IMPLEMENTATION OF MULTIDIMENSIONAL ANALYTICAL METHODS TO COMPARE PERFORMANCE BETWEEN SPA FACILITIES

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Abstract

In financial management it is often necessary to compare the position of similar companies in a competitive market space. The use of multidimensional methods in such a case is desirable. This paper discusses the implementation of multivariate methods which allow the comparison of spa facilities in the Slovak Republic. The spa facilities operating in the Slovak Republic according to the Statistics Classification of Economic Activities (SK NACE) belong to the section 869 - Other health care. The paper deals with the 21 spa companies in the Slovak Republic. The rating of these companies is the contribution realized by defined criteria that represent proportional financial indicators such as basic production strength of an enterprise, return on sales, financial performance and financial productivity of one employee. Financial and economic position of the company in the space is realized on the basis of the order method, the scoring method, the normalized variable method and the method of distance from a fictitious object. As a result, the market order of the spa facilities is set. In addition multidimensional scaling is applied to show similarities in the group of 21 spa facilities in a two-dimensional space.

Key words: spa facilities, competition, financial indicators, multidimensional scaling

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Introduction

Spas are becoming a global phenomenon, even though in general we do not have many information and evidence describing its scale. Spa services are the fastest growing leisure industry. Thanks to the quality services and proven therapeutic effects, Slovak Republic has a significant position among the world's countries in providing spa services.

The spa development can be viewed from different perspectives and disciplines, especially hydrology, history, culture, politics, balneology, climatology. According to the water register at the Ministry of Health of the Slovak Republic, 1,657 mineral springs are

documented in our territory, 112 of which are recognised as suitable for the purpose of filling in containers and medical care. At present, Slovak spa companies are mainly providers of health and medical services with proven therapeutic effects and significant improvement of patients' health. Not only internal business performance, but also the expansion of supply is essential in context of spa firms. Rajnoha et al. (2016) deals with measuring and managing business performance. In recent years, the competitive environment has increased the importance of other additionally offered services. When undertaking comparisons, one should have available data for businesses in the same industry. Zalai et al (2013) describes the terms of comparability which include the materials produced, format of operations, time period and size of businesses being compared. Under conditions comparable to the same: design parameters; balance sheet policy; time period; business activity; and macroeconomic framework. Dluhošová (2008) points out that important roles of financial management include: ensuring sufficient financial resources are available; ensuring they are used effectively; and aligning solvency (liquidity), capital structure (debt) and financial performance (profitability) in order to achieve financial balance.

1   Multi-criteria evaluation

The aim of all methods of multi-criteria evaluation is the transformation and synthesis of values for different variables into one integral indicator that comprehensively expresses the activity level of individual companies in the surveyed sample. The methods differ both, first of all, in sub-points, and the method of aggregation of these sub-points in the overall evaluation (Zalai et al, 2013).

Business evaluation is, in practice, often implemented on the proportional financial metrics of the company. This paper identifies four criteria: First, Return on Assets (ROA), which is the basis of production value (Basic Earning Power); earning power of the enterprise quantifying the amount generating an operating profits before interest and taxes (EBIT) from one monetary unit average balance of assets at the period's end; stocks, which represent how the assets change during the period in size, usually growing; and, EBIT as a flow variable accumulating throughout the year. The second criterion is the operating profit margin, or Return on Sales (ROS), which quantifies how many monetary units of profit fall on one unit of sales. When comparing different companies in the design of this indicator, we refer to earnings before interest and taxes (EBIT) before Net profit (Earnings After Taxes, EAT). This indicator is also referred to as the profit margin or rate of return on sales. The indicator ROS

is particularly interesting in the fields of marketing and pricing policy. The third criterion is the share of personal costs on sales and the forth criterion represent the share of added value on the net turnover of the facility. (more in Jenčová, 2016)

1.1   Multivariate Methods

The recent developments of the global economy have affected the thinking and decision-making of many economic entities. The attention of them has shifted to various methods and tools that allow reliable identification of companies' financial situation and stability and effectively affect them (Kubíčková, 2015). Multivariate methods of comparison between companies pursue a goal to gain a comprehensive picture of the status of enterprises based on multiple financial indicators. An example may be e.g. research by Lofti et al. (2014), who evaluate hospital performance by applying multivariate techniques, to compare similarities and differences between these methods and suggest the most comprehensive and practical method of appraisal. Zmeškal and Dluhošová (2015) points out problems with multi-criteria decision making in finances and economics. In the area of financial decision-making, it is necessary to take into account more than one criterion.

