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PREDICTING CORPORATE FAILURE OF JORDANIAN COMPANIES USING DISCRIMINANT ANALYSIS

Bassam Abu-Abbas[*], *Mohammed Shehadeh*[**] *and Mohammed Samara*[**]

Abstract: *This research studies the corporate failure of Jordanian companies using Discriminant Analysis. The study contains detailed analysis and comparisons of two groups of failure and continues companies. The study examines the usefulness of the annual reports to predict the failure of the companies using Discriminant Analysis. Z-Score model is used to predict the corporate failure of companies in the industrial sector. The study consists of 16 companies of the industrial sector; 7 failed, 7 continued and another 2 companies that are hold-out sample to test the ability of the model to predict and classify the companies into fail or continue companies. All the financial data related to this research are taken from Amman Stock Exchange (ASE) and are limited to the industrial sector, during the period 1999-2014. The results show that Discriminant Analysis can predict corporate failure. The results also show that Gross Profit Ratio and the Working Capital are the most important ratios, which help in predicting the corporate failure of the industrial companies. The Discriminant Analysis model shows an accuracy of 73.2% in predicting corporate failure.*

Keywords: *Jordanian Companies; Corporate Failure; Discriminant Analysis.*

1. INTRODUCTION

Financial reporting has become an essential component of communication between a business and its stakeholders. All companies should issue an annual report that should contain financial statements. The published annual report is the most significant way for a company to communicate with the external stakeholders. This study examines the usefulness of the annual reports to predict the failure of the companies.

The collapse of many companies and stock markets has destroyed many economic sectors throughout the world, an example of that is the 2007-2008 financial crises. Auditing standards oblige auditors to give assessment and report about the companies' ability to continue as a going concern. Although companies face failure after receiving clean or unqualified audit opinion.

* Ph.D, Department of Accounting and Information Systems, College of Business and Economics, Qatar University, *E-mail: babuabbas@qu.edu.qa*

** The King Talal Faculty of Business and Technology, Princess Sumaya University for Technology, Amman, Jordan

Some people make mistakes in the term of bankruptcy, corporate failure and liquidation; they do not differentiate between them. Bankruptcy is the system that is created to merchants, a special system designed to organize the mass execution of the bankrupt debtor who ceases to pay its debts because of his disorder and poor financial conditions, which must be done in accordance with a court ruling at the request of the company's own representatives, or at the request of one of the creditors of the company or the public prosecution. A state of bankruptcy for a merchant is when he fails to pay its commercial debts or can only support its financial credentials through illegitimate means. Corporate failure refers to companies operations which get to inability to make profits or bring in enough revenues to cover its expenses which can occur as result of poor management skills, inability to complete or have insufficient marketing. In other words, low performance management. Liquidation is the system that is created for companies whether in the form of partnerships, limited liability companies, private shareholding companies or public shareholding companies, when any of these firms is terminated or bankrupt, its assets are sold and the proceeds are paid to the creditors and what is leftover is distributed to shareholders.

Nowadays, many capital owners tend to invest their money in performing a new business. They start with a company without taking into consideration the place where it is located or how much it will take them to reclaim the capital they invested. Most of these companies face bankruptcy and failures. The failures of a company would affect several parties including shareholders, stakeholders, creditors, investors and the employees working in the company.

1.1. Importance of the Study

Corporate failure prediction studies in Jordan is still pretty limited, researchers use many samples and statistical techniques that predict the accurately failure of a company. We think that studying the annual reports for a company is important for the users of financial reports in order to judge on the sustainability of the company.

This research helps several parties including shareholders, stakeholders, creditors, investors and the employees working in the company. It is also a useful tool for decision making. It helps shareholders managing their business, creditors give credit to a company or not, investors whether to invest in a company or not and the employees in the same company to ensure the continuity of their jobs.

The application of Discriminant Analysis helps in predicting the financial failure of Jordanian Corporations in the industrial sector using pre-determined ratios can also help statutory auditors who are required by the law to determine the continuity of a company.

1.2. Research Objectives

This research applies a practical model that uses Discriminant Analysis method to predict the corporate failure of the corporations called (Z-Score model). This model examines the financial health of the companies and provides decision makers with useful information about the situation of the company and its ability to continue. The model provides investors with a useful tool to take an investment decision. The research focuses on ratios that can predict the probability that a company will fail and face corporate failure or the probability that it will continue using three annual financial reports. The research focuses on the companies in industrial sector in the Jordanian market.

Furthermore, we also think that the practical model of the Discriminant Analysis helps several parties including shareholders, stakeholders, creditors, investors and the employees working in the company. Furthermore, the model helps decision makers to manage their businesses.

Moreover, this research examines if the industrial sector in the Jordanian market is in line with the Discriminant model and tests if that model can predict accurately or not. This research also tests if the model can be used and if it can be applied through the entire sector and to what extent of usefulness can be achieved.

Thus, the research aims for applying the Discriminant Analysis model for other financial problems: (a) consumer credit evaluation; (b) investment classification; (c) high and low price-earnings ratio firms; and (d) classification of firms into standard investment categories.

