, i = 1,2,\ldots, M_r\}$ and h_{ri} represent that the delivery order of retailer h_{ri} in the path r is i, h_{r0} is distribution center. So can get the mathematical model of the following.

$$\min Z = \sum_{r=1}^{R} \left(\sum_{i=1}^{M_r} D_{h_{r(i-1)}h_{ri}} + D_{h_{r0}h_{rM_r}}\right)$$

$$\begin{cases} \sum_{i=1}^{M_r} q_{h_{ri}} \le Q & ① \\ \dfrac{\sum_{i=1}^{M_r} d_{h_{r(i-1)}h_{ri}} + d_{h_{r0}h_{ri}}}{v} + M_r \times t \le T & ② \\ R \le C & ③ \\ \sum_{r=1}^{R} M_r = M & ④ \\ 0 \le M_r \le M & ⑤ \\ H_{r1} \cap H_{r2} = \Theta(\forall r_1 \ne r_2) & ⑥ \end{cases}$$

Take minimum the sum of all the line distance according to objective function, each line contains two parts back and forth.$D_{h_{r(i-1)}h_{ri}}$ represent the distance between retailer $h_{r(i-1)}$ and retailer h_{ri}, $D_{h_{r0}h_{rn_r}}$ represent the distance between distribution center h_{r0} and the r line of the last retailer h_{rn_r}. h_{ri} represent the i retailer on the r line.

The first constraint represents each route of no more than the distribution of vehicle load distribution.

The second constraint conditions of each line distribution task should be finished within the prescribed period of time, inequality left two parts respectively, represents the total transportation time and transaction time.

The third constraint represents transportation quantity does not exceed the number of transport vehicles.

The fourth constraint conditions to meet the needs of each retailer.

The fifth constraints the retailer represents each route number less than total Numbers of retailers in the region.

The sixth constraints represents each retailer can only exist in a line.

The model solving process is as follows:

- All retailers are connected to the distribution center, the assumption of each line corresponds to a retailer, computing the total distance.
- Choose two points connected to a line, the new line saves S(i, j) than the two lines before, where $S(i,j) = 2(D_{0i} + D_{0j}) - (D_{0i} + D_{ij} + D_{0j}) = D_{0i} - D_{ij} + D_{0j}$
- Calculate all $S(i, j)$, a total of a C_N^2. Whether changes in each line must be reasonable? Retailers i, j and the distribution center can form a triangle, because both sides is greater than the sum of the third principle of reason and always less than the distance between distribution center and the distance to the two retailers, namely $S(i, j)>0$, therefore looked from the distance to improve each line is reasonable. This line to improve is marked as collection $S = \{S(i,j)| S(i,j)>0\}$.
- Order the elements in the set S from big to small, namely according to improve the degree of size.
- When S for the empty set, calculation ends. Otherwise calculate each line to improve $S(i, j)$ is to meet the other conditions, such as the limitation of transport capacity and transport time limit.

CONCLUSION

For the analysis of Yantai tobacco core competitiveness, this study puts forward some suggestions.

First of all, use the grey correlation method to calculate the closest Yantai tobacco development factors, namely "the illegal cases" is the most important factor in the development, the second is the " customer number", so tobacco companies need to strengthen legal education and discipline, put an end to the occurrence of illegal cases, maintaining corporate reputation.

Then, by using the grey correlation method to different parts of tobacco enterprises make a horizontal contrast, found that tobacco in Yantai for several ranked the sixth in the tobacco enterprise, to Yantai tobacco, sales, number of customers and the market share these three indicators in a dominant position. As total assets, profits growth rate was only about half of the optimal value indexes such as the need to intensify efforts to improve.

This study uses game theory to prove the relationship between government and enterprises, gives the mathematical model of the government protecting local tobacco companies.

Last part of the article designs the distribution center location and logistics distribution process, using center of gravity method to calculate the location of the distribution center, optimize the transportation lines and the choice of transport also gives a method, simulated by an example.

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REFERENCES

Baoan, Y. and J. Hai, 2001. Commercial bank loans risk early warning system based on artificial neural network. Syst. Eng. Theor. Pract., 5: 70-74.

Chen, R. and W. Zhang, 2005. The research on the management of the subsidiary material to tobacco suppliers. J. Kunming Metall. Coll., 6: 62-65.

Dongyun, Y. and W. Weizhong, 2010. Study review on regional innovative efficiency. Technol. Econ., 29(10): 44-48.

Fucheng, W., 2011. Development situation and production requirement in tobacco. Jilin Agricult., 23(8): 104-104.

Gong, H., Y. Gong and L. Yuan, 2011. Evaluation on information sharing level between manufacturer and supplier based on BP neural network. J. Modern Info., 31(1): 40-43.

He, Y. and L. Xiang, 2004. Study and application of BP neural network model based on fuzzy clustering. Eng. Theor. Pract., 2: 79-82.

Jian, S., 2011. Consideration on the change of economic development mode in tobacco industry. China Mark., 17(12): 62-63.

Jinchang, L., W. Jilin and C. Guotai, 2008. The evaluation of economic development based on entropy AHP. Stat. Decis., 24(19): 70-72.

Junju, L., 2008. Consideration on the modern tobacco agriculture development. J. Hebei Agric. Develop., 20(9): 108-110.

Li, J., Y. Hu and X. Tao, 2005. Recognition method based on principal component analysis and back-propagation neural network. Infrared Laser Eng., 34(6): 719-723.

Liu, T., H.X. Tian and W. Guo, 2010. Application of PCA to diesel engine oil spectrometric analysis. Spectrosc. Spect. Anal., 3(30): 779-781.

Shuangying, W., 2009. Study review on innovation efficiency in high technology industry. China High Tech. Enterp., 15(8): 3-4.

Tang, W., 2005. The study of the optimal structure of BP nueral network. Eng. Theor. Pract., 10: 95-100.