Multivariate methods are based on fundamental characteristics, such as arithmetic means, variances, standard deviations, coefficients of variation and variation margins. Multivariate methods allow the assessment of phenomena by applying different methods. When scoring, the method for each i-th company is on each monitored variable $x_{i,j}$. The analysis seeks the best value, which is selected for the item being analysed. When productivity indicators achieve maximum level, as is given by equation (1), the variable's intensity minimum value is determined according to equation (2). The values of this indicator are based on points (nearby) under the above relationships, as determined by linear interpolation. In this method, normalized variables are the original values of selected indicators converted into a normalized form. When normalized methods are calculated, first by x_{pj} arithmetic means, the standard deviation and variance are calculated for each indicator separately. From the original value, the arithmetic mean is subtracted and the difference is divided by the standard deviation. Normalized value of the j-th indicator of the i-th company with a positive higher value is given by equation (3), and with a positive lower value is given by equation (4). Companies according to this method are listed in order from the smallest deviation from the normalized shape of standard deviation to the largest, (Jenčová et al, 2017). To obtain the most accurate results, the multi-criteria method utilizes a fictitious distance from the object, which indicates the distance of the company from the ideal, with

regards to all indicators, i.e. their criteria; it being understood that the lower the value the enterprise reaches, the better the score. All variables are expressed in normalized shape. Subsequently distance calculations, from each object to the fictitious object, are Euclidean. Spa enterprises are compared on the basis of equation (6), (Kubíčková and Jindřichovská, 2015).

$$b_{ij} = \frac{x_{ij}}{x_{i\,max}} \cdot 100 \qquad (1)$$

$$b_{ij} = \frac{x_{i\,min}}{x_{ij}} \cdot 100 \qquad (2)$$

$$u_{ij} = \frac{x_{ij} - x_{pj}}{\delta_j^2} \qquad (3)$$

$$u_{ij} = \frac{x_{pj} - x_{ij}}{\delta_j^2} \qquad (4)$$

$$\delta^2 = \frac{1}{n} \sum_{i=1}^{n} (x_{ij} - x_{pj})^2 \qquad (5)$$

$$k_{ij} = \sqrt{\sum_{j=1}^{m} (u_{ij} - u_{oj})^2} \qquad (6)$$

As Cox and Cox (2001) point out, multidimensional scaling (MDS) is the search for a low dimensional space, usually Euclidean, in which points in the space represent the objects and such that the distances between the points in the space d_{rs} match, as well as possible, the original dissimilarities δ_{rs}. The techniques used for the search for the space and the associated configuration of points form metric and nonmetric multidimensional scaling. The basic criterion for assessing the quality of the solution found is *stress* function. The *stress* function used by Kruskal (1964) is often referred to as *stress1*. An alternative *stress* function is sometimes employed in nonmetric MDS given by

$$STRESS2 = \frac{\sum_{r,s} \left(d_{rs} - \hat{d}_{rs} \right)^2}{\sum_{r,s} \left(d_{rs} - d_{..} \right)^2}, \quad 1 \le r < s \le n, \qquad (7)$$

where $d_{..}$ is the mean of the distances d_{rs}. This is referred to as *stress2*, where $\hat{d}_{rs}$ are the fit values. It was seen that the monotonic least squares regression of d_{rs} on δ_{rs} portioned δ_{rs} into blocks in which the values of $\hat{d}_{rs}$ were constant, and equal to the mean of the corresponding d_{rs} values. Guttman (1968) took a different approach to Kruskal (1964) in defined a loss function called coefficient of alienation, which is basically equivalent to *stress* but which led

to different algorithm of minimisation. Because of the complicated nature of *stress* when seeking a minimum, several authors have studied *stress* in more detail. All the *stress* studies have shown that *stress* decreases with increase of dimension *p*, increases with the number of points *n*, and that there is not a simple relationship between *stress*, *n* and *p*. (Cox and Cox, 2001).

Our data have been analysed by using PROXSCAL algorithm in IBM SPSS ver. 20. PROXSCAL performs multidimensional scaling of proximity data to find a least-squares representation of the objects in a low-dimensional space. Individual differences models can be specified for multiple sources. A majorization algorithm guarantees monotone convergence for optionally transformed, metric and nonmetric data under a variety of models and constraints. (Commandeur and Heiser 1993). Formulas for used stress functions *stress I*, *stress II* and *stress S* can be found in IBM SPSS help (link in references).

