

# CATEGORIZING ENTERPRISES THROUGH ADVANCED OPERATING PROFIT MARGIN METRICS

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## ABSTRACT

*The research objective is to test the potential for overcoming limitations in the interpretation of ratios, with a focus on Operating Profit Margin (OPM). The research examines the OPM values of 43 enterprises over five consecutive accounting periods. It uses Linear Discriminant Analysis (LDA) to determine the range of OPM values and assess financial performance more dynamically. The methodology focuses on calculating the OPM for each enterprise, followed by a categorization into successful, neutral or bankrupt based on the financial results derived from the financial reports. This research not only challenges traditional financial ratio analysis, but also contributes to strategic financial management by allowing a more detailed categorization of enterprises based on their operational profitability, thus providing a robust tool for financial decision making and predictive analysis.*

**Keywords:** Operating Profit Margin (OPM), Financial Performance, Linear Discriminant Analysis (LDA), Ratio Analysis, Bankruptcy Prediction.

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## INTRODUCTION

Resilient growth of enterprise is mostly driven by real and financial capital, or in recent time by the instruments of weightless economy, providing the value added as physical product, service, or intellectual properties [1]. The analysis of an enterprise's financial performance is a decisive factor in assessing its overall success [2]. Financial performance serves as a key indicator of an enterprise's health and viability [3, 4]. Studies have shown that financial variables, such as productivity, profitability, and financial health, significantly impact firms' decisions, survival, and success, including their ability to expand into new markets [5, 6].

The use of ratio analysis as a method for determining financial performance has a significant impact on the evaluation of the success and stability of enterprises in any sector of economy [7, 8]. Ratio analysis involves the calculation and interpretation of various financial ratios derived from a company's annual financial statements. By comparing these ratios over time or against industry benchmarks, stakeholders can gain insights into a company's financial health and performance [9, 10]. Financial ratios are essential for benchmarking and comparing a company's performance against its peers or industry standards [11, 12]. The use of financial ratios in assessing financial performance is not without challenges. While ratio analysis can provide valuable insights, it is essential to consider the limitations and potential biases associated with using these metrics. Critics argue that ratio analysis oversimplifies complex financial situations and may not capture the full picture of a company's performance [13, 14]. The interpretation of ratios requires a deep understanding of the industry, accounting principles, and economic conditions to avoid misinterpretation [15, 14]. By analyzing trends in financial ratios, stakeholders can identify early warning signs of financial instability and take proactive measures to mitigate risks [16]. Furthermore, ratio analysis plays a crucial role in predicting financial distress and bankruptcy [17].

The comparison of the results of the financial performance analysis expressed by the ratio of two enterprises presupposes their equivalence in terms of the type of activity, size (business volume), technical equipment, personnel structure, natural conditions, and market position [18]. On the other hand, the comparison over time requires the comparison of the values of an enterprise's financial performance expressed by the ratio in several consecutive accounting periods [19, 20].

The research objective is to test the ability to overcome limitations in the interpretation of ratios using an example of financial performance. The subject of the study is the operating profit margin values of 43 enterprises in five consecutive accounting periods. The objective was achieved using linear discriminant analysis (LDA), the results of which made it possible to determine the range of operating profit margin values. The research results are used to test the hypothesis ( $H_1$ ): The defined range of operating profit margin values eliminates the limitations in interpreting the value of this ratio.

The approach of this paper reflects the call for advanced analytical techniques in the financial management literature, as expressed in the work of [16], who emphasizes the need for innovative methods to predict business failure.

