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ANALYTICAL STUDY AND MODELING OF STATISTICAL METHODS FOR FINANCIAL DATA ANALYSIS: THEORETICAL ASPECT

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Abstract. In order to achieve the main objective – to facilitate the analysis of financial reports and assessment of company's financial condition and activity, the analysis and modelling of usage of statistical methods becomes one of the tasks. The statistical analysis may also be treated as one of the main assessment modes of the company's financial condition or activity, which can facilitate the work of analysts significantly. The conducted analysis of scientific literature allows stating that the usage of statistical methods in the assessment of company's financial activity has not been widely analysed; besides, there are no assessment models, which would allow analysing the company's finances sufficiently precisely and quickly. Thus the objective of the scientific research presented in this article is to identify and to define clearly the theoretical aspects of modelling of statistical methods within the context of financial analysis. Therefore it is meaningful to prepare a theoretical model of financial analysis with the help of statistical methods, on the basis of which the scientists, managers of the company or other interested persons would be able to conduct the company's financial analysis sufficiently precisely and easily.

Keywords: Financial analysis, modeling, hiring subsidies, methods of statistical analysis, taxation, financial ratios.

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JEL Classifications: M21, M40, M41, M49

1. Introduction

In the modern conditions of complex and competitive business it is very important to have as much comprehensive information on the company's financial condition and activity results as it would make possible to assess objectively the current place of the company in the market and its future competitive possibilities, thus the assessment of financial condition gains more and more importance. Therefore even if majority of companies have not been showing interest in the financial analysis and importance of data it provides, now they are already interested. However, according to Director (2012), Bragg (2012), not all the accountants, bookkeepers or managers of the company may conduct the company's financial analysis successfully, purposefully and in certain direction, because it is possible only when people have enough knowledge and analytical skills. This problem is analysed by many foreign and Lithuanian scientists, among which is Mackevičius (2006, 2008, 2011), Mackevičius, Valkauskas (2010), Mackevičius *et al*. (2007), Bivainis, Garškaitė (2011), Rees (1995, 2003), Gibson (2008), Dzikevičius, Šaranda (2011) and others.

It should be noted that only comprehensive analysis of the company's financial condition allows orienting more reliably in the dynamic business environment, making reasonable management decisions with regard to the activity of the company or its structural departments in order to prevent mistakes, which appear while assessing the financial results or diagnosing the activity's perspective, and taking risks in

unstable financial market and competitive environment. Thus, according to Huang *et al.* (2003), the usage of various computer programs or statistical methods, which are easily applicable in practice, has been getting more and more popular with regard to the company's financial analysis.

So the objective of this research is to form a conceptual model of usage of statistical methods in the company's financial analysis, which would allow the employee, who does not have special skills and knowledge, conducting the financial analysis sufficiently precisely and quickly.

- To identify the analysis' components, i.e. elements of the financial analysis;
- To determine the meaning and direction of the usage of statistical methods for financial analysis;
- To form a conceptual model of financial analysis.

The object of research – financial analysis of the companies.

Work covers the analysis of scientific works of Lithuanian and foreign scientists, empirical surveys and economical literature, and practical study regarding the questions of the company's financial analysis and its results interpretation.

2. Usage of statistical methods in the financial analysis

It should be noted companies financial analysis is important not only for managers of the companies, but also for investors and shareholders in order to learn, in which business it would be more profitable to invest, the shares of which companies it would be worth acquiring, as well as for other interested persons (Vogel 2010). However in order to use properly the information provided by financial accountability, it is necessary to be able to analyse it – to calculate certain indexes, to group them, to systemize, to determine the factors affecting their changes, to present conclusions, etc. However, it has to be stressed that not everyone is able to do this, thus recently according to Kaufmann *et al.* (2001) the usage of various statistical methods has been encountered more and more often in the financial analysis. When the statistical or mathematical methods are used, the efficiency of the companies' financial analysis increases, the duration of analysis gets shorter, the accuracy of calculations is guaranteed, and the solution of new multidimensional tasks of analysis is secured. However, according to Bagdžiūnienė (2005), in order to use the mathematical methods for financial analysis, it is necessary to create the complex of such mathematical models of economics, which would reflect the quantitative characteristics of economic processes; to improve the system of economic information about the corporate activity; to have technical means, which would help to accumulate, store, process and convey the information; and to organize the group of analysts from the economists, manufacturers, specialists of mathematical modelling of economics, and calculation technique, etc.

