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Study on Comprehensive Performance Assessment for Listed Tourism Company Based on Principal Component Analysis

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Abstract: Tourist industry plays a greater and greater role in the economic development in China. In order to learn about the comprehensive strength of the listed tourism company, the principal component analysis has been applied to carry out the comprehensive performance assessment for six listed tourism company, which will be favorable for their improvements through finding out the gaps between the groups through data analysis.

Key words: Principal component analysis, factor analysis, comprehensive assessment

INTRODUCTION

Tourist industry plays a more and more significant role in the economic development in China, as an important component in the tertiary industry, while the listed tourism company plays a decisive role in the whole tourism enterprise. For the tourism enterprises in China, it is quite significant to strengthen the study on the performance evaluation, which will contribute to improving the quality of investment decision-making, establishing fair and effective enterprise restriction mechanism and incentive mechanism and making correct business measures and development strategy, be favorable for the long-term development of tourist enterprise, as well as the acceleration of Chinese economic construction (Cen, 2000).

At present, quite a few achievements have been obtained in the studies targeting at the performance evaluation of listed company and it also tries to analyze with different mathematic modes, including additive weighting method, TOPSIS, method, linear distribution method, fuzzy comprehensive evaluation method, AHP, etc. (Qin and Dou, 2007; Chen, 2005). All these mathematic models have their own advantages, as well as disadvantages. In this study, the principal component analysis model was applied to evaluate the performance of listed tourism company, trying to find out the deficiencies of each tourism company to help improve.

Since the tourism industry is characterized by comprehensive characteristic and its major business mainly includes the hotel management, food service, vehicle leasing service, travel agency and adverting agency. Therefore, the listed tourism company can be divided into hotels, scenic spots and comprehensive types, among which, the listed comprehensive tourism company expands its business scope through enterprise diversification and horizontal integration on the premise of operating the tourist industry. Therefore, besides the traditional tourism income, such as the catering, accommodation, tickets, etc. these listed comprehensive tourism company also operates business in various industries, such as finance, real estate, logistics, advertisement, general merchandise, high technology. Consequently, such listed tourist company is much stronger in anti-risk capability than that relying on the traditional business. In this study, the evaluation target is the listed comprehensive tourism company.

Establishment of comprehensive performance assessment model for listed tourism company based on principal component analysis

Selection of comprehensive performance evaluation index for the listed tourism company: In this study, based on the characteristics of the listed tourism company and the traditional performance evaluation index for the listed company, the following eight indexes have been selected as the comprehensive performance evaluation index of the

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listed tourism company, namely basic earnings per share (x1), basic earnings per share after deducting the non-recurring profit and loss (x2), weighted average net assets returns ratio after deducting the non-recurring profit and loss (x3), total asset (x4), net asset yield (x5), net profit belonged to the shareholders of listed company (x6), business income (x7) and net cash flow generated in business activities (x8).

Procedures of establishing the mathematical model for principal component analysis (Zhao *et al.*, 2007; Li *et al.*, 2006; Chen, 2001; Cao, 2000): The concept of principal component was firstly introduced in 1901 by Karl Person and at that time, it was only discussed by aiming at the nonrandom variable. In 1993, it was promoted to the random vector by Hotelling in 1993 (Qin and Dou, 2007). The principal component analysis refers to a kind of multivariate statistical analysis of integrating the information scattering on a group of variables onto several comprehensive indexes (namely the principal component) and the comprehensive index obtained is the linear combination of the original variables, which can make it convenient for describing the internal data structure with the principal component.

The procedure for establishing the mathematical model of principal component analysis has been shown as follows:

- Establish a p-dimensional random vector constructing by p indexes $X = (x_1, x_2,..., x_p)^T$ and an original data matrix $X = (x_{ij})_{n\times p}$ formed by n evaluation plans
- Carry out the standardization processing for the original data matric, aiming at eliminating the dimensional influence, as well as the differences of each index in order of magnitudes and Eq. 1 will be employed for processing:

$$X_{ij}^{*} = \frac{X_{ij} - \overline{X}_j}{S_j} \tag{1}$$

where, X_{ij}^{*} is the data of X_{ij} after standardization processing, $\overline{X}_j$ is the sample average of the j index and S_j is the sample standard deviation of j indexes.

