

Using Profitability and Debt ratios through Discriminant Analysis and Logistic Regression to Predict Financial Situation

An Applied Study on Financial Companies' Services on the – Amman Stock Exchange

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Abstract:

This research aimed to evaluate the effectiveness of using quantitative methods, specifically logistic regression and discriminant analysis models, in predicting the financial status of companies based on key profitability and leverage ratios. The research relied on historical financial data from a sample of 18 financial services companies listed on the Amman Stock Exchange.

This study adopted a descriptive approach to monitor and track financial ratios, particularly profitability and leverage ratios, over an eight-year period from 2014 to 2021. Data was collected from the website of the Securities Depository Center at the Amman Stock Exchange. Subsequently, several quantitative statistical methods were used to analyze and evaluate these ratios and to predict the future financial status of these companies.

The results showed that the accuracy of predicting companies' classification and financial status ranged between 72.2% and 75% in both the logistic regression and discriminant analysis methods, and was 73.6% in the decision tree method. Furthermore, earnings per share and the market-to-book ratio had a statistically significant effect on the response variable (companies' financial status), while the debt coverage ratio did not play a role in improving the model used.

Keywords:

Financial ratios, financial forecasting, logistic regression, discriminant analysis, Decision tree.

استخدام نسب الربحية والمديونية بواسطة التحليل التمييزي والانحدار اللوجستي للتنبؤ بالوضع المالي

- دراسة تطبيقية على شركات الخدمات المالية في بورصة عمان -

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المستخلص:

هدف البحث إلى تقييم فاعلية استعمال الأساليب الكمية، وتحديدًا نماذج الانحدار اللوجستي والتحليل التمييزي، في التنبؤ بالوضع المالي للشركات بناءً على مؤشرات رئيسة لنسب الربحية والمديونية. اعتمد البحث على بيانات مالية تاريخية لمجموعة من شركات الخدمات المالية المدرجة في بورصة عمان، والتي بلغ عددها 18 شركة.

اتبع هذا البحث المنهج الوصفي لرصد ومتابعة النسب المالية، ولاسيما نسب الربحية ونسب المديونية، لمدة ثمانية أعوام بدءاً من عام 2014 ولغاية عام 2021، اعتمد أسلوب جمع البيانات من خلال موقع مركز إيداع الأوراق المالية في بورصة عمان، وفيما بعد تم استعمال بعض الأساليب الكمية الإحصائية لدراسة هذه النسب وتقييمها، والتنبؤ المستقبلي بالوضع المالي لهذه الشركات.

أظهرت النتائج أن دقة التنبؤ بتصنيف الشركات ووضعها المالي بلغت ما بين 72.2% و 75% في كل من أسلوب الانحدار اللوجستي وأسلوب التحليل التمييزي، وكانت في شجرة القرارات 73.6%، إضافة إلى أن ربحية السهم الواحد ونسبة القيمة السوقية إلى القيمة الدفترية للسهم لهما تأثير ذو دلالة إحصائية على متغير الاستجابة (الوضع المالي للشركات)، كما أن نسبة تغطية الدين لم يكن لها أثر في تحسين النموذج المستعمل.

الكلمات المفتاحية:

النسب المالية، نسب الربحية، نسب المديونية، الأساليب الكمية، التنبؤ المالي، الانحدار اللوجستي، التحليل التمييزي، شجرة القرار، المخاطر المالية.

Introduction:

The financial sector is the backbone of the economy and one of the pillars of development in any country. It serves as the link between savers and investors, and between individuals and companies on the one hand, and sources of financing on the other. Its importance is not limited to providing liquidity, but extends to promoting investment, stimulating economic growth, creating job opportunities, and supporting financial and social stability. The financial sector and the stock exchange act as a supportive environment for economic growth, a catalyst for innovation, and an attractive factor for domestic and foreign investments. Without them, it is difficult to achieve sustainable development or build an economy capable of facing global challenges.

In light of rapid economic fluctuations and a highly competitive business environment, the ability to predict the financial situation of companies has become crucial for all stakeholders, including investors, creditors, and management. Financial analysis is an important strategic tool in evaluating company performance and predicting its future. Amidst the ever-evolving economic challenges, the need has arisen to adopt accurate and effective analytical methodologies and tools that rely on quantitative methods in evaluating financial performance and predicting the financial situation of companies, especially in the financial services sector, which is a cornerstone of economic activity, a major factor in the stability of financial markets, and contributes to enhancing sound investment and management decision-making.

