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A Comprehensive Study of Bankruptcy Prediction: Accounting Ratios, Market Variables, and Microstructure

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A COMPREHENSIVE STUDY OF BANKRUPTCY PREDICTION: ACCOUNTING RATIOS, MARKET VARIABLES, AND MICROSTRUCTURE

A dissertation submitted in partial fulfillment of the

requirements for the degree of

DOCTOR OF PHILOSOPHY

in

BUSINESS ADMINISTRATION

by

Giovanni Fernandez

2012

To: Dean Joyce Elam
College of Business Administration

This dissertation, written by Giovanni Fernandez, and entitled A Comprehensive Study of Bankruptcy Prediction: Accounting Ratios, Market Variables, and Microstructure, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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Dev Prasad

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Suchismita Mishra

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Chun-Hao Chang

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Arun J. Prakash, Major Professor

Date of Defense: June 21, 2012

The dissertation of Giovanni Fernandez is approved.

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Dean Joyce Elam
College of Business Administration

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Dean Lakshmi N. Reddi
University Graduate School

Florida International University, 2012

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ABSTRACT OF THE DISSERTATION

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by

Giovanni Fernandez

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Professor Arun J. Prakash, Major Professor

Bankruptcy prediction has been a fruitful area of research. Univariate analysis and discriminant analysis were the first methodologies used. While they perform relatively well at correctly classifying bankrupt and nonbankrupt firms, their predictive ability has come into question over time. Univariate analysis lacks the big picture that financial distress entails. Multivariate discriminant analysis requires stringent assumptions that are violated when dealing with accounting ratios and market variables. This has led to the use of more complex models such as neural networks.

While the accuracy of the predictions has improved with the use of more technical models, there is still an important point missing. Accounting ratios are the usual discriminating variables used in bankruptcy prediction. However, accounting ratios are backward-looking variables. At best, they are a current snapshot of the firm. Market variables are forward-looking variables. They are determined by discounting future outcomes. Microstructure variables, such as the bid-ask spread, also contain important information. Insiders are privy to more information that the retail investor, so if any financial distress is looming, the insiders should know before the general public.

Therefore, any model in bankruptcy prediction should include market and microstructure variables. This is the focus of this dissertation. The traditional models and the newer, more technical models were tested and compared to the previous literature by employing accounting ratios, market variables, and microstructure variables. Our findings suggest that the more technical models are preferable, and that a mix of accounting and market variables are best at correctly classifying and predicting bankrupt firms. Multi-layer perceptron appears to be the most accurate model following the results. The set of best discriminating variables includes price, standard deviation of price, the bid-ask spread, net income to sale, working capital to total assets, and current liabilities to total assets.

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CHAPTER 1: INTRODUCTION

Bankruptcy prediction has been extensively studied over the past five decades. Beaver (1966) and Altman's (1968) studies are the seminal works that began a plethora of research done on a very important topic. From academics to corporate directors to investors, the financial distress, and the path taken to get there, is a very important topic. While the research is rich in techniques and answers, many questions are still left unanswered. The models used and the variables selected have been a huge topic in themselves, and that is what is studied in this dissertation.

Beaver (1966) begins the conversation employing univariate analysis. Analyzing the intertemporal behavior of numerous accounting ratios, he concludes that there is a clear difference between the accounting ratios of bankrupt and nonbankrupt firms. Hence, accounting ratios have been used as the main discriminating variables in bankruptcy prediction studies since then. Following this finding, Altman (1968) employs multivariate discriminant analysis to determine which set of accounting ratios are best at discriminating between bankrupt and nonbankrupt firms. This is the famous Altman's Z-score model. The model performs well and has withstood time. However, as with many traditional, parametric models, this model has stringent underlying assumptions that have come into question over time. Prakash and Karels (1987) demonstrate that the multivariate normality assumption needed to use the linear multivariate discriminant model is violated when dealing with accounting ratios. This has led to the use of more complex models, such as neural networks, which are less limited by distributional assumptions.

Furthermore, as stated above, most research is centered on using accounting ratios as the input or discriminatory variables in bankruptcy prediction models. While these ratios have performed well over time, there is still space for improvement. An important limitation of these ratios is the fact that these ratios are backward-looking variables. When a company publishes its' accounting numbers, it is months after these numbers were created; at best, it is a current picture of the firm. Therefore, as an input variable in a prediction model, a backward-looking or current-looking variable is not ideal. Ideally, a forward-looking variable is best suited in a predictive framework. This has led to the use of market variables.

Market variables are theoretically good predictors. For example, the price of a company's stock is not only reflective of the current situation of the firm, but also on its' future potential cash flows and risks. While the accuracy of this price may not be exact, over time, the markets' sentiment (mixed with insiders and retail investors) is correct. Forward-looking variables, such as price and volume, should provide better predictive power.

Furthermore, microstructure is a growing field. The behavior of insiders and information only found on the trading floor has been shown to contain information not found in other variables. Since insiders are privy to more information than the general public, they are more educated about the current and future prospects of their firm. If a firm is in financial distress or is headed in that direction, insiders should be able to see it coming before the market. Consequently, any bankruptcy prediction model should be improved by the inclusion of microstructure variables.

This dissertation is a comprehensive study that tries to answer all of the above mentioned questions. Different models are used in testing the classification accuracy as well as the predictive ability of the models. Accounting ratios, market variables and microstructure variables are used each by themselves and in conjunction with each other to test whether each model is can be improved than previously found in the research.

In chapter 2, we study the univariate time-series behavior of each of the variables prior to bankruptcy and see which variables change significantly prior to bankruptcy. Discriminant analysis will is employed in chapter 3. Chapter 4 focuses on neural networks. We evaluate, compare the models, and conclude with chapter 5.

CHAPTER 2: UNIVARIATE ANALYSIS

2.1 Introduction

While the behavior of individual accounting ratios prior to bankruptcy [Beaver (1966)] and the multivariate time-series of accounting ratios [Gonedes(1973)] have been studied, a comprehensive examination of the behavior of accounting, market, and microstructure variables prior to bankruptcy has not been done. It has been demonstrated throughout the literature that accounting ratios and market variables have predictive power; however, some important aspects have been neglected. First, the intertemporal behavior of market variables has been a very fruitful area of research. From volume to price levels, the time-series patterns are well documented. However, the behavior of those variables specifically for future bankrupt firms has not been studied. Second, microstructure variables have not been fully implemented in terms of bankruptcy. Frino, Jones, and Wong (2007) examine the behavior of stock prices on the Australian Stock Exchange leading up to bankruptcy and document significant negative abnormal returns leading up to bankruptcy along with a widening of the bid-ask spread up to 7 months before bankruptcy. To understand the predictive ability of the bid-ask spread, it is important to test whether the variable deteriorates before or after other market variables and the accounting ratios. The purpose of this chapter is to dissect each of the above mentioned components. To the best of our knowledge, this is the first study to investigate the behavior of all three types of variables: accounting ratios, market variables, and microstructure variables.

To understand why it is important to include market and microstructure variables in the analysis, we need to explain their main difference with accounting ratios. Any firm

that is in financial distress will eventually show deteriorating accounting ratios; the ratios are basically a measure of the financial health of a firm. The issue is with the timing. Companies report their accounting numbers after the fact; the balance sheet of a company is a snapshot of the company at the time it is created. Therefore, these ratios are backward-looking, or at best, current. Market variables, such as price, are very different. In determining a stock's price, analysts use estimates of future cash flows. While the accuracy of the market variables at any time can be called into question, over the long-run they must be correct in an efficient market. This allows the stock price to be a forward-looking variable.

Hence, as predictive tools, we want to focus more on forward-looking variables than backward-looking variables. To do so, it is important to understand the behaviors of these variables, comparing those of bankrupt and non-bankrupt firms, while also comparing accounting and market variables.

The most important finding is that market and microstructure variables are best at correctly classifying bankrupt firms. Furthermore, the Type I errors for these variables are much smaller relative to Type II errors when compared to other variables in the prior literature. The best predictors are price, standard deviation, and bid-ask spread. These variables display the lowest misclassification rates.

With the accounting ratios, cash flow plays a less important role than found in previous studies. Ratios that include net income, current liabilities, and working capital perform much better than other ratios. Therefore, any multivariate bankruptcy prediction model should include price, standard deviation, bid-ask spread, along with the accounting

ratios. That will be the starting point for the coming chapters. This should lead to more powerful and accurate models.

This study attempts to describe and distinguish these two groups. The remainder of this paper is organized as follows: Section 1.2 reviews the previous literature associated with bankruptcy univariate analysis. Section 1.3 discusses the data used in this study. Section 1.4 describes the methodology. Section 1.5 discusses the results, and Section 1.6 summarizes and concludes.

2.2 Literature Review

Most of the literature focuses on multivariate analysis since the deterioration of a company is multi-faceted, and one variable alone cannot describe the entire picture. However, before the entire picture is seen, the pieces must be understood.

The study of bankruptcy prediction through ratio analysis truly began through univariate analysis. Beaver (1966) set the field in a new direction. As a means of showing the usefulness of financial ratios, Beaver chooses corporate failure. He finds that while the time-series of the ratios of nonfailed firms are relatively stable, that of failed firms significantly deteriorates as bankruptcy looms.

The distributions of certain ratios overlap substantially five years before failure, but the overlap is very small a year before failure. Cash-flow to total-debt classifies failed and nonfailed firms correctly and better than random up to at least five years before failure. However, not all ratios perform as well. Most ratios are much more useful in correctly classifying nonfailed firms than they are at classifying failed firms. Furthermore, Beaver (1968) finds that changes in stock market prices are also indicative of financial distress.

However, Casey and Bartczak (1984) find that none of the variables studied, mostly cash flow variables, can accurately discriminate between bankrupt and non-bankrupt firms. They conclude that this method of classification is faulty because of the fact that many healthy firms go through periods of low operating cash flow.

Lin and Piesse (2001) also find that the ratios of failed and non-failed firms are significantly different. Furthermore, the market-to-book ratio, which takes into account forward-looking market prices, also is significantly different between failed and non-failed firms. Nonetheless, the t-statistics are still highest for profitability and liquidity ratios.

Neophytou et al. (2001) also document deterioration in accounting and cash-flow variables. They find that the financial leverage ratios provide the highest classification accuracy. Profitability and cash-flow ratios also perform very well.

2.3 Data

The list of bankrupt firms was obtained from bankruptcydata.com. The list includes companies the filed for bankruptcy from January 1995 to December 2010. The subsample of non-bankrupt firms comes from the entire database of Compustat, consisting of firms that did not file for bankruptcy during our sample period. The accounting ratios for all firms, bankrupt and non-bankrupt, are obtained from Compustat. The market variables for these firms were obtained from CRSP.

2.4 Methodology

As is common in the bankruptcy prediction literature, the non-bankrupt firms are selected in such a way so that firm size does not severely affect the results. Ex-ante, successful firms are expected to be larger than failing firms. Furthermore, firm success

rates are highly influenced by their industry. For example, when the tech bubble was growing, any firm with a dotcom in its name benefited heavily. To mitigate this issue, it

Table 1
Summary_Br_Nbr_Ratio_data Bankrupt

Variable	N	Mean	Std Dev	Minimum	Maximum
SHROUT	4624		86169.89	42	1571700
BIDLO	4530	11.12	13.21	-72.25	113.85
ASKHI	4530	13.25	15.69	-52.25	207.44
PRC	4512	12.10	14.44	-72.25	130.00
VOL	4530	86025.86	260903.62	0.00	4141655.00
BID	4249	12.65	13.92	0.03	130.00
ASK	4249	12.83	13.95	0.06	131.00
SPREAD	240	0.38	0.38	0.03	2.50
CEQQ	4541	452.38	1505.16	-2887.00	25789.00
CSHOQ	4513	48.67	91.09	0.01	1500.14
TXTQ	4573	6.82	47.83	-770.13	2076.00
REQ	4447	-17.15	1088.36	-13603.00	8450.15
REVTQ	4585	337.19	1182.21	0.00	36882.00
NETINCOMETOSALES	4431	-3.10	52.42	-2629.00	32.35
NETINCOMETOTOTALASSETS	4556	-0.05	0.79	-51.10	1.14
TOTALDEBT	4483	928.70	3242.33	0.00	44267.00
NETINCOMETOTOTALDEBT	4466	-0.46	19.63	-1307.00	2.10
CURLIABTOTOTASSET	4545	0.28	0.22	0.00	3.43
LTLIABTOTOTASSET	4483	0.29	0.58	0.00	22.68
TOTDEBTTOTOTASSET	4483	0.58	0.62	0.00	23.52
TOTDEBTPLUSPREFTOTOTASSET	4450	0.60	0.68	0.00	23.52
CASHTOTOTALASSETS	905	0.14	0.16	0.00	0.97
QUICKASSETS	4504	313.91	966.05	0.06	11579.00
QUICKASSETSTOTOTALASSTS	4504	0.36	0.24	0.01	1.00
WORKINGCAPITAL	4543	88.34	507.56	-4499.00	4907.00
WCTOTOTALASSETS	4543	0.19	0.30	-3.24	0.97
CASHTOCURLIABILITIES	904	0.98	1.86	0.00	24.94
QASSETSTOCURLIABILITIES	4503	2.90	39.98	0.02	2663.00
CURRENTRATIO	4543	3.40	42.23	0.02	2828.00
CASHTOSALES	878	1.72	17.96	0.00	516.90
INVENTORYTOSALES	4361	0.90	12.73	0.00	650.14
QUICKASSETSTOSALES	4334	10.63	224.58	0.05	13986.00
CURRENTASSETSTOSALES	4374	12.49	236.64	0.11	13986.00
WORKINGCAPITALTOSALES	4373	8.04	188.37	-606.07	11605.00
TOTALASSETSTOSALES	4403	19.90	266.90	0.63	14453.00

BIDASKSPREAD	4249	0.18	0.23	-0.81	3.50
HILOBIDASKSPREAD	4530	2.13	6.31	-101.13	153.94

Summary_Br_Nbr_Ratio_data Nonbankrupt

Variable	N	Mean	Std Dev	Minimum	Maximum
SHROUT	4250	113515.58	436934.97	35.00	6064759.00
BIDLO	4226	18.11	17.65	-25.53	119.86
ASKHI	4226	20.89	19.91	-34.88	161.39
PRC	4222	19.43	18.90	-38.50	153.29
VOL	4226	130886.25	454724.84	2.00	8280692.00
BID	3989	19.25	17.93	0.10	153.00
ASK	3989	19.44	17.99	0.11	153.37
SPREAD	101	0.33	0.26	0.02	1.50
CEQQ	4188	1541.63	6982.92	-424.48	115367.00
CSHOQ	4124	120.95	452.41	1.09	6043.55
TXTQ	4195	24.29	168.28	-6573.00	2863.00
REQ	3955	596.50	2846.65	-7586.00	35863.00
REVTQ	4211	666.70	2264.68	-0.13	31581.00
NETINCOMETOSALES	4167	-0.84	11.08	-480.98	36.60
NETINCOMETOTOTALASSETS	4184	-0.01	0.23	-10.76	0.34
TOTALDEBT	4030	2378.79	11350.47	0.26	172571.00
NETINCOMETOTOTALDEBT	4028	-0.04	0.45	-11.38	2.87
CURLIABTOTOTASSET	4093	0.24	0.21	0.00	6.01
LTLIABTOTOTASSET	4030	0.23	0.23	0.00	2.58
TOTDEBTTOTOTASSET	4030	0.48	0.31	0.01	7.22
TOTDEBTPLUSPREFTOTOTASSE	4028	0.49	0.33	0.01	7.84
CASHTOTOTALASSETS	1222	0.14	0.17	0.00	0.95
QUICKASSETS	4061	615.11	1820.24	0.01	23567.00
QUICKASSETSTOTOTALASSTS	4061	0.38	0.23	0.00	0.98
WORKINGCAPITAL	4091	98.53	1311.37	-21893.00	8960.48
WCTOTOTALASSETS	4091	0.27	0.30	-5.96	0.96
CASHTOCURLIABILITIES	1199	0.90	1.55	0.00	14.55
QASSETSTOCURLIABILITIES	4061	2.37	3.87	0.00	63.24
CURRENTRATIO	4091	2.98	3.89	0.00	64.71
CASHTOSALES	1212	5.38	55.11	0.00	1276.84
INVENTORYTOSALES	4072	0.53	1.12	-2.68	31.33
QUICKASSETSTOSALES	4015	5.88	54.46	-505.26	2340.64
CURRENTASSETSTOSALES	4045	6.37	54.31	-507.94	2341.76
WORKINGCAPITALTOSALES	4045	4.74	49.04	-494.21	2093.38
TOTALASSETSTOSALES	4143	14.29	113.44	-603.91	3802.83
BIDASKSPREAD	3989	0.19	0.28	-0.50	4.50
HILOBIDASKSPREAD	4226	2.77	4.99	-65.25	75.31

is common to select firms in such a way that size and industry factors do not distort the results.

The procedure is two-fold. First, a bankrupt firm is selected. Second, a non-bankrupt firm within the same industry with asset size closest to the bankrupt firm is selected. These two firms (the one bankrupt and the one non-bankrupt) are then stored and removed from the continuing procedure. A second bankrupt firm is selected, and the selection process is done with the remaining non-bankrupt firms. This is done for each bankrupt firm, so that in the end there are an equal number of bankrupt and non-bankrupt firms.

To clearly understand the difference in behavior between the two subsamples, a graphical demonstration is a great place to begin. To do so, the annual mean value of each ratio is calculated from one year before failure to five years before failure. The same is done for non-bankrupt firms, but the cutoff date is just matched to that of the bankrupt firm. Furthermore, since the behavior of the ratios in the two subsamples should differ over time, especially as bankruptcy approaches, a test of autocorrelation is applied. This will demonstrate the trends of the ratios in each subsample.

To further demonstrate the behavior of the variables, especially the downward (or upward spiral) for bankrupt firms as bankruptcy looms, tests of autocorrelation are run. There should be a clear trend during the quarters nearest bankruptcy. For brevity, I run the autocorrelations from the last quarter, three years before bankruptcy, up until the quarter right before bankruptcy. This is performed also on the nonbankrupt sample.

While the trend analysis and autocorrelations provide explanations of the trends and comparisons of the ratios of each subsample, this is not a predictive test.

A useful predictive test employed to test the power of each ratio in distinguishing between bankrupt and non-bankrupt firms is a dichotomous test. The ratios for bankrupt and non-bankrupt firms are each ranked from lowest to highest, and a cutoff point is chosen to minimize the misclassification between failed and non-failed. This is synonymous to the decision-making process of a practitioner; the ratios of a firm are analyzed, and if they are above or below a certain level, then the firm is believed to be healthy or under distress. This is procedure one.

The problem with this procedure is that the cutoff point is derived from the entire sample, so it is not purely a predictive test. To avoid this issue, the entire sample is further randomly divided into two subsamples. A cutoff point is then derived in each subsample, but then that cutoff point is used to classify firms in the other subsample. This is procedure 2.

One important problem with the preceding predictive test is that Type I (misclassifying a failed firm) and Type II (misclassifying a non-failed firm) errors are treated equally. However, the severity of committing these errors is very different. A lender who wrongfully lends to a firm that eventually fails will suffer deeper consequences than a lender who denies a loan to an eventually proven healthy firm. In order to distinguish between these errors, contingency tables are employed. The contingency tables are made for each ratio, one to five years before failure. The rows of the table signify the predicted outcome (failed or non-failed), and the columns demonstrates the actual outcome (failed or non-failed).

2.5 Empirical Results

While each variable does not tell the whole story, it is important to understand how the different variables and types of variables behave prior to bankruptcy, and how the behaviors of the ratios of failing and non-failing firms differ. The individual ratios are studied through dichotomous tests, contingency tables, and likelihood ratios.

While the levels of the different ratios (accounting, market, or microstructure) for the bankrupt and non-bankrupt firms are clearly different, the differences do not change as much in magnitude as has been documented in the previous literature. Market turmoil clearly has an effect on all firms, whether under distress or not. The magnitude may differ, but the market as whole was effected. This will make the multivariate analysis in the coming chapters that much more important.

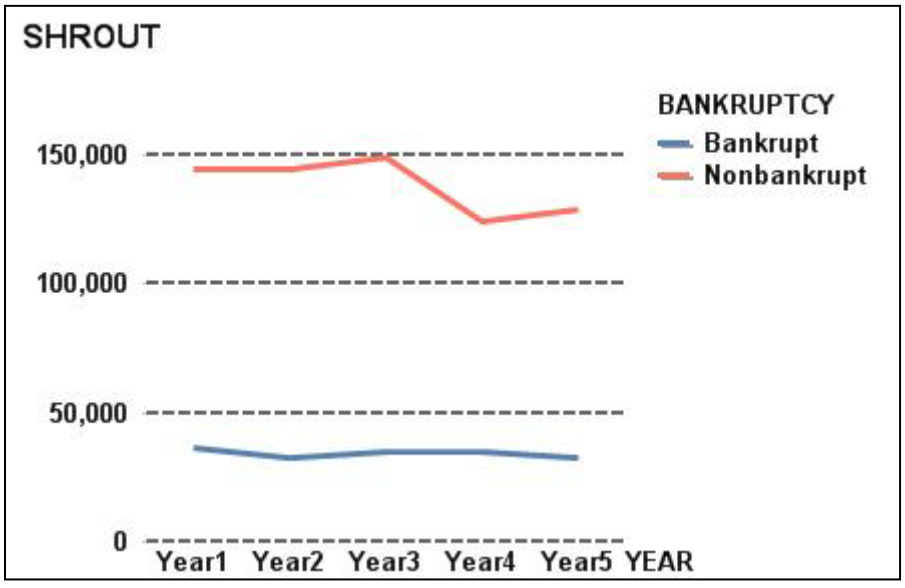
Focusing on market and microstructure variables, volume for bankrupt firms is substantially lower than that of non-bankrupt firms, but there is no trend. The market might be able to notice financial distress farther than five years out. The spread stays in a tight range, again indicating that the market made up its' mind long before five years before bankruptcy. However, the high-loww bid-ask spread does show an upward trend for bankrupt firms.

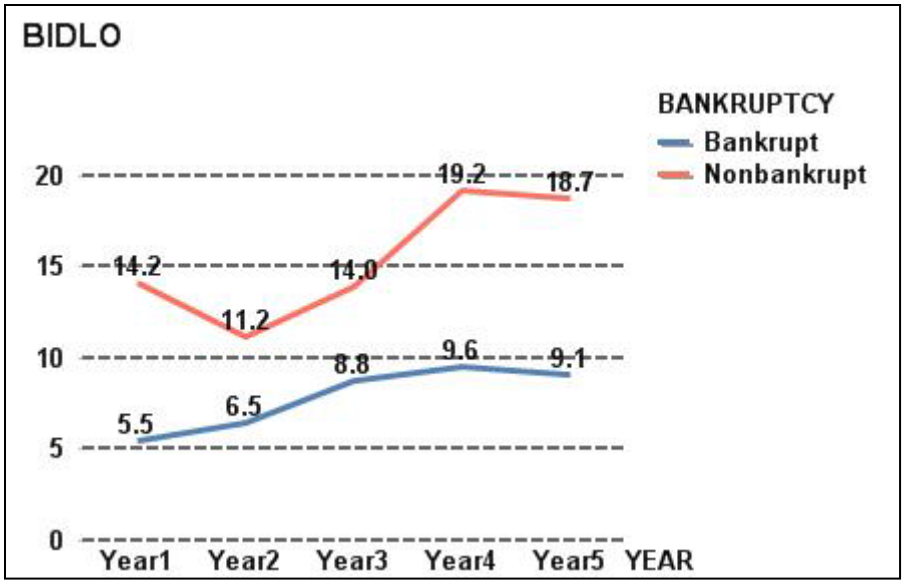
While the prices of all securities show a downward trend (due to the financial crisis), the stock prices of bankrupt firms decline by 40%, while those of non-bankrupt firms decline by only 25%. Furthermore, there is an upward trend in prices one year before the cutoff period for non-bankrupt firms. Since this sample time-period includes the financial crisis, most stock prices trend downward. However, one year before either bankruptcy or the cutoff, the market is able to distinguish between firms in distress and

those not. Hence, the prices of bankrupt firms continue the downward spiral, while those of nonbankrupt firms show a spike. Returns turn negative for bankrupt firms, while those of non-bankrupt firms stay relatively flat; moreover, returns for nonbankrupt firms are mean-reverting, as commonly found in the overall market, while those for bankrupt firms display a downward trend. This is a substantial difference. Clearly, market determined prices are leading indicators of financial distress. The standard deviation of the returns are mostly higher for bankrupt firms. This is due to the uncertainty surrounding firms in distress. While the entire market has a substantially higher level of systematic risk during this sample period, the unsystematic risk is higher for deteriorating firms. Relative systematic risk is upward trending for bankrupt firms, while the opposite is true for non-bankrupt firms.