2   Results and discussion

The chapter is focused on comparison of the spa facilities located in Slovakia. Four proportional financial indicators were applied to set order of the spa companies. Three indicators represented productivity and one of them represented a metric of difficulty. The indicators of productivity are represented by the share of added value in the total net turnover, by basic productive strength of a particular facility quantified by the share of the profit before taxation and by the interest of the total property of the enterprise. The indicator of profitability of sales is measured by EBIT. The financial indicator of difficulty in particular companies is measured by the share of personal costs in the net turnover. The entering data are obtained from the Register of Balancing. On the basis of those data the average, standard deviation and coefficient of variation for ratio financial indicators are calculated. According to the method of rating of financial metrics the best spas are Bojnice Spa, Inc., Lúčky Spa, Inc. and Dudince Spa, Inc. The last three spas are Červený Kláštor-Smerdžonka Spa, Ltd., Číž Natural Iodine Spa, Inc. and Sliač Spa, Inc.

The scoring method showed that the best spas are Bojnice Spa, Inc. (96.24 points), Lúčky Spa, Inc. (68.29 points), Slovak Healing Spa Rajecké Teplice, Inc. (65.21 points) and Dudince Spa, Inc. (61.24). The lowest score belongs to Brusno Spa, Inc., Číž Natural Iodine Spa, Inc., Vyšné Ružbachy Spa, Inc. and Červený Kláštor-Smerdžonka Spa, Ltd. (108 points).

The total order of companies was set on the basis of normalized values calculated from the entering data that gave the average values of normalized quantities. The normalized

variable method showed that the first three places are taken again by Bojnice Spa, Inc., Lúčky Spa, Inc. and Dudince Spa, Inc.. Natural Healing Červený Kláštor-Smerdžonka Spa, Ltd. with the annual turnover 0,452 is in the 19ᵗʰ place, Sliač Spa Inc. with the annual turnover 3,369 mil. EUR is in the 20ᵗʰ place. The last is Brusno Spa, Inc. with the annual turnover 3.08 mil. EUR in the year 2016.

The analysis of the method of distance from a fictitious object showed, that the longest distance is for Brusno Spa, Inc. (3.896), Sliač Spa, Inc. and Natural Healing Červený Kláštor-Smerdžonka Spa, Ltd.. The shortest distance is for Bojnice Spa, Inc. (0.243), Lúčky Spa, Inc. (0.776), Dudince Spa, Inc. (0.820), Slovak Healing Piešťany Spa, Inc. (1.060).

Table No 1 shows the order of spa companies in Slovakia on the bases of applying a particular method of multi-criteria evaluation. On the basis of calculated values of Spearman's rank correlation coefficient it is possible to state that the order of individual spa companies correspond with the application of the order method (A), scoring method (B), normalized variable method (C) and the method of distance from a fictitious object (D). Calculated correlations are: A~B 0.977, A~C 0.888, A~D 0.725, B~C 0.868, B~D 0.666, C~D 0.905, all significant at level 0.001.

Tab. 1: The order of spa companies on the bases of multidimensional methods

| Spa	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
A	10	12	16	8	4	1	3	9	2	5	21	15	14	18	17	11	6	20	7	13	19
B	11	10	14	6	3	1	4	9	2	5	19	15	16	21	17	12	7	20	8	13	18
C	5	12	15	6	4	1	3	11	2	13	20	14	8	21	16	10	7	18	9	17	19
D	4	15	16	8	11	1	3	13	2	17	19	10	5	21	12	7	6	18	9	14	20

Note: 1 - Slovak Healing Spa Piešťany, Inc., 2 - Slovak Healing Spa Turčianske Teplice, Inc., 3 - Trenčianske Teplice Spa, Inc., 4 - Bardejov Spa, Inc., 5 - Slovak Healing Spa Rajecké Teplice, Inc., 6 - Bojnice Spa, Inc., 7 - Dudince Spa, Inc., 8 - Nimnica Spa, Inc., 9 - Lúčky Spa, Inc., 10 - Specialized Medical Institution Marína Kováčová, stated owned enterprise, 11 - Sliač Spa, Inc., 12 Vyšné Ružbachy Spa, Inc., 13 - Lučivná Spa, Inc., 14 - Brusno Spa, Inc., 15 - Slovthermae Diamant Dudince Spa, stated owned enterprise, 16 - Nový Smokovec Spa, Inc., 17 - Štós Spa, Inc., 18 - Natural Healing Iodine Číž Spa, Inc., 19 - Kováčová Spa, Ltd., 20 - Horný Smokovec Spa, Ltd., 21 - Natural Healing Červený Kláštor-Smerdžonka Spa, PIENINY RESORT, Ltd.
Source: own calculation.

Multidimensional scaling of 19 spa resorts (except two extreme points Pieniny resort and Brusno) results to solution in two dimensional space. This optimal solution provides values of stress functions: *stress-I* equals 0.0613, *stress-II* equals 0.1292 and *S-stress* equals 0.0047. According to the rule of the thumb proposed by Kruskal (1964) it means not excellent, but good solution. However, more recent articles caution against using this rule since acceptable values of stress depends on the quality of the distance matrix and the number of objects in that matrix. Final configuration of multidimensional scaling presented in Figure

1 after comparison with input data leads to interpretation: dimension 1 indicates points with higher values of ROA and ROS on the right side and dimension 2 can be perceived more by values AV/S (higher up) like values PC/S. Interesting is that lower PC/S values lie below the line $y=x$, higher above it.