On that basis, the standardization matrix Z is obtained:

$$Z = \begin{bmatrix} z_1 \\ z_2 \\ \vdots \\ z_n \end{bmatrix} = \begin{bmatrix} x_{11}^{*} & x_{12}^{*} & \cdots & x_{1p}^{*} \\ x_{21}^{*} & x_{22}^{*} & \cdots & x_{2p}^{*} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1}^{*} & x_{n2}^{*} & \cdots & x_{np}^{*} \end{bmatrix}$$

- Calculate the correlation coefficient matrix $R = (r_{ij})_{p\times p}$ of standardization matrix Z, in which r_{ij} is the correlation coefficient of X_i^{*} and X_j^{*}
- Work out p characteristic values of correlation coefficient matrix R $\lambda_1 \geq \lambda_2 \geq .... \geq \lambda_p > 0$, as well as the corresponding characteristic vector $u_1, u_2,..., u_p$, in which, $u_i = (u_1, u_2,..., u_p)$, i = 1, 2,…, p.

Accordingly, p principal components can be obtained:

$$Y_i = u_{i1}X_1^{*} + u_{i2}X_2^{*} + \cdots + u_{ip}X_p^{*} \tag{2}$$

where, Y_i is the ith principal component.

The characteristic value λ_i of the ith principal component Y_i is the variance of this principal component. The greater the variance is, the greater the contribution of total variation will be and the contribution rate is:

$$\alpha_i = \lambda_i / \sum_{k=1}^{p} \lambda_k \tag{3}$$

α_i reflects the percentage of the comprehensive original variable information of the i^{th} principal component:

- Determine the final principal component and take the variance contribution of each principal component as the weight to contrast the comprehensive evaluation function. Select the minimum integral m of the cumulative contribution rate:

$$\sum_{i=1}^{m} \alpha_i \geq 85\%$$

At this moment, the front m principal component would be determined for constructing the comprehensive evaluation function. Namely:

$$f = \alpha_1 Y_1 + \alpha_2 Y_2 + \cdots + \alpha_m Y_m \tag{4}$$

Empirical analysis of the performance evaluation for listed tourism company

Each index evaluation value of the listed tourism company: In this study, six listed comprehensive tourism company have been selected and the annual report of each tourism company in 2012 has been regarded as the major reference frame and then each index evaluation value of the six listed tourism company has been obtained, as shown in Table 1.

Table 1: Each index evaluation value of listed tourism compan

Name	Basic share earnings per (Yuan)	Basic earnings per share after deducting the non-recurring profit and loss (Yuan)	Weighted average net assets returns ratio after deducting the non-recurring profit and loss (%)	Total asset (Yuan)	Net Asset Yield (%)	Net profit belonged to the shareholders of listed company (Yuan)	Business income (Yuan)	Net cash flow generated in business activities (Yuan)
CYTS	0.7100	0.6500	11.77	777, 819, 43	12.83	29, 521.60	1, 027, 989, 84	25, 031.82
Xi'an tourism	0.0800	0.0610	1.70	626, 583, 462.28	3.54	15, 731, 097.0	851, 230, 033.12	73, 157, 480.26
CITS	0.8400	1.0600	18.10	8,930, 269, 704.25	16.80	1, 05, 639474.30	589, 582, 321.58	1, 272572562.35
CUTC	1.1430	1.0600	18.15	8,930, 269, 704.25	19.56	5, 600, 456, 684.36	16, 133, 919, 927.84	1, 272, 572,562.35
Beijing capital tourism	0.4857	0.5057	11.81	2,255, 545, 774.28	10.98	112, 380, 442.95	3,040, 758122.32	337, 082, 095.92
Tibet tourism	0.0618	0.0610	1.70	1,126,822,231.71	1.72	11,191,853.31	162, 620, 227.28	81, 053975.31

Table 2: Standard data table of each index value

Name	Basic share earnings per (Yuan)	Basic earnings per share after deducting the non-recurring profit and loss (Yuan)	Weighted average net assets returns ratio after deducting the non-recurring profit and loss (%)	Total asset (Yuan)	Net Asset Yield (%)	Net profit belonged to the shareholders of listed company (Yuan)	Business income (Yuan)	Net cash flow generated in business activities (Yuan)
CYTS	0.364	0.186	0.166	-0.863	0.271	-0.430	-0.537	-0.837
Xi'an tourism	-1.101	-1.125	-1.193	-0.731	-1.037	-0.423	-0.418	-0.716
CITS	0.666	1.099	1.021	1.271	0.830	-0.383	-0.459	1.268
CUTC	1.371	1.099	1.027	1.271	1.219	2.041	2.011	1.268
Beijing capital tourism	-0.157	-0.135	0.172	-0.338	0.011	-0.380	-0.070	-0.280
Tibet tourism	-1.143	-1.125	-1.193	-0.610	-1.294	-0.425	-0.527	-0.703