Figure 1

The figure present the market variables, accounting ratios, and the microstructure variables for the bankrupt and nonbankrupt firms from one year before bankruptcy (year 1) to five years before bankrupt (year 5).

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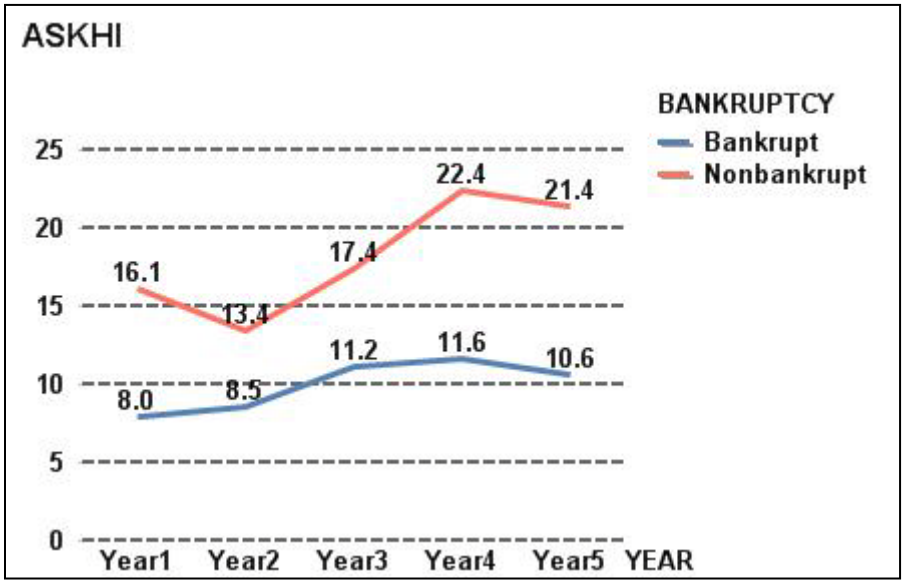
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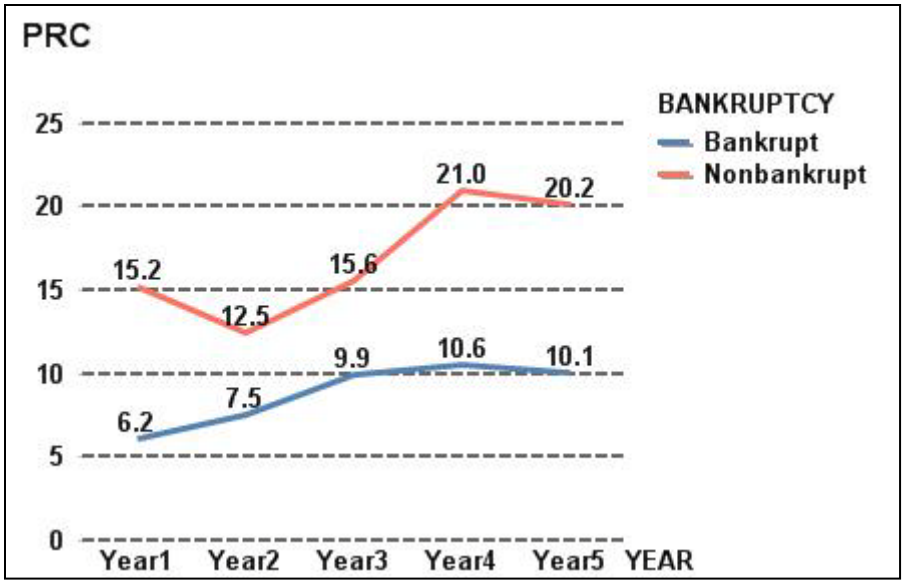
Year5
YEAR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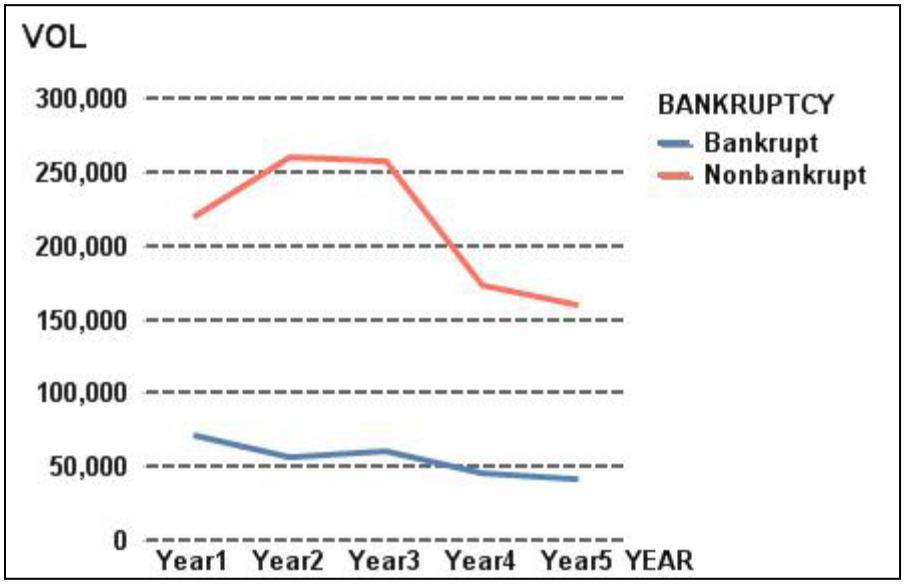
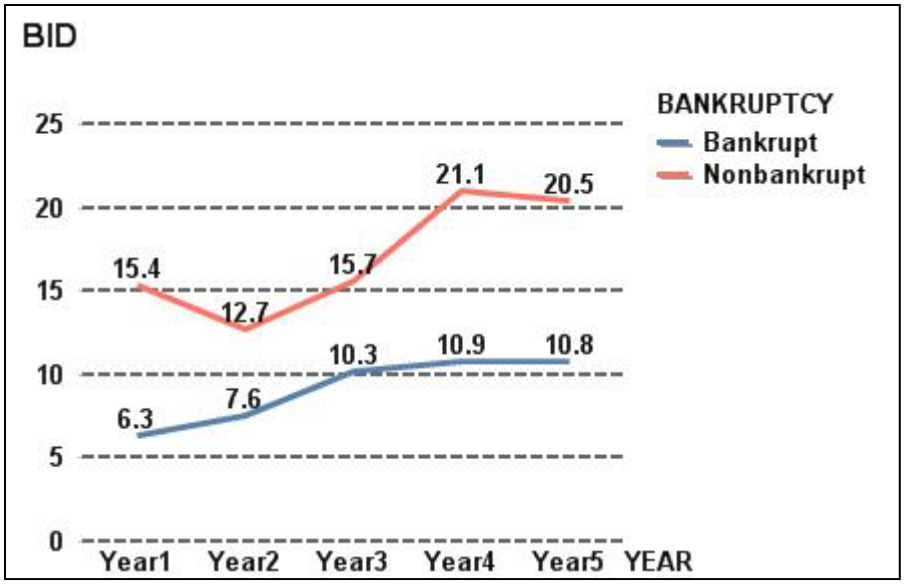
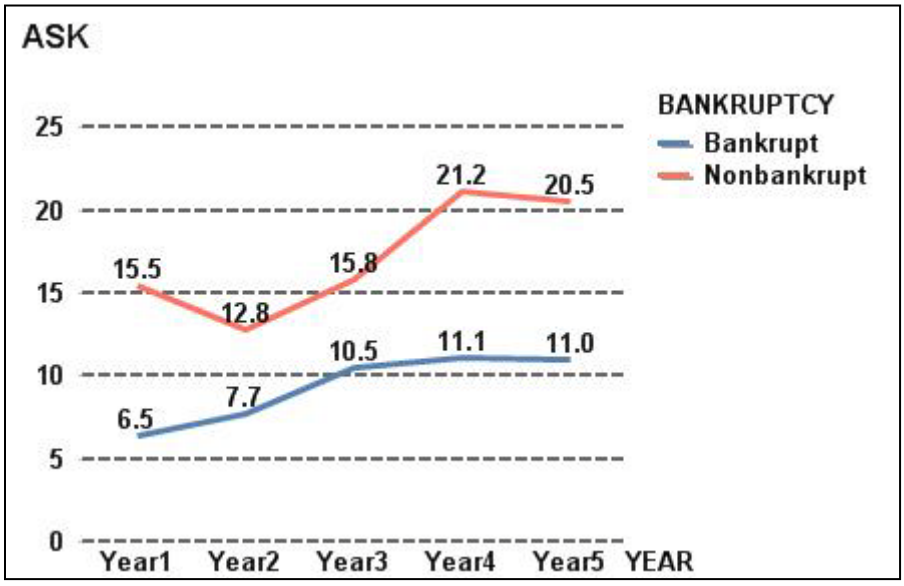
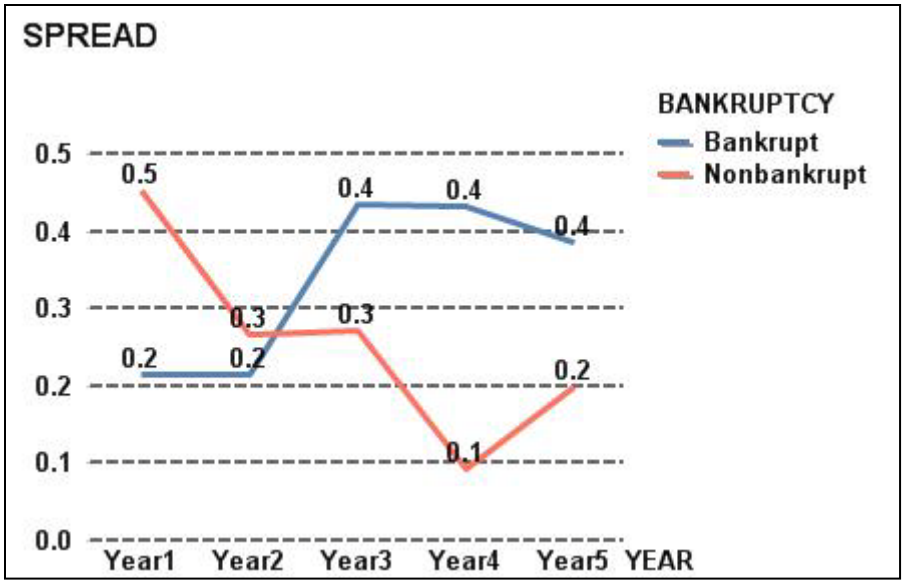
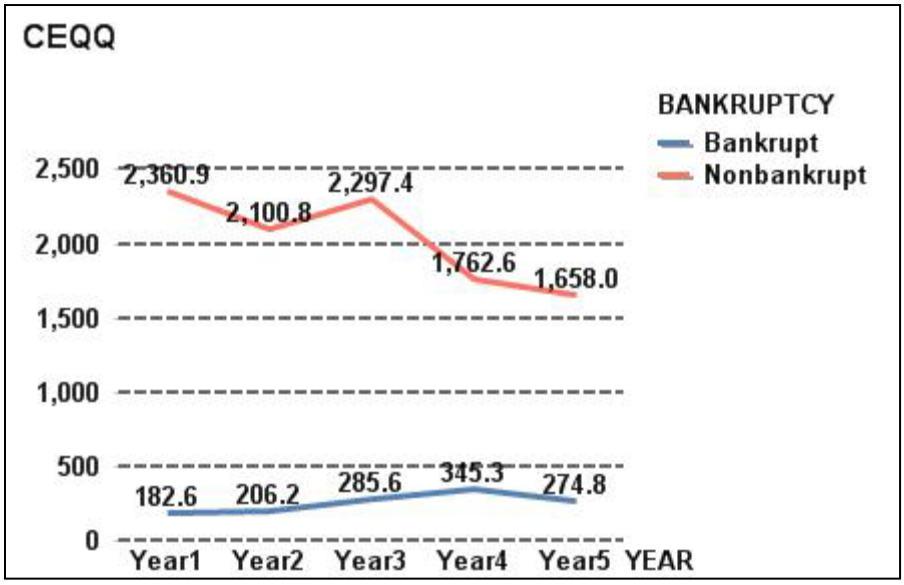
Year4
Year5
YEAR

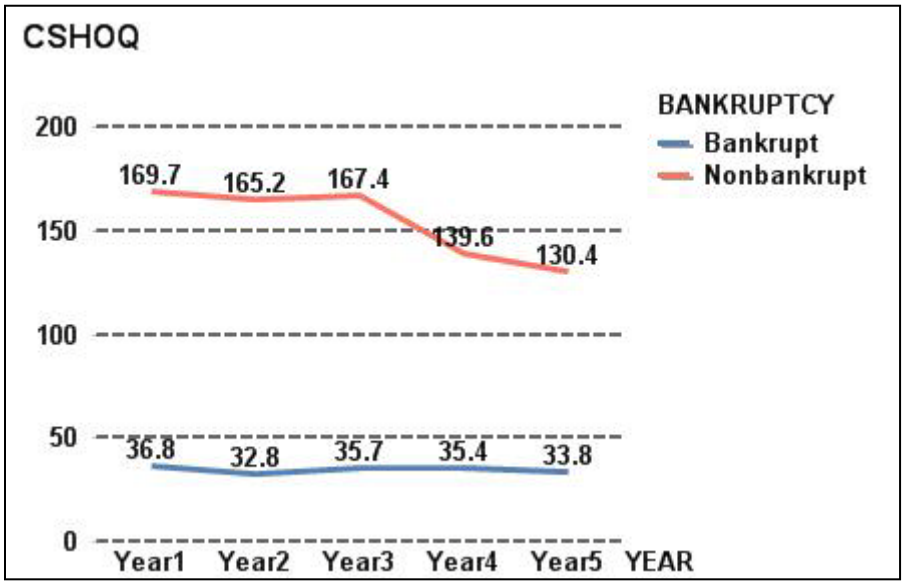

VOL
BANKRUPTCY
Bankrupt
Nonbankrupt
300,000
250,000
200,000
150,000
100,000
50,000
0
Year1
Year2
Year3
Year4
Year5
YEAR

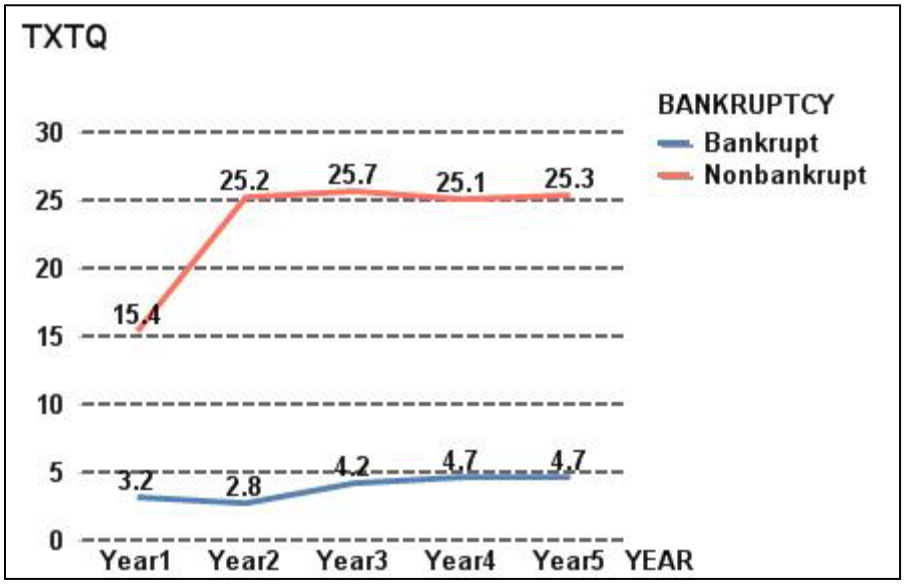

BID
BANKRUPTCY
Bankrupt
Nonbankrupt
25
20
15
10
5
0
15.4
12.7
15.7
21.1
20.5
6.3
7.6
10.3
10.9
10.8
Year1
Year2
Year3
Year4
Year5
YEAR

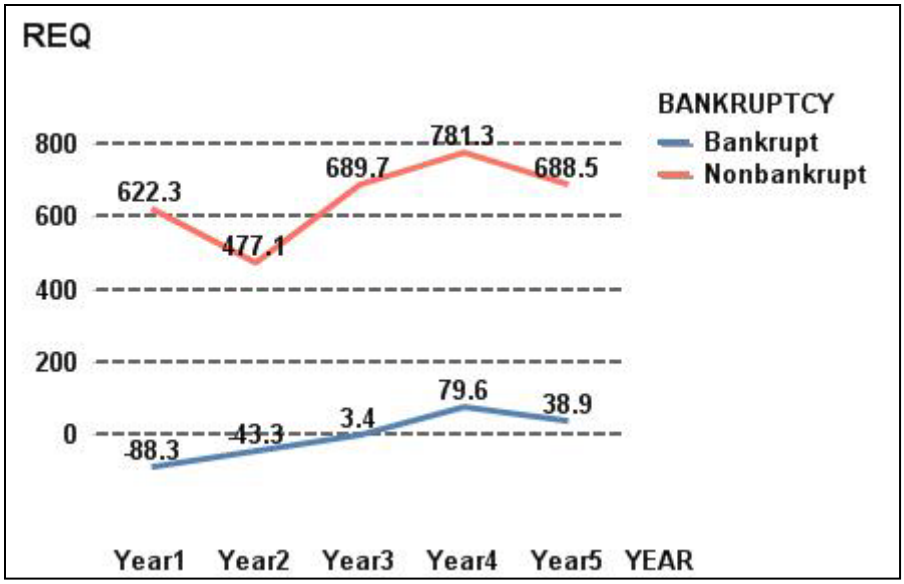

ASK
BANKRUPTCY
Bankrupt
Nonbankrupt
25
20
15
10
5
0
15.5
12.8
15.8
21.2
20.5
6.5
7.7
10.5
11.1
11.0
Year1
Year2
Year3
Year4
Year5
YEAR

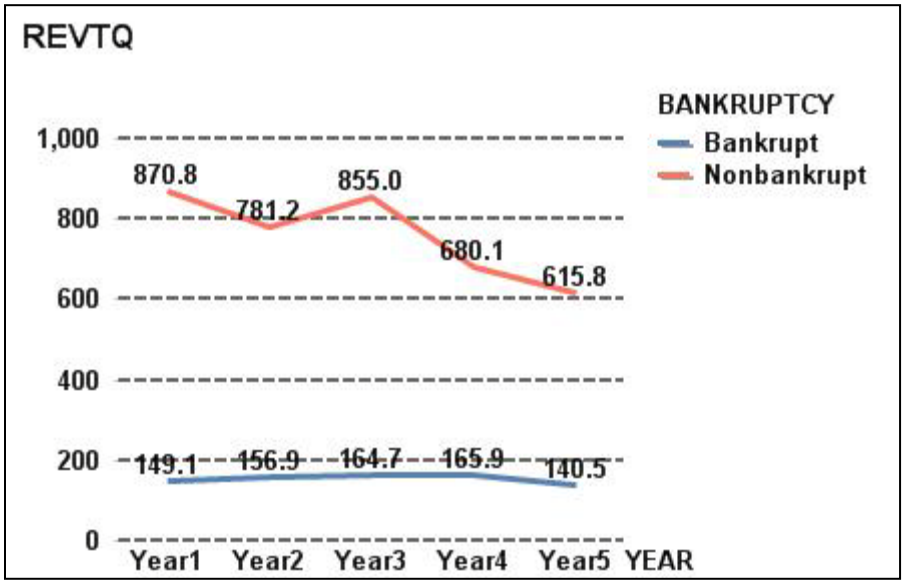

SPREAD
BANKRUPTCY
Bankrupt
Nonbankrupt
0.5
0.4
0.3
0.2
0.1
0.0
0.5
0.2
0.2
0.4
0.3
0.4
0.3
0.4
0.1
0.2
Year1
Year2
Year3
Year4
Year5
YEAR

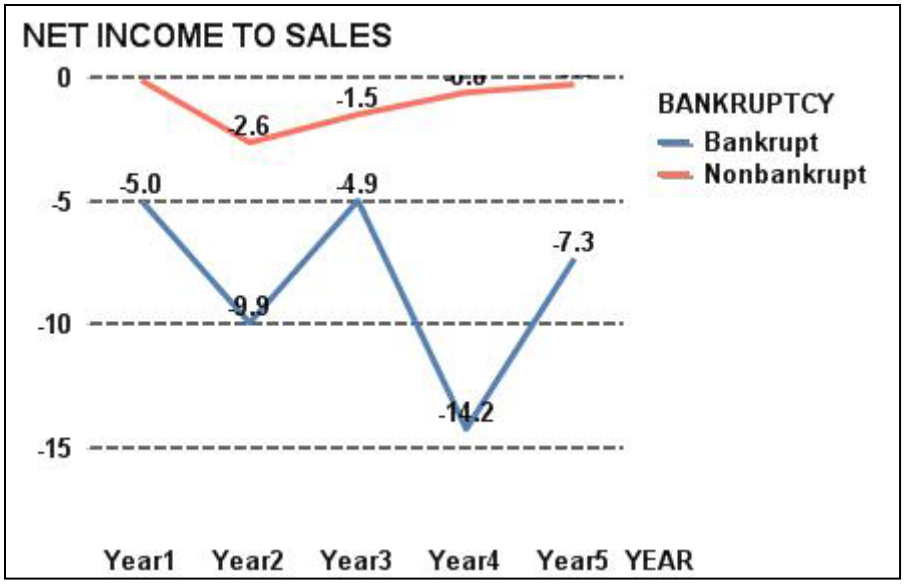

CEQQ
BANKRUPTCY
Bankrupt
Nonbankrupt
2,500
2,000
1,500
1,000
500
0
2,360.9
2,100.8
2,297.4
1,762.6
1,658.0
182.6
206.2
285.6
345.3
274.8
Year1
Year2
Year3
Year4
Year5
YEAR

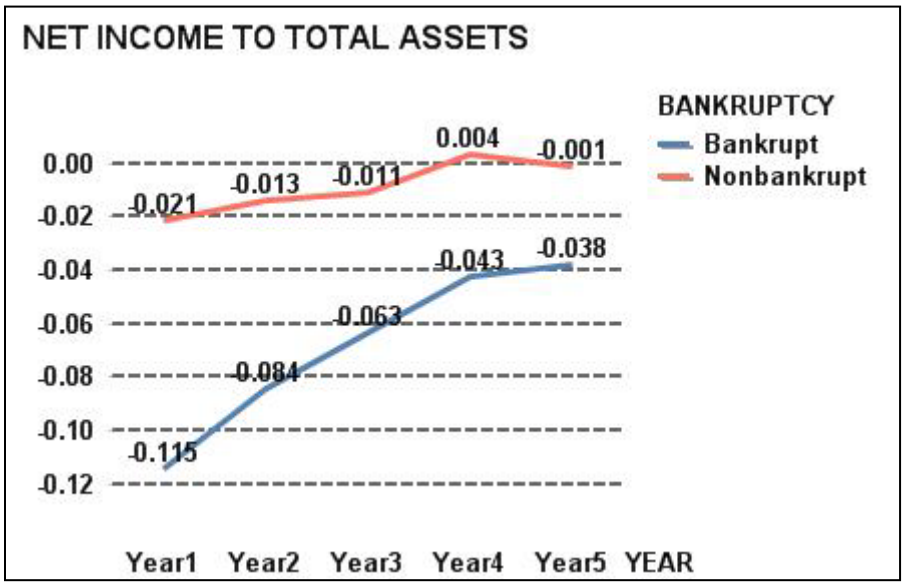

CSHOQ
BANKRUPTCY
Bankrupt
Nonbankrupt
200
150
100
50
0
169.7
165.2
167.4
139.6
130.4
36.8
32.8
35.7
35.4
33.8
Year1
Year2
Year3
Year4
Year5
YEAR