This research aims to address the problem of companies facing financial distress and failure. It seeks to develop a model using logistic regression and discriminant analysis to evaluate financial services companies listed on the Amman Stock Exchange and attempt to predict their future financial performance.

This research tackles a vital and highly important topic: modern financial forecasting methods. It may also contribute to the development of financial analysis studies in institutions.

Methodology:**Research Problem:**

Business companies face many challenges and problems that limit their ability to achieve the desired return on their investments and prevent them from fulfilling their debts and obligations to creditors. These problems include financial distress and financial failure, both of which pose a significant risk to the company's operations and financial position. Furthermore, company managements, investors, and stakeholders face

increasing difficulty in accurately predicting potential financial difficulties or failures of companies in a timely manner. Many traditional models rely on a single indicator analysis or qualitative methods that may be subject to personal bias.

In this regard, the following question can be raised: Is there a statistically significant relationship between profitability ratios, debt ratios, and predicting the financial position of companies?

The research problem can be summarized in the following questions:

1. Is there a statistically significant direct relationship between higher profitability ratios and an improved future financial position for the company?
2. Is there a statistically significant direct relationship between lower debt ratios and an improved future financial position for the company?
3. Is the discriminant function more accurate than the logistic function in assessing the financial situation?

Research Importance:

The importance of this study lies in its addressing and tackling a vital and extremely important topic, namely, modern methods of financial forecasting. It may also contribute to the development of financial analysis studies in institutions, as the modern methods used in this study, both quantitative and statistical, are expected to provide effective and accurate results and yield more useful information that can be used in various fields, particularly in diagnosing the financial situation of companies, identifying the success achieved and the parties contributing to this success, and then taking appropriate corrective actions. Therefore, it can be said that this research represents a bridge between financial analysis and modern quantitative techniques, making it of high practical value in risk management and ensuring financial sustainability.

Research Objectives:

This research aims to achieve the following:

1. Determine the relationship between financial ratios and financial position using quantitative methods.
2. Select the optimal quantitative method (logosophical regression, discriminant analysis) for integrating these financial ratios.
3. Develop a model using logistic regression and discriminant analysis, and apply it to company evaluation and future financial forecasting.
4. Provide recommendations and suggestions to help companies and investors make more accurate and realistic decisions.

Research Hypotheses:

This research seeks to verify the validity of the following hypothesis: There is a statistically significant relationship between profitability and debt ratios and the prediction of the financial position of companies.

The following sub-hypotheses stem from this hypothesis:

1. There is a statistically significant positive correlation between higher profitability ratios and an improvement in the company's future financial position.
2. There is a statistically significant positive correlation between lower debt ratios and an improvement in the company's future financial position.
3. The discriminant function is more accurate than the logistic function in assessing the financial situation.

Research Variables:

The research addressed the following variables:

- a- Independent variables: Profitability ratios – Debt ratios.
- b- Dependent variable: The financial position of the companies.

Research Population:

The research population includes all the elements and units to which the study aims to generalize its findings. The study population consists of all companies operating in the services sector of the Amman Financial Market, which numbered 18 companies, during the time period covered by the study. The following table shows the companies included in the study:

Table No.1 Companies included in the study

No.	Company Name	No.	Company Name
1	Tihama Financial Investments	10	Jordanian Mortgage Refinancing Company
2	Dar Al-Aman for Islamic Finance	11	Al-Amal Financial Consulting
3	Jordanian Development and Investment Company	12	National Portfolio for Securities
4	Al-Daman Investment	13	Jordanian Expatriates Holding Investment Company
5	United Financial Consulting	14	Jordanian Management and Consulting
6	Al-Bilad Securities and Investment	15	Babylon Gardens Consulting
7	Al-Kafaa Financial Investments	16	Dimensions of Jordan and UAE Investment
8	Jordanian Investment Funds Management	17	Dar Al-Urdun Holding
9	Al-Sanabel International Consulting	18	Sabaek Investment

Source: Prepared by the researcher based on data from the Securities Depository Center at the Amman Stock Exchange <https://sdc.com.jo/ar/financialRatios?toBox=111002> .

The study followed a survey approach, encompassing all the companies studied and analyzing their profitability and debt ratios. The survey approach is a method that allows for the precise interpretation and analysis of information and data available about a particular phenomenon, whereby purely descriptive data and facts are identified, classified, and organized. It also seeks to distinguish the scientific and correlational aspects or those with specific implications, and to interpret them clearly and objectively.