Table 3: Related coefficient table of standard data

	X^*_1	X^*_2	X^*_3	X^*_4	X^*_5	X^*_6	X^*_7	X^*_8
X^*_1	1.0000	1.0304	1.0420	1.3049	1.0115	1.4716	1.5017	1.2775
X^*_2	0.9705	1.0000	1.0117	1.1936	1.0154	1.8200	1.8669	1.1723
X^*_3	0.9597	0.9885	1.0000	1.2492	1.0147	1.9384	1.9066	1.2190
X^*_4	0.7664	0.8378	0.8005	1.0000	1.2767	1.5743	1.6193	1.0013
X^*_5	0.9886	0.9848	0.9855	0.7832	1.0000	1.6457	1.6448	1.2436
X^*_6	0.6795	0.5494	0.5159	0.6352	0.6076	1.0000	1.0126	1.5776
X^*_7	0.6659	0.5357	0.5245	0.6175	0.6080	0.9875	1.0000	1.6097
X^*_8	0.7828	0.8530	0.8203	0.9987	0.8041	0.6339	0.6212	1.0000

Table 4: Corresponding characteristic value and variance contribution rate of each principal component

No. of principal component	Characteristic value	Variance contribution rate	Cumulative variance contribution rate
1	6.4181	0.8023	0.8023
2	1.0664	0.1333	0.9356
3	0.4821	0.0603	0.9958
4	0.0289	0.0036	0.9994
5	0.0045	0.0006	1.0000
6	0.0000	0.0000	1.0000
7	0.0000	0.0000	1.0000
8	0.0000	0.0000	1.0000

Comprehensive evaluation of the performance of listed tourism company with principal component analysis

Standardization process for the original data: Standardization processing has been conducted for the data in Table 1 with Eq. 1 and the result is shown in Table 2.

Calculate the related coefficient matrix of the standard data: The related coefficients have been calculated for the data in Table 3 and the results were listed in Table 3.

Calculate the characteristic value, characteristic vector and each variance contribution value: The Eig function of MATLAB7.0 software has been adopted for calculation to work out the characteristic value and characteristic vector of each principal component. Please refer to the characteristic value and variance contribution rate of each principal component in Table 4.

As shown in Table 4, the variance contribution rate of the first principal component is 80.23%, which that of the second principal component is 13.33%. The cumulative contribution rate of the first and second principal component reaches 93.56%. Therefore, only the first and second principal components are selected as the final principal component.

And calculate the characteristic vector and obtain:

$$Y_2 = -0.1830x_1 - 0.1787x_2 + 0.4296x_3 + 0.0205x_4 - 0.5084x_5 - 0.1211x_6 - 0.6224x_7 + 0.2986x_8$$

Table 5: Comprehensive performance evaluation result of the six listed tourism companies

Listed tourism company	f-value	Rank
CYTS	-0.65793	6
Xi'an tourism	-0.15296	4
CITS	0.04883	2
CUTC	1.19041	1
Beijing capital tourism	-0.32780	5
Tibet tourism	-0.10010	3

$$Y_2 = -0.1830x_1 - 0.1787x_2 + 0.4296x_3 + 0.0205x_4 - 0.5084x_5 - 0.1211x_6 - 0.6224x_7 + 0.2986x_8$$

Constructing comprehensive evaluation function: According to the above analysis, the comprehensive evaluation function is determined as:

$$f = 0.8023Y_1 + 0.1333Y_2 \quad (5)$$

Evaluation of comprehensive performance of listed tourism company with the comprehensive evaluation function: The performance of the six listed tourism companies has been evaluated comprehensively with Eq. 5 and the evaluation result is shown in Table 5.

The gap between these listed tourism companies can be seen clearly from the table, among which, CUTC has the strongest comprehensive strength.

In this study, the principal component analysis has been applied to carry out the comprehensive assessment for the performance of six listed tourism companies. It can be seen from the analysis that it receives good result by applying the principal component analysis in the comprehensive assessment for the performance of listed tourism company and it can be promoted to a certain degree.

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