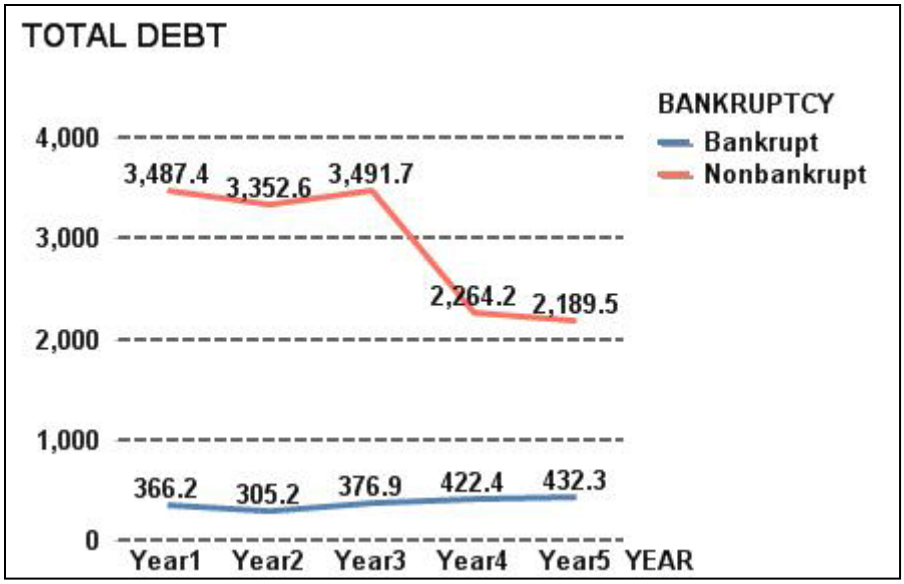

TXTQ
BANKRUPTCY
Bankrupt
Nonbankrupt
30
25
20
15
10
5
0
15.4
25.2
25.7
25.1
25.3
3.2
2.8
4.2
4.7
4.7
Year1
Year2
Year3
Year4
Year5
YEAR

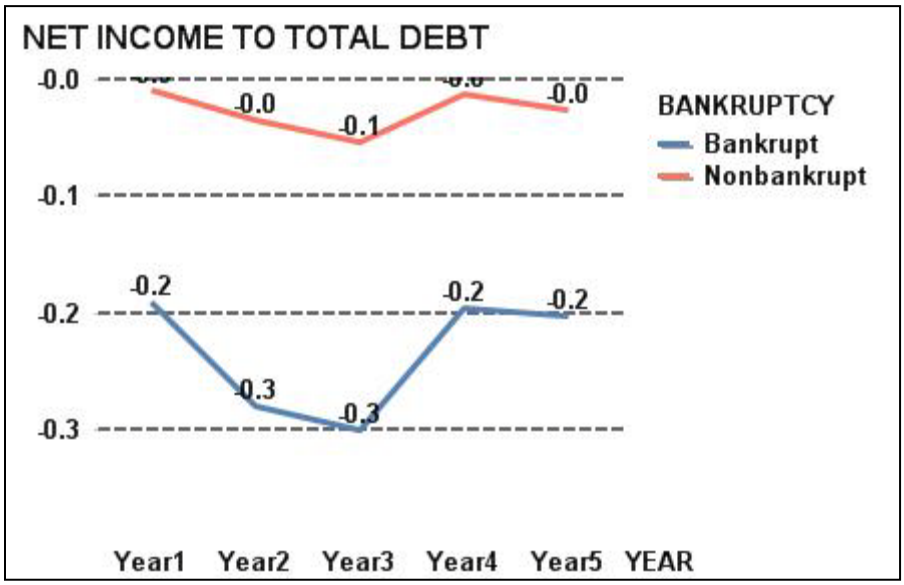

REQ
BANKRUPTCY
Bankrupt
Nonbankrupt
800
600
400
200
0
622.3
477.1
689.7
781.3
688.5
-88.3
-43.3
3.4
79.6
38.9
Year1
Year2
Year3
Year4
Year5
YEAR

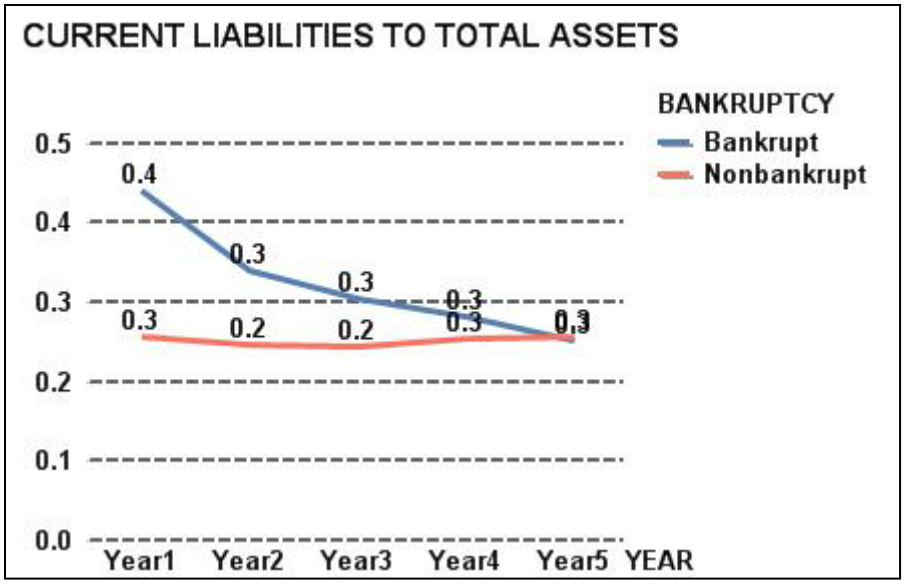

REVTQ
BANKRUPTCY
Bankrupt
Nonbankrupt
1,000
800
600
400
200
0
870.8
781.2
855.0
680.1
615.8
149.1
156.9
164.7
165.9
140.5
Year1
Year2
Year3
Year4
Year5
YEAR

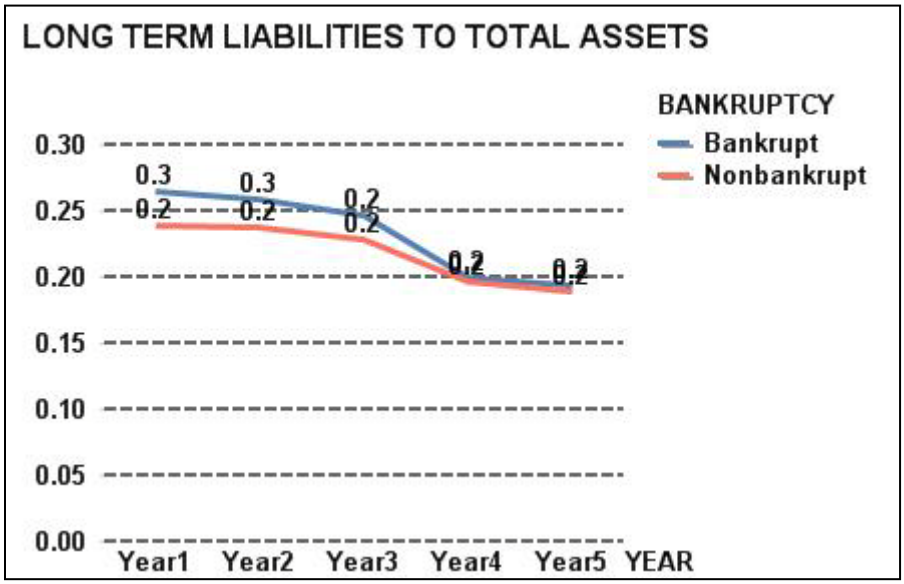

NET INCOME TO SALES
0
-5
-10
-15
-5.0
-2.6
-9.9
-4.9
-1.5
-14.2
-7.3
BANKRUPTCY
Bankrupt
Nonbankrupt
Year1
Year2
Year3
Year4
Year5
YEAR

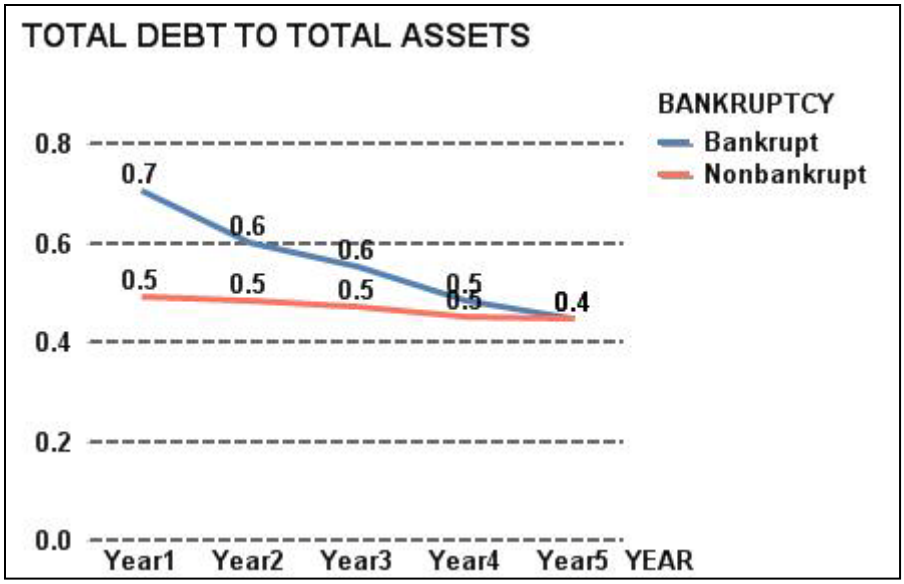

NET INCOME TO TOTAL ASSETS
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.021
-0.013
-0.011
0.004
-0.001
-0.115
-0.084
-0.063
-0.043
-0.038
BANKRUPTCY
Bankrupt
Nonbankrupt
Year1
Year2
Year3
Year4
Year5
YEAR

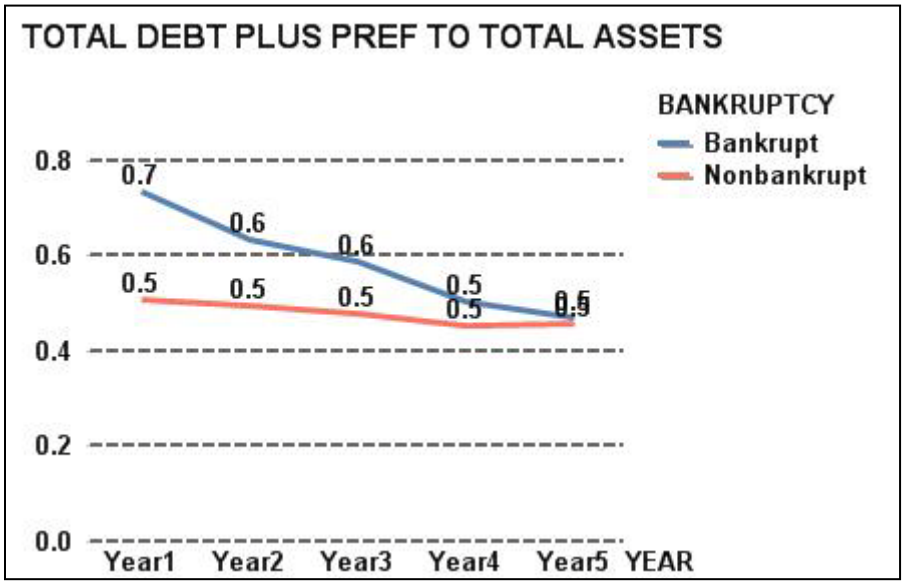

TOTAL DEBT
BANKRUPTCY
Bankrupt
Nonbankrupt
4,000
3,000
2,000
1,000
0
3,487.4
3,352.6
3,491.7
2,264.2
2,189.5
366.2
305.2
376.9
422.4
432.3
Year1
Year2
Year3
Year4
Year5
YEAR

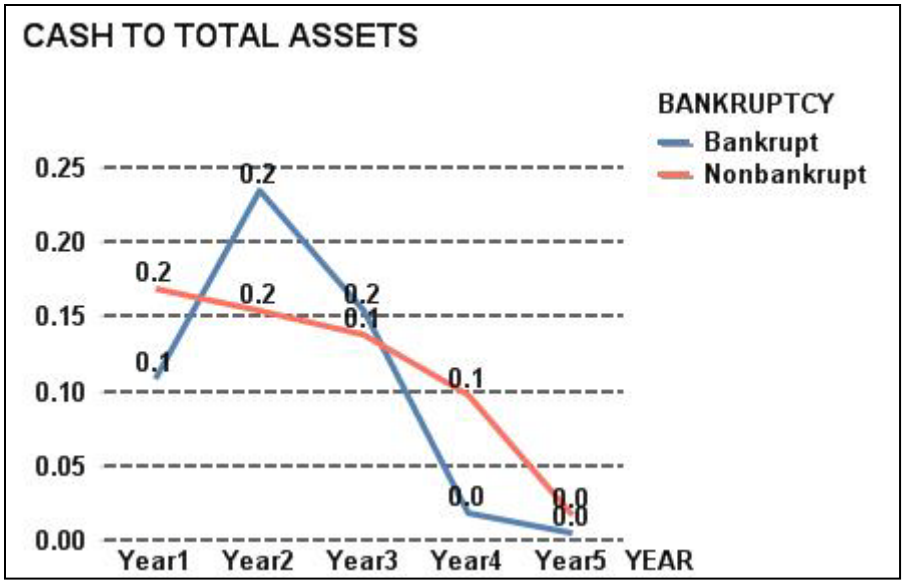

NET INCOME TO TOTAL DEBT
BANKRUPTCY
Bankrupt
Nonbankrupt
-0.0
-0.1
-0.2
-0.3
-0.0
-0.0
-0.1
-0.0
-0.2
-0.3
-0.3
-0.2
-0.2
Year1
Year2
Year3
Year4
Year5
YEAR

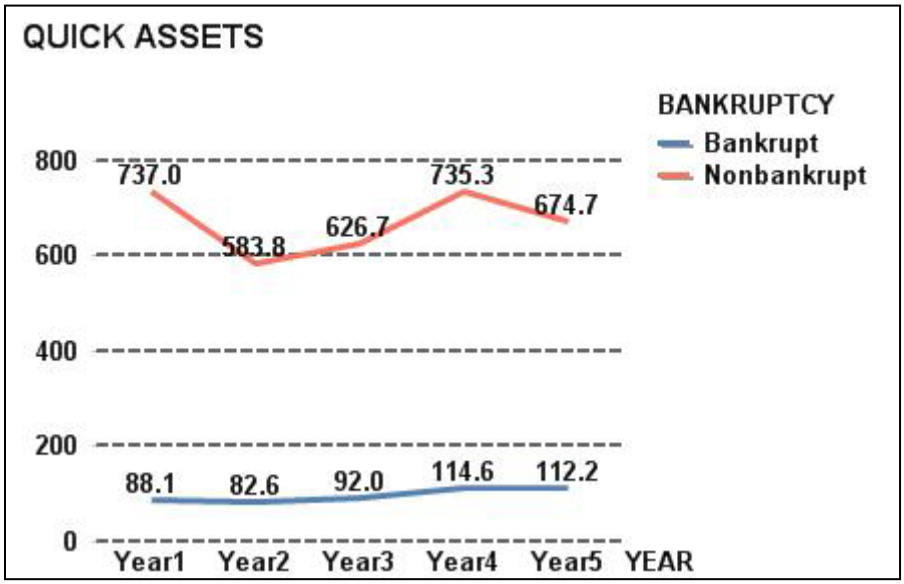

CURRENT LIABILITIES TO TOTAL ASSETS
BANKRUPTCY
Bankrupt
Nonbankrupt
0.5
0.4
0.3
0.2
0.1
0.0
0.4
0.3
0.3
0.3
0.3
0.2
0.2
0.3
Year1
Year2
Year3
Year4
Year5
YEAR

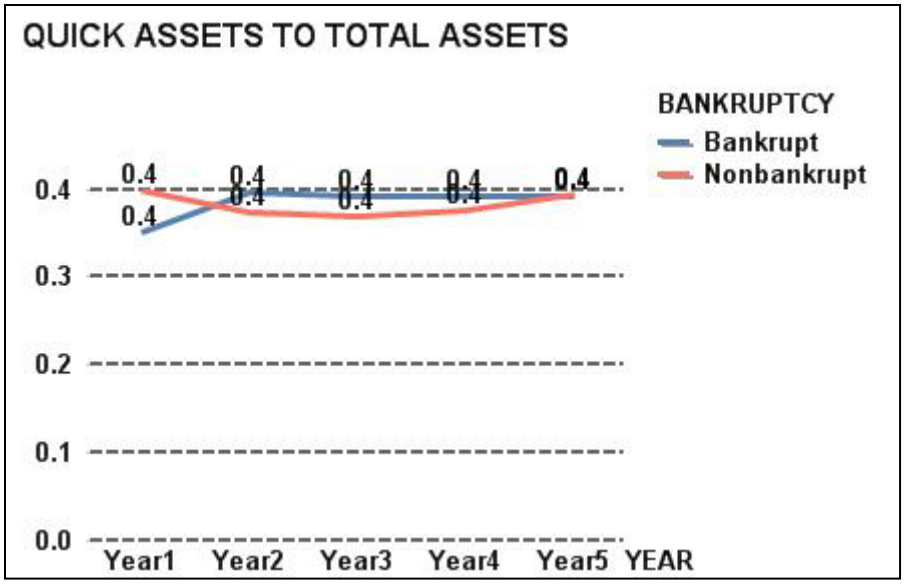

LONG TERM LIABILITIES TO TOTAL ASSETS
BANKRUPTCY
Bankrupt
Nonbankrupt
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.3
0.3
0.2
0.2
0.2
0.2
0.2
0.2
Year1
Year2
Year3
Year4
Year5
YEAR

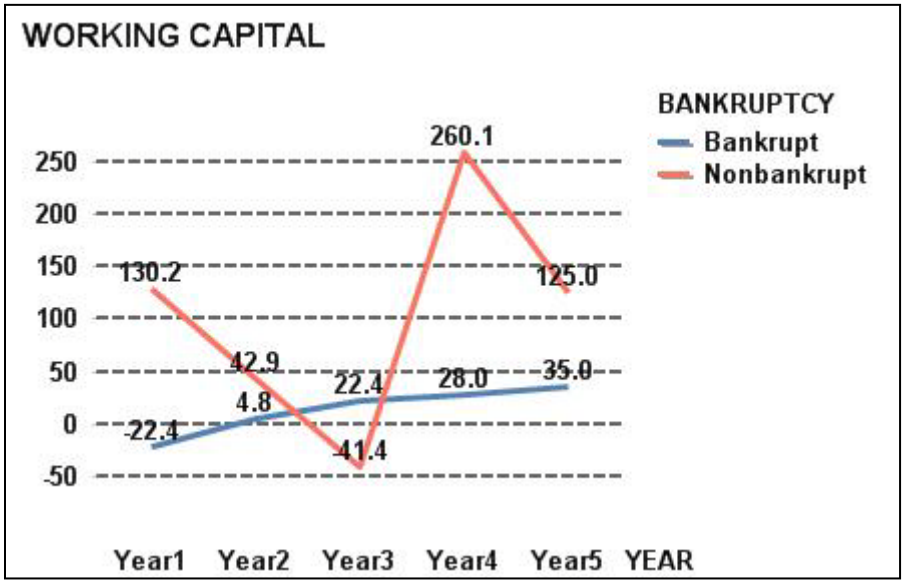

TOTAL DEBT TO TOTAL ASSETS
BANKRUPTCY
Bankrupt
Nonbankrupt
0.8
0.6
0.4
0.2
0.0
0.7
0.6
0.6
0.5
0.4
0.5
0.5
0.5
0.5
Year1
Year2
Year3
Year4
Year5
YEAR

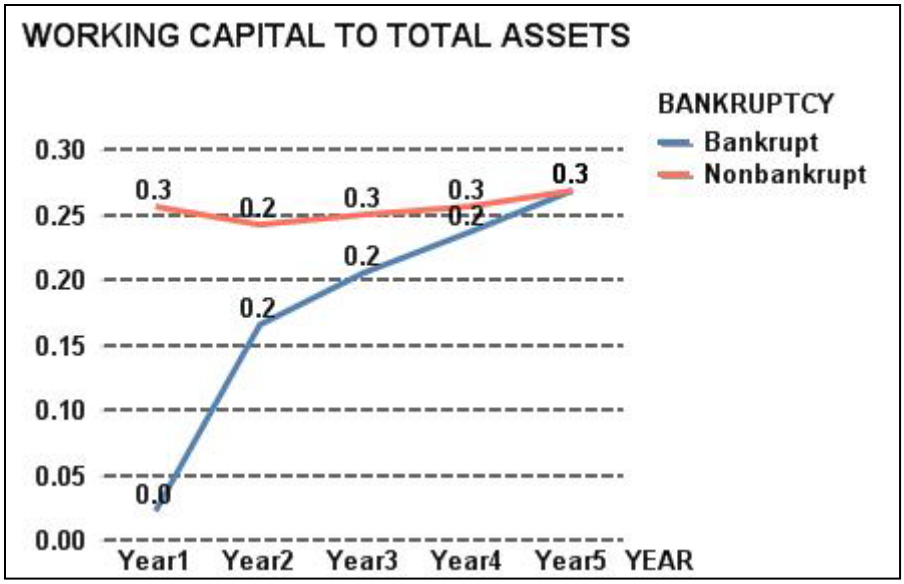

TOTAL DEBT PLUS PREF TO TOTAL ASSETS
BANKRUPTCY
Bankrupt
Nonbankrupt
0.8
0.6
0.4
0.2
0.0
0.7
0.6
0.6
0.5
0.5
0.5
0.5
0.5
Year1
Year2
Year3
Year4
Year5
YEAR

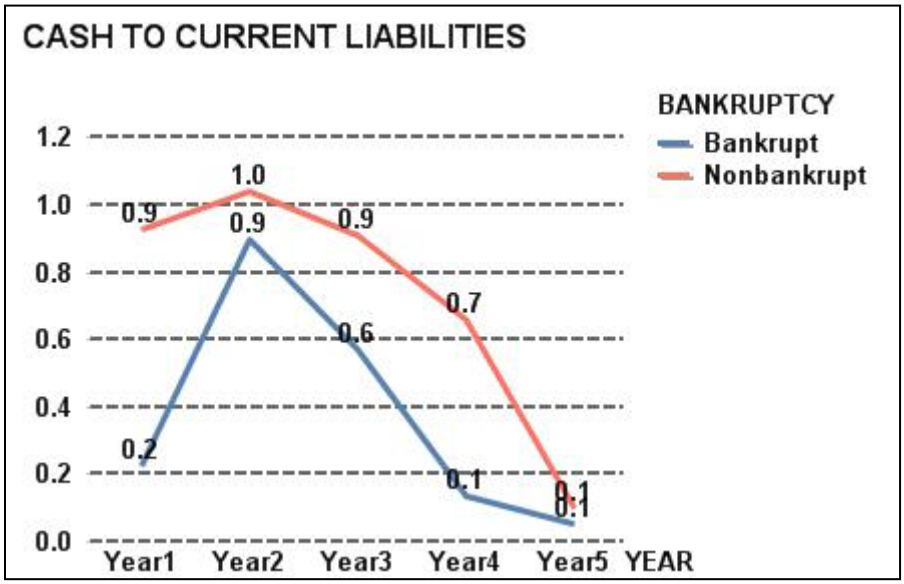

CASH TO TOTAL ASSETS
BANKRUPTCY
Bankrupt
Nonbankrupt
0.25
0.20
0.15
0.10
0.05
0.00
0.2
0.2
0.2
0.1
0.2
0.1
0.1
0.0
0.0
0.0
Year1
Year2
Year3
Year4
Year5
YEAR

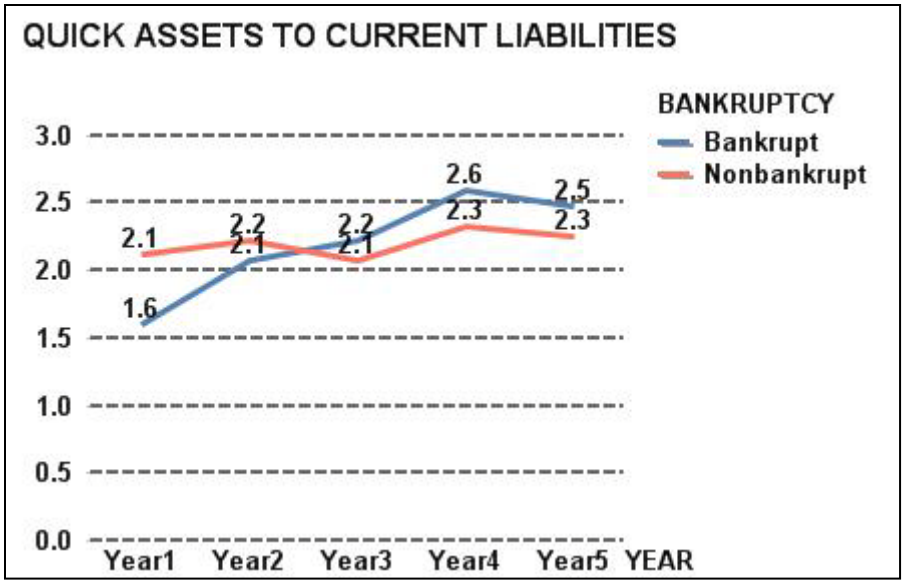

QUICK ASSETS
BANKRUPTCY
Bankrupt
Nonbankrupt
800
600
400
200
0
737.0
583.8
626.7
735.3
674.7
88.1
82.6
92.0
114.6
112.2
Year1
Year2
Year3
Year4
Year5
YEAR