Research Methodology and Tools Used:

The descriptive approach is considered the most suitable methodology for financial analysis studies, as it describes the reality of companies and analyzes the relationships between variables. The quantitative approach, which relies on financial data, was used to analyze relationships and make predictions using statistical and mathematical methods.

The data necessary for the study and hypothesis testing were collected from the historical financial data of companies listed on the Amman Stock Exchange. The data were analyzed using specialized computer programs, particularly SPSS.

Research Limitations:

•**Subjective Limitations:** The study addresses the analysis and application of profitability and debt ratios using both discriminant analysis and logistic regression, and their impact on the financial position of the studied companies.

•**Spatial Limitations:** The study applies only to financial services companies listed on the Amman Stock Exchange.

•**Temporal Limitations:** The study covers financial data for the period 2014-2021, based on the availability of the necessary data for the study during this period.

Literature Review and Previous Studies:

1- A study by (Ahmed, Al-Kassar, 2009) entitled: **The Use of Financial Ratios in Evaluating Financial Performance and Predicting Financial Crises of Companies (Financial Failure)**, Seventh International Scientific Conference, Al-Zarqa Private University, Jordan. (Alkassar, 2019)

The study aimed to build an integrated framework (an integrated package) of financial ratios by adopting a set of mathematical models representing a comprehensive framework that would assist researchers and financial analysts in evaluating the financial performance of a project and predicting financial failure.

The study examined both profitability ratios and debt ratios as independent variables, with the dependent variable being the financial performance of companies.

The study concluded that there was a convergence between the value of the financial performance of companies and the value of financial failure, and the possibility of using and presenting the results in financial markets for their benefit.

2- A study by (Salem, 2014) entitled: **The Role of Financial Ratios in Predicting the Stock Prices of Jordanian Public Shareholding Industrial Companies Listed on the Amman Stock Exchange (An Empirical Study)**, Master's Thesis, Faculty of Business, Middle East University, Jordan. (Salem, 2014)

The study aimed to reveal the nature of the relationship between the financial ratios extracted from the five types of financial statements and the stock prices of industrial companies listed on the Amman Financial Market, and to identify the most important types of financial ratios extracted from the published financial statements and how each is derived.

The study included variables (liquidity ratios - profitability ratios - debt ratios - activity ratios - market ratios) as independent variables, and the market price per share as a dependent variable.

The study reached several important conclusions, most notably: all categories of financial ratios have a statistically significant effect on the market prices of shares of public shareholding industrial companies listed on the Amman Stock Exchange. This result can also be considered indicative that the Amman Financial Market is semi-efficient. Efficiency.

3- A study (Hiziyah, Ali, 2016) entitled: **An Analytical Study of Modern Methods for Measuring Financial Performance - A Case Study of the Saudi Cement Company**, Economic Dimensions Journal, Ibn Khaldoun University, Algeria, Boumerdes. (Hiziyah, 2016)

The study aimed to measure and evaluate the financial performance of the Saudi Cement Company using modern indicators and methods of financial analysis, including (index numbers, time series, multiple regression), and to identify the strengths and weaknesses of the studied cement company.

The study addressed some modern indicators such as the variables (gross profits - total expenses - sales - profitability) as independent variables, and financial performance as a dependent variable.

The study followed the descriptive analytical approach as a method to understand modern methods for measuring financial performance, in addition to the applied study, using quantitative methods, economic value added, and market value added.

The study concluded that the application of modern indicators allows for measuring financial performance to address the problem of uncertainty facing economic institutions, and that the process of predicting the future financial situation (financial failure, financial distress) is a complementary stage to the process of measuring financial performance in order to reassure shareholders and investors about the financial future of the institutions.

4- A study (Krousha, Al-Zghoul, Gharaibeh, 2016) entitled: **Using Financial Ratios to Predict the Failure of Jordanian Industrial Companies: An Applied Study**, King Abdulaziz University Journal: Economics and Administration, Volume 30, Issue 1. (Krousha&others,2016)

This study aimed to develop a mathematical model consisting of a set of financial ratios using the logistic regression model, each of which has its own weighting, which expresses its importance in distinguishing between distressed and non-distressed industrial companies in Jordan, and to test the model's ability to distinguish between companies. Distressed and non-distressed industrial companies, from one to three years before the point of distress.