Fig. 1: Final configuration of spas in the two-dimensional space
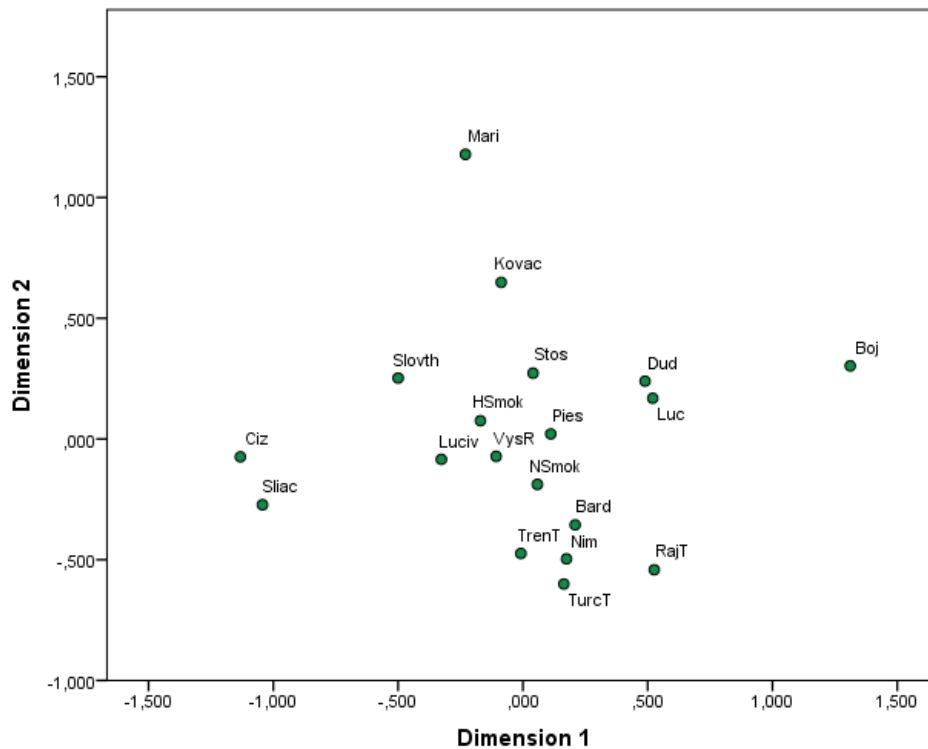
Source: own calculation in IBM SPSS 20

Conclusion

The paper is focused on implementation of multivariable methods in the area of financial and economic analyses, on comparison of spa facilities in the Slovak Republic. 21 companies have been analysed. They were chosen according to generated sales in a given spa. Financial indicators were calculated on the bases of the exact date gained from the Register of Balancing and from financial managers of some companies. The analyses of multi-criteria evaluation included productivity and the indicator of difficulty. Basic productive strength of a facility, profitability of sales, the share of personal costs in the net turnover and the share of added value on the total turnover – these four criteria represented the bases for the analyses of the fours methods of assessment. The assessment of the spa facilities was accomplished by implementation of the following methods: the ordering method, scaling method, normalized

variable method and method of distance from a fictitious object. The order of facilities in a market space is set.

On the basis of the above mentioned analyses it is possible to state that the best spas having been the dominant spas in Slovakia for years are Bojnice Spa, Inc. and Lúčky Spa, Inc.. Interpretation of a two-dimensional space of the multidimensional scaling identified groups of similar spas and the most different spas from the point of view of the four analysed financial indicators. Číž Spa – Bojnice Spa and Sliač Spa – Bojnice Spa are different in horizontal dimension. Turčianske Teplice Spa – Marína Spa Kováčová are different in vertical dimension. But the two extreme values, Pieniny and Brusno, were excluded from the analysis. Taking into consideration the large number of facilities and limited possibilities of the paper it is not possible to present some particular analyses of individual methods. These facts did not influence the marked out aim of the paper. The assessment of facilities in a given space and applying mathematical and statistical methods can help financial managers judge the position of a facility in a market place. Growing productivity is the aim of businesses in the field of health tourism. So further research should be oriented towards the application of progressive methods of multi-criteria evaluation and decision making to compare spa companies in the countries of the European Union.

Acknowledgment

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IBM SPSS help: /help/index.jsp?topic=/com.ibm.spss.statistics.cs/catpca_table.htm

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