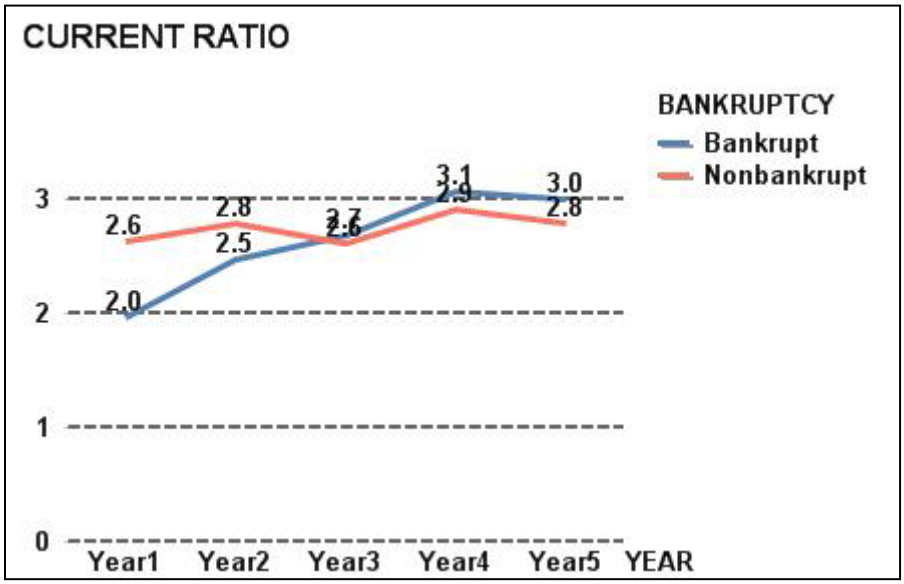

QUICK ASSETS TO TOTAL ASSETS
BANKRUPTCY
Bankrupt
Nonbankrupt
0.4
0.3
0.2
0.1
0.0
Year1
Year2
Year3
Year4
Year5
YEAR

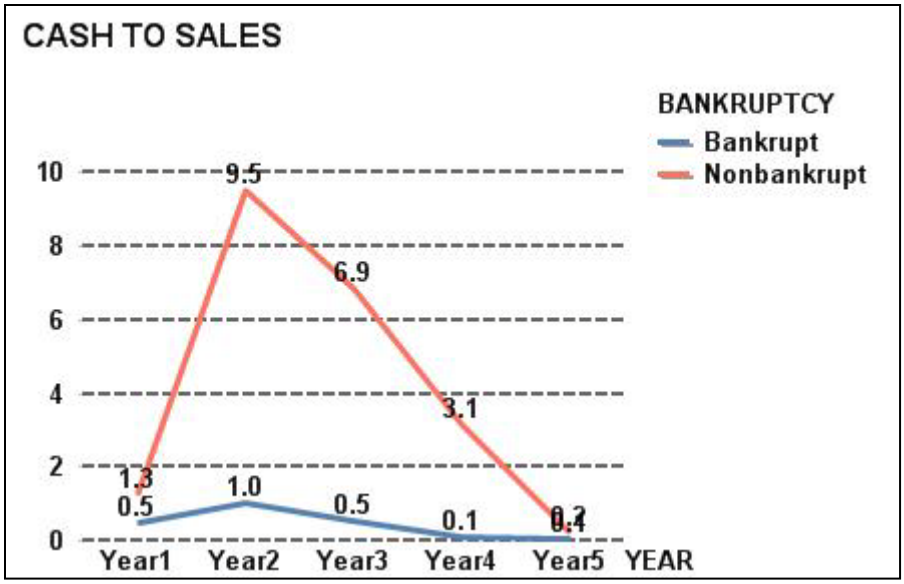

WORKING CAPITAL
BANKRUPTCY
Bankrupt
Nonbankrupt
250
200
150
100
50
0
-50
130.2
42.9
-41.4
260.1
125.0
-22.4
4.8
22.4
28.0
35.0
Year1
Year2
Year3
Year4
Year5
YEAR

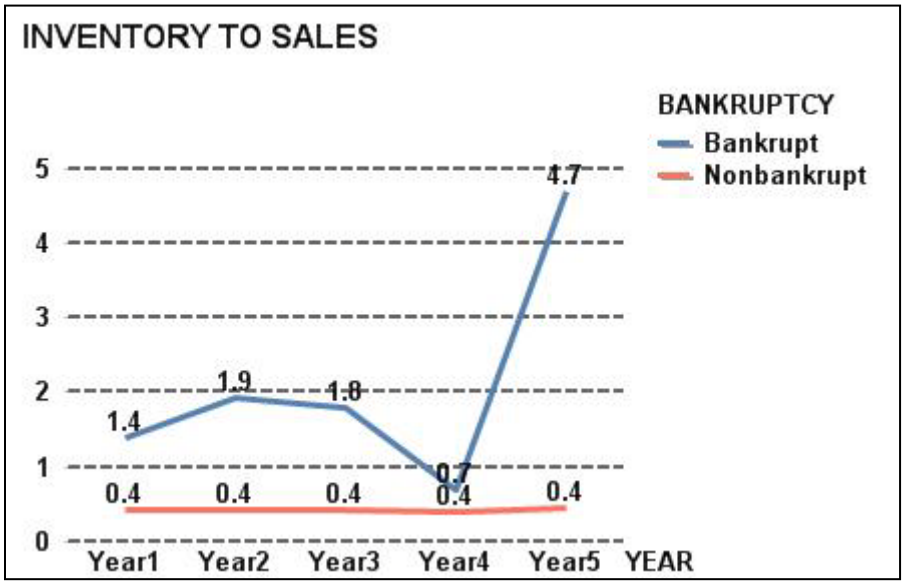

WORKING CAPITAL TO TOTAL ASSETS
BANKRUPTCY
Bankrupt
Nonbankrupt
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.3
0.2
0.3
0.3
0.3
0.2
0.2
0.2
0.0
Year1
Year2
Year3
Year4
Year5
YEAR

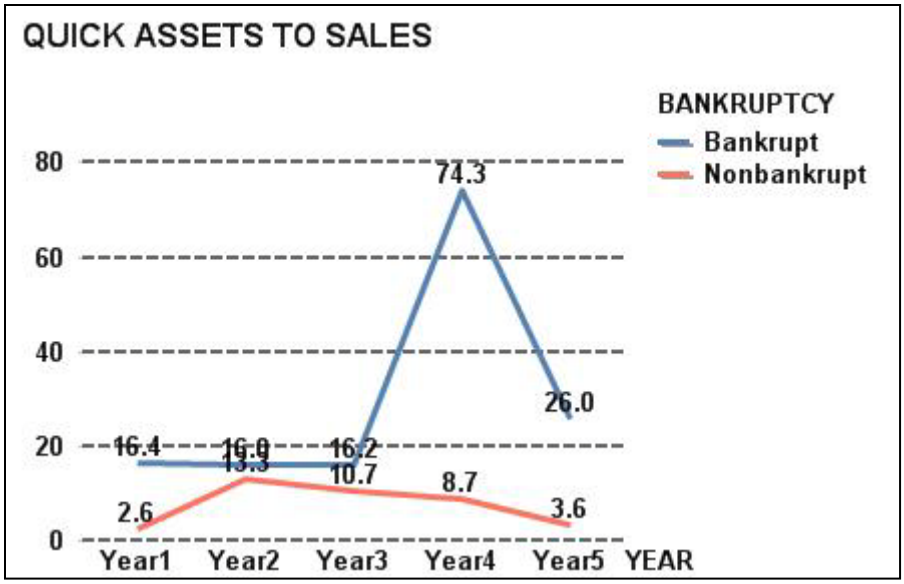

CASH TO CURRENT LIABILITIES
BANKRUPTCY
Bankrupt
Nonbankrupt
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.9
1.0
0.9
0.9
0.7
0.6
0.2
0.1
0.1
0.1
Year1
Year2
Year3
Year4
Year5
YEAR

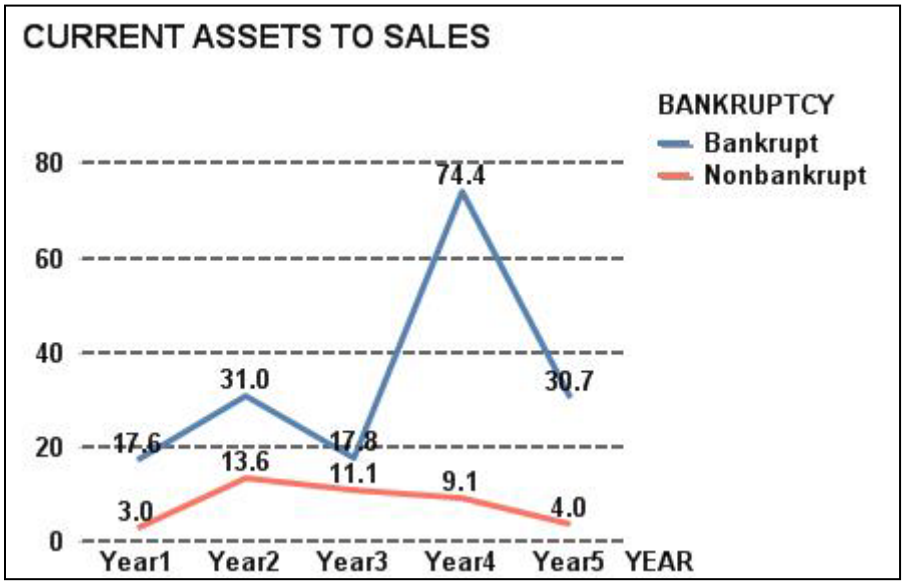

QUICK ASSETS TO CURRENT LIABILITIES
BANKRUPTCY
Bankrupt
Nonbankrupt
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2.1
2.2
2.1
2.2
2.1
2.6
2.3
2.5
2.3
1.6
Year1
Year2
Year3
Year4
Year5
YEAR

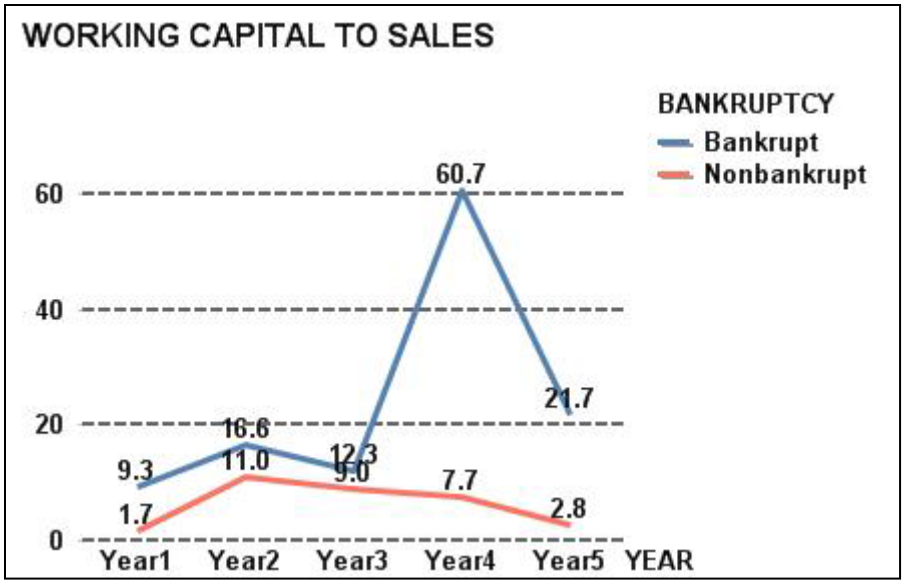

CURRENT RATIO
BANKRUPTCY
Bankrupt
Nonbankrupt
3
2
1
0
2.6
2.8
2.5
2.6
3.1
2.9
3.0
2.8
2.0
Year1
Year2
Year3
Year4
Year5
YEAR

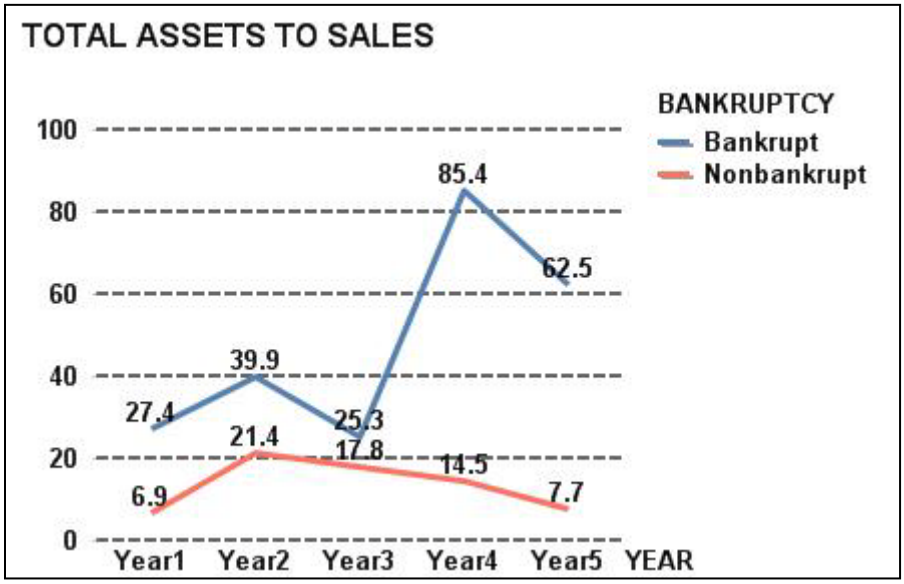

CASH TO SALES
BANKRUPTCY
Bankrupt
Nonbankrupt
10
8
6
4
2
0
9.5
6.9
3.1
1.3
0.5
1.0
0.5
0.1
0.2
0.4
Year1
Year2
Year3
Year4
Year5
YEAR

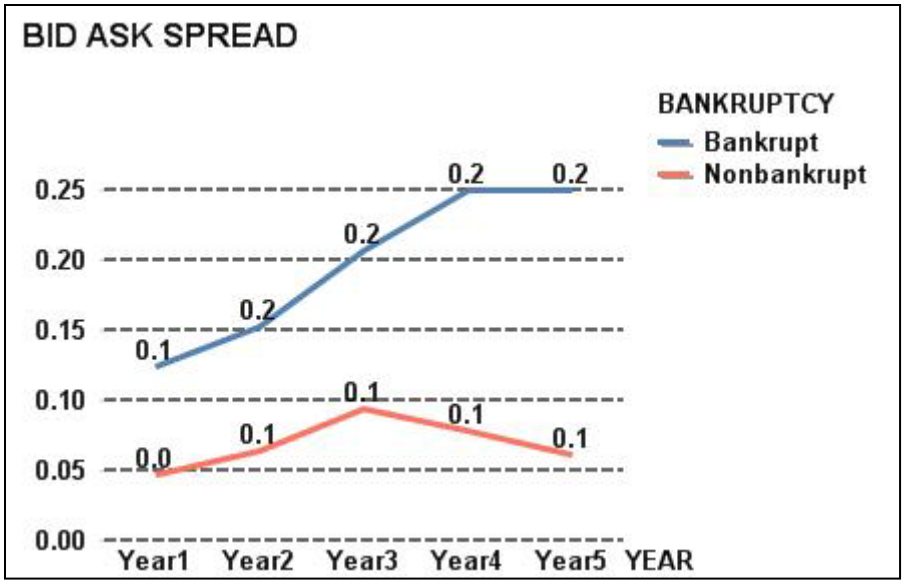

INVENTORY TO SALES
BANKRUPTCY
Bankrupt
Nonbankrupt
5
4
3
2
1
0
4.7
1.9
1.8
1.4
0.7
0.4
0.4
0.4
0.4
0.4
Year1
Year2
Year3
Year4
Year5
YEAR

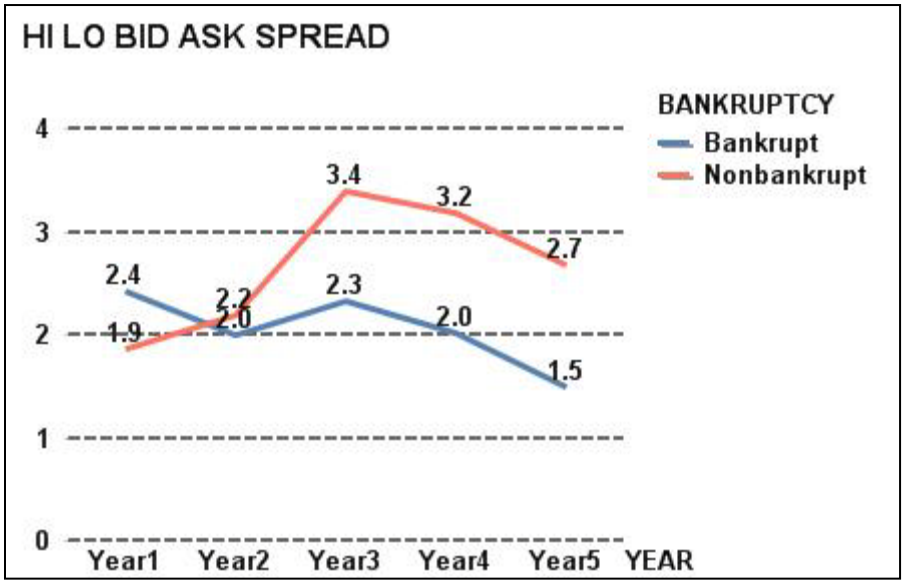

QUICK ASSETS TO SALES
BANKRUPTCY
Bankrupt
Nonbankrupt
80
60
40
20
0
74.3
26.0
16.4
16.0
16.2
13.3
10.7
8.7
3.6
2.6
Year1
Year2
Year3
Year4
Year5
YEAR

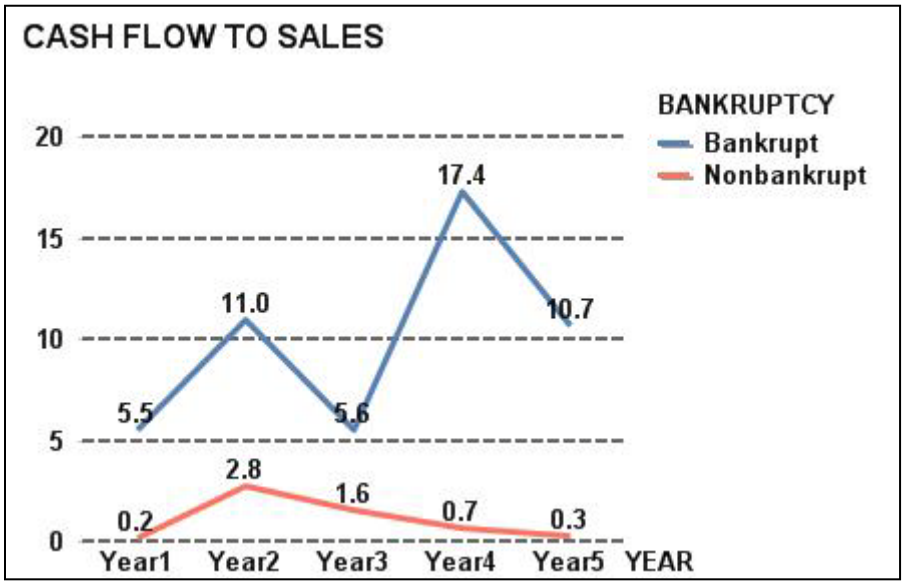

CURRENT ASSETS TO SALES
BANKRUPTCY
Bankrupt
Nonbankrupt
80
60
40
20
0
74.4
31.0
30.7
17.6
17.8
13.6
11.1
9.1
4.0
3.0
Year1
Year2
Year3
Year4
Year5
YEAR

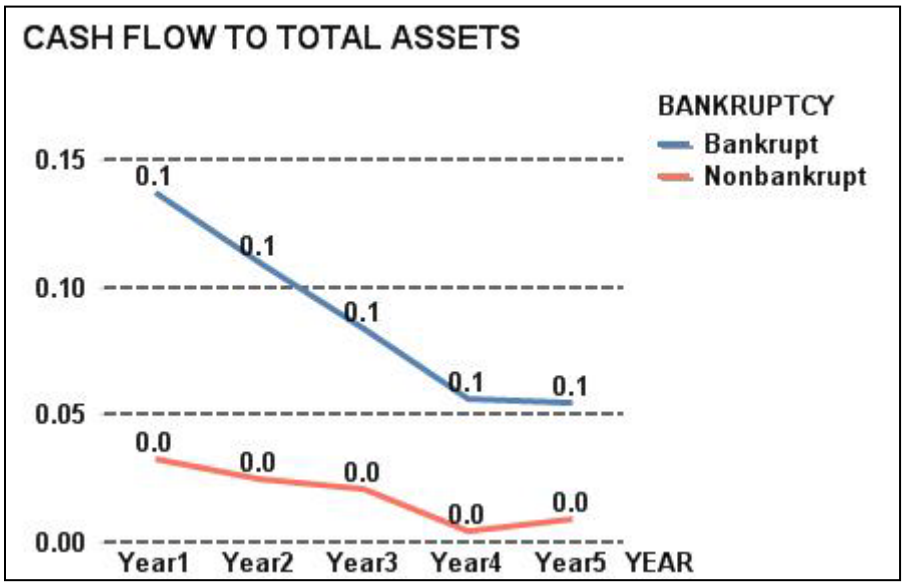

WORKING CAPITAL TO SALES
BANKRUPTCY
Bankrupt
Nonbankrupt
60
40
20
0
60.7
21.7
16.6
12.3
11.0
9.0
9.3
7.7
1.7
2.8
Year1
Year2
Year3
Year4
Year5
YEAR

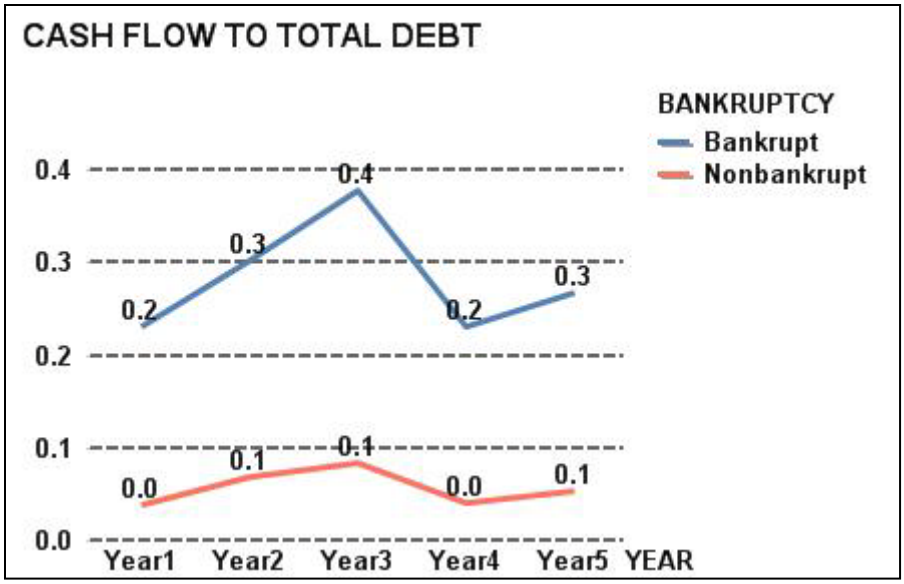

TOTAL ASSETS TO SALES
BANKRUPTCY
Bankrupt
Nonbankrupt
100
80
60
40
20
0
85.4
62.5
39.9
27.4
25.3
21.4
17.8
14.5
6.9
7.7
Year1
Year2
Year3
Year4
Year5
YEAR

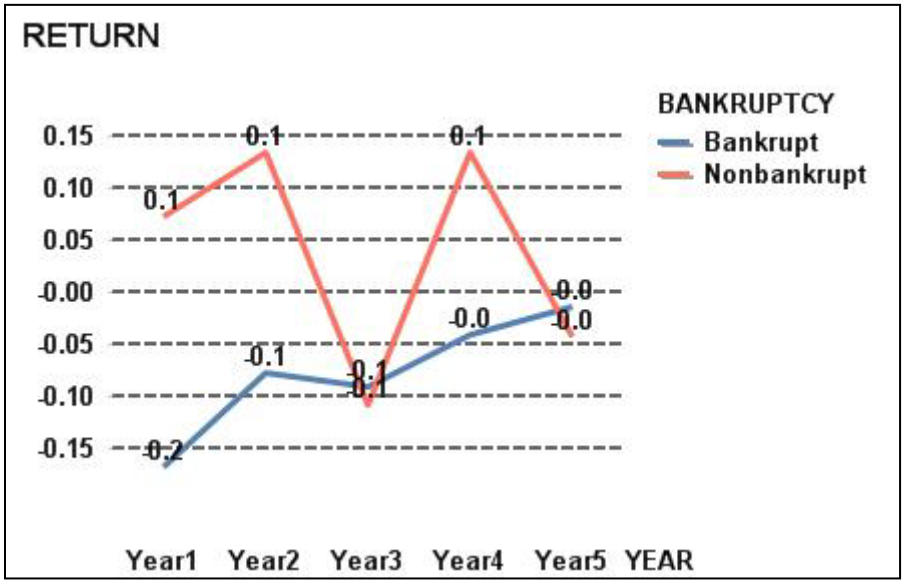

BID ASK SPREAD
BANKRUPTCY
Bankrupt
Nonbankrupt
0.25
0.20
0.15
0.10
0.05
0.00
0.1
0.2
0.2
0.2
0.2
0.0
0.1
0.1
0.1
Year1
Year2
Year3
Year4
Year5
YEAR