The independent variables in this study were financial ratios (liquidity ratios, profitability ratios, debt ratios, and activity ratios), while financial distress was the dependent variable.

The descriptive approach was used to present the theoretical aspects of the research phenomenon, while the analytical approach was employed in the practical aspect of the study. This involved analyzing financial data extracted from the financial statements and then identifying the significance and relationships between the items in the financial statements through quantitative analysis of the financial ratios.

The study concluded that a model for predicting the financial distress of Jordanian industrial companies can be developed using logistic analysis. This model comprises three financial ratios (working capital to equity ratio, accounts receivable turnover ratio, and equity to fixed assets ratio). Furthermore, the accuracy of the prediction remains almost constant when the model is applied to the test sample, indicating its efficiency and predictive power. The longer the prediction period, the greater the accuracy of the prediction.

5- A study by Taqararat (2017) entitled: **"The Use of Financial Analysis Tools in Diagnosing the Financial Situation of Economic Institutions**

under Accounting Reform: A Case Study of the National Company for the Production of Screws, Knives, and Taps 'BCR' in Setif Province – for the Financial Periods (2011-2014)," published in the University of Algiers, Research Journal, Volume 11, Issue 2. (Taqqarat, 2017)

This study aimed to identify the new aspects introduced by accounting reform in Algeria regarding the analysis of financial statements for the purpose of diagnosing the financial situation of Algerian economic institutions in light of current economic transformations, and to clarify the importance of using financial analysis tools in evaluating the financial situation under accounting reform.

The study addressed both the analysis of financial statements and various financial analysis tools (financial ratios and financial equilibrium indicators).

The study adopted a descriptive-analytical approach in its theoretical aspect and a case study methodology in its applied aspect.

The study reached several conclusions, the most important of which are: the significant impact of the content of financial statements and the accounting methods used on the quality and reliability of financial statements, understanding the financial situation of the institution, diagnosing its financial condition, and identifying its strengths and weaknesses.

6- A study by Hakimi, Mouloud (2022) entitled: **"Using Financial Ratios with Quantitative Models to Predict Financial Failure in Light of Accounting System Outputs – The Case of AOM Invest"**. Al-Maqrizi Journal of Financial and Economic Studies, Algeria, Volume 6, Issue 1. (Hakimi&Mouloud,2022)

This study aimed to determine the role of financial ratios extracted from financial statements prepared according to the financial accounting system in revealing the potential for financial risk in an economic institution, based on the results of well-known mathematical models used to measure financial failure.

The research examined several financial ratios (liquidity ratios, profitability ratios, debt ratios, activity ratios, and market ratios) as independent variables, while financial failure was the dependent variable.

The study concluded that this institution is in a good position based on indicators reflecting its success, its ability to survive and grow, and its capacity to manage debt thanks to available liquidity.

What distinguishes the current research from previous research and studies:

The current research is distinguished from previous research and studies in integrating multiple indicators, as it combines financial ratios (profitability ratios and debt ratios) in an innovative way to improve forecasting accuracy,

and gives a more comprehensive picture of the company's financial health, since high profitability does not necessarily mean a sound financial position if debt is high, in addition to addressing modern and advanced quantitative methods used in the financial forecasting process based on these financial ratios, including discriminant analysis, logistic regression, and decision tree.

The research also differs from previous research in that the prediction accuracy in the discriminant analysis method was 75%, while it was 72.2% in the logistic regression method, and the accuracy in the decision tree was 73.6%. This means that the results of the discriminant analysis are more effective in prediction.

-Theoretical Framework of the Research:

The process of predicting the financial position of companies is a cornerstone in making sound decisions, whether for investors, analysts, or even the companies' managements themselves. In this context, the Amman Stock Exchange stands out as a major financial market reflecting the economic situation of Jordan, where all parties seek to understand the future trends of listed companies and assess their ability to grow and continue. This understanding cannot be achieved randomly; Rather, it relies on precise analytical tools, most importantly financial analysis using financial ratios. Profitability ratios and debt ratios are among the most effective and important indicators in this process. Profitability ratios reveal the company's efficiency in generating profits from its operations and utilizing its resources, and indicate whether the company is actually profitable. Debt ratios, on the other hand, serve as a measure of the company's reliance on borrowed funds and the bankruptcy risks associated with its capital structure. They illustrate how these profits are financed and show whether the financing structure is sound and sustainable.