(a) Consumer credit evaluation: Credit evaluation is a business or lenders process undertakes when evaluating a request for credit or become eligible for a loan to pay for goods and services over an extended period. The approval of granting credit depends on the willingness of the creditor to lend money in the current economy and the same lender's assessment of the ability and willingness of the borrower to repay the money plus interest during a specified period. Generally, small businesses request credit approval from lenders to obtain funds. Lenders should study the financial health of the businesses in order approve or disapprove the credit.

(b) Investment classification: Investing in businesses is by cash, bonds and stocks. People would like to invest in businesses that would sustain, grow and get high income. It is very hard for investors to invest in any company or business without studying the financial health of the business; they wouldn't invest blindly and take the high risk of failure in the businesses.

(c) High and low price-earnings ratio firms: Nowadays, earnings have become hard to predict. Everyone is demanding high rates of return and high income of what is invested. Our model provides helpful information to

ensure the satisfaction of taking the action and knowing more about the business.

(d) Classification of firms into standard investment categories: Using the statistical models on many firms, getting the results, analyzing and interpretations of the results would help to classify the firms into groups to determine which is better to invest in from different criteria. So they give more confidence to the investors where to put their money. This would lower the risk of corporate failures.

1.3. Hypotheses

According to previous studies, the Discriminant Analysis using Z-Score model showed the effectiveness of the model in predicting corporate failure. Also previous studies indicate that Multiple Discriminant Analysis is very reliably and potent statistical tool compared with the other methods of predicting corporate financial failure. Altman, Haldeman and Narayanan (1977) model shows an accuracy that ranges from over 96 percent one period prior to bankruptcy to 70 percent five annual reporting periods prior to bankruptcy. Altman (1968) model shows an accuracy of 95 percent of all firms in the bankrupt and non-bankrupt groups assigned in the manufacturing sector. Yap *et al.* (2010) show a model that has accuracy between 88% and 94% in predicting failures. As a result, we develop our hypotheses as follows:

1. The Discriminant Analysis model using pre-determined ratios can predict the financial failure of Listed Jordanian Corporations in the industrial sector in ASE.
2. The model shows usefulness for decision makers in performing their decisions.

1.4. Methodology

This study adopts the quantitative approach in analyzing data taken from ASE. The research is based on statistical methods for applying a practical model (Z-Score Model) on the Jordanian market.

This research uses Discriminant Analysis for predicting corporate failure; it is a statistical method using financial ratios for predicting the corporate failure of the industrial sector in the Jordanian market. The time period of this research is taken between 1999 and 2014. The period of prediction is 2-3 years before the failure occurs. Two samples were taken; each consists of 8 companies. The first sample contains all the companies that faced corporate failure and faced liquidation. The other sample includes companies from the same sector which continued to present. The second sample is chosen to be equivalent to the first sample in the total assets of the first sample companies. Some ratios were chosen according to previous

studies and according to some analysis and to what extent the usefulness of these ratios. A practical model should arise based on some analysis.

In performing the analysis, we study 2 groups of companies; the 7 companies which have faced corporate failure and the other 7 which have continued based on the total assets. The remaining 2 companies were left to test the accuracy of the model.

1.5. Summary of this Research

This paper consists of four sections. Section 1 presents an introduction about financial reporting and how it is important to the companies; it also indicates the significance and usefulness of annual reports. Furthermore, the section indicates the differences in terms between bankruptcy, corporate failure and liquidation. Moreover, it indicates the importance of Discriminant Analysis study, its objectives, hypothesis, methodology and the summary of the overall study. Sections 1 also shows the importance of predicting corporate failure for shareholders, stakeholders, creditors, investors and the employees working in the company.

Section 2 presents the literature review and a summary of them. It also indicates how these studies are related to our study. Furthermore, it also indicated the use of Discriminant Analysis and performing the Z-Score model in Jordan, and how it is limited. Section 2 also shows some added value and explains how this study is different from the previous studies; and how the model succeeded in prediction of corporate failure.

Section 3 presents the sample that is taken from the industrial sector; including all the companies that faced failure and an equivalent sample from the companies that continued based on their total assets. Moreover, it shows a brief introduction and explanation about Discriminant Analysis, it also shows the advantages of Multiple Discriminant Analysis. Section 3 also shows the Z-Score model that we conduct compared to Altman's and Kida's model, it also shows the statistical analysis and how accuracy in the model in predicting corporate failure, it shows 73.2% accuracy in predicting corporate failure. The model also showed that there are 2 variables (ratios) which are most important in predicting the failure; the variables are gross profit ratio (x1) and working capital (x13). In addition to that, the section presents testing the accuracy of the model by applying it on a hold-out sample (a sample outside the analysis); it showed an accuracy of 100% on both failed and continued companies.

Section 4 presents the conclusions for the study. In addition, it shows recommendations and limitations of the model used in this study. The conclusions presented in section4 are the explanations of section 3. These conclusions are supported from the literature review section.