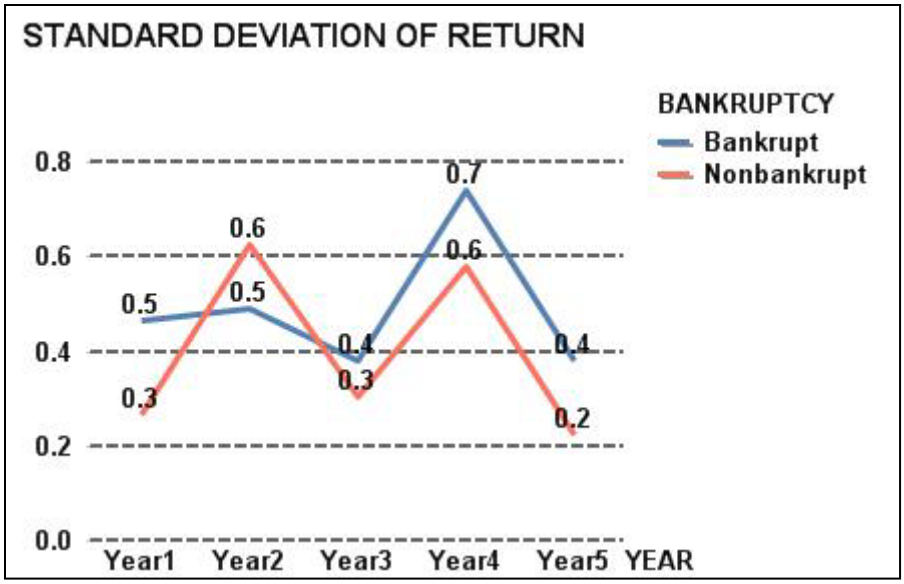

HI LO BID ASK SPREAD
BANKRUPTCY
Bankrupt
Nonbankrupt
4
3
2
1
0
2.4
1.9
2.0
2.3
2.0
1.5
2.2
3.4
3.2
2.7
Year1
Year2
Year3
Year4
Year5
YEAR

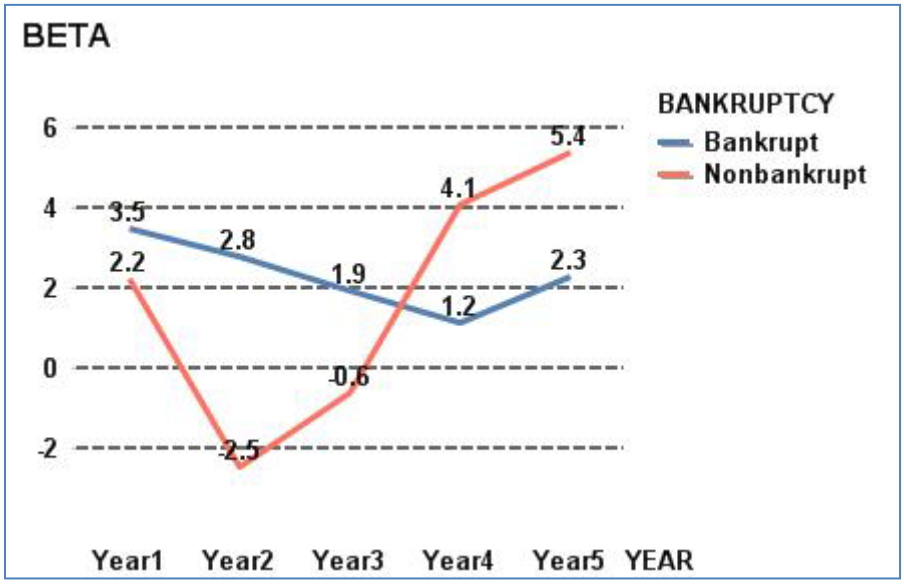

CASH FLOW TO SALES
BANKRUPTCY
Bankrupt
Nonbankrupt
20
15
10
5
0
5.5
11.0
5.6
17.4
10.7
0.2
2.8
1.6
0.7
0.3
Year1
Year2
Year3
Year4
Year5
YEAR


CASH FLOW TO TOTAL ASSETS
BANKRUPTCY
Bankrupt
Nonbankrupt
0.15
0.10
0.05
0.00
0.1
0.1
0.1
0.1
0.1
0.0
0.0
0.0
0.0
0.0
Year1
Year2
Year3
Year4
Year5
YEAR


CASH FLOW TO TOTAL DEBT
BANKRUPTCY
Bankrupt
Nonbankrupt
0.4
0.3
0.2
0.1
0.0
0.2
0.3
0.4
0.2
0.3
0.0
0.1
0.1
0.0
0.1
Year1
Year2
Year3
Year4
Year5
YEAR


RETURN
BANKRUPTCY
Bankrupt
Nonbankrupt
0.15
0.10
0.05
-0.00
-0.05
-0.10
-0.15
0.1
0.1
0.1
-0.2
-0.1
-0.1
-0.0
0.0
0.0
Year1
Year2
Year3
Year4
Year5
YEAR





When compared to previous studies, cash flow plays a much smaller role in this study. While there is a clear difference between the cash flow ratios of the two samples, there is not much of a trend. Net income to total assets tells a much different story. Due to

the crisis, net incomes are low and on the decline for both samples. However, the trend is much steeper for the bankrupt firms. Net income to total debt is much more flat.

Even though total debt does not fluctuate too much, current liabilities do. This is due to the fact that firms take on more short-term debt in distress to try to survive. Current liabilities to total assets are relatively stable for non-bankrupt firms, those for bankrupt firms increase 33% from five years before bankruptcy to one year before. Long-term liabilities to total assets are more stable for both samples. Total debt to total assets and total debt plus preferred stock to total assets increase 60-75% leading up to bankruptcy, but those for non-bankrupt firms are stable. Cash to total assets increase for both samples, which is at first surprising for bankrupt firms; this is mainly due to the decline of total assets. Furthermore, working capital to total assets significantly declines when approaching bankruptcy, demonstrating that current assets other than cash decreased, and/or current liabilities increased. This is further highlighted through the cash to current liabilities ratio. Also, both quick assets and all current assets decline as current liabilities rise, as is expected. Inventories decline mostly 5 years prior to bankruptcy, and then stay relatively flat. These findings are consistent with the belief that firms ramp up short-term risks trying to find a last minute solution to the deterioration.

While the trend analysis serves an explanatory purpose, it is not a predictive analysis. To do so, a dichotomous classification test is first applied. A clear difference between this study and prior studies is that the misclassifications found using our sample are much higher than those found in the literature. This is mainly due to the fact that many firms, whether the firms went bankrupt or not, suffered some distress due to the financial crisis. Therefore, any one variable or ratio alone will be less able to predict

which firm will go bankrupt and which firm will not. This will make the multivariate analysis in the coming chapters even more important.

Since the results are fairly similar between procedure 1 and 2, the results discussed in the following paragraphs will be specifically about procedure 2. This is more accurately a predictive test since the cutoff point is derived from one sample and then used to predict bankrupt or non-bankrupt firms in the other sample.

We begin again with the market and microstructure variables. Volume seems to have less predictive power as bankruptcy looms. The crisis led to heavy trading in all securities, so this makes volume a less discriminatory variable. While there may be more information in volume during normal periods, it is difficult to use during turmoil. Price, however, performs better, and improves in accuracy as bankruptcy approaches. The same occurs with the bid-ask spread and returns. Beta performs poorly and is erratic, but the standard deviation performs as well as price does. Overall, the market variables that are best at correctly classifying firms are prices, bid-ask spreads, and standard deviation. However, the variable with the most long-term accuracy (five years before bankruptcy) is the bid ask spread, with some misclassifications in the low 20%. This is consistent with our hypothesis, that the bid-ask spread, which is set by market makers, is a leading indicator since a lot of information not found in the accounting books or by retail investors is found on the trading floor.

Moving on to accounting ratios, the most accurate group is the cash flow group. While the accuracy is not monotonic, the misclassifications mostly range from the mid 20% to the mid 30%. Cash flow to total assets and cash flow to total debt correctly classify about 75% of the firms even five years before bankruptcy. This is interesting,

especially since we later find that the cash flow variables are not part of the set of best predictors in the multivariate frameworks.

The net income ratios also perform well, but are less accurate and more erratic than the cash flow or market variables. The inaccuracy mostly ranges from the high 20% to 40%. The net income to sales ratio misclassifies 25% to 33% of the firms. Surprisingly, the debt ratios are poor classifiers. This seems to go against the idea that firms leverage themselves as financial distress occurs in order to survive. However, one key characteristic of all firms during the recent financial crisis was high leverage. Therefore, it is much more difficult to use debt as a discriminating variable in our sample. The same seems to occur with assets; this is clearly seen through the accounting identity. Working capital performs well by itself, meaning that the relationship between current assets and current liabilities is important; unfortunately, the same is not found for the current ratio.

While the results of the dichotomous test lead to predictions, they lack in one important area. Clearly, a loan officer or investor would prefer incorrectly predicting that a future non-bankrupt will go bankrupt (Type II error) to predicting that a future bankrupt firm will not go bankrupt (Type I error). One way to display these different errors is through a contingency table. Since we have already seen that certain variables or ratios perform substantially better than others, we will focus on those better performing variables and ratios.

Table 2

Dichotomous classification Test Results for Ratios

This table presents the dichotomous classification test by classifying firms as either bankrupt or nonbankrupt by using a cutoff point for each variable or ratio that minimizes the misclassification rate. Procedure 1 classifies firms in each sample by using a cutoff derived from the same sample. Procedure 2 classifies firms in each sample by using a cutoff derived from the other sample. Year 1 is one year before bankruptcy and year 5 is five years before bankruptcy.

SHROUT

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	40.16	39.34	37.72	35.92	40.45
	Sample2	42.52	39.17	35.24	30.43	34.18
Procedure 2	Sample1	40.16	37.70	36.84	37.86	39.33
	Sample2	43.31	39.17	35.24	30.43	34.18

PRC

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	32.80	39.67	37.72	35.92	40.45
	Sample2	29.13	35.83	37.14	35.87	32.91
Procedure 2	Sample1	32.80	38.84	41.23	34.95	40.45
	Sample2	29.92	38.33	39.05	34.78	34.18

VOL

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	41.73	38.52	37.72	34.95	38.20
	Sample2	40.16	39.17	36.19	36.96	32.91

Procedure 2	Sample1	40.94	37.70	36.84	33.98	37.08
	Sample2	43.31	37.50	36.19	35.87	32.91

SPREAD

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	100.00	42.86	28.57	20.00	33.33
	Sample2	57.14	60.00	33.33	66.67	33.33
Procedure 2	Sample1	100.00	42.86	28.57	0.00	33.33
	Sample2	42.86	80.00	66.67	66.67	66.67

NET INCOME TO SALES

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	34.68	35.83	49.11	43.00	40.23
	Sample2	24.17	28.45	32.35	33.33	28.57
Procedure 2	Sample1	36.29	34.17	45.54	40.00	40.23
	Sample2	25.00	26.72	31.37	32.22	29.87

NET INCOME TO TOTAL ASSETS

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	33.59	34.71	44.74	38.83	40.45
	Sample2	26.19	29.17	31.43	33.70	29.11
Procedure 2	Sample1	36.72	33.88	45.61	40.78	40.45
	Sample2	26.98	26.67	30.48	31.52	29.11

TOTAL DEBT

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	64.00	61.86	63.06	64.00	67.44
	Sample2	54.40	58.82	61.54	63.74	62.82
Procedure 2	Sample1	64.00	61.86	63.06	61.00	69.77
	Sample2	55.20	57.98	62.50	65.93	62.82

NET INCOME TO TOTAL DEBT

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	31.20	33.90	45.95	40.00	40.70
	Sample2	28.00	28.57	31.73	32.97	32.05
Procedure 2	Sample1	34.40	33.05	44.14	42.00	39.53
	Sample2	29.60	27.73	31.73	31.87	29.49

CURRENT LIABILITIES TO TOTAL ASSETS

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	38.10	44.54	41.96	42.57	51.72
	Sample2	40.48	45.00	46.67	42.39	50.63
Procedure 2	Sample1	35.71	42.02	41.07	42.57	51.72
	Sample2	39.68	45.83	46.67	40.22	50.63

LONG TERM LIABILTIES TO TOTAL ASSETS

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	49.60	50.00	49.55	53.00	46.51
	Sample2	44.00	41.18	50.96	48.35	47.44
Procedure 2	Sample1	50.40	53.39	53.15	57.00	52.33
	Sample2	44.00	44.54	50.00	49.45	50.00

TOTAL DEBT TO TOTAL ASSETS

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	38.40	41.53	41.44	41.00	52.33
	Sample2	32.00	38.66	44.23	42.86	46.15
Procedure 2	Sample1	40.80	42.37	41.44	44.00	53.49
	Sample2	32.80	42.02	41.35	41.76	46.15

TOTAL DEBT PLUS PREF TO TOTAL ASSETS

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	39.20	42.37	42.34	37.00	48.84
	Sample2	31.45	37.82	39.42	37.36	44.87
Procedure 2	Sample1	40.00	42.37	42.34	43.00	53.49
	Sample2	31.45	40.34	42.31	42.86	41.03

CASH TO TOTAL ASSETS

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	42.11	46.30	50.00	50.00	66.67
	Sample2	48.08	52.94	52.27	61.90	100.00
Procedure 2	Sample1	59.65	57.41	66.00	65.22	66.67
	Sample2	34.62	33.33	43.18	45.24	100.00

QUICK ASSETS

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	36.29	38.14	34.23	29.70	36.05
	Sample2	25.40	30.00	28.57	21.74	29.11
Procedure 2	Sample1	36.29	38.14	35.14	29.70	36.05
	Sample2	25.40	30.00	28.57	21.74	29.11

QUICK ASSETS TO TOTAL ASSETS

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	51.61	52.54	55.86	49.50	52.33
	Sample2	39.68	53.33	48.57	50.00	48.10
Procedure 2	Sample1	50.00	50.85	54.05	50.50	50.00
	Sample2	43.65	50.00	50.48	50.00	46.84

WORKING CAPITAL

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	35.71	39.50	35.71	35.64	34.48
	Sample2	26.19	30.83	30.48	27.17	35.44
Procedure 2	Sample1	35.71	39.50	34.82	35.64	34.48
	Sample2	25.40	30.83	27.62	27.17	31.65

WORKING CAPITAL TO TOTAL ASSETS

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	40.48	50.42	46.43	47.52	49.43
	Sample2	31.75	46.67	48.57	48.91	49.37
Procedure 2	Sample1	43.65	49.58	50.00	46.53	51.72
	Sample2	34.92	43.33	46.67	47.83	48.10

CASH TO CURRENT LIABILITIES

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	38.18	48.08	52.08	50.00	66.67
	Sample2	38.46	52.94	50.00	57.14	100.00
Procedure 2	Sample1	49.09	50.00	58.33	61.36	66.67
	Sample2	36.54	33.33	45.45	45.24	100.00

QUICK ASSETS TO CURRENT LIABILITIES

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	41.13	44.07	48.65	44.55	50.00
	Sample2	35.71	43.33	46.67	44.57	50.63
Procedure 2	Sample1	41.13	44.07	49.55	50.50	55.81
	Sample2	33.33	42.50	43.81	41.30	49.37

CURRENT RATIO

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	38.89	42.02	44.64	44.55	50.57
	Sample2	34.13	47.50	41.90	45.65	51.90
Procedure 2	Sample1	38.89	42.02	46.43	44.55	48.28
	Sample2	33.33	47.50	44.76	46.74	51.90

CASH TO SALES

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	42.86	43.40	48.98	52.17	66.67
	Sample2	49.02	42.00	58.14	61.90	100.00
Procedure 2	Sample1	46.43	52.83	55.10	54.35	66.67
	Sample2	43.14	40.00	53.49	54.76	50.00

INVENTORY TO SALES

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	49.18	52.59	52.25	48.00	54.12
	Sample2	50.00	47.41	52.94	48.89	49.35
Procedure 2	Sample1	48.36	52.59	52.25	46.00	54.12
	Sample2	50.83	48.28	53.92	50.00	50.65

QUICK ASSETS TO SALES

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	58.68	53.04	55.96	55.10	57.14
	Sample2	53.33	50.86	51.96	55.56	50.65
Procedure 2	Sample1	55.37	51.30	57.80	56.12	59.52
	Sample2	51.67	54.31	51.96	47.78	44.16

CURRENT ASSETS TO SALES

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	59.35	52.99	52.73	54.08	55.29
	Sample2	53.33	56.03	51.96	53.33	50.65
Procedure 2	Sample1	56.10	52.14	53.64	55.10	57.65
	Sample2	52.50	52.59	50.98	51.11	50.65

WORKING CAPITAL TO SALES

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	39.84	46.15	43.64	44.90	54.12
	Sample2	39.17	48.28	47.06	48.89	53.25
Procedure 2	Sample1	43.90	47.01	51.82	54.08	57.65
	Sample2	35.00	40.52	45.10	48.89	49.35

TOTAL ASSETS TO SALES

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	47.20	50.42	50.00	52.00	49.43
	Sample2	47.50	50.86	46.08	51.11	48.05
Procedure 2	Sample1	47.20	50.42	50.00	51.00	49.43
	Sample2	46.67	49.14	46.08	51.11	48.05

BID ASK SPREAD

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	32.26	28.93	33.33	33.01	30.59
	Sample2	30.40	24.37	35.58	24.18	19.74
Procedure 2	Sample1	27.42	26.45	33.33	35.92	29.41
	Sample2	36.00	29.41	37.50	23.08	22.37

HI LO BID ASK SPREAD

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	55.91	58.20	64.04	62.14	56.18
	Sample2	59.84	57.50	59.05	53.26	60.76
Procedure 2	Sample1	57.48	59.02	60.53	60.19	55.06
	Sample2	59.06	57.50	60.00	48.91	53.16

CASH FLOW TO SALES

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	28.69	35.65	37.50	38.46	35.53
	Sample2	28.57	31.48	39.36	36.59	26.87
Procedure 2	Sample1	29.51	33.04	38.46	38.46	38.16
	Sample2	27.73	30.56	40.43	37.80	28.36

CASH FLOW TO TOTAL ASSETS

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	27.42	30.17	40.00	34.78	36.36
	Sample2	27.42	29.09	38.14	32.94	28.57
Procedure 2	Sample1	29.84	31.03	38.10	33.70	33.77
	Sample2	29.84	27.27	40.21	32.94	24.29

CASH FLOW TO TOTAL DEBT

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	31.71	33.04	40.38	40.66	40.79
	Sample2	29.75	29.91	36.17	34.15	29.85
Procedure 2	Sample1	27.64	32.17	39.42	35.16	38.16
	Sample2	28.10	30.84	36.17	31.71	23.88

RETURN

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	72.36	67.50	41.28	55.43	45.45
	Sample2	74.17	72.57	39.39	47.67	49.35
Procedure 2	Sample1	72.36	68.33	41.28	55.43	45.45
	Sample2	74.17	72.57	38.38	47.67	48.05

STANDARD DEVIATION OF RETURN

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	36.73	57.14	40.66	46.15	36.00
	Sample2	41.05	47.42	40.23	34.88	40.91
Procedure 2	Sample1	34.69	53.57	43.96	46.15	40.00
	Sample2	41.05	44.33	36.78	34.88	40.91

BETA

Procedure	Sample	%Mis-classifications				
		Year1	Year2	Year3	Year4	Year5
Procedure 1	Sample1	56.47	26.83	32.43	60.61	63.64
	Sample2	57.14	34.07	28.57	41.94	45.90
Procedure 2	Sample1	58.82	26.83	35.14	48.48	61.82
	Sample2	51.65	34.07	27.27	41.94	44.26

The best classifying market variables according to the dichotomous test are price, bid-ask spread, and standard deviation. One year before failure, price leads to a 20% Type I error versus a 44% type II error, whereas five years before failure it leads to a 36% Type I error versus a 32% Type II error. For the bid-ask spread, one year before failure there is a 52% Type I error versus a 15% Type II error, but five years before failure it leads to an 18% Type I error versus a 37% Type II error. Lastly, the standard deviation predictions have a Type I error of 31% versus a Type II error of 38% in year one, and Type I error of 38% versus a Type II error of 11% in year five. One key difference with these results and those found previously in the literature is that Type I errors are sometimes lower than Type II errors using this sample. The prior literature consistently found that it was easier to correctly classify non-bankrupt firms than bankrupt firms. While this is not a definitive finding, it does show that market variables are better at correctly classifying firms that under distress, which is of utmost importance. This is consistent with our hypothesis that market variables are good long-term predictors

of bankruptcy since market variables take into account future events, making them forward-looking variables.

Accounting ratios perform relatively well, but a clear pattern persists. Cash flow to total assets provides a Type I error of 15% versus a Type II error of 47% in year one, and a Type I error of 36% versus a Type II error of 33% in year five. Net income to total asset leads to a Type I error of 22% versus a Type II error of 52% in year one, and a Type I error of 46% versus a Type II error of 37% in year five. Net income to sales produce a Type I error of 20% versus a Type II error of 31% on year before bankruptcy, and Type I error of 51% versus a Type II error of 15% five years before bankruptcy. For working capital to total assets, the Type I and Type II errors in year one are 34% versus 54%, and 49% versus 54% in year five, respectively. For the most part, Type I errors are smaller than Type II errors one year before failure, whereas Type I errors are larger than Type II errors five years before failure. This validates the idea that accounting ratios are backward-looking. By the time accounting ratios begin to correctly signal that firms are under distress, bankruptcy is imminent. This does not mean that these ratios are not important in the predictive process; it just means that there is more to the story. This finding, along with the above mentioned finding that market variables have overall lower Type I errors, are important findings. Any bankruptcy prediction model and/or research should include both accounting ratios and market variables to capture both short-term and long-term information.

Table 3

Contingency Table Results for Classification Tests of Ratios

This table presents the contingency tables of classifying firms as either bankrupt or nonbankrupt by using a cutoff point for each variable or ratio that minimizes the misclassification rate. Procedure 2 classifies firms in each sample by using a cutoff derived from the other sample. Year 1 is one year before bankruptcy and year 5 is five years before bankruptcy.