By applying these ratios to companies listed on the Amman Stock Exchange, a predictive model can be built to forecast the future. For example, a company with high profitability coupled with moderate and well-managed debt may indicate a bright future and potential for growth, making it attractive to investors. Conversely, a company with low profitability and high debt may be a warning sign of impending financial risks, such as the inability to repay debts or the need for a capital increase.

Based on the above, studying and analyzing these ratios is not merely a look at historical figures, but rather a gateway to predicting future performance. They enable researchers and analysts to assess the company's financial

health and its ability to compete in the local and global markets, and ultimately, determine its true value as an investment opportunity within the Jordanian market. This research delves into how these ratios can be used as a strategic tool to predict the future of companies on the Amman Stock Exchange.

1- Definition of Financial Analysis:

Financial analysis is also defined as a systematic processing of available data to obtain information used in the decision-making process, evaluating the performance of institutions in the past and present, and predicting what it will be like in the future. Financial analysis also includes the process of interpreting and understanding financial statements for the purpose of making future decisions. (Alhayyali, 2007)

It can also be defined as the use of financial statements to analyze the financial position and performance of an institution, and to predict future financial performance. (Subramanyam & Wild, 2008)

It can also be defined as a set of operations concerned with studying and understanding the financial data and information available in the financial statements of an institution, analyzing and interpreting them to benefit from them in judging the financial position of the institution. (Alsartawi & others, 2019)

It is also defined as an evaluation of the financial performance of an institution, with the aim of identifying the strengths and weaknesses in the institution's performance, and then developing solutions for the weaknesses to address them, and maintaining and enhancing its strengths. This process depends on a set of criteria or measures that can be used to identify the nature of the financial performance of institutions, which reflects the results of performance in other functions and departments. These criteria are measures of profitability or cost, measures of liquidity and solvency, measures of activity or asset management, and a measure of growth. (Shannouf, 2012)

Based on the previous definitions, it can be said that financial analysis is the process of evaluating and interpreting the data, information, and financial statements of a company or project, with the aim of understanding the past and present financial situation, evaluating efficiency and profitability, in addition to measuring financial solvency and risks, as well as predicting the future performance of the company or institution, and assisting management

in making decisions. Financial analysis can also be described as being used to evaluate a company's past and present financial performance, estimate its future trajectory, and predict risks and opportunities. It transforms raw financial data into valuable information that enhances sound decision-making, future planning, reduces potential risks, and helps in choosing appropriate financing methods.

2- Financial Analysis Tools:

Financial analysis relies on a set of tools and techniques that help interpret financial data and transform it into valuable information. These financial analysis tools are essential for understanding companies' financial performance, assessing the soundness of their financial position, and making investment and management decisions.

Financial analysis tools are defined as: a set of different technical means, methods, and approaches used by the financial analyst to evaluate various aspects of the economic unit's activity in its financial and operational processes, enabling the necessary comparisons and conclusions for evaluation. (Nour, 2000)

Financial analysis tools primarily include financial statements (such as the income statement, balance sheet, and cash flows), financial ratios (such as liquidity, profitability, and debt ratios), horizontal and vertical analysis, in addition to other tools such as break-even analysis and specialized analytical software. (Muhamad, 2013)

Financial ratios are among the most important and powerful tools that help the economic unit understand its financial liquidity position, the availability of funds for investment, the adequacy of equity, and the profitability of the economic unit. Financial ratios are defined as establishing a meaningful monetary relationship between two variables, one in the numerator and the other in the denominator, each representing an item or group of items from the financial statements. The figures presented in the financial statements may not be meaningful on their own and do not clearly reveal the financial position and performance of a business. This necessitates relating some of these figures to others in a proportional manner to obtain specific and meaningful results that are useful in the performance evaluation process. (Altamimi, 2019)

The following sections will focus on and discuss in detail some of the financial ratios that will be used in the practical application and hypothesis testing. Among the most important of these tools are:

A- Profitability Ratios:

The management, investors, and lenders of an establishment are concerned with its earning power, as it is the most important measure for judging the efficiency of management and its ability to utilize available resources. Investors are interested in the return on their investments in the establishment compared to the return in competing companies, while lenders are interested in the profitability of the establishment as a guaranteed source for repaying loan obligations. (Taim, 2011)

Profitability ratios are financial metrics used to assess a company's ability to generate profits through its various operations. They are calculated by comparing profits to revenues, assets, or equity. These ratios help measure the efficiency and effectiveness of the institution in generating profits by efficiently utilizing its assets (Khanfari & Borneesa, 2017), and they are essential for investors and management in making financial decisions.