2. LITERATURE REVIEW

2.1. Literature Studies

Altman (1968) assesses the quality of ratio analysis as an analytical technique. The prediction of corporate bankruptcy is used as an illustrative case. Specifically, a set of financial and economic ratios will be investigated in a bankruptcy prediction context wherein a multiple discriminant statistical methodology is employed. The data used in the study are limited to manufacturing corporations. The paper seeks to assess the analytical quality of ratio analysis. It has been suggested that traditional ratio analysis is no longer an important analytical technique in the academic environment due to the relatively unsophisticated manner in which it has been presented. In order to assess its potential rigorously, a set of financial ratios was combined in a discriminant analysis approach to the problem of corporate bankruptcy prediction. The theory is that ratios, if analyzed within a multivariate framework, will take on greater statistical significance than the common technique of sequential ratio comparisons. The results are very encouraging. The author concludes that the discriminant-ratio model proved to be extremely accurate in predicting bankruptcy correctly in 94 percent of the initial sample with 95 percent of all firms in the bankrupt and non-bankrupt groups assigned to their actual group classification. Furthermore, the discriminant function is accurate in several secondary samples introduced to test the reliability of the model. Investigation of the individual ratio movements prior to bankruptcy corroborated the model's findings that bankruptcy can be accurately predicted up to two years prior to actual failure with the accuracy diminishing rapidly after the second year.

Altman *et al*. (1977) explore the development of a bankruptcy classification model which incorporates comprehensive inputs with respect to discriminant analysis and utilizes a sample of bankrupt firms essentially covering the period 1969-1975. The model's bankruptcy classification accuracy ranges from over 96 percent one period prior to bankruptcy to 70 percent five annual reporting periods prior to bankruptcy. The results of the study are compared with other alternative bankruptcy classification strategies. The results of the study indicate potential significant application to credit worthiness assessment, portfolio management and to external and internal performance analysis. Abu Orabi (2014) testes the effectiveness of financial failure prediction models on forecasting the failure of public shareholding companies. The study concludes that Altman model is a reliable financial predictor for all sectors of the public shareholding companies. Also the study concludes that Sherrod model is not a reliable predictor for industrial shareholding companies. The test results shows a suitability of some financial ratios in both proposed models, but there is no conclusive ability of either model to predict any financial failure of public shareholding companies with a high degree of accuracy, this is probably due to external factors and circumstances.

Al-khatib and Al-Horani (2012) investigate the role of a set of financial ratios in predicting financial distress of publicly listed companies in Jordan. The authors concluded that Return on Equity (ROE), Return on Assets (ROA) and some other ratios appear to predict financial distress of public companies in Jordan. Chung *et al.* (2008) use Multivariate discriminant analysis and artificial neural network to create an insolvency predictive model that could effectively predict any future failure of companies in New Zealand. The results of the study indicate the financial ratios of failed companies differ significantly from non-failed companies. Failed companies were also less profitable and less liquid and had higher leverage ratios and lower quality assets. Kuruppu *et al.* (2002) examine the efficacy of a corporate liquidation model and a benchmark bankruptcy prediction model for assessing company liquidation. The authors conclude that the liquidation model is more accurate in predicting company liquidations in comparison with the benchmark bankruptcy prediction model.

Bellovary *et al.* (2007) provide a comprehensive review of the literature on going concern studies which provide detailed reviews of the evolution of the going concern report and requirements of the standards related to auditors' assessment of going concern. The authors conclude by updating Asare's efforts and by outlining the research concerning the development of going concern prediction models and makes these contributions: (1) summarizes statistics on model attributes, such as the number of factors and method used; (2) discusses the factors used most frequently in studies; (3) breaks down the predictive accuracies of the models by decade; (4) compares model accuracies based on the method used for model development; (5) identifies studies that used a hold-out sample for validation; and (6) provides a summary of studies involving non-U.S. firms. Al- Rawi *et al.*(2008) uses the Altman z-score analysis to predict a firm's insolvency. The researchers used Altman Z-scores and ratio analysis approaches to conclude their views why the firm under study went bankrupt. Therefore, we concluded that Altman's model may be used as an indicator and perhaps evidence to determine the firm's bankruptcy- in the future. We know that a mathematical model is an abstraction of reality, therefore, we believe that further evidence and economic indicators may be needed to determine outcome of the firm's future operating activities and its financial position performance. The study results for the period 2002-2004 indicated the weaknesses of "Jordan Establishment for Marketing Durable goods". Keener (2013) focuses specifically on the application of a failure prediction model to companies from the retail industry. The results indicate that smaller retail companies with fewer employees are more likely to fail and firms with lower cash to current liability ratios, lower cash flow margins and higher debt to equity ratios are more likely to file for bankruptcy.