SHROUT – Year1

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	37	24	61
		Nonbankrupt	27	39	66
		Total	64	63	127
		% Mis classifications = 40.15			
	Sample2	Bankrupt	38	20	58
		Nonbankrupt	35	34	69
		Total	73	54	127
		% Mis classifications = 43.30			

SHROUT - Year 4

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	30	25	55
		Nonbankrupt	14	34	48
		Total	44	59	103
		% Mis classifications = 37.86			
	Sample2	Bankrupt	31	18	49
		Nonbankrupt	10	33	43
		Total	41	51	92
		% Mis classifications = 30.43			

SHROUT - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	24	22	46
		Nonbankrupt	13	30	43
		Total	37	52	89
		% Mis classifications = 39.32			
	Sample2	Bankrupt	23	17	40
		Nonbankrupt	10	29	39
		Total	33	46	79
		% Mis classifications = 34.17			

PRC– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	47	25	72
		Nonbankrupt	16	37	53
		Total	63	62	125
		% Mis classifications = 32.8			
	Sample2	Bankrupt	59	24	83
		Nonbankrupt	14	30	44
		Total	73	54	127
		% Mis classifications = 29.92			

PRC - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	22	14	36
		Nonbankrupt	22	45	67
		Total	44	59	103
		% Mis classifications = 34.95			
	Sample2	Bankrupt	26	17	43
		Nonbankrupt	15	34	49
		Total	41	51	92
		% Mis classifications = 34.78			

PRC- Year 5

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	15	14	29
		Nonbankrupt	22	38	60
		Total	37	52	89
		% Mis classifications = 40.44			
	Sample2	Bankrupt	21	15	36
		Nonbankrupt	12	31	43
		Total	33	46	79
		% Mis classifications = 34.17			

VOL - Year1

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	38	26	64
		Nonbankrupt	26	37	63
		Total	64	63	127
		% Mis classifications = 40.94			
	Sample2	Bankrupt	40	22	62
		Nonbankrupt	33	32	65
		Total	73	54	127
		% Mis classifications = 43.30			

VOL - Year 4

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	27	18	45
		Nonbankrupt	17	41	58
		Total	44	59	103
		% Mis classifications = 33.98			
	Sample2	Bankrupt	31	23	54
		Nonbankrupt	10	28	38
		Total	41	51	92
		% Mis classifications = 35.86			

VOL - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	27	23	50
		Nonbankrupt	10	29	39
		Total	37	52	89
		% Mis classifications = 37.07			
	Sample2	Bankrupt	25	18	43
		Nonbankrupt	8	28	36
		Total	33	46	79
		% Mis classifications = 32.91			

NET INCOME TO SALES– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	50	31	81
		Nonbankrupt	14	29	43
		Total	64	60	124
		% Mis classifications = 36.29			
	Sample2	Bankrupt	54	16	70
		Nonbankrupt	14	36	50
		Total	68	52	120
		% Mis classifications = 25.0			

NET INCOME TO SALES - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	25	22	47
		Nonbankrupt	18	35	53
		Total	43	57	100
		% Mis classifications = 30.0			
	Sample2	Bankrupt	20	10	30
		Nonbankrupt	19	41	60
		Total	39	51	90
		% Mis classifications = 32.22			

NET INCOME TO SALES - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	20	18	38
		Nonbankrupt	17	32	49
		Total	37	50	87
		% Mis classifications = 40.22			
	Sample2	Bankrupt	15	7	22
		Nonbankrupt	16	39	55
		Total	31	46	77
		% Mis classifications = 29.87			

NET INCOME TO TOTAL ASSETS– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	51	33	84
		Nonbankrupt	14	30	44
		Total	65	63	128
		% Mis classifications = 36.71			
	Sample2	Bankrupt	57	19	76
		Nonbankrupt	15	35	50
		Total	72	54	126
		% Mis classifications = 26.98			

NET INCOME TO TOTAL ASSETS - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	26	24	50
		Nonbankrupt	18	35	53
		Total	44	59	103
		% Mis classifications = 40.77			
	Sample2	Bankrupt	22	10	32
		Nonbankrupt	19	41	60
		Total	41	51	92
		% Mis classifications = 31.52			

NET INCOME TO TOTAL ASSETS - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	20	19	39
		Nonbankrupt	17	33	50
		Total	37	52	89
		% Mis classifications = 40.44			
	Sample2	Bankrupt	16	6	22
		Nonbankrupt	17	40	57
		Total	33	46	79
		% Mis classifications = 29.11			

NET INCOME TO TOTAL DEBT– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	51	30	81
		Nonbankrupt	13	31	44
		Total	64	61	125
		% Mis classifications = 34.4			
	Sample2	Bankrupt	54	19	73
		Nonbankrupt	18	34	52
		Total	72	53	125
		% Mis classifications = 29.6			

NET INCOME TO TOTAL DEBT - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	24	23	47
		Nonbankrupt	19	34	53
		Total	43	57	100
		% Mis classifications = 42.0			
	Sample2	Bankrupt	22	10	32
		Nonbankrupt	19	40	59
		Total	41	50	91
		% Mis classifications = 31.86			

NET INCOME TO TOTAL DEBT - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	20	18	38
		Nonbankrupt	16	32	48
		Total	36	50	86
		% Mis classifications = 39.53			
	Sample2	Bankrupt	16	6	22
		Nonbankrupt	17	39	56
		Total	33	45	78
		% Mis classifications = 29.48			

CASH TO TOTAL ASSETS– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	4	33	37
		Nonbankrupt	1	19	20
		Total	5	52	57
		% Mis classifications = 59.64			
	Sample2	Bankrupt	0	15	15
		Nonbankrupt	3	34	37
		Total	3	49	52
		% Mis classifications = 34.61			

CASH TO TOTAL ASSETS - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	1	30	31
		Nonbankrupt	0	15	15
		Total	1	45	46
		% Mis classifications = 65.21			
	Sample2	Bankrupt		19	19
		Nonbankrupt		23	23
		Total		42	42
		% Mis classifications = 45.23			

CASH TO TOTAL ASSETS - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	1	2	3
		Nonbankrupt			
		Total	1	2	3
		% Mis classifications = 66.67			
	Sample2	Bankrupt		2	2
		Nonbankrupt			
		Total		2	2
		% Mis classifications = 100.0			

QUICK ASSETS– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	42	23	65
		Nonbankrupt	22	37	59
		Total	64	60	124
		% Mis classifications = 36.29			
	Sample2	Bankrupt	53	13	66
		Nonbankrupt	19	41	60
		Total	72	54	126
		% Mis classifications = 25.39			

QUICK ASSETS - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	30	16	46
		Nonbankrupt	14	41	55
		Total	44	57	101
		% Mis classifications = 29.70			
	Sample2	Bankrupt	32	11	43
		Nonbankrupt	9	40	49
		Total	41	51	92
		% Mis classifications = 21.73			

QUICK ASSETS - Year 5

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	27	21	48
		Nonbankrupt	10	28	38
		Total	37	49	86
		% Mis classifications = 36.04			
	Sample2	Bankrupt	26	16	42
		Nonbankrupt	7	30	37
		Total	33	46	79
		% Mis classifications = 29.11			

QUICK ASSETS TO TOTAL ASSETS– Year1

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	39	37	76
		Nonbankrupt	25	23	48
		Total	64	60	124
		% Mis classifications = 50.0			
	Sample2	Bankrupt	37	20	57
		Nonbankrupt	35	34	69
		Total	72	54	126
		% Mis classifications = 43.65			

QUICK ASSETS TO TOTAL ASSETS - Year 4

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	27	34	61
		Nonbankrupt	17	23	40
		Total	44	57	101
		% Mis classifications = 50.49			
	Sample2	Bankrupt	17	22	39
		Nonbankrupt	24	29	53
		Total	41	51	92
		% Mis classifications = 50.0			

QUICK ASSETS TO TOTAL ASSETS - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	22	28	50
		Nonbankrupt	15	21	36
		Total	37	49	86
		% Mis classifications = 50.0			
	Sample2	Bankrupt	13	17	30
		Nonbankrupt	20	29	49
		Total	33	46	79
		% Mis classifications = 46.83			

QUICK ASSETS TO SALES– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	29	33	62
		Nonbankrupt	34	25	59
		Total	63	58	121
		% Mis classifications = 52.89			
	Sample2	Bankrupt	23	17	40
		Nonbankrupt	45	35	80
		Total	68	52	120
		% Mis classifications = 51.67			

QUICK ASSETS TO SALES - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	24	36	60
		Nonbankrupt	19	19	38
		Total	43	55	98
		% Mis classifications = 56.12			
	Sample2	Bankrupt	17	21	38
		Nonbankrupt	22	30	52
		Total	39	51	90
		% Mis classifications = 47.78			

QUICK ASSETS TO SALES - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	18	31	49
		Nonbankrupt	19	16	35
		Total	37	47	84
		% Mis classifications = 59.52			
	Sample2	Bankrupt	14	17	31
		Nonbankrupt	17	29	46
		Total	31	46	77
		% Mis classifications = 44.15			

WORKING CAPITAL– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	46	26	72
		Nonbankrupt	19	35	54
		Total	65	61	126
		% Mis classifications = 35.71			
	Sample2	Bankrupt	54	14	68
		Nonbankrupt	18	40	58
		Total	72	54	126
		% Mis classifications = 25.39			

WORKING CAPITAL - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	26	18	44
		Nonbankrupt	18	39	57
		Total	44	57	101
		% Mis classifications = 35.64			
	Sample2	Bankrupt	25	9	34
		Nonbankrupt	16	42	58
		Total	41	51	92
		% Mis classifications = 27.17			

WORKING CAPITAL - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	24	17	41
		Nonbankrupt	13	33	46
		Total	37	50	87
		% Mis classifications = 34.48			
	Sample2	Bankrupt	22	14	36
		Nonbankrupt	11	32	43
		Total	33	46	79
		% Mis classifications = 31.64			

WORKING CAPITAL TO TOTAL ASSETS– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	43	33	76
		Nonbankrupt	22	28	50
		Total	65	61	126
		% Mis classifications = 43.65			
	Sample2	Bankrupt	47	19	66
		Nonbankrupt	25	35	60
		Total	72	54	126
		% Mis classifications = 34.92			

WORKING CAPITAL TO TOTAL ASSETS - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	24	27	51
		Nonbankrupt	20	30	50
		Total	44	57	101
		% Mis classifications = 46.53			
	Sample2	Bankrupt	14	17	31
		Nonbankrupt	27	34	61
		Total	41	51	92
		% Mis classifications = 47.82			

WORKING CAPITAL TO TOTAL ASSETS - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	19	27	46
		Nonbankrupt	18	23	41
		Total	37	50	87
		% Mis classifications = 51.72			
	Sample2	Bankrupt	14	19	33
		Nonbankrupt	19	27	46
		Total	33	46	79
		% Mis classifications = 48.10			

WORKING CAPITAL TO SALES– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	42	32	74
		Nonbankrupt	22	27	49
		Total	64	59	123
		% Mis classifications = 43.90			
	Sample2	Bankrupt	40	14	54
		Nonbankrupt	28	38	66
		Total	68	52	120
		% Mis classifications = 35.0			

WORKING CAPITAL TO SALES - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	26	36	62
		Nonbankrupt	17	19	36
		Total	43	55	98
		% Mis classifications = 54.08			
	Sample2	Bankrupt	14	19	33
		Nonbankrupt	25	32	57
		Total	39	51	90
		% Mis classifications = 48.89			

WORKING CAPITAL TO SALES - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	20	32	52
		Nonbankrupt	17	16	33
		Total	37	48	85
		% Mis classifications = 57.64			
	Sample2	Bankrupt	10	17	27
		Nonbankrupt	21	29	50
		Total	31	46	77
		% Mis classifications = 49.35			

CASH TO CURRENT LIABILITIES– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	4	26	30
		Nonbankrupt	1	24	25
		Total	5	50	55
		% Mis classifications = 49.09			
	Sample2	Bankrupt	2	18	20
		Nonbankrupt	1	31	32
		Total	3	49	52
		% Mis classifications = 36.53			

CASH TO CURRENT LIABILITIES - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	1	27	28
		Nonbankrupt	0	16	16
		Total	1	43	44
		% Mis classifications = 61.36			
	Sample2	Bankrupt		19	19
		Nonbankrupt		23	23
		Total		42	42
		% Mis classifications = 54.76			

CASH TO CURRENT LIABILITIES - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	1	2	3
		Nonbankrupt			
		Total	1	2	3
		% Mis classifications = 66.67			
	Sample2	Bankrupt		2	2
		Nonbankrupt			
		Total		2	2
		% Mis classifications = 100.0			

QUICK ASSETS TO CURRENT LIABILITIES– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	43	30	73
		Nonbankrupt	21	30	51
		Total	64	60	124
		% Mis classifications = 41.12			
	Sample2	Bankrupt	46	16	62
		Nonbankrupt	26	38	64
		Total	72	54	126
		% Mis classifications = 33.33			

QUICK ASSETS TO CURRENT LIABILITIES - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	26	33	59
		Nonbankrupt	18	24	42
		Total	44	57	101
		% Mis classifications = 50.49			
	Sample2	Bankrupt	17	14	31
		Nonbankrupt	24	37	61
		Total	41	51	92
		% Mis classifications = 41.3			

QUICK ASSETS TO CURRENT LIABILITIES - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	18	29	47
		Nonbankrupt	19	20	39
		Total	37	49	86
		% Mis classifications = 55.81			
	Sample2	Bankrupt	12	18	30
		Nonbankrupt	21	28	49
		Total	33	46	79
		% Mis classifications = 49.36			

CURRENT RATIO– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	42	26	68
		Nonbankrupt	23	35	58
		Total	65	61	126
		% Mis classifications = 38.89			
	Sample2	Bankrupt	52	22	74
		Nonbankrupt	20	32	52
		Total	72	54	126
		% Mis classifications = 33.33			

CURRENT RATIO - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	23	24	47
		Nonbankrupt	21	33	54
		Total	44	57	101
		% Mis classifications = 44.55			
	Sample2	Bankrupt	19	21	40
		Nonbankrupt	22	30	52
		Total	41	51	92
		% Mis classifications = 46.73			

CURRENT RATIO - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	19	24	43
		Nonbankrupt	18	26	44
		Total	37	50	87
		% Mis classifications = 48.27			
	Sample2	Bankrupt	15	23	38
		Nonbankrupt	18	23	41
		Total	33	46	79
		% Mis classifications = 51.89			

CASH TO SALES– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	4	25	29
		Nonbankrupt	1	26	27
		Total	5	51	56
		% Mis classifications = 46.42			
	Sample2	Bankrupt	0	20	20
		Nonbankrupt	2	29	31
		Total	2	49	51
		% Mis classifications = 43.13			

CASH TO SALES - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	1	25	26
		Nonbankrupt	0	20	20
		Total	1	45	46
		% Mis classifications = 54.34			
	Sample2	Bankrupt		23	23
		Nonbankrupt		19	19
		Total		42	42
		% Mis classifications = 54.76			

CASH TO SALES - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	1	2	3
		Nonbankrupt			
		Total	1	2	3
		% Mis classifications = 66.67			
	Sample2	Bankrupt		1	1
		Nonbankrupt		1	1
		Total		2	2
		% Mis classifications = 50.0			

CURRENT ASSETS TO SALES– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	31	36	67
		Nonbankrupt	33	23	56
		Total	64	59	123
		% Mis classifications = 56.09			
	Sample2	Bankrupt	22	17	39
		Nonbankrupt	46	35	81
		Total	68	52	120
		% Mis classifications = 52.5			

CURRENT ASSETS TO SALES - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	26	37	63
		Nonbankrupt	17	18	35
		Total	43	55	98
		% Mis classifications = 55.10			
	Sample2	Bankrupt	14	21	35
		Nonbankrupt	25	30	55
		Total	39	51	90
		% Mis classifications = 51.11			

CURRENT ASSETS TO SALES - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	21	33	54
		Nonbankrupt	16	15	31
		Total	37	48	85
		% Mis classifications = 57.64			
	Sample2	Bankrupt	11	19	30
		Nonbankrupt	20	27	47
		Total	31	46	77
		% Mis classifications = 50.64			

SPREAD– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	0	2	2
		Nonbankrupt	4	0	4
		Total	4	2	6
		% Mis classifications = 100.0			
	Sample2	Bankrupt	3	0	3
		Nonbankrupt	3	1	4
		Total	6	1	7
		% Mis classifications = 42.85			

SPREAD - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	4	0	4
		Nonbankrupt	0	1	1
		Total	4	1	5
		% Mis classifications = 0			
	Sample2	Bankrupt	1		1
		Nonbankrupt	2		2
		Total	3		3
		% Mis classifications = 66.67			

SPREAD - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	3	1	4
		Nonbankrupt	1	1	2
		Total	4	2	6
		% Mis classifications = 33.33			
	Sample2	Bankrupt	1	0	1
		Nonbankrupt	4	1	5
		Total	5	1	6
		% Mis classifications = 66.67			

TOTAL DEBT– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	29	45	74
		Nonbankrupt	35	16	51
		Total	64	61	125
		% Mis classifications = 64.0			
	Sample2	Bankrupt	33	30	63
		Nonbankrupt	39	23	62
		Total	72	53	125
		% Mis classifications = 55.2			

TOTAL DEBT - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	19	37	56
		Nonbankrupt	24	20	44
		Total	43	57	100
		% Mis classifications = 61.0			
	Sample2	Bankrupt	11	30	41
		Nonbankrupt	30	20	50
		Total	41	50	91
		% Mis classifications = 65.93			

TOTAL DEBT - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	10	34	44
		Nonbankrupt	26	16	42
		Total	36	50	86
		% Mis classifications = 69.76			
	Sample2	Bankrupt	9	25	34
		Nonbankrupt	24	20	44
		Total	33	45	78
		% Mis classifications = 62.82			

CURRENT LIABILITIES TO TOTAL ASSETS– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	47	27	74
		Nonbankrupt	18	34	52
		Total	65	61	126
		% Mis classifications = 35.71			
	Sample2	Bankrupt	44	22	66
		Nonbankrupt	28	32	60
		Total	72	54	126
		% Mis classifications = 39.68			

CURRENT LIABILITIES TO TOTAL ASSETS - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	26	25	51
		Nonbankrupt	18	32	50
		Total	44	57	101
		% Mis classifications = 42.57			
	Sample2	Bankrupt	23	19	42
		Nonbankrupt	18	32	50
		Total	41	51	92
		% Mis classifications = 40.21			

CURRENT LIABILITIES TO TOTAL ASSETS - Year 5

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	16	24	40
		Nonbankrupt	21	26	47
		Total	37	50	87
		% Mis classifications = 51.72			
	Sample2	Bankrupt	14	21	35
		Nonbankrupt	19	25	44
		Total	33	46	79
		% Mis classifications = 50.63			

LONGTERM LIABILITIES TO TOTAL ASSETS– Year1

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	38	37	75
		Nonbankrupt	26	24	50
		Total	64	61	125
		% Mis classifications = 50.4			
	Sample2	Bankrupt	40	23	63
		Nonbankrupt	32	30	62
		Total	72	53	125
		% Mis classifications = 44.0			

LONGTERM LIABILITIES TO TOTAL ASSETS - Year 4

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	18	32	50
		Nonbankrupt	25	25	50
		Total	43	57	100
		% Mis classifications = 57.0			
	Sample2	Bankrupt	19	23	42
		Nonbankrupt	22	27	49
		Total	41	50	91
		% Mis classifications = 49.45			

LONGTERM LIABILITIES TO TOTAL ASSETS - Year 5

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	19	28	47
		Nonbankrupt	17	22	39
		Total	36	50	86
		% Mis classifications = 52.32			
	Sample2	Bankrupt	11	17	28
		Nonbankrupt	22	28	50
		Total	33	45	78
		% Mis classifications = 50.0			

TOTAL DEBT TO TOTAL ASSETS– Year1

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	45	32	77
		Nonbankrupt	19	29	48
		Total	64	61	125
		% Mis classifications = 40.8			
	Sample2	Bankrupt	47	16	63
		Nonbankrupt	25	37	62
		Total	72	53	125
		% Mis classifications = 32.8			

TOTAL DEBT TO TOTAL ASSETS - Year 4

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	25	26	51
		Nonbankrupt	18	31	49
		Total	43	57	100
		% Mis classifications = 44.0			
	Sample2	Bankrupt	18	15	33
		Nonbankrupt	23	35	58
		Total	41	50	91
		% Mis classifications = 52.74			

TOTAL DEBT TO TOTAL ASSETS - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	15	25	40
		Nonbankrupt	21	25	46
		Total	36	50	86
		% Mis classifications = 53.48			
	Sample2	Bankrupt	13	16	29
		Nonbankrupt	20	29	49
		Total	33	45	78
		% Mis classifications = 46.15			

TOTAL DEBT PLUS PREF TO TOTAL ASSETS– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	46	32	78
		Nonbankrupt	18	29	47
		Total	64	61	125
		% Mis classifications = 40.0			
	Sample2	Bankrupt	48	15	63
		Nonbankrupt	24	37	61
		Total	72	52	124
		% Mis classifications = 31.45			

TOTAL DEBT PLUS PREF TO TOTAL ASSETS - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	26	26	52
		Nonbankrupt	17	31	48
		Total	43	57	100
		% Mis classifications = 43.0			
	Sample2	Bankrupt	17	15	32
		Nonbankrupt	24	35	59
		Total	41	50	91
		% Mis classifications = 42.85			

TOTAL DEBT PLUS PREF TO TOTAL ASSETS - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	15	25	40
		Nonbankrupt	21	25	46
		Total	36	50	86
		% Mis classifications = 53.48			
	Sample2	Bankrupt	15	14	29
		Nonbankrupt	18	31	49
		Total	33	45	78
		% Mis classifications = 41.02			

INVENTORY TO SALES– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	32	28	60
		Nonbankrupt	31	31	62
		Total	63	59	122
		% Mis classifications = 52.67			
	Sample2	Bankrupt	34	27	61
		Nonbankrupt	34	25	59
		Total	68	52	120
		% Mis classifications = 50.83			

INVENTORY TO SALES - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	22	25	47
		Nonbankrupt	21	32	53
		Total	43	57	100
		% Mis classifications = 46.0			
	Sample2	Bankrupt	21	27	48
		Nonbankrupt	18	24	42
		Total	39	51	90
		% Mis classifications = 50.0			

INVENTORY TO SALES - Year 5

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	19	28	47
		Nonbankrupt	18	20	38
		Total	37	48	85
		% Mis classifications = 54.11			
	Sample2	Bankrupt	16	24	40
		Nonbankrupt	15	22	37
		Total	31	46	77
		% Mis classifications = 50.64			

TOTAL ASSETS TO SALES– Year1

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	33	28	61
		Nonbankrupt	31	33	64
		Total	64	61	125
		% Mis classifications = 47.2			
	Sample2	Bankrupt	41	29	70
		Nonbankrupt	27	23	50
		Total	68	52	120
		% Mis classifications = 46.67			

TOTAL ASSETS TO SALES - Year 4

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	19	27	46
		Nonbankrupt	24	30	54
		Total	43	57	100
		% Mis classifications = 51.0			
	Sample2	Bankrupt	17	24	41
		Nonbankrupt	22	27	49
		Total	39	51	90
		% Mis classifications = 51.11			

TOTAL ASSETS TO SALES - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	18	24	42
		Nonbankrupt	19	26	45
		Total	37	50	87
		% Mis classifications = 49.42			
	Sample2	Bankrupt	15	21	36
		Nonbankrupt	16	25	41
		Total	31	46	77
		% Mis classifications = 48.05			

BID ASK SPREAD– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	39	11	50
		Nonbankrupt	23	51	74
		Total	62	62	124
		% Mis classifications = 27.41			
	Sample2	Bankrupt	34	8	42
		Nonbankrupt	37	46	83
		Total	71	54	125
		% Mis classifications = 36.0			

BID ASK SPREAD - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	37	30	67
		Nonbankrupt	7	29	36
		Total	44	59	103
		% Mis classifications = 35.92			
	Sample2	Bankrupt	34	15	49
		Nonbankrupt	6	36	42
		Total	40	51	91
		% Mis classifications = 20.37			

BID ASK SPREAD - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	28	19	47
		Nonbankrupt	6	32	38
		Total	34	51	85
		% Mis classifications = 29.41			
	Sample2	Bankrupt	24	11	35
		Nonbankrupt	6	35	41
		Total	30	46	76
		% Mis classifications = 22.36			

HI LO BID ASK SPREAD– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	24	33	57
		Nonbankrupt	40	30	70
		Total	64	63	127
		% Mis classifications = 57.48			
	Sample2	Bankrupt	22	24	46
		Nonbankrupt	51	30	81
		Total	73	54	127
		% Mis classifications = 59.05			

HI LO BID ASK SPREAD - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	24	42	66
		Nonbankrupt	20	17	37
		Total	44	59	103
		% Mis classifications = 60.19			
	Sample2	Bankrupt	22	26	48
		Nonbankrupt	19	25	44
		Total	41	51	92
		% Mis classifications = 48.91			

HI LO BID ASK SPREAD - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	22	34	56
		Nonbankrupt	15	18	33
		Total	37	52	89
		% Mis classifications = 55.05			
	Sample2	Bankrupt	10	19	29
		Nonbankrupt	23	27	50
		Total	33	46	79
		% Mis classifications = 53.16			

CASHFLOW TO SALES– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	58	28	86
		Nonbankrupt	8	28	36
		Total	66	56	122
		% Mis classifications = 29.5			
	Sample2	Bankrupt	44	15	59
		Nonbankrupt	18	42	60
		Total	62	57	119
		% Mis classifications = 27.73			

CASHFLOW TO SALES - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	23	21	44
		Nonbankrupt	14	33	47
		Total	37	54	91
		% Mis classifications = 38.46			
	Sample2	Bankrupt	11	13	24
		Nonbankrupt	18	40	58
		Total	29	53	82
		% Mis classifications = 37.80			

CASHFLOW TO SALES - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	19	20	39
		Nonbankrupt	9	28	37
		Total	28	48	76
		% Mis classifications = 38.15			
	Sample2	Bankrupt	8	7	15
		Nonbankrupt	12	40	52
		Total	20	47	67
		% Mis classifications = 28.35			

CASHFLOW TO TOTAL ASSETS– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	57	27	84
		Nonbankrupt	10	30	40
		Total	67	57	124
		% Mis classifications = 29.83			
	Sample2	Bankrupt	49	21	70
		Nonbankrupt	16	38	54
		Total	65	59	124
		% Mis classifications = 29.83			