The most important profitability ratios used in this research are:

- 1- Return on Investment: $(\text{Net Profit} / \text{Value of Invested Capital}) * 100$
- 2- Return on Equity: $(\text{Net Profit} / \text{Total Shareholders' Equity}) * 100$
- 3- Earnings Per Share: $(\text{Net Income} - \text{Preferred Dividends}) / \text{Weighted Average Number of Outstanding Common Shares}$.
- 4- Market-to-Book Ratio: $(\text{Market Value} / \text{Book Value})$.

B- Leverage Ratios:

These are financial indicators that assess the extent to which an establishment or institution can repay its debt obligations to others. Among the most common are the debt-to-total assets ratio and the short-term debt-to-equity ratio, which help determine the company's financial risks and its ability to meet its obligations.

The most important leverage ratio used in this research is:

- 1- Leverage Ratio: $(\text{Total Debt} / \text{Total Fixed Assets})$.
2. Debt Coverage Ratio: $\text{Net Operating Income} / \text{Total Debt Service}$.
3. Debt-to-Equity Ratio: $(\text{Total Current Liabilities} / \text{Total Equity})$.
4. Debt-to-Fixed Assets Ratio: $\text{Total Long-Term Debt} / \text{Total Fixed Assets}$.

3- Practical Aspect and Data Analysis:

Discriminant analysis is an advanced statistical method for classifying observations or individuals into a number of groups based on a set of statistically significant variables. It is used to determine the extent to which the occurrence of any phenomenon can be predicted based on specific measures. This method also allows for the identification of the variables contributing to the classification.

Discriminant analysis is one of the important procedures in multivariate statistical analysis, which focuses on how to distinguish or separate two or more groups, based on certain criteria of measurements that are similar in some characteristics. Each item or observation belongs to the correct group by using the discriminant function, which is a linear combination of variables. It is used for predicting and classifying new observations into one of the groups, providing an integrated estimate of the efficiency of the classification rules. It should yield the lowest probability of misclassification error to obtain the best results. (Asghar & Hadi, 2024)

It can be said that linear discriminant analysis works by identifying a linear combination of features that distinguish or separate two or more categories of objects or events. It projects two-dimensional or higher-dimensional data onto a single dimension to make classification easier. Therefore, this method is sometimes referred to as dimensionality reduction.

Logistic regression is also a model used to predict the probability of an event occurring by fitting the data to a logistic curve. Logistic regression uses several independent variables—which can be continuous, categorical, nominal, or ordinal—against a single dependent variable. For example, the likelihood of an individual developing asthma can be predicted by knowing information about the individual's genetic and immunological profile and estimating their degree of sensitivity. Logistic regression is also called the logistic model, as it analyzes the relationship between a set of independent variables and a dependent variable that is categorical or ordinal, by estimating the probability of an event occurring or not occurring through fitting a logistic curve.

A decision tree is a non-parametric supervised learning algorithm used for classification and regression tasks. It has a hierarchical tree structure consisting of a root node, branches, internal nodes, and leaf nodes. A decision tree can be represented as an inverted tree diagram that shows the different options and possible outcomes of any decision. It is essentially a

guide for making decisions, where each branching point represents a choice you have to make. (Ark, 2013)

The data of the studied companies, particularly profitability and debt ratios, will be analyzed using some quantitative methods, including: discriminant analysis and logistic regression.

A- Using discriminant analysis to predict the financial status of companies.

When testing the financial ratio data using discriminant analysis, the following tables were obtained:

Table No.2 Tests of Equality of Group Means

Ratio	Wilks' Lambda	F	df1	df2	Sig.
Return on Investment	0.9080	14.426	1	142	0.0000
Return on Equity	0.8600	23.058	1	142	0.0000
Earnings Per Share	0.8590	23.214	1	142	0.0000
Market-to-Book Ratio	0.8880	17.830	1	142	0.0000
Solvency Ratio	0.9520	7.205	1	142	0.0080
Debt Coverage Ratio	0.9890	1.612	1	142	0.2060
Debt-to-Equity Ratio	0.9500	7.399	1	142	0.0070
Debt-to-Fixed Assets Ratio	0.9530	6.978	1	142	0.0090

The results in the previous table show statistically significant differences between distressed and non-distressed companies in the financial ratios studied, except for the debt coverage ratio, where there was no statistically significant difference.