## DATA AND METHODOLOGY

The ratio analysis method was used to calculate the operating profit margin (OPM) of 43 enterprises registered in the Republic of Serbia. The enterprises were selected using a random sampling method. The sample consists of 20 manufacturing enterprises and 23 service enterprises. Of the total of 43 enterprises, 37 are classified as "active", while 6 enterprises are classified as "bankrupt". The data used to calculate the operating profit margin was disclosed in the financial statements of the enterprises studied. The financial statements were obtained from the Serbian Business Register Agency (SBRA). Research also include deep consultation of available scientific literature focused on observed topic. In order to obtain the most realistic research results, the operating profit margin was calculated for each enterprise for five consecutive accounting periods. The average value of the operating profit margin ratio was calculated for each company whose financial statements were analyzed. The following formula was used to calculate the operating profit margin ratio [21]:

$$\text{OPM} = \frac{\text{Operating profit}}{\text{Total Revenue}} \times 100 \quad (1)$$

After calculating the average value of the operating profit margin, it was uniformly marked with a capital X and the corresponding index (1). Therefore, the variable representing the average value of the operating profit margin is referred to as  $X_1$ .

Based on the results of the Linear Discriminant Analysis (LDA), the range of values for the operating profit margin was determined. The analysis was conducted using the statistical software IBM SPSS Statistics (version 21). So, using the data from the SBRA, the enterprises were first divided into active and bankrupt enterprises, and then subdivided into three basic categories using discriminant analysis: bankrupt category, neutral result category, and successful business category.

The categorization method used is similar, but not identical, to Altman's classification of enterprises into three zones [22]. Although there is already an initial categorization into active and bankrupt enterprises, the application of discriminant analysis using the operating profit margin led to the creation of a linear discriminant function that is used to evaluate the status of enterprises under the SBRA. It is assumed that the status of most enterprises is correctly assessed. However, it is suspected that there are enterprises in the randomly selected sample whose discriminant analysis results indicate an inadequate initial assessment of their status. According to the results of the discriminant analysis, the enterprises are classified as follows:

- Enterprises correctly classified as "bankrupt" were classified as "bankrupt",
- Enterprises correctly classified as "active" were reclassified to the new category "successful",
- A new category "neutral" was assigned to enterprises for which it was determined that their actual and assessed status did not match.

In assessing the degree of correct classification, the focus was on the correct classification of enterprises in bankruptcy and not on those classified as active. This is partly due to the small number of bankrupt enterprises in the sample, but also because an accurate assessment of the status of underperforming enterprises is more important. Priority was given to an appropriate assessment of the status of underperforming enterprises, as the consequences are more severe if an enterprise that will go bankrupt is predicted to be in the neutral outcome zone, than if an enterprise that will move into the successful zone is predicted to be in the neutral outcome zone.

## RESULTS AND DISCUSSION

The results of the linear discriminant analysis are shown in Table 1. The results show that the percentage of correctly classified insolvent enterprises according to the variable  $X_1$  is exactly 50%. This means that half of the enterprises were classified correctly, but the other half were not.

*Table 1. – Classification Resultsa – variable  $X_1$*

Status			Predicted Group Membership		Total
			In bankruptcy	Active	
Original	Count	in bankruptcy	3	3	6
		active	6	31	37
	%	in bankruptcy	50.0	50.0	100.0
		active	16.2	83.8	100.0

*a) 79,1% of original grouped cases are correctly classified.*

*Source: Authors' calculation*

In order to accurately determine the boundaries of the three categories of enterprises based on the variables considered, it is necessary to analyze the representation of their comparative classification according to the actual and evaluated status, which is determined using discriminant analysis.

Table 2. – Comparative classification of enterprises based on actual and assessed status for variable  $X_1$ 