Pradhan (2011) uses Z-Score to predict the bankruptcy of banks in the lending arena when they actually go in for borrowing credit and attempts to draw a

comparison of the three banks Axis Bank, HDFC Bank and ICICI Bank. The analysis suggests that the model can forecast the financial position of the firm in case of loan value enhancement as well as the extension of the repayment period implying to be effective in the designing of policy measures related to credit viability thus proves to be a vital tool to regulate the occurrence of credit defaults. Alkhatib and Al Bzour (2011) report the effect of financial ratios in bankruptcy prediction in Jordanian listed companies through the use of Altman and Kida models. The outcome of the analysis shows that Jordanian listed companies may not be using such models in their financial and credit analysis. The authors suggest that companies should at least apply one of these models with high credibility for predicting corporate bankruptcy.Alareeni and Branson (2013) test the generalizable of Altman Z-score (1968) model and the Altman Z''-Score model (1993) in the Jordanian environment. The authors conclude that the original Altman Z-Score (1968) model still works effectively. The model is generalizable in the Jordanian context for assessing failed industrial companies. For service companies and the Altman models could not provide strong indicators to differentiate between failed and non-failed companies.

Haron *et al.* (2009) provide evidence to the practically consideration of auditor judgment on going concern opinion. The authors conclude also that auditors' judgment is affected by financial indicators, evidence and disclosure. Pervan *et al.* (2011) decide to use a sample of different sized bankrupted companies from manufacturing and wholesale/retail trade industry. The authors conclude that publicly available financial statements and calculated financial ratios have informational value since they can be effectively used for prediction of companies' bankruptcy. Hayes *et al.* (2010) outline the construction and interpretation of the Z-Score and apply it to several pairs of firms from a variety of specialty retail industries spanning two consecutive years. The authors suggest that further exploration of Altman's Z score, and alternative formulas, is necessary to refine this potentially useful tool in order to develop a predictive collection of tools useful in predicting not only bankruptcy, but financial distress in a variety of firms in a variety of contexts.

Anjum (2012) describes in detail the studies carried out by Altman to predict business bankruptcy and summarizes the research of Altman that have being made to develop the Altman Z score model summaries significant studies in the bankruptcy prediction area and provides a comparison of the different models which are commonly used. Bal *et al.* (2013) examine empirically the effectiveness of entropy measures derived from information theory combined with discriminant analysis in the prediction of construction business failure. The authors found that "return on assets," "return on capital," and "earning per share" are good discriminators between failed and no failed companies. Li and Rahgozar (2012) re-examine the accuracy of the original Z-score model in predicting corporate

failures in the U.S. from 2000-2010 and explores whether asset volatility substantiates the Z-score in predicting bankruptcies. The conclude that results show that the original Z-score model is valuable in predicting corporate financial stress for both manufacturing and non-manufacturing firms and total asset volatility might be a missing variable from the original model when predicting financial distress of manufacturing firms. Other results imply that stakeholders would further benefit from observing a company's financial status for a period longer than one or two years. Sulphey and Nisa (2013) assess the solvency position of 220 companies listed in the BSE Small Cap Index using Z score. The analysis of authors concludes that only 79 companies were in the safe zone. 117 companies were in the grey zone and 24 in the distress zone.

Zeytınoglu and Akarým (2013) develop reliable model to identify the financial failure risk of the firms listed on Istanbul Stock Exchange National-All Share Index. As a result of the analysis using these 20 financial ratios, it is identified that there are 5, 3 and 4 important financial ratios in the discrimination of the successful and unsuccessful firms in 2009, 2010 and 2011 respectively. Taffler and Agarwal (2007) describe the operating characteristics of a well-known UK-based z-score model and evaluate its performance over the twenty-five year period since it was originally developed. This study describes a widely-used UK-based z-score model and explores its track record over the twenty five year period since it was developed. It is the first study to conduct valid tests of the true predictive ability of such models explicitly. Yap *et al.* (2010) develop a model to improve the company's ability to predict failures in a later time frame with different financial and business conditions in Malaysia. Using Multiple Discriminant Analysis, they analyzed a number of 64 companies with 16 financial ratios. The study showed a high predictive accuracy which is between 88% and 94%. This study also indicated that MDA is still a very reliably and potent statistical tool compared with more advanced statistical tools that are more popular recently.

2.2. Summary of Literature Studies

Previous researches focused on methods of predicting corporate failure or going concern using various methods and models. The most important one is the Multiple Discriminant Analysis through the Z-Score. It is a statistical method that uses some ratios as indicators of the financial health of the companies and they are used on companies from manufacturing and trade/wholesale industries. The basic concerns of this model are to evaluate the terms of credit to ensure repayment for safety lending and as a measure of performance. The mostly used model is the Z-Score; it showed high accuracy and preciseness in predicting the corporate failure. Z-Score is used to predict a firm's insolvency and evidence suggests that the firm has increased its debt and will be facing bankruptcy or failure in the near future. Also Discriminant Analysis through the Z-Score was used as business bankruptcy

efficiency prediction up to 2-3 years in advance and as determination of an auditor's judgment and assessment on going concern.