Furthermore, upon calculating the canonical correlation coefficient and squaring it to obtain the eta-squared coefficient, the results were as follows:

Table No.3 Latent Root and Correlation Coefficient

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation	Eta squared
1	0.378 ^a	100.0	100.0	0.524	0.275

The correlation coefficient was 0.524, and the eta-squared value was 0.275, which explains the variance between the two groups in the discriminant function. Furthermore, regarding the Wilks' Lambda table, the results were as follows:

Table No.4 Latent root and correlation coefficient

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	.726	44.265	8	.000

Since the significance level is less than 5%, the value is statistically significant between the two groups in the predicted variables based on the discriminant function that was created.

The 18 companies studied were initially classified equally (distressed and non-distressed), with 9 companies classified as distressed and 9 as non-distressed. The data for the companies was collected over 8 years, from 2014 to 2021. Therefore, there were 72 values classified as belonging to distressed companies and another 72 classified as belonging to non-distressed companies.

The final classification table for the companies was as follows:

Table No. 5 Final Classification Table for Companies

		Predicted Group for Analysis 1		Total
		Distressed	Not Distressed	
Distress	Distressed	61	11	72
	Not Distressed	25	47	72
Total		86	58	144

The previous table shows that 61 companies were correctly classified as financially distressed and suffering from financial problems, while 47 companies were correctly classified as financially sound and not experiencing financial difficulties. The overall percentage of correct classifications was 75%, and when compared to the initial percentage of 50%, it is evident that the classification accuracy increased by 25%.

B- Using Logistic Regression in Predicting the Financial Status of Companies.

The results of the logistic regression analysis of the financial ratios data for the companies studied in the initial table showed that the percentage of cases where the classification was correct is 50%, as shown in the results of the following table:

Table No.6 Overall Percentage of Initial Classification of Companies

	Observed		Predicted		
			Distress		Correct Percentage
			Distressed	Not Distressed	
Step 0	Distress	Distressed	0	72	.0
		Not Distressed	0	72	100.0
	Overall Percentage				50.0

The following table shows the variables that were not included in the model:

Table No.7 Variables not included in the model

			Score	df	Sig.
Step 0	Variables	Return on investment	13.280	1	.000
		Return on equity	20.116	1	.000
		Earnings per share	20.233	1	.000
		Market-to-book ratio	16.064	1	.000

		Solvency ratio	6.954	1	.008
		Debt coverage ratio	1.617	1	.204
		Debt-to-equity ratio	7.132	1	.008
		Debt-to-fixed assets ratio	6.745	1	.009

It is clear from the previous table that all the independent variables included in it (profitability ratios - debt ratios) contribute to improving the model when included within it, with the exception of the debt coverage ratio variable.

The following table shows the change in the model resulting from the inclusion of the independent variables:

Table No.8 Comprehensive tests of the model coefficients

		Chi Square	df	Sig.
Step 1	Step	62.681	8	.000
	Block	62.681	8	.000
	Model	62.681	8	.000

As is evident from the results in the previous table, there is a statistically significant improvement in the model compared to the previous step, as shown by the significance level value, which was less than 5%.

The model summary table, which reflects the quality of the logistic regression equation's fit to the data, also shows the correlation coefficients between the independent variables and the response variable (the categorical variable). The results were as follows:

Table No.9 Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	136.945 ^a	.353	.471

The value in the table shows that the percentage of variance among the studied companies with regard to the response variable that can be explained by the independent variables was approximately 47%. This means that the financial ratios studied explain 47% of the change in the financial situation of the companies, while the remaining percentage is due to other factors not included in the study.

The classification table also shows the ability of the final model to classify companies (distressed-non-distressed) and predict their financial status, with the results as follows:

Table No.10 Classification Table

	Observed		Predicted		
			Distress		Correct Percentage
			Distressed	Not Distressed	
Step 0	Distress	Distressed	58	14	80.6
		Not Distressed	26	46	63.9
	Overall Percentage				72.2

The previous table shows that 58 companies were correctly classified as financially distressed and experiencing financial problems, while 46 companies were correctly classified as financially sound and not experiencing financial problems. The overall percentage of correct classifications was 72.2%, and when compared to the initial percentage of 50%, it is clear that the classification accuracy increased by 22.2%.