The modern financial analysis is based on mathematical methods, which allow substantiating the passed decisions by objective facts. It has to be noted that the mathematical statistical methods are applied when the change of the analysed indexes is a statistical process. The most frequently applied mathematical statistical method is the double and multidimensional correlation. According to Mackevičius, Poškaitė (1998), there are two main measurement methods in the measurement theory:

- Measurement is the attribution of various values to the set of objects after the measurement scale has been fixed;
- Measurement is the determination of value of certain directly non-measured variable with regard to the values of directly measured variables. When this measurement method is chosen, it is necessary to pre-determine the dependency of latent variable on indicators, and this is quite difficult.

Although both methods are often interrelated in practice, the differences may be also encountered: the first method enables to assess only the quantitative aspects of the financial analysis, while the second is applied for the qualitative ones, as well. When the first measurement method is used for the econometric researches, the official data of various statistical organizations or accounting data are taken as the base of initial data, thus the subjects of economic measurement are closely related to the statistical and accounting problems. However, it is important to note that according to Teo and Tan (1999) when the economic processes are measured, the essential problem to be solved is that the measurement scale has to be defined unambiguously, and it is most frequently done by the following:

- relations;
- intervals;
- grades;

- names.

The first two scales are used to measure the quantitative variables, while the third and the fourth are used to measure the quantitative and qualitative variables. Thus in order to form a conceptual model of financial analysis, all the qualitative variables will be assessed in the quantitative expression, because according to Kloptchenko *et al*. (2004), the financial analysis becomes more delicate when we have a statistical situation, where the indexes are assessed qualitatively and not quantitatively.

3. Formation of the conceptual model of financial analysis

It is meaningful to start forming the assessment system of the company's financial condition from the determination of indexes – to form such set of the indexes that would allow assessing the financial condition comprehensively. Such data characteristics as sufficiency, significance or character of value distribution have visible influence on the results of majority of statistical algorithms, thus when proper methods of data analysis are applied, the accuracy of results may be often increased through the improvement of set of analyzed variables. If insufficient number of variables is included into the data analysis, the risk exists that the data set will not allow assessing the internal control system and its effectiveness properly. However, according to Quek *et al.* (2009), if too big amount of data is analyzed, the negative effect of information of little significance may be manifested, thus it should be noted that the determination of features, which allow assessing the company's financial condition may have effect on stability and results of the company's activity. It is not a simple task; therefore the variables assessing the company's financial condition are defined by the function:

$$SR=f(x,Q)$$

where: x – set of indexes reflecting results of the financial condition;

Q – matrix of weights.

Thus we have two important tasks: to form a set and to determine weights. The first path allows taking into account the fact that the companies differ by their activity or traditions of the activity and that the things important to one company are of smaller or no importance to other. In other words, the priority of formation of index system is the peculiarities of commercial economic activity of the companies. According to Huang *et al.* (2008), the second path is more comprehensive: it provides the formation of universal index system, where it is possible to distinguish the minimal and maximal set of indexes. The minimal number of indexes is obligatory, while the maximal number is the supplemented minimal variant taking into account the peculiarities of company's activity. The list of essential items defines the company's financial condition. It is in some way obligatory. The maximal variant of practically used system is supplemented by internal and external factors affecting its activity.

In order to form the conceptual model of financial analysis, such statistical methods and financial indexes are chosen, which can be used to assess all the companies, thus the model has to have clear and logical structure:

- groups of dimensions of general assessment;
- groups of features describing dimensions;
- assessment criteria of features;
- indexes for assessment of criteria;
- calculation methodology;
- formula to calculate final result.

The tree-type hierarchical structure was chosen as the most suitable structure method for the scheme of assessment of the company's financial condition. The tree's hierarchical structure of four levels was formed for this purpose. It consists of the following elements:

- dimensions;
- features;
- criteria;

indexes (see Fig.1).