In Jordan, limited previous studies show the application of Discriminant Analysis through the Z-Score model. Z-Score model is used for financial failure prediction of public shareholding companies in both industrial and service sectors to give warning about the possibility of bankruptcy before 2-3 years. Discriminant Analysis was compared with Logistic Regression and both were used to predict financial distress of public listed companies to determine which is more appropriate to use.

Most of theprevious studies were conducted in theUnited States and Europe; examples of the United States (Altman, 1968), example of Europe (Taffler and Agarwal, 2007). Other previous studies were applied in other countries and got many useful results, such as using multiple Discriminant Analysis in Malaysia and New Zealand. Also Z-score model was used to predict the bankruptcy of banks in the lending arena such as Axis Bank, HDFC Bank and ICICI Bank, althoughtheireconomic differencesand diversity ofthe accountingstandards appliedin those countries and banks. This study focuses on using Discriminant Analysis (DA) to predict financial failure and uses a matched sample by factors including size and industry in the industrial sector in Jordan. In addition, the studyuses othersampleoutside thecompaniesthat have entered intothe modelto checkthe accuracy ofthe model.

3. DATA ANALYSIS

3.1. Introduction to Multiple Discriminant Analysis

Multi Discriminant analysis is a statistical method or technique used to classify data into predefined groups based on a set of variables known as predictors or input variables.

Based on data, the technique build a linear functions of the predictors include Discriminant coefficients, input variables or predictors and constants known as Discriminant functions.

$$z = b_1X_1 + b_2X_2 + \cdots.. bxXn + c$$

Where B's = Discriminant coefficient

X's = Predictors or input variables

C = Constant

Through using the Discriminant function or model, we can classify data with unknown groups into pre-defined groups where the dependent variable appears in qualitative form, e.g., male or female, bankrupt or non-bankrupt, to buy or not

to buy a stock. Multi Discriminant analysis classify data by setting rule using values that have a high influence to reach a meaningful separation that value. Edward Altman is famous in using multi Discriminant analysis in creating Altman-z score.

3.2. Advantages of Multiple Discriminant Analysis

There are several advantages for using multiple Discriminant analysis, such as accurate classifying data, observations and cases or testing theories, easy explanation of between-group differences results, and discarding variables that seem unimportant and unrelated heavily to groups' variance. In addition, determining the variables that have a sequence effect and reducing errors in results of analysis can be concluded as advantages of using multi Discriminant analysis.

3.3. Prior Failure Prediction Models Using Multi Discriminant Analysis

1- Altman (1968)

Altman built a model using Discriminant analysis using a sample of 66 companies from the manufacturing sector.

Z = .012X1 +.014X2 +.033X3+.006X4 +.999Xs

Where X_1 = Working capital/Total assets

X_2 = Retained Earnings/Total assets

X_3 = Earnings before interest and taxes/Total assets

X_4 = Market value equity/Book value of total debt

X_5 = Sales/Total assets

Z = Overall Index

2- Kida's Z score Model

Kida model consist of five separate financial ratios. The model is represented as follow:

$$Z = 1.042X_1 + 0.42X_2 + 0.461X_3 + 0.463X_4 + 0.271X_5$$

Where Z = weighted average of five separate ratios

X_1 = net profit after tax / the total assets

X_2 = Interest and expenses discounted for short-term and long-term obligations

X_3 = (Accounts and Notes Payable / total sales)*12

X_4 = Sales / total assets

X_5 = Cash / total assets

Where companies result a Z-score more than 0.38 refer as a good sign for successful and continues. On the other hand, companies result a Z-score less than 0.38 refer as a bad sign of its financial health and may face a bankruptcy.

3.4. Sample of this Study

A period from 1999 – 2014 were chosen for this study, industrial sector in Jordan was the best choice to use in building a model by using multiple Discriminant analysis because of number of corporations faces failure in this sector compared with other sectors of the Jordanian market. Sample chosen contain 14 companies divided to two groups, the first group consists of seven companies of eight that are failed in the chosen sector during the period 1999-2014. Data is not available in ASE prior to this period. The second group consists of another seven companies that are continued. Each company in the second group is equivalent in its assets to one in the first group during the same period taken. Additional two companies, one failure and one continue, are chosen randomly to be out of the sample to be used for testing the model.

After the groups are defined and firms selected, financial statement are collected from ASE market. The 13 chosen ratios are divided into 4 groups; profitability, debt, performance and liquidity. The above ratios are chosen because of the popularity of using them by users, using them in literature reviews and the availability of financial data.

3.5. Statistical Analysis

This section shows the ratios used in analysis. It also includes the Discriminant equation that is conducted. Table 1 shows the summary of ratios used in the analysis and the variables that are assigned for each ratio.