The following table shows the extent to which the independent variables contribute to the response variable:

Table No.11 Variables Entered into the Model

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1 ^a	Return on investment	-.166	.202	.671	1	.413	0.847
	Return on equity	-.016	.205	.006	1	.938	0.984

	Earnings per share	24.889	11.670	4.549	1	.033	0.644
	Market-to-book ratio	-1.397	.627	4.959	1	.026	0.247
	Solvency ratio	.011	.006	3.367	1	.067	1.011
	Debt coverage ratio	.173	.139	1.539	1	.215	1.189
	Debt-to-equity ratio	.144	.513	.079	1	.779	1.155
	Debt-to-fixed assets ratio	-.006	.012	.280	1	.597	0.994

It is clear from the results in the previous table that both earnings per share and the market-to-book ratio have a statistically significant effect on the response variable (financial distress). Specifically, increasing earnings per share from 1 to 2 only increases the probability of default by 64%. Similarly, increasing the market-to-book ratio from 1 to 2 only decreases the probability of default by 25%.

C. Using a decision tree to predict the financial status of companies.

The results of the analysis of the financial ratios studied using a decision tree are shown in the following figure:

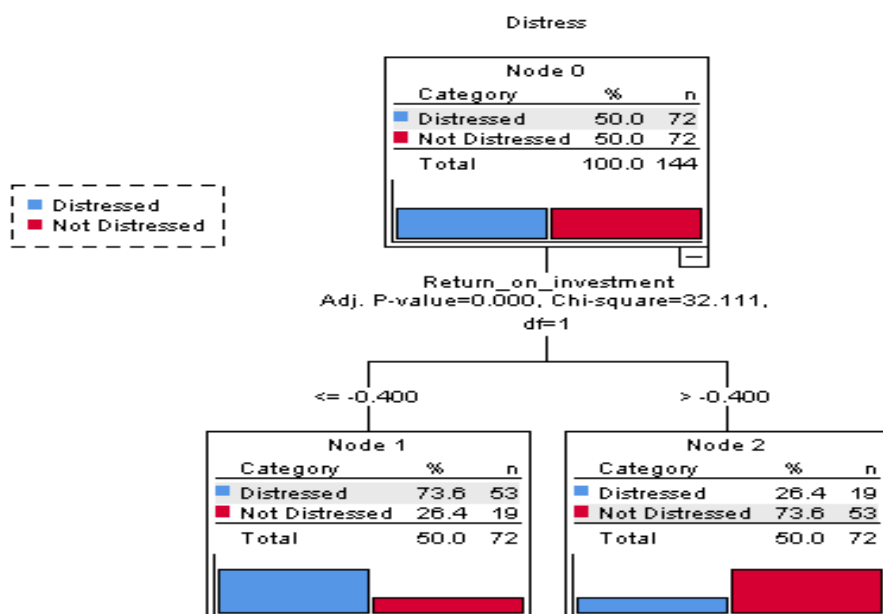


Figure No.1 Decision Tree for the Companies Studied

It is clear from the above diagram that the prediction accuracy reached 73.6%, with 53 companies predicted to be in financial distress. When compared to the initial prediction, there is an increase in prediction accuracy of 23.6%.

Results:

The research reached a number of key findings, most notably:

1. Earnings per share and the market-to-book ratio have a statistically significant effect on the response variable (the financial status of companies), meaning that these two ratios play the largest role in predicting the future financial status of companies (distressed/non-distressed).
2. The debt coverage ratio did not play a role in improving the model used.
3. The prediction accuracy in the discriminant analysis method was 75%, while it was 72.2% in the logistic regression method, and 73.6% in the decision tree method. This means that the results of the discriminant analysis are more effective in prediction.

4. There are statistically significant differences between companies classified as distressed and suffering from financial problems and companies classified as non-distressed and in sound financial condition.

Recommendations:

The research concluded with a number of recommendations, most notably:

1. Applying statistical and quantitative modeling techniques, such as logistic regression and discriminant analysis, to profitability and debt ratios to predict the future financial performance of companies.
2. Utilizing profitability and debt ratios to study the financial status of companies.
3. Using quantitative methods, particularly discriminant analysis, in analyzing the financial reports and statements of financial companies listed on the stock exchange.
4. Working to forecast the financial future of companies annually, which reduces the potential risks of loss and financial distress.
5. Striving to provide continuous and detailed data, which helps data analysts conduct the necessary analyses.

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