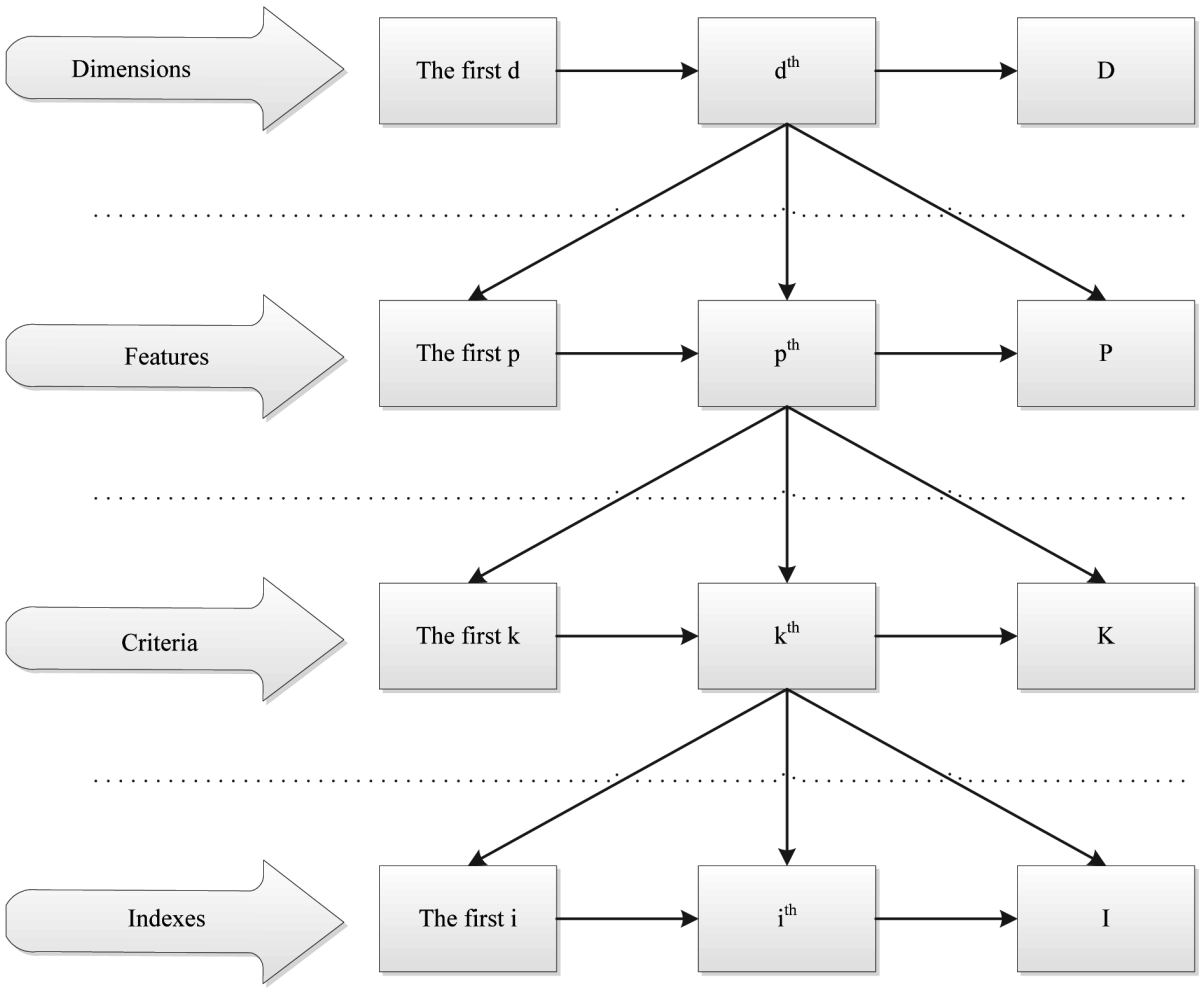

Fig.1. Hierarchical structure of the conceptual model of company's financial analysis

Source: prepared by authors

It has to be noted that dimension is the top group in the hierarchical structure that links certain groups of company's features. The dimension covers wide thematic area and presents the final evaluation of the assessment readings in certain area. According to Milligan (1981), a feature is the group of certain criteria that reflects the assessment of certain environment and represents the composition of dimensions. Each dimension consists of numerous features attributed to it, which may reflect some particular dimension the best, and which may be measured by particular values using the results of the criteria. Thus it should be noted that the feature's value consists of the mean of defining criteria's values. According to Vendramin *et al.* (2010), a criterion is the assessment of certain peculiarity of the company, which is meant to define certain part of the feature, thus the feature consists of numerous criteria, and their numerical values are provided by indexes. An index is the lowest link of the hierarchical structure that provides main data for numerical assessment of information. The assessment scale of strips is meant exactly for values of indexes.