Table 1
Ratios used and variables assigned for each ratio

Ratios	*Variables*
Gross Margin	X_1
Margin Before Interest and Tax	X_2
Profit Margin	X_3
Return on Assets	X_4
Return on Equity	X_5
Debit Ratio	X_6
Equity Ratio	X_7
Interest Coverage Ratio	X_8
Total Assets Turnover	X_9
Fixed Assets Turnover	X_{10}
Working Capital Turnover	X_{11}
Current Ratio	X_{12}
Working Capital	X_{13}

Table 2 shows the Canonical Discriminant Function Coefficients that are used to build the Z-Score equation. It is consisted of X_1 (the gross profit), X_{13} (the working

capital) and a Constant. From Table 2, we build equation ofDiscriminant Analysis (Z-Score equation)as follows:

$$Z \text{ score} = 0.433 + X_1 * 0.0001 + X_{13} * 0.001$$

Table 2
Canonical Discriminant Function Coefficients

	Function 1
x1	0.0001
x13	0.001
(Constant)	0.433

Unstandardized coefficients

Table 3 is used to establish the cutting point for classifying cases where Centroids are the mean Discriminant scores for each group. If the two groups are of equal or unequal size, the best cutting point is half way between the values of the functions at group centroids (that is, the average).

Average = (0.448-0.523)/2
= -0.075/2
= -0.0375 where this value is the cut-off point

Table 3
Functions at Group Centroids

group	*Function* 1
1	0.448
2	-0.523

Classification Statistics

Table 4
Prediction and Classification Results[a]

		group	*Predicted Group Membership*		*Total*
			1	*2*	
Original	Count	1	7	0	7
		2	5	2	7
	%	1	100.0	.0	100.0
		2	71.4	28.6	100.0

a.73.2% of original grouped cases correctly classified.

Table 4 shows that the model's ability to predict up to 73.2%, this result is considered satisfactory. For the companies that have continued, the predictive accuracy for Discriminant model was 100% and for the companies that have failed, the predictive accuracy for Discriminant model was 71.4%.

3.6. Testing the Accuracy of the Equation in Classification

To test the accuracy of the model, we classified the companies into 2 groups:

Group 1 (Failure companies): Table 5 shows the results of testing the accuracy of the equation in group 1:

Table 5
Testing the accuracy of the equation in Group1: failure companies

		Jordan Kuwait for agriculture products	*Nayzak*	*Jordan Medical Corporation*	*International Textile Manufac-turing*	*United-Glass-Industries-Company*	*Arabian Group for Investment & Interna-tional Trading Co*	*Arab Company for Food and Medical Supplies*
	X_1	0.224	0.530	-0.853	0.852	0.334	0.051	-0.388
	X_{13}	-1489152	-39035	-2517406	-255154	451466	377434	-7015887
X_1	0.00001	0.0000022	0.0000053	-0.0000085	0.0000085	0.0000033	0.0000005	-0.0000039
X_{13}	0.001	-1489.152	-39.035	-2517.406	255.154	451.466	377.434	-7015.887
(Constant)	0.433	0.433	0.433	0.433	0.433	0.433	0.433	0.433
z-score		-1488.719	-38.602	-2516.973	-254.721	451.899	377.867	-7015.454
result		**fail**	**fail**	**fail**	**fail**	**continue**	**continue**	**fail**

After the equation is applied for group 1 companies, we find that the equation predicts all the companies that faced corporate failure in the industrial sector except two companies (United-Glass-Industries-Company, Arabian Group For Investment & International Trading Co).

Group 2 (Companies still continuing in their work): Table 6 shows the results of testing the accuracy of the equation in group 2:

Table 6
Testing the accuracy of the equation in Group 2: continue companies

		The Puplic Mining	*Arab Center for Pharm.& Chemicals*	*Woolen Industries*	*Industrial Industries & Match/ Jimco*	*International for Optical and Hearing Aid Ind*	*Interna-tional Detergent Manufac-turing*	*Interna-tional Silica Industrial*
	X_1	0.550	0.404	0.132	0.324	0.273	0.078	0.379
	X_{13}	1334138	4600871	800943	403645	644444	-371	254971.000
X_1	0.00001	0.000005	0.000004	0.000001	0.000003	0.000003	0.000001	0.000004
X_{13}	0.001	1334.138	4600.871	800.943	403.645	644.444	-0.371	254.971
(Constant)	0.433	0.433	0.433	0.433	0.433	0.433	0.433	0.433
z-score		1334.571	4601.304	801.376	404.078	644.877	0.062	255.404
Result		**continue**	**continue**	**continue**	**Continue**	**continue**	**Continue**	**continue**

After the equation is applied for group 2 companies, we find that the equation correctly predict all companies.

3.7. Hold-out Sample

To confirm the ability of the model to predict and classify the companies to fail or continue, we have tested the model on two companies out of the sample; one of them is continue company and the other is failed company. Table 7 shows the test of the model on the hold-out sample.

Table 7
Testing the accuracy of the equation in the hold-out sample

		Company 1	*Company 2*
	X_1	-113982.000	-0.844
	X_{13}	-170847.000	466307.000
X_1	0.0001	-11.3982000	-0.0000844
X_{13}	0.001	-170.847	466.307
(Constant)	0.433	0.433	0.433
z-score		-181.812	466.740
Result		Fail	Continue

Table 7 shows additional two companies; one failed and the other continued. Where the failed one is National Textile and Plastic Industries that have total assets of 1,977,766 JDs and the continue one is Akary for Industries and Real Estate Investments that have total assets of 1,425,239 JDs. Fromthe results inTable 7 the modelhas succeededin itsassessment ofthe two companiesproperly,which indicatesthe ability ofthe modelto predict.