CASHFLOW TO TOTAL ASSETS - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	25	19	44
		Nonbankrupt	12	36	48
		Total	37	55	92
		% Mis classifications = 33.69			
	Sample2	Bankrupt	14	11	25
		Nonbankrupt	17	43	60
		Total	31	54	85
		% Mis classifications = 32.94			

CASHFLOW TO TOTAL ASSETS - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	18	16	34
		Nonbankrupt	10	33	43
		Total	28	49	77
		% Mis classifications = 33.76			
	Sample2	Bankrupt	11	6	17
		Nonbankrupt	11	42	53
		Total	22	48	70
		% Mis classifications = 24.28			

CASHFLOW TO TOTAL DEBT– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	58	25	83
		Nonbankrupt	9	31	40
		Total	67	56	123
		% Mis classifications = 27.64			
	Sample2	Bankrupt	49	19	68
		Nonbankrupt	15	38	53
		Total	64	57	121
		% Mis classifications = 28.09			

CASHFLOW TO TOTAL DEBT - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	24	19	43
		Nonbankrupt	13	35	48
		Total	37	54	91
		% Mis classifications = 35.16			
	Sample2	Bankrupt	15	11	26
		Nonbankrupt	15	41	56
		Total	30	52	82
		% Mis classifications = 31.70			

CASHFLOW TO TOTAL DEBT - Year 5

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	17	18	35
		Nonbankrupt	11	30	41
		Total	28	48	76
		% Mis classifications = 38.15			
	Sample2	Bankrupt	11	6	17
		Nonbankrupt	10	40	50
		Total	21	46	67
		% Mis classifications = 23.88			

RETURN– Year1

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	20	42	62
		Nonbankrupt	47	14	61
		Total	67	56	123
		% Mis classifications = 72.35			
	Sample2	Bankrupt	21	48	69
		Nonbankrupt	41	10	51
		Total	62	58	120
		% Mis classifications = 74.16			

RETURN - Year 4

Procedure	Sample	Predicted	Actual		Total
			Bankrupt	Nonbankrupt	
Procedure 2	Sample1	Bankrupt	23	32	55
		Nonbankrupt	19	18	37
		Total	42	50	92
		% Mis classifications = 55.43			
	Sample2	Bankrupt	22	27	49
		Nonbankrupt	14	23	37
		Total	36	50	86
		% Mis classifications = 47.67			

RETURN - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	18	24	42
		Nonbankrupt	11	24	35
		Total	29	48	77
		% Mis classifications = 45.45			
	Sample2	Bankrupt	17	24	41
		Nonbankrupt	13	23	36
		Total	30	47	77
		% Mis classifications = 48.05			

STANDARD DEVIATION OF RETURN– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	31	20	51
		Nonbankrupt	14	33	47
		Total	45	53	98
		% Mis classifications = 34.69			
	Sample2	Bankrupt	22	17	39
		Nonbankrupt	22	34	56
		Total	44	51	95
		% Mis classifications = 41.05			

STANDARD DEVIATION OF RETURN - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	22	8	30
		Nonbankrupt	16	6	22
		Total	38	14	52
		% Mis classifications = 46.15			
	Sample2	Bankrupt	20	5	25
		Nonbankrupt	10	8	18
		Total	30	13	43
		% Mis classifications = 34.88			

STANDARD DEVIATION OF RETURN - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	10	4	14
		Nonbankrupt	6	5	11
		Total	16	9	25
		% Mis classifications = 40.0			
	Sample2	Bankrupt	5	1	6
		Nonbankrupt	8	8	16
		Total	13	9	22
		% Mis classifications = 40.90			

BETA– Year1

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	25	33	58
		Nonbankrupt	17	10	27
		Total	42	43	85
		% Mis classifications = 58.82			
	Sample2	Bankrupt	20	29	49
		Nonbankrupt	18	24	42
		Total	38	53	91
		% Mis classifications = 51.64			

BETA - Year 4

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	17	5	22
		Nonbankrupt	11	0	11
		Total	28	5	33
		% Mis classifications = 48.48			
	Sample2	Bankrupt	16	5	21
		Nonbankrupt	8	2	10
		Total	24	7	31
		% Mis classifications = 41.93			

BETA - Year 5

Procedure	Sample	Predicted	Actual Bankrupt	Actual Nonbankrupt	Total
Procedure 2	Sample1	Bankrupt	10	24	34
		Nonbankrupt	10	11	21
		Total	20	35	55
		% Mis classifications = 61.81			
	Sample2	Bankrupt	12	23	35
		Nonbankrupt	4	22	26
		Total	16	45	61
		% Mis classifications = 44.26			

2.6 Summary and Conclusions

The literature on bankruptcy prediction has focused on utilizing accounting ratios, backward-looking variables. While these have provided decent predictive power, they do not tell the whole story. To add to the literature, we have included market and microstructure variables in our analysis. These variables are forward-looking since they are derived from discounted estimates of the future. Therefore, any type of predictive process should employ variables that are focused on the future.

We find that the best performing predictors are price, standard deviation, and bid-ask spread. The market correctly signals that the future of a distressed firm is grim. However, accounting ratios still have explanatory power, namely those ratios that include working capital, net income, and current liabilities. Cash flow plays a less important role in correctly classifying distressed firms than is found in the prior literature. Therefore, our most important findings are that, while accounting ratios are still important to bankruptcy prediction, market variables need to be included for more accuracy.

The univariate analysis is a starting point in understanding how the different underlying variables behave prior to bankruptcy. However, a firm is not just one puzzle piece, but rather a sum of all of the pieces. While many of the pieces alone might not signal distress, together a very differ story is painted. Hence, we will now move on to multivariate analysis. Certain variables that did not play important roles in the univariate analysis might actually be extremely important when looking at the picture as a whole. This is where we begin the next chapter.

CHAPTER 3: MULTIVARIATE DISCIMINANT ANALYSIS

3.1 Introduction

Bankruptcy prediction has been thoroughly investigated in the literature, especially with financial ratios as predictors. The main models used in bankruptcy prediction have been discriminant analysis and logit regression. The assumption of multivariate normality of the ratios used in these models is an important one. Any significant deviation from normality will put into question any conclusions made with the models. Karels and Prakash (1987) study the financial ratios used in previous studies. The preliminary results demonstrate statistical significance of multivariate skewness and kurtosis for the ratios used in the prior studies. A set of ratios that best conforms to multivariate normality is selected and used for prediction. However, most of the ratios used are accounting ratios, while only a couple are market variables. Following the results found in essay one, a set of variables will be selected that best conforms to multivariate normality. One set will contain only accounting ratios, another will contain only market variables, and the last will contain a mixture of the two. While market variables have been previously included in bankruptcy prediction, the assumptions underlying these models have not been verified. Furthermore, microstructure variables in a study of this kind have not been included.

This study attempts to describe and distinguish these two groups. The remainder of this paper is organized as follows: Section 3.2 reviews the previous literature associated with bankruptcy prediction and multivariate discriminant analysis. Section 3.3 discusses the data used in this study. Section 3.4 describes the methodology. Section 3.5 discusses the results, and Section 3.6 summarizes and concludes.

3.2 Literature Review

The literature of bankruptcy prediction, and especially those applying multivariate discriminant analyses, is vast. The focus of most studies is the usefulness of accounting ratios in discriminating between bankrupt and non-bankrupt firms. The genesis of this methodology in bankruptcy prediction can be traced back to Altman (1968).

Altman (1968) extends the univariate analysis used for bankruptcy prediction. Employing twenty-two ratios that have been used in the prior literature, Altman finds that five ratios are best at discriminating between bankrupt and non-bankrupt firms. Even though some of these ratios performed poorly in a univariate setting, they still boosted the discriminating power of the function. The ratios are Working Capital/Total Assets, Retained Earnings/Total Assets, Earnings Before Interest and Taxes/Total Assets, Market Value of Equity/Book Value of Total Debt, and Sales/Total Assets. This analysis results in correctly classifying 94% of the bankrupt firms in the original sample, and 95% of the firms in the bankrupt and non-bankrupt samples.

Deakin (1972) extends the research done by Beaver (1968) and Altman (1968), and his results support those found in the prior literature. Blum (1974) performs a similar analysis, finding 94% accuracy one year before failure, 80% accuracy two years before failure, and 70% accuracy three to five years before failure. Most important, Type II errors occur less than Type I errors one year before bankruptcy. In agreement with Beaver (1968), Cash Flow/Total Debt is found to be the best predictor. Interestingly, a market variable included in his analysis does not enhance predictability.

Moyer (1977) applies Altman's (1968) methodology and concludes that the model does not perform as well out-of-sample, and that predictive accuracy is modest when

larger firms are included in the analysis. Re-estimating the model parameters, Moyer finds that two of the discriminating variables can be eliminated leading to better explanatory power.

Ketz (1978) tests the hypothesis that price-level variables are better at correctly classifying failed and non-failed firms than are historical accounting ratios. The R^2, overall error rates, and error rates of classifying non-failed firms are equivalent using both methods, but the price-level variables show lower error rates in misclassifying failed firms. Norton and Smith (1979) perform a similar study, but find that the two different sets of variables perform relatively equally, meaning that price-level variables do not improve the predictability of bankruptcy prediction models.

Booth (1983) employs a decomposition measure to predict financial failure and discriminate between failed and non-failed firms. The decomposition measures are total assets, total liabilities, total equities, and total balance sheet, and these measures represent the change in the balance sheet from year to year. The findings do not support the inclusion of decomposition measures in bankruptcy prediction.

Hennaway and Morris (1983) develop multivariate discriminant models each year, one to five years before bankruptcy, and also incorporate macro-level and industry-level variables/indicators. The main finding is that the models perform well one to five years before failure, which is important since earlier predictions are desirable.

Frydman et al. (1985) focus on the issues with discriminant analysis, along with other parametric models, namely the violations of the underlying assumptions. While their non-parametric model outperforms the more traditional parametric models, the discriminant analysis model still performs well.

Gombola et al. (1987) focus on the ability of Cash Flow from Operations to predict financial deterioration. Previous studies find this to be an important variable in bankruptcy prediction. Their main finding is that the Cash Flow variables' predictive ability declines over time, going from a significant to an insignificant discriminatory variable. However, Aziz et al. (1988) find that Cash Flow based models perform well in relation to the traditional models, especially three or more years prior to bankruptcy.

McGurr and DeVaney (1998) study the financial ratios and cash flow items of bankrupt and non-bankrupt retail firms. They conclude that there are three apparent biases: industry bias (different ratio levels for companies in different industries), population bias (changing population over time in Compustat, leading to a bias in older studies), and time bias (the effect of recessionary and expansionary periods on different industries). Yang et al. (1999) compare MDA to newer, more data-intensive techniques, and find that MDA still performs better in bankruptcy prediction. However, Dimitras et al. (1999) find that using rough sets to avoid some of the limiting assumptions underlying MDA provides better predictive results. Brockman and Turtle (2003) apply an options framework to bankruptcy prediction and find that this outperforms Z-scores found through MDA.

3.3 Data

The list of bankrupt firms was obtained from bankruptcydata.com. The list includes companies the filed for bankruptcy from January 1995 to December 2010. The subsample of non-bankrupt firms comes from the entire database of Compustat, consisting of firms that did not file for bankruptcy during our sample period. The

accounting ratios for all firms, bankrupt and non-bankrupt, are obtained from Compustat. The market variables for these firms were obtained from CRSP.

3.4 Methodology

As is common in the bankruptcy prediction literature, the non-bankrupt firms are selected in such a way so that firm size does not severely affect the results. Ex-ante, successful firms are expected to be larger than failing firms. Furthermore, firm success rates are highly influenced by their industry. For example, when the tech bubble was growing, any firm with a dotcom in its name benefited heavily. To mitigate this issue, it is common to select firms in such a way that size and industry factors do not distort the results.

The procedure is two-fold. First, a bankrupt firm is selected. Second, a non-bankrupt firm within the same industry with asset size closest to the bankrupt firm is selected. These two firms (the one bankrupt and the one non-bankrupt) are then stored and removed from the continuing procedure. A second bankrupt firm is selected, and the selection process is done with the remaining non-bankrupt firms. This is done for each bankrupt firm, so that in the end there are an equal number of bankrupt and non-bankrupt firms.

Before beginning the MDA, it is important to check whether or not the underlying assumptions are upheld (notably the normality assumptions and the equality of the dispersion matrices). We begin by studying the individual distribution of each ratio. To test for univariate normality, we employ the Shapiro-Wilk W test. The procedure is as follows:

H_0: The parent population is normal.

H_1: The parent population is not normal.

The procedure is as follows:

1. Let FV_{ij} be the i^{th} financial variable for the j^{th} company (i=1, 2,…,k; j=1,2,…,n), where FV_{in} and FV_{i1} are the largest and smallest ratios over all the companies in the sample.
2. Arrange the ratios in decreasing order:
    a. $FV_{i1} \leq FV_{i2} \leq \ldots \leq FV_{in}$
3. Set m=n/2 if n is even, (n-1)/2 otherwise.
4. Calculate:
    a. $b_i = a_n(FV_{in} - FV_{i1}) + \cdots + a_{n-m+1}(FV_{i,n-m+1} - FV_{im})$
    b. a_i can be found in Hahn and Shapiro (1970).
5. Calculate:
    a. $S_i^2 = \frac{1}{n}\sum_{j=1}^{n}(FV_{ij} - FV_i bar)$
6. Calculate the W-statistic:
    a. $W_i = \frac{b_i^2}{S_i^2}$ for each ratio (i=1,2,…,k).

Small values for W_i will indicate non-normality. Due to the fact that financial variables tend to more often be lognormally distributed, the same procedure will be done to the logarithm of the ratios.

Next, since an important assumption of the MDA is multivariate normality, we will test to check whether or not the set of ratios selected are multivariate normal. To do so, we employ Maridia's test of multivariate normality, which tests skewness and kurtosis

statistics. As a robustness check, the Henze-Zirkler T test is also used. The Mardia test is as follows:

Let V be a vector of p financial variables with V_r as the r^{th} element of the vector, μ as the unknown mean vector, and ∑ as the covariance-variance matrix. The test then depends on an augmentation of the univariate measures of skewness and kurtosis. The steps are as follows:

Skewness:

1. Calculate the p- sample means:
    a. $V_r bar = \frac{1}{n}\sum_{i=1}^{n} V_r^i$
    b. For any two attributes V_r and V_r', calculate the sum of squares:
        i. $S_{rr'} = \frac{1}{n}\sum_{i=1}^{n}(V_r^i - V_r bar)(V_{r'}^i - V_{r'} bar)$
    c. For any three attributes V_r, V_q, $and\ V_y$, calculate:
        i. $M_{rqy} = \frac{1}{n}\sum_{i=1}^{n}(V_r^i - V_r bar)(V_q^i - V_q bar)(V_y^i - V_y bar)$
2. Calculate the multivariate measure of skewness:
    a. $b_{1,p} = \sum_{r,q,y}\sum_{r'q'y'} S_{rr'}S_{qq'}S_{yy'}\, M_{rqy}M_{r'q'y'}$
        i. where $S_{rr'} = S_{rr'}^{-1}$.
3. Under the null hypothesis H_0: $\beta_{1,p} = 0$, the test statistic $A = 1/6n\ b_{1,p}$ will follow a chi-squared distribution with p(p+1)(p+2)/6 degrees of freedom.

Kurtosis:

1. Calculate:

$$b_{2,p} = \frac{1}{n}\sum_{i=1}^{n}[(V_r^i - V_r bar)S_{rq}(V_q^i - V_q bar)]^2 = \frac{1}{n}\sum_{i=1}^{n}(V_i - V bar)'\, S^{-1}(V_i - V bar)]^2$$

i. where $V_i = (V_{1i}, V_{2i}, \dots, V_{pi}), i = 1,2, \dots, n$ is the vector of the i[th] measure on each of the p-attributes, Vbar is the vector of sample means for the p-sample, and S^{-1} is the inverse of the sample variance-covariance matrix.

2. Under the null hypothesis $H_0: \beta_{2,p} = p(p+2)$, the test statistic $B = \frac{b_{2,p} - \beta_{2,p}}{[\frac{8p(p+2)}{n}]^{1/2}}$ will be a N(0,1) variate.

Finally, since equality of the dispersion matrix is another important assumption underlying MDA, we use Box M Test for the equality of the variance-covariance matrix.

To test for multivariate normality, we must choose sets of variables. First, we will test for multivariate normality for all accounting ratios. Second, we will do so for all market variables (this will be done four different ways, substituting different measures of the bid-ask spread). Third, we will do so for the three accounting ratios and three market variables that had the highest W statistic from the above mentioned univariate normality test; this is also done for the logarithm of the ratios/variables. Finally, the same procedure is done for the six variables (three accounting ratios and three market variables) that showed the highest predictive power from the univariate analysis performed in the previous chapter.

While certain types of MDA are better suited for certain data than others, our purpose is to comprehensively study bankruptcy prediction. Therefore, we will not limit ourselves to one model specification. When the underlying assumptions that are mentioned above are satisfied, then linear MDA is appropriate. While this is a possibility, it is highly unlikely. Quadratic MDA is one possible solution to this problem; it is useful

when the equality of the dispersion matrices is rejected. Furthermore, when the data does not prove to come from a normally distributed population (or any specified distribution), the nonparametric MDA is another solution. Given these outcomes, we will apply the analysis using the three different MDA methods.

Finally, to test that actual predictive ability of the MDA, we perform an out-of-sample test. Since we found the nonparametric MDA to perform best at correctly classifying bankrupt firms, also use it in the out-of-sample test. Using the ratios and variables from 5 years up until 2 years before bankruptcy, the nonparametric MDA model is created. Then, using this model, the predictive ability of the model is test one year before bankruptcy.

3.5 Empirical Results

We begin with the univariate normality test results (Table I). The W-statistic is used. For all the ratios, whether those of bankrupt or non-bankrupt firms, the null is rejected (i.e. the results indicate a departure from normality); all ratio statistics have p values of less (and much less in most cases) than 1%. After taking the logarithm of the ratios, the results only change for the spread variable. However, this must be taken with caution; the dataset for the spread variable is much smaller than that of the other ratios/variables. When looking at other measures of the spread, the variables are still found to be non-normal.

While univariate normality is not met, the underlying assumption for MDA requires multivariate normality. Even though the ratios and variables are not univariate normal, this does not necessarily mean that a set of the ratios are not multivariate normal.

Therefore, we test for multivariate normality for the different sets of variables mentioned above.

Table 4

Univariate normality results for Ratios : Bankrupt firms

RATIO	N	W STATISTIC	P VALUE
SHROUT	1339	0.467422	<0.0001
PRC	1331	0.718935	<0.0001
VOL	1339	0.45501	<0.0001
SPREAD	53	0.840866	<0.0001
NET INCOME TO SALES	1267	0.057279	<0.0001
NET INCOME TO TOTAL ASSETS	1327	0.480268	<0.0001
TOTAL DEBT	1313	0.260369	<0.0001
NET INCOME TO TOTAL DEBT	1310	0.289402	<0.0001
CURRENT LIABILITIES TO TOTAL ASSETS	1329	0.813787	<0.0001
LONG TERM LIABILITIES TO TOTAL ASSETS	1313	0.828406	<0.0001
TOTAL DEBT TO TOTAL ASSETS	1313	0.919367	<0.0001
TOTAL DEBT PLUS PREF TO TOTAL ASSETS	1310	0.85664	<0.0001
CASH TO TOTAL ASSETS	52	0.794427	<0.0001
QUICK ASSETS TO TOTAL ASSETS	1315	0.942621	<0.0001
WORKING CAPITAL TO TOTAL ASSETS	1329	0.954237	<0.0001
CASH TO CURRENT LIABILITIES	52	0.77012	<0.0001
QUICK ASSETS TO CURRENT LIABILITIES	1315	0.50031	<0.0001
CURRENT RATIO	1329	0.519753	<0.0001
CASH TO SALES	46	0.738928	<0.0001
INVENTORY TO SALES	1248	0.044135	<0.0001
QUICK ASSETS TO SALES	1248	0.034549	<0.0001

CURRENT ASSETS TO SALES	1262	0.042619	<0.0001
WORKING CAPITAL TO SALES	1262	0.040176	<0.0001
TOTAL ASSETS TO SALES	1263	0.053942	<0.0001
BID ASK SPREAD	1297	0.802743	<0.0001
HI LO BID ASK SPREAD	1339	0.274931	<0.0001
STANDARD DEVIATION OF RETURN	1116	0.4026	<0.0001
BETA	892	0.378702	<0.0001

Univariate normality results for Logarithmic Ratios : Bankrupt firms

RATIO	N	W STATISTIC	P VALUE
SHROUT	1339	0.972232	<0.0001
PRC	1278	0.981476	<0.0001
VOL	1337	0.993966	<0.0001
SPREAD	53	0.94208	0.0125
NET INCOME TO SALES	493	0.970445	<0.0001
NET INCOME TO TOTAL ASSETS	497	0.969024	<0.0001
TOTAL DEBT	1313	0.975077	<0.0001
NET INCOME TO TOTAL DEBT	482	0.98526	<0.0001
CURRENT LIABILITIES TO TOTAL ASSETS	1329	0.989039	<0.0001
LONG TERM LIABILITIES TO TOTAL ASSETS	1198	0.909605	<0.0001
TOTAL DEBT TO TOTAL ASSETS	1313	0.914667	<0.0001
TOTAL DEBT PLUS PREF TO TOTAL ASSETS	1310	0.933872	<0.0001
CASH TO TOTAL ASSETS	52	0.895725	0.0003
QUICK ASSETS TO TOTAL ASSETS	1315	0.949774	<0.0001
WORKING CAPITAL TO TOTAL ASSETS	943	0.841992	<0.0001
CASH TO CURRENT LIABILITIES	52	0.94103	0.0123

QUICK ASSETS TO CURRENT LIABILITIES	1315	0.995243	0.0004
CURRENT RATIO	1329	0.993424	<0.0001
CASH TO SALES	46	0.91722	0.0030
INVENTORY TO SALES	945	0.945348	<0.0001
QUICK ASSETS TO SALES	1248	0.927727	<0.0001
CURRENT ASSETS TO SALES	1262	0.884118	<0.0001
WORKING CAPITAL TO SALES	901	0.95849	<0.0001
TOTAL ASSETS TO SALES	1263	0.858276	<0.0001
BID ASK SPREAD	1269	0.96145	<0.0001
HI LO BID ASK SPREAD	1283	0.992995	<0.0001
STANDARD DEVIATION OF RETURN	1116	0.972684	<0.0001
BETA	588	0.960947	<0.0001

Univariate normality results for Ratios : Nonbankrupt firms

RATIO	N	W STATISTIC	P VALUE
SHROUT	1611	0.205651	<0.0001
PRC	1601	0.865639	<0.0001
VOL	1605	0.33087	<0.0001
SPREAD	26	0.88319	0.0067
NET INCOME TO SALES	1559	0.051582	<0.0001
NET INCOME TO TOTAL ASSETS	1584	0.234626	<0.0001
TOTAL DEBT	1541	0.175537	<0.0001
NET INCOME TO TOTAL DEBT	1540	0.571895	<0.0001
CURRENT LIABILITIES TO TOTAL ASSETS	1558	0.505346	<0.0001
LONG TERM LIABILITIES TO TOTAL ASSETS	1541	0.843893	<0.0001

TOTAL DEBT TO TOTAL ASSETS	1541	0.727685	<0.0001
TOTAL DEBT PLUS PREF TO TOTAL ASSETS	1540	0.64565	<0.0001
CASH TO TOTAL ASSETS	1175	0.799459	<0.0001
QUICK ASSETS TO TOTAL ASSETS	1540	0.955474	<0.0001
WORKING CAPITAL TO TOTAL ASSETS	1558	0.749972	<0.0001
CASH TO CURRENT LIABILITIES	1152	0.548243	<0.0001
QUICK ASSETS TO CURRENT LIABILITIES	1540	0.570288	<0.0001
CURRENT RATIO	1558	0.636071	<0.0001
CASH TO SALES	1165	0.067674	<0.0001
INVENTORY TO SALES	1529	0.43067	<0.0001
QUICK ASSETS TO SALES	1511	0.0645	<0.0001
CURRENT ASSETS TO SALES	1529	0.064764	<0.0001
WORKING CAPITAL TO SALES	1529	0.066057	<0.0001
TOTAL ASSETS TO SALES	1558	0.073278	<0.0001
BID ASK SPREAD	1597	0.418527	<0.0001
HI LO BID ASK SPREAD	1605	0.534956	<0.0001
STANDARD DEVIATION OF RETURN	1337	0.149911	<0.0001
BETA	1287	0.527272	<0.0001

Univariate normality results for Logarithmic Ratios : Nonbankrupt firms

RATIO	N	W STATISTIC	P VALUE
SHROUT	1611	0.960442	<0.0001
PRC	1575	0.955702	<0.0001
VOL	1605	0.990826	<0.0001
SPREAD	26	0.950027	0.2322

NET INCOME TO SALES	1052	0.954629	<0.0001
NET INCOME TO TOTAL ASSETS	1054	0.94683	<0.0001
TOTAL DEBT	1541	0.971175	<0.0001
NET INCOME TO TOTAL DEBT	1030	0.976557	<0.0001
CURRENT LIABILITIES TO TOTAL ASSETS	1558	0.934419	<0.0001
LONG TERM LIABILITIES TO TOTAL ASSETS	1469	0.897339	<0.0001
TOTAL DEBT TO TOTAL ASSETS	1541	0.955337	<0.0001
TOTAL DEBT PLUS PREF TO TOTAL ASSETS	1540	0.956655	<0.0001
CASH TO TOTAL ASSETS	1161	0.953687	<0.0001
QUICK ASSETS TO TOTAL ASSETS	1540	0.934988	<0.0001
WORKING CAPITAL TO TOTAL ASSETS	1334	0.860201	<0.0001
CASH TO CURRENT LIABILITIES	1138	0.976883	<0.0001
QUICK ASSETS TO CURRENT LIABILITIES	1540	0.9697	<0.0001
CURRENT RATIO	1558	0.967229	<0.0001
CASH TO SALES	1151	0.963218	<0.0001
INVENTORY TO SALES	1204	0.93087	<0.0001
QUICK ASSETS TO SALES	1511	0.870741	<0.0001
CURRENT ASSETS TO SALES	1529	0.833411	<0.0001
WORKING CAPITAL TO SALES	1312	0.927458	<0.0001
TOTAL ASSETS TO SALES	1558	0.874383	<0.0001
BID ASK SPREAD	1577	0.910491	<0.0001
HI LO BID ASK SPREAD	1578	0.990328	<0.0001
STANDARD DEVIATION OF RETURN	1337	0.958347	<0.0001
BETA	612	0.979232	<0.0001

As seen in Table 5, for the most part, all variables and ratios, whether for bankrupt or nonbankrupt firms, display results indicating that these samples are multivariate nonnormal. The null is rejected for almost all sets of variables. This has been documented in the literature [Karels and Prakash (1987)] as a major problem with interpreting the results of other MDA results in the past. Multivariate normality is an important assumption underpinning these types of models.