It should be noted that each element of the lowest hierarchical level is characterized by the variable X_{dpki}, i.e. the value of the i^{th} index of k^{th} criterion of p^{th} feature of d^{th} dimension. According to Ruppert (2010), the value of the k^{th} criterion is calculated using this formula:

$$X_{dpk} = \begin{cases} \{1 \div 5\}, if\ i \in significant \\ 0, if\ i \notin not\ significant \end{cases}$$

The value of the p^{th} feature is calculated using this formula:

$$X_{dp} = \frac{\sum_{k=i}^{K} X_{dpk}}{K}$$

The value of the d^{th} dimension is calculated using this formula:

$$X_d = \sum_{p=i}^{p} X_{dp}$$

Such division allows analyzing in detail the company's financial condition – to perform the financial analysis and to present it in numerical expression. Following the defined conceptual model's scheme, the structure of the model of the company's financial analysis is completed. In order to achieve this goal and to assess the company's financial condition comprehensively, the assessment system is suggested that consists of the partial, integrated and complex index. Such system of indexes formed using the hierarchical principle creates preconditions for comprehensive assessment of the company's financial condition (see Fig.2).

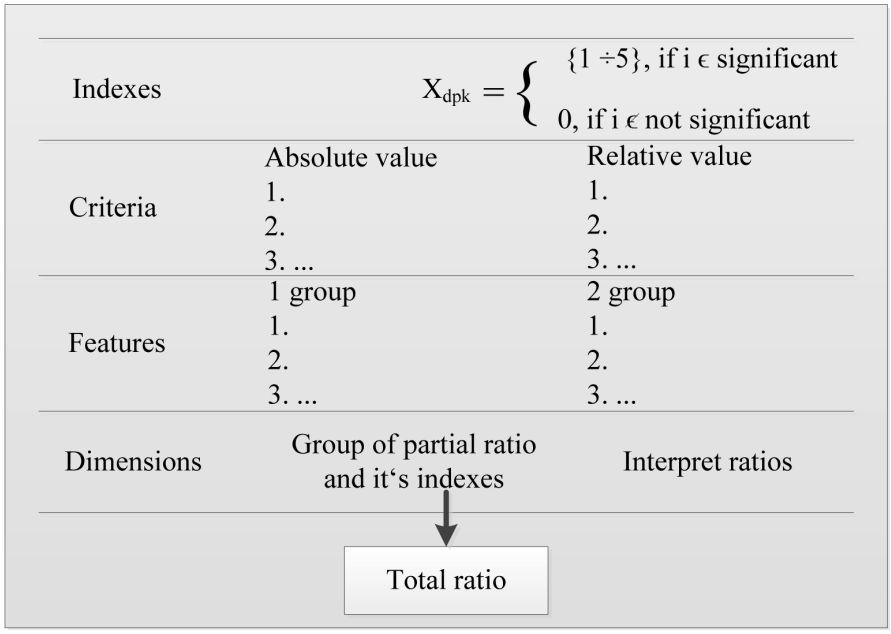

Fig.2. Conceptual model of the company's financial analysis
Source: prepared by authors

When this methodology of analysis of the company's financial condition is applied, the most difficult thing is to form the compounds of indexes. The absolute financial indexes describing financial condition and relative financial indexes differ by their substance and roles in assessments. Their generalization is related to general problem of data standardization and analysis. When the formed conceptual model of the analysis of the company's financial condition is generalized, it has to be noted that it is typical for it to create the possibilities to form the absolute and relative complex indexes first of all, and thus it is possible to use the hierarchical principle with regard to both – absolute and relative indexes. Thus it is possible to state that it is not only characterized by the new attitude to the usage of statistical methods, but that it also may facilitate the company's financial analysis and its course, and not only for analysts.

Concluding remarks

The analysis and generalization of scientific literature with regard to financial analysis allows stating that the financial analysis is the tool to learn the economic processes, which goal is to assess objectively the current financial condition of the company so that it was possible to make adequate management decisions and to project the perspectives of business development. Following the performed analysis of scientific works and practical study with regard to search for usage possibilities of statistical methods, it is possible to say that the most suitable composition method for the assessment scheme of the company's financial condition is the tree-type hierarchical structure. Therefore the hierarchical structure of tree of four levels was formed during the research, and it consists of dimensions, features, criteria and indexes. The presentation of the latter ones in the quantitative expression is exactly the thing that allowed creating the model, which has one total summary index of

quantitative and qualitative features that allows assessing the company's financial condition comprehensively. Thus it is possible to state that the made conceptual model is characterized not only by new attitude to the usage of statistical methods, but it is also able to facilitate and simplify the quite complex financial analysis of the company.