Enterprise	Actual status (SBRA)	$X_1$	Assessed status
43	Bankrupt	-67.62	Bankrupt
42	Bankrupt	-18.74	Bankrupt
41	Bankrupt	-12.60	Bankrupt
11	Bankrupt	-6.82	Active
6	Bankrupt	-2.55	Active
14	Bankrupt	9.95	Active
24	Active	-118.96	Bankrupt
12	Active	-58.32	Bankrupt
20	Active	-43.85	Bankrupt
8	Active	-14.51	Bankrupt
34	Active	-13.97	Bankrupt
3	Active	-12.26	Bankrupt
29	Active	-1.60	Active
15	Active	-0.96	Active
26	Active	-0.24	Active
23	Active	-0.20	Active
31	Active	1.15	Active
22	Active	1.42	Active
27	Active	1.67	Active
32	Active	2.10	Active
36	Active	2.12	Active
38	Active	2.33	Active
30	Active	2.40	Active
2	Active	2.42	Active
1	Active	2.58	Active
7	Active	2.98	Active
19	Active	3.42	Active
5	Active	4.29	Active
40	Active	4.42	Active
10	Active	4.48	Active
9	Active	5.10	Active
18	Active	5.25	Active
25	Active	5.28	Active
4	Active	6.65	Active
28	Active	7.60	Active
16	Active	8.04	Active
39	Active	9.45	Active
21	Active	10.19	Active
13	Active	10.25	Active
33	Active	10.79	Active
35	Active	10.81	Active
17	Active	12.69	Active
37	Active	23.03	Active

Source: Authors' calculation

Based on the data from Table 2., the value range for the variable  $X_1$  was determined, i.e. the zone in which an enterprise operates according to the value range of the specified ratio. The results obtained confirm hypothesis  $H_1$ : The defined value range of the operating profit margin eliminates the limitations in interpreting the value of this ratio. According to the value range determined for variable  $X_1$ , the enterprises whose operating profit margin falls within the range are located:

- up to -12.60 belong to the "bankrupt" category,
- from -12.59 to -1.61 belong to the "neutral" category,
- from -1.60 and above belong to the "successful" category.

Using Linear Discriminant Analysis, 43 enterprises were classified according to the average operating profit margin in five consecutive accounting periods as follows:

- category "bankrupt": 3 enterprises, i.e. 7% of the total number of enterprises included in the sample;
- category "neutral": 9 enterprises, i.e. 21% of the total number of enterprises included in the sample;
- category "successful": 31 enterprises, i.e. 72% of the total number of enterprises included in the sample.

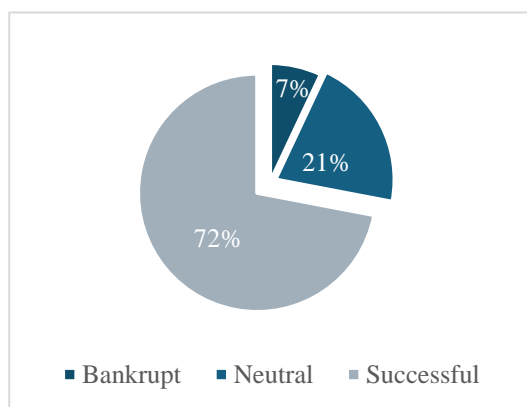


Figure 1. Business zones according to the average value of OPM

Source: Authors' calculation

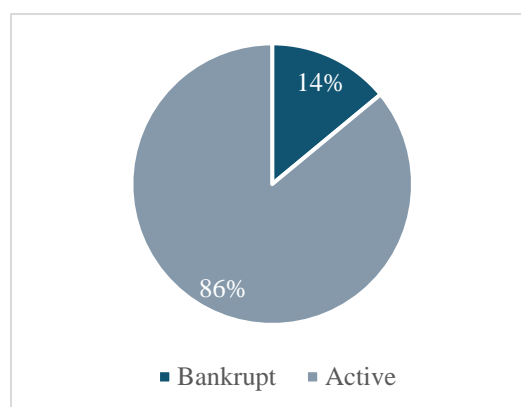


Figure 2. Actual status

Source: SBRA

The results of the Linear Discriminant Analysis, in which the enterprises are divided into three categories, are shown in Figure 1., while their actual status according to the SBRA data is shown in Figure 2. In terms of actual status, of the total number of enterprises analyzed, 14% are bankrupt and 86% are active. On the other hand, as was previously mentioned, using the range of values for the variable  $X_1$ , which was determined by applying Linear discriminant analysis, it was found that of the total number of enterprises included in the analysis, 7% fall into the "bankruptcy" category, 21% into the "neutral outcome" category and 72% into the "successful" category. According to the value range for the variable  $X_1$ , which was determined by applying linear discriminant analysis, 7% of the enterprises moved from the actual status "in bankruptcy" to the "neutral" category, while 14% of the enterprises moved from the actual status "active" to the "neutral" category.