3.8. Results

A lot of factors can contribute to corporate failure problem either directly or indirectly. In this study, two potential variables are identified as the factors of corporate failure based on Discriminant model. The variables are gross profit ratio (X_1), working capital (X_{13}). More importantly, Table 5, Table 6 and Table 7 show that Discriminant model can be used as a tool in predicting corporate failure in Jordan. Based upon the results, we can conclude that our proposed Discriminant model is simple to implement and performs well according to the overall percent of cases that are correctly predicted by the model which indicates 73.2% accurate in predicting corporate failure for Jordanian firms.

We also conclude that our model help several parties including shareholders, stakeholders, creditors, investors and the employees working in the company. Results show that the ratios that measures profitability and liquidity are the most useful in predicting company's failure or continuity.

The prediction of business failure is an important for taking timely corrective and remedial measures for protecting business from the problem of failure.

4. CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS

4.1. Conclusions

This research studies the role of a set of financial ratios in predicting corporate financial failure of companies listed in ASE. It studies the industrial sector and uses Discriminant Analysis in predicting the corporate failure of the companies.

Many factors can contribute to corporate failure either directly or indirectly. Two main variables are identified as factors of corporate failure based on the Discriminant Analysis model. The variables are gross profit ratio (X_1) and working capital (X_{13}). Most importantly, this study indicates that the Discriminant Analysis model can be a tool in predicting corporate failure in Jordan. Based on the results, we conclude that our proposed Discriminant Analysis model is simple to implement and performs well according to cases that are correctly predicted by the model which indicates 73.2% accurate in predicting the corporate failure of companies in the industrial sector in Jordan.

The prediction of corporate failure is important for taking timely, corrective and remedial measures for protecting the company from failure.

The main result of the study is shown on the Table 8. It can be indicated that, 12 correct classifications under our Discriminant model and there are 2 incorrect classifications under the model. For the companies that have continued, the predictive accuracy for Discriminant model was 100% and for the companies that have failed, the predictive accuracy for Discriminant model was 71.4%.

Table 8
Results of the study

Classification	*Companies failed*	*Companies continued*
Correct	5	7
Incorrect	2	0

The other results we find are:

1. The analysis showed evidence that corporate failure can be predicted as shown in the above table.
2. Companies that faced failure show negative working capital value, compared to companies that have survived.
3. The Power of activity ratios using Discriminant model to predict failure companies in Jordan.

4. The test of the model shows the accuracy of 100% on hold-out sample which have failed in the sector, and shows 100% on the hold-out sample that is taken against the failure company.

We find that the practical model (Z-Score) can give a prediction accuracy of 73.2% if the firm will continue or face failure based on the analysis. The model is formed through some ratio analysis, that model is applicable through the entire sector.

In addition, we find that the formed Z-Score model is very predictive and reliable statistical tool in predicting the corporate failure. There is a decisive relationship between the financial health and the corporate failures, the results show the significant predictive power about the company's failure or continuity. Finally, the results show that the ratios that measures profitability and liquidity are the most useful in predicting company's failure or continuity.

4.2. Recommendations

Researchers may study different methods of predicting corporate failure of the companies based on their inclinations. There are many other factors affecting the continuity of the companies that they can study using many other techniques. In this regard, the following recommendations are suggested for further research:

1. We would like to recommend ASE to use this model for evaluating the listed companies, it is important because this model can make sure that only qualified company can be listed in ASE and help investors to make a right choice in investing decision.
2. All prediction models must be re-evaluated and updated on a periodic basis, because the economic conditions can change the models accuracy.
3. The Ministry of Industry and Trade must increase disclosure about the failure companies, display and make data available to researchers and students.
4. We recommend researchers in the near future to use other tools such as regression analysis to predict corporate failure.
5. We recommend using Discriminant Analysis on a much larger market that has larger amounts of companies; this would increase the percentage of accuracy.
6. We recommend using Z-Score model under the Discriminant Analysis because it is easy and simple. Also it is a good indicator for predicting the financial health of the companies.
7. We recommend decision makers to use such Discriminant Analysis or a model for predicting corporate failure to help those taking useful decisions that help them performing the business.

4.3. Limitations

As researches going through their study, they would face many limitations which could lead them to face many obstacles. The limitations of our study may be summarized as follows:

1. The Jordanian market is a small market and it does not contain large number of listed companies that have failed.
2. Our model is limited and only formulated for operating industrial companies, it can only predict accurately in that sector.
3. The indication of negative working capital does not always mean that the company is facing failure, it can be a sign of business efficiency, if the business is with low inventory and accounts receivables; it means they operate effectively on cash basis.
4. The model (that we conducted) does not give an accurate decision to take, and it does not give an accurate percentage of how weak/good the company is.