References

Bagdžiūnienė, V. 2005. *Finansinių ataskaitų analizė* [Analysis of financial statements]. Vilnius: Conto litera.

Bivainis, J.; Garškaitė, K. 2011. The System of Diagnostics of Bankruptcy Threat to the Enterprises, *Verslas: teorija ir praktika* [Business: theory and practice] 11(3): 204–212.

Bragg, S. M. 2012. *Financial analysis: a controller's guide.* Wiley. SBN: 978-1-118-42892-4, E-book, 416 p.

Director, S. 2012. *Financial Analysis for HR Managers: Tools for Linking HR Strategy to Business Strategy*. FT Press.

Dzikevičius, A.; Šaranda, S. 2011. Can financial ratios

help to forecast stock prices?, *Journal of Security and Sustainability Issues* 1(2): 147–157.
http://dx.doi.org/10.9770/jssi.2011.1.2(7)

Gibson, C. H. 2008. *Financial reporting & analysis: Using financial accounting information*. South-Western Pub.

Huang, S. M.; Tsai, C. F.; Yen, D. C.; Cheng, Y. L. 2008. A hybrid financial analysis model for business failure prediction, *Expert Systems with Applications* 35(3): 1034–1040.

Huang, N. E.; Wu, M. L.; Qu, W.; Long, S. R.; Shen, S. S. 2003. Applications of Hilbert–Huang transform to non-stationary financial time series analysis, *Applied Stochastic Models in Business and Industry* 19(3): 245–268.

Kaufmann, R.; Gadmer, A.; Klett, R. 2001. Introduction to dynamic financial analysis, *Astin Bulletin* 31(1): 213–250.

Kloptchenko, A.; Eklund, T.; Karlsson, J.; Back, B.; Vanharanta, H.; Visa, A. 2004. Combining data and text mining techniques for analysing financial reports, *Intelligent systems in accounting, finance and management* 12(1): 29–41.

Mackevičius, J. 2006. Finansinių santykinių rodiklių skaičiavimas ir grupavimas [The calculation and grouping of financial rational indicators], *Economics* 75*:* 20–32.

Mackevičius, J. 2008. Įmonių veiklos analizė–informacijos rinkimo, tyrimo ir vertinimo sistema [The analysis of companies' business as a system of collection, research and evaluation of information], *Informacijos mokslai* [Information sciences]: (46): 46–56.

Mackevičius, J. 2011. Methodology of Complex Analysis of Tangible Long-Term Assets, *Verslas: teorija ir praktika* [Business: theory and practice] 9(4): 237–244.

Mackevičius, J.; Molienė, O.; Poškaitė, D. 2007. Methodology of complex analysis of return on equity, *Verslas: teorija ir praktika* [Business: theory and practice] 8(2): 73–81.

Mackevičius, J.; Poškaitė, D. 1998. *Finansinė analizė* [Financial analysis]. Vilnius: Katalikų pasaulis. 410 p.

Mackevičius, J.; Valkauskas, R. 2010. Integruota įmonės finansinės būklės ir veiklos rezultatų analizės metodika [Methodology of the Integrated Analysis of Company's Financial Status and Its Performance Results], *Verslas: teorija ir praktika* [Business: Theory and practice] 11(3): 213–221.

Milligan, G. W. 1981. A Monte Carlo study of thirty internal criterion measures for cluster analysis, *Psychometrika* 46(2): 187–199.

Quek, C.; Zhou, R. W.; Lee, C. H. 2009. A novel fuzzy neural approach to data reconstruction and failure prediction, *Intelligent systems in accounting, finance and management* 16: 165–187. doi: 10.1002/isaf.299

Rees, W. P. 1995. *Financial analysis*. Prentice-Hall.

Rees, W. P. 2003. The impact of dividends, debt and investment on valuation models, *Journal of Business Finance & Accounting* 24(7-8): 1111–1140.

Ruppert, D. 2010. *Statistics and Data Analysis for Financial Engineering* . New York: Springer-Verlag Inc. ISBN-13: 9781441977861.

Teo, T. S.; Tan, M. 1999. Spreadsheet development and 'what-if' analysis: quantitative versus qualitative errors, *Accounting, Management and Information Technologies* 9(3): 141–160.

Vendramin, L.; Campello, R. J.; Hruschka, E. R. 2010. Relative clustering validity criteria: A comparative overview, *Statistical Analysis and Data Mining* 3(4): 209–235.

Vogel, H. L. 2010. *Entertainment industry economics: a guide for financial analysis*. Cambridge University Press.

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