This categorization reveals the nuanced complexity of corporate financial health and provides a more detailed perspective than traditional financial ratios. Compared to the existing literature, the findings of this paper emphasize the importance of applying more nuanced analytical techniques to the assessment of financial performance. The application of LDA provides a framework that could potentially improve the predictive accuracy of financial distress in enterprises.

The distribution of companies across the bankruptcy, neutral, and successful categories, with a notable majority being classified as successful, aligns with the optimistic outlook on the financial viability of firms discussed by [12]. Their analysis, which emphasizes the usefulness of financial ratios in evaluating performance, could be complemented by the discriminant analysis approach, which proposes a refined method for evaluating companies' potential for success.

The comparison of discriminant analysis and logit models in bankruptcy prediction highlights the potential of discriminant analysis to provide detailed insights into financial health, particularly by looking at specific financial ratios [23, 24]. This is consistent with research findings where discriminant analysis has helped to identify meaningful categories of financial performance based on operating profit margins. The emphasis on net income to total assets ratio, current ratio, and current liabilities to total assets ratio as significant predictors of bankruptcy is consistent with our identification of operating profit margin as a key categorization metric [25].

Investigating the prediction of financial distress in Chinese companies using discriminant analysis is in line with the aim of our study to refine the assessment of financial performance [26]. Their success in identifying net profit margin as a key indicator of financial health validates our choice of operating profit

margin as the basis for analysis and suggests a common ground for the predictive value of profitability ratios. Similarly, a study was conducted to predict the bankruptcy of companies listed on the Bombay Stock Exchange using discriminant analysis [27]. This research highlights the application of discriminant analysis in predicting financial distress. Moreover, other research has found that net profit margin along with other variables plays an important role in predicting financial distress [28].

The consistency of the research results with these studies not only confirms the effectiveness of LDA in financial analysis, but also underlines the potential of discriminant analysis to improve the predictive accuracy of financial distress. By successfully categorizing enterprises as "bankrupt", "neutral" and "successful" based on their operating profit margins, this research underscores the critical importance of innovative statistical techniques for a more comprehensive understanding of corporate financial health.

## CONCLUSION

The research contributes to the expanding field of financial performance analysis by applying Linear discriminant analysis to categorize enterprises based on operating profit margins. This methodological innovation is in line with recent trends in financial research that emphasize the need for more sophisticated methods of analysis.

The successful application of LDA to categorize enterprises based on OPM not only contributes to the body of knowledge on financial analysis methods but also paves the way for future research focused on specific sectors where financial performance indicators may require tailored analytical frameworks. Classifying enterprises as "bankrupt" (below -12.60), "neutral" (-12.59 to -1.61) and "successful" (-1.60 and above) based on the operating profit margin provides a refined method for accurately interpreting financial results.

Furthermore, the methodology's ability to refine the classification of enterprises based on financial performance represents a groundbreaking step towards developing a more robust framework for financial analysis. This approach could make an important contribution to the advancement of financial management theories and provide stakeholders with a more reliable tool for evaluating company performance and making informed decisions.

The successful categorization of enterprises using discriminant analysis represents a decisive advance in financial analysis technology. It opens new paths for future research to further explore and refine these methods in different industries. This research not only enriches the existing body of knowledge on financial performance evaluation, but also sets the stage for subsequent research efforts that build on these findings and explore the great potential of discriminant analysis for more informed and strategic financial decision making.

Further research should look at sector-specific financial indicators in order to make the linear discriminant analysis (LDA) method more accurate. Policymakers are recommended to consider this refined categorization for more targeted economic interventions to improve the predictive accuracy of financial distress. From a scientific and technical perspective, adopting the results of this study could significantly improve financial decision-making and risk assessment and lead to more sustainable business practices and economic policies.

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