Furthermore, the equality of the variance-covariance matrix is another important assumption. It is often violated. We find similar results (Table 6). While certain subgroups display equality of the dispersion matrices (null not rejected), these results must be taken with caution; the subgroups that have equal dispersion matrices suffer from small sample bias. When looking at the larger subgroups (i.e. all of the market variables, and the two subgroups of the top three market variables and accounting ratios from the univariate analysis in Chapter 2), it is evident that the Variance-Covariance matrices are not equivalent. Therefore, linear MDA is not appropriate. Quadratic MDA has been used as a solution the issue of non-equal dispersion matrices. However, we also have to deal with the fact that the variables are not multivariate normal. Since our purpose is a comprehensive study of bankruptcy prediction, we will employ linear, quadratic, and nonparametric MDA, and then compare the results of each.

Since accounting ratios alone in bankruptcy prediction have been exhaustively used in the prior literature, we will begin by looking at the market variables, and then the mix of the two. This is the crux of the analysis. The analysis is performed for years one through five before bankruptcy, but we will focus on year one and year five. The market

variables used are shares outstanding, price, volume, and two different measures of the bid-ask spread.

Table 5

Multivariate Normality Results for Ratios : Bankrupt firms

Accounting variables

Test	Statistic	P value
Mardia Skewness	1459	<.0001
Mardia Kurtosis	1.89	0.0582
Henze-Zirkler T	47.19	<.0001
Market variables		
Test	Statistic	P value
Mardia Skewness	73699	<.0001
Mardia Kurtosis	1069	<.0001
Henze-Zirkler T	107.5	<.0001
Market variables without spread and hi lo bid ask spread		
=Test	Statistic	P value
Mardia Skewness	19073	<.0001
Mardia Kurtosis	377.3	<.0001
Henze-Zirkler T	65.33	<.0001
Market variables without spread and bid ask spread		
Test	Statistic	P value
Mardia Skewness	75729	<.0001
Mardia Kurtosis	1309	<.0001
Henze-Zirkler T	73.90	<.0001
Market variables without bid ask spread and hi lo bid ask spread		
Test	Statistic	P value
Mardia Skewness	296.8	<.0001
Mardia Kurtosis	15.78	<.0001
Henze-Zirkler T	14.28	<.0001

Top 3 Account and Market variables

Test	Statistic	P value
Mardia Skewness	8470	<.0001
Mardia Kurtosis	117.6	<.0001
Henze-Zirkler T	88.27	<.0001

Top 3 account and market logarithmic variables

Test	Statistic	P value
Mardia Skewness	74521	<.0001
Mardia Kurtosis	897.8	<.0001
Henze-Zirkler T	135.8	<.0001

Variables (Price, Standard deviation, bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

Test	Statistic	P value
Mardia Skewness	93575	<.0001
Mardia Kurtosis	1026	<.0001
Henze-Zirkler T	104.2	<.0001

Variables (Price, Standard deviation, hi lo bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

Test	Statistic	P value
Mardia Skewness	134E3	<.0001
Mardia Kurtosis	1517	<.0001
Henze-Zirkler T	123.7	<.0001

Multivariate Normality Results for Ratios : Non bankrupt firms

Accounting variables

Test	Statistic	P value
Mardia Skewness	729E3	<.0001
Mardia Kurtosis	3166	<.0001
Henze-Zirkler T	4597	<.0001

Market variables

Test	Statistic	P value
Mardia Skewness	45305	<.0001
Mardia Kurtosis	791.3	<.0001
Henze-Zirkler T	119.8	<.0001

Market variables without spread and hi lo bid ask spread

Test	Statistic	P value
Mardia Skewness	42249	<.0001
Mardia Kurtosis	674.8	<.0001
Henze-Zirkler T	74.18	<.0001

Market variables without spread and bid ask spread

Test	Statistic	P value
Mardia Skewness	29502	<.0001
Mardia Kurtosis	653.8	<.0001
Henze-Zirkler T	76.50	<.0001

Market variables without bid ask spread and hi lo bid ask spread

Test	Statistic	P value
Mardia Skewness	45.83	0.0008
Mardia Kurtosis	1.28	0.2010
Henze-Zirkler T	3.17	0.0015

Top 3 Account and Market variables

Test	Statistic	P value
Mardia Skewness	27625	<.0001
Mardia Kurtosis	408.0	<.0001
Henze-Zirkler T	94.18	<.0001

Top 3 Account and Market logarithmic variables

Test	Statistic	P value
Mardia Skewness	34570	<.0001
Mardia Kurtosis	482.8	<.0001
Henze-Zirkler T	165.0	<.0001

Variables (Price, Standard deviation, bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

Test	Statistic	P value
Mardia Skewness	169E3	<.0001
Mardia Kurtosis	1674	<.0001
Henze-Zirkler T	131.1	<.0001

Variables (Price, Standard deviation, hi lo bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

Test	Statistic	P value
Mardia Skewness	157E3	<.0001
Mardia Kurtosis	1706	<.0001
Henze-Zirkler T	131.5	<.0001

For the linear MDA, one year before bankruptcy, 16% of actual bankrupt firms are erroneously labeled as non-bankrupt, whereas 38% of non-bankrupt firms are erroneously labeled as bankrupt. Five years before bankruptcy the error rates are 28% and 10%, respectively. Interestingly, the misclassification rate for bankrupt firms decreases as bankruptcy looms, but the opposite occurs for nonbankrupt firms. For the quadratic MDA, one year before bankruptcy, 10% of actual bankrupt firms are erroneously labeled as non-bankrupt, whereas 57% of non-bankrupt firms are erroneously labeled as bankrupt. Five years before bankruptcy the error rates are 8% and 61%, respectively. Here, both misclassification rates decrease as bankruptcy looms. For the nonparametric MDA, one year before bankruptcy, 12% of actual bankrupt firms are erroneously labeled as non-bankrupt, whereas 15% of non-bankrupt firms are erroneously labeled as bankrupt. Five years before bankruptcy the error rates are 25% and 3%, respectively. These results are similar, but lower in magnitude, to the linear MDA.

For the set of only market variables, the quadratic MDA performs the best at correctly classifying bankrupt firms, whereas the nonparametric MDA performs best at correctly classifying nonbankrupt firms. Overall, the total error rates are lowest for the nonparametric MDA (misclassification rates for bankrupt as well as those of nonbankrupt firms). While this form of MDA has not been widely used throughout the literature, it is consistent and a continuation of prior research. As noted earlier, the assumptions underlying the parametric models are almost always violated. Therefore, it should come as no surprise that this (nonparametric) version of the model performs well.

The next two sets of variables used consist of those variables that performed best in the univariate analysis. The first set of these two contains price, standard deviation,

bid-ask spread, net income to total sales, working capital to total assets, and current liabilities to total assets. For the linear MDA, one year before bankruptcy, 30% of actual bankrupt firms are erroneously labeled as non-bankrupt, whereas 12% of non-bankrupt firms are erroneously labeled as bankrupt. Five years before bankruptcy the error rates are 22% and 13%, respectively. While the misclassification rates of the bankrupt firms slightly worsen as bankruptcy looms, those of nonbankrupt firms stay relatively flat. For the quadratic MDA, one year before bankruptcy, 45% of actual bankrupt firms are erroneously labeled as non-bankrupt, whereas 8% of non-bankrupt

Table 6

Results of Box's M Test for Equality of Variance-Covariance Matrix

Accounting variables

Year	Bankruptcy	N	Chi-square Statistic	P value
Year 1	Bankrupt	6	0.000000	1.0000
	Nonbankrupt	95		
Year 2	Bankrupt	6	0.000000	1.0000
	Nonbankrupt	93		
Year 3	Bankrupt	2	0.000000	1.0000
	Nonbankrupt	86		
Year 4	Bankrupt	-	-	-
	Nonbankrupt			
Year 5	Bankrupt	-	-	-
	Nonbankrupt			

Market variables

Year	Bankruptcy	N	Chi-square Statistic	P value
Year 1	Bankrupt	133	967.451325	<.0001
	Nonbankrupt	116		
Year 2	Bankrupt	128	607.058492	<.0001
	Nonbankrupt	112		

Year 3	Bankrupt	107	515.281454	<.0001
	Nonbankrupt	111		
Year 4	Bankrupt	84	567.979735	<.0001
	Nonbankrupt	110		
Year 5	Bankrupt	64	316.579924	<.0001
	Nonbankrupt	97		

Market variables without spread and hi lo bid ask spread

Year	Bankruptcy	N	Chi-square Statistic	P value
Year 1	Bankrupt	133	629.701533	<.0001
	Nonbankrupt	116		
Year 2	Bankrupt	128	547.342903	<.0001
	Nonbankrupt	112		
Year 3	Bankrupt	107	504.123756	<.0001
	Nonbankrupt	111		
Year 4	Bankrupt	84	469.823469	<.0001
	Nonbankrupt	110		
Year 5	Bankrupt	64	311.466705	<.0001
	Nonbankrupt	97		

Market variables without spread and bid ask spread

Year	Bankruptcy	N	Chi-square Statistic	P value
Year 1	Bankrupt	136	935.473575	<.0001
	Nonbankrupt	116		
Year 2	Bankrupt	129	584.366113	<.0001
	Nonbankrupt	112		
Year 3	Bankrupt	108	510.771170	<.0001
	Nonbankrupt	111		

Year 4	Bankrupt	85	507.031076	<.0001
	Nonbankrupt	110		
Year 5	Bankrupt	70	247.083392	<.0001
	Nonbankrupt	98		

Market variables without bid ask spread and hi lo bid ask spread

Year	Bankruptcy	N	Chi-square Statistic	P value
Year 1	Bankrupt	10	21.306626	0.0191
	Nonbankrupt	3		
Year 2	Bankrupt	6	15.350371	0.1198
	Nonbankrupt	6		
Year 3	Bankrupt	7	15.637599	0.1105
	Nonbankrupt	3		
Year 4	Bankrupt	7	-	-
	Nonbankrupt	1		
Year 5	Bankrupt	9	19.382668	0.0357
	Nonbankrupt	3		

Top 3 Account and Market variables

Year	Bankruptcy	N	Chi-square Statistic	P value
Year 1	Bankrupt	7	45.947752	0.0013
	Nonbankrupt	97		
Year 2	Bankrupt	7	45.432227	0.0015
	Nonbankrupt	93		
Year 3	Bankrupt	3	0.000000	1.0000
	Nonbankrupt	87		
Year 4	Bankrupt	-	-	-
	Nonbankrupt			
Year 5	Bankrupt	-	-	-
	Nonbankrupt			

Top 3 Account and Market logarithmic variables

Year	Bankruptcy	N	Chi-square Statistic	P value
Year 1	Bankrupt	4	43.532931	0.0027
	Nonbankrupt	78		
Year 2	Bankrupt	3	0.000000	1.0000
	Nonbankrupt	77		
Year 3	Bankrupt	1	-	-
	Nonbankrupt	74		
Year 4	Bankrupt	-	-	-
	Nonbankrupt			
Year 5	Bankrupt	-	-	-
	Nonbankrupt			

Variables (Price, Standard deviation, bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

Year	Bankruptcy	N	Chi-square Statistic	P value
Year 1	Bankrupt	85	898.519782	<.0001
	Nonbankrupt	99		
Year 2	Bankrupt	95	445.264189	<.0001
	Nonbankrupt	106		
Year 3	Bankrupt	74	173.135756	<.0001
	Nonbankrupt	99		
Year 4	Bankrupt	66	391.112753	<.0001
	Nonbankrupt	24		
Year 5	Bankrupt	27	177.245746	<.0001
	Nonbankrupt	16		

Variables (Price, Standard deviation, hi lo bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

Year	Bankruptcy	N	Chi-square Statistic	P value
Year 1	Bankrupt	86	1159.435684	<.0001
	Nonbankrupt	99		
Year 2	Bankrupt	95	435.487169	<.0001
	Nonbankrupt	106		
Year 3	Bankrupt	75	182.030581	<.0001
	Nonbankrupt	99		
Year 4	Bankrupt	66	380.104350	<.0001
	Nonbankrupt	24		
Year 5	Bankrupt	29	163.480053	<.0001
	Nonbankrupt	16		

firms are erroneously labeled as bankrupt. Five years before bankruptcy the error rates are 33% and 0%, respectively. The misclassification rates for bankrupt firms are surprisingly high. For the nonparametric MDA, one year before bankruptcy, 20% of actual bankrupt firms are erroneously labeled as non-bankrupt, whereas 10% of non-bankrupt firms are erroneously labeled as bankrupt. Five years before bankruptcy the error rates are 11% and 25%, respectively.

For this first set of mixed accounting ratios and market variables, the nonparametric MDA is most accurate at classifying bankrupt firms as such, but this set is better at correctly classifying nonbankrupt firms with the use of the quadratic MDA. Unfortunately, the quadratic MDA has very high misclassification rates for bankrupt firms. Therefore, again, overall accuracy is mostly best with the nonparametric MDA, and is consistent with the violations of the underlying assumptions tested above.

The second set of these two contains price, standard deviation, high-low bid-ask spread, net income to total sales, working capital to total assets, and current liabilities to total assets. For the linear MDA, one year before bankruptcy, 28% of actual bankrupt firms are erroneously labeled as non-bankrupt, whereas 14% of non-bankrupt firms are erroneously labeled as bankrupt. Five years before bankruptcy the error rates are 22% and 13%, respectively. This is similar to the first 'mixed' set. For the quadratic MDA, one year before bankruptcy, 54% of actual bankrupt firms are erroneously labeled as non-bankrupt, whereas 7% of non-bankrupt firms are erroneously labeled as bankrupt. Five years before bankruptcy the error rates are 59% and 0%, respectively. This is also consistent with the first 'mixed' set, but the misclassification rates for bankrupt firms are even higher. For the nonparametric MDA, one year before bankruptcy, 24% of actual

bankrupt firms are erroneously labeled as non-bankrupt, whereas 9% of non-bankrupt firms are erroneously labeled as bankrupt. Five years before bankruptcy the error rates are 21% and 31%, respectively.

For this last set of accounting ratios and market variables, the nonparametric MDA slightly outperforms the linear MDA at correctly classifying bankrupt firms, whereas the

Table 7

Results of Linear Discriminant Analysis : Accounting variables

YEAR 1

Observations	101	DF Total	100
Variables	17	DF Within Classes	99
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	6	6.0000	0.059406	0.500000
Nonbankrupt	Nonbankrupt	95	95.0000	0.940594	0.500000

Pooled Covariance Matrix Information

Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
17	-22.67893

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	11.07153
Nonbankrupt	11.07153	0

LINEAR DISCRIMINANT FUNCTION

Variable	Bankrupt	Nonbankrupt
Constant	-23.89413	-11.26707
M_NETINCOMETOSALES	4.75443	1.30017
M_NETINCOMETOTOTALASSETS	-0.52603	20.53297
M_TOTALDEBT	0.0000126	0.0000354
M_NETINCOMETOTOTALDEBT	2.04585	-0.23351
M_CURLIABTOTOTASSET	83.15026	54.41938
M_LTLIABTOTOTASSET	81.27229	45.39088
M_TOTDEBTPLUSPREFTOTOTASSET	-54.09291	-28.20442
M_WCTOTOTALASSETS	14.38336	15.48818
M_QASSETSTOCURLIABILITIES	5.48194	4.43071
M_CURRENTRATIO	0.79798	0.12866
M_INVENTORYTOSALES	6.26052	3.77308
M_QUICKASSETSTOSALES	2.67253	-0.27784
M_WORKINGCAPITALTOSALES	-7.14631	-3.34170
M_TOTALASSETSTOSALES	0.27541	0.43231
M_CASHTOTOTALASSETS	8.50860	4.37690
M_CASHTOCURLIABILITIES	-6.49114	-4.81007
M_CASHTOSALES	5.16078	4.11512

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	3 50.00	3 50.00	6 100.00
Nonbankrupt	3 3.16	92 96.84	95 100.00
Total	6 5.94	95 94.06	101 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.5000	0.0316	0.2658
Priors	0.5000	0.5000	

Results of Linear Discriminant Analysis : Market variables

YEAR 1

Observations	249	DF Total	248
Variables	5	DF Within Classes	247
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	133	133.0000	0.534137	0.500000
Nonbankrupt	Nonbankrupt	116	116.0000	0.465863	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
5	54.25902

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	1.10199
Nonbankrupt	1.10199	0

LINEAR DISCRIMINANT FUNCTION

Linear Discriminant Function for BANKRUPTCY		
Variable	Bankrupt	Nonbankrupt
Constant	-0.70287	-1.04106
M_SHROUT	-1.1535E-6	-1.5762E-6
M_PRC	0.04253	0.12219
M_VOL	1.37506E-6	1.99419E-6
M_BIDASKSPREAD	8.49887	4.35015
M_HILOBIDASKSPREAD	0.01103	-0.06242

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	112	21	133
	84.21	15.79	100.00
Nonbankrupt	44	72	116
	37.93	62.07	100.00
Total	156	93	249
	62.65	37.35	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.1579	0.3793	0.2686
Priors	0.5000	0.5000	

YEAR 4

Observations	194	DF Total	193
Variables	5	DF Within Classes	192
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	84	84.0000	0.432990	0.500000
Nonbankrupt	Nonbankrupt	110	110.0000	0.567010	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
5	53.44970

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	2.23491
Nonbankrupt	2.23491	0

LINEAR DISCRIMINANT FUNCTION

Linear Discriminant Function for BANKRUPTCY		
Variable	Bankrupt	Nonbankrupt
Constant	-1.81313	-1.10490
M_SHROUT	-8.6769E-7	-6.0896E-7
M_PRC	0.03938	0.08833
M_VOL	1.12428E-6	8.52787E-7
M_BIDASKSPREAD	12.12005	3.11058
M_HILOBIDASKSPREAD	0.02012	0.04323

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	61 72.62	23 27.38	84 100.00
Nonbankrupt	11 10.00	99 90.00	110 100.00
Total	72 37.11	122 62.89	194 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.2738	0.1000	0.1869
Priors	0.5000	0.5000	

YEAR 5

Observations	161	DF Total	160
Variables	5	DF Within Classes	159
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	64	64.0000	0.397516	0.500000
Nonbankrupt	Nonbankrupt	97	97.0000	0.602484	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
5	51.76772

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	2.47216
Nonbankrupt	2.47216	0

LINEAR DISCRIMINANT FUNCTION

Linear Discriminant Function for BANKRUPTCY		
Variable	Bankrupt	Nonbankrupt
Constant	-2.04668	-1.02227
M_SHROUT	3.84133E-8	2.49029E-7
M_PRC	0.03473	0.06832
M_VOL	3.69855E-7	3.78623E-7
M_BIDASKSPREAD	13.64273	3.33147
M_HILOBIDASKSPREAD	0.08978	0.13395

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	46 71.88	18 28.13	64 100.00
Nonbankrupt	10 10.31	87 89.69	97 100.00
Total	56 34.78	105 65.22	161 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.2813	0.1031	0.1922
Priors	0.5000	0.5000	

Results of Linear Discriminant Analysis : Market variables without spread and hi lo bid ask spread

YEAR 1

Observations	249	DF Total	248
Variables	4	DF Within Classes	247
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	133	133.0000	0.534137	0.500000
Nonbankrupt	Nonbankrupt	116	116.0000	0.465863	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
4	50.68621

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	0.90985
Nonbankrupt	0.90985	0

LINEAR DISCRIMINANT FUNCTION

Linear Discriminant Function for BANKRUPTCY		
Variable	Bankrupt	Nonbankrupt
Constant	-0.70070	-0.97167
M_SHROUT	-1.1779E-6	-1.4379E-6
M_PRC	0.04544	0.10574
M_VOL	1.38777E-6	1.92228E-6
M_BIDASKSPREAD	8.55784	4.01632

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	110	23	133
	82.71	17.29	100.00
Nonbankrupt	45	71	116
	38.79	61.21	100.00
Total	155	94	249
	62.25	37.75	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.1729	0.3879	0.2804
Priors	0.5000	0.5000	

YEAR 4

Observations	194	DF Total	193
Variables	4	DF Within Classes	192
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	84	84.0000	0.432990	0.500000
Nonbankrupt	Nonbankrupt	110	110.0000	0.567010	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
4	50.74589

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	2.22693
Nonbankrupt	2.22693	0

LINEAR DISCRIMINANT FUNCTION

Linear Discriminant Function for BANKRUPTCY		
Variable	Bankrupt	Nonbankrupt
Constant	-1.81011	-1.09094
M_SHROUT	-8.7659E-7	-6.2809E-7
M_PRC	0.04186	0.09366
M_VOL	1.12116E-6	8.46076E-7
M_BIDASKSPREAD	12.15603	3.18789

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	61 72.62	23 27.38	84 100.00
Nonbankrupt	11 10.00	99 90.00	110 100.00
Total	72 37.11	122 62.89	194 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.2738	0.1000	0.1869
Priors	0.5000	0.5000	

YEAR 5

Observations	161	DF Total	160
Variables	4	DF Within Classes	159
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	64	64.0000	0.397516	0.500000
Nonbankrupt	Nonbankrupt	97	97.0000	0.602484	0.500000

Pooled Covariance Matrix Information

Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
4	50.22446

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	2.46303
Nonbankrupt	2.46303	0

LINEAR DISCRIMINANT FUNCTION

Linear Discriminant Function for BANKRUPTCY

Variable	Bankrupt	Nonbankrupt
Constant	-2.02782	-0.98029
M_SHROUT	-5.2201E-7	-5.8711E-7
M_PRC	0.04399	0.08213
M_VOL	8.31508E-7	1.06741E-6
M_BIDASKSPREAD	13.69023	3.40235

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	46	18	64
	71.88	28.13	100.00
Nonbankrupt	10	87	97
	10.31	89.69	100.00
Total	56	105	161
	34.78	65.22	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.2813	0.1031	0.1922
Priors	0.5000	0.5000	

Results of Linear Discriminant Analysis : Market variables without spread and bid ask spread

YEAR 1

Observations	252	DF Total	251
Variables	4	DF Within Classes	250
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	136	136.0000	0.539683	0.500000
Nonbankrupt	Nonbankrupt	116	116.0000	0.460317	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
4	58.41133

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	0.86000
Nonbankrupt	0.86000	0

LINEAR DISCRIMINANT FUNCTION

Linear Discriminant Function for BANKRUPTCY		