References

Abu Orabi, M. M. (2014), Empirical Tests on Financial Failure Prediction Models, "*Interdisciplinary Journal of Contemporary Research in Business*", Vol. 5, No. 9, 29-43.

Al Areeni, B. and J. Branson (2013), Predicting Listed Companies' Failure in Jordan Using Altman Models: A Case Study, "*International Journal of Business and Management*", Vol. 8, No. 1, 113-126.

Al-khatib, H. B. and A. Al-Horani (2012), Predicting financial distress of public companies listed in Amman stock exchange, "*European Scientific Journal*", Vol. 8, No. 5, 1-17.

Alkhatib, K. and A. Q. Al Bzour (2011), Predicting Corporate Bankruptcy of Jordanian Listed Companies: Using Altman and Kida Models, "*International Journal of Business and Management*", Vol. 6, No. 3, 208-215.

Altman, E. I. (1968), Financial ratios, discriminant analysis and the prediction of corporate bankruptcy, "*Journal of Finance*", Vol. 23, No. 4, 589–610.

Altman, E. I., R. G. Haldeman and P. Naraynan (1977), Zeta Tin Analysis a new model to identify bankruptcy risk of corporations, "*Journal of Banking and Finance 1*", Vol. 1, No. 1 29-54.

Al-Rawi, K., R. Kiani and R. R. Vedd (2008), The Use of Altman Equation for Bankruptcy Prediction in an Industrial Frim (Case Study), "*Industrial Business & Economics Research Journal*", Vol. 7, No. 7, 115-128.

Anjum, S. (2012), Business Bankruptcy Prediction Models: A significant Study of Altman's Z-score Model, "*Asian Journal of Management Research*", Vol. 3, No.1, 212-219.

Bal, J., Y. Cheung and H. Wu (2013), Entropy for Business Failure Prediction: An Improved Prediction Model for the Construction Industry, "*Advances in Decision Sciences*", Vol.1, 1-14.

Bellovary, J. L., D. E. Giacomino and M. D. Akers (2007), A Review of Going Concern Prediction Studies: 1976 to Present, "*Journal of Business and Economic Research*", Vol. 1, No. 5, 9-28.

Chung, K., S. S. Tan and D.K Holdsworth (2008), Insolvency Prediction Model Using Multivariate Discriminant Analysis and Artificial Neural Network for Finance Industry in New Zealand, "*International Journal of Business and Management*", Vol. 1, No. 1, 19-29.

Haron, H., Hartadi, B., M. Ansari and I. Ismail (2009), Factors Influencing Auditors' Going Concern Opinion, "*Asian Academy of Management Journal*", Vol. 14, No. 1, 1-19.

Hayes, S. K., K. H. Hodge and L. W. Hughes (2010), A Study of Efficacy of Altman's Z to Predict Bankruptcy of Specialty Retail Firms Doing Business in Contemporary Times, "*Economic & Business Journal: Inquiries & Perspectives*", Vol. 3, No. 1, 130-134.

Keener, M. H. (2013), Predicting the Financial Failure of Retail Companies in the United States, "*Journal of Business and Economic Research*", Vol. 11, No. 8, 373-280.

Kuruppu, N., F. Laswad and P. Oyelere (2002), The Efficacy if Liquidation and Banruptcy Prediction Models for Assessing Going Concern, "*Center of Accounting Education and Research*", No. 97, 1-21.

Li, J. and R. Rahgozar (2012), Application of the Z-Score Model with Consideration of Total Assets Volatility in Predicting Corporate Financial Failures from 2000-2010, "*Journal of Accounting and Finance*", Vol. 12, No. 2, 11-19.

Pradhan, R. (2011), Predicting of Z Score for Private Sector Banking Firms, *International Referred Research Journal*", Vol. 2, No. 22, 94-98.

Pervan, I., M. Pervan and B. Vukoja (2011), Prediction of Company Bankruptcy Using Statistical Techniques – Case of Croatia, "*Croatian Operational Research Review*", Vol. 2, 158-167.

Sulphey, M. M., S. Nisa (2013), The Analytical Implication of Altman's Z Score Analysis of BSE Listed Small CAP Companies, "*Global Institute for Research & Education*", Vol. 2, No. 4, 145-155.

Taffler, R. J. and V. Agarwal (2007), Twenty Five Years of the Taffler Z-score Model: Does it Really Have a Predictive Abilty? , "*Accounting and Business Research*", Vol. 37, 285-300.

Yap, B. C., Yong, D. G. and W. Poon (2010), How Well Do Financial Ratios and Multiple Discriminant Analysis Predict Company Failures in Malaysia, "*International Research Journal of Finance and Economics*", No. 54, 166-175.

Zeytmoglu, E. and Y. D. Akarim (2013), Financial Failure Prediction Using Financial Ratios: An Empirical Application of Istanbul Stock Exchange, "*Journal of Applied Finance & Banking*", Vol. 3, No. 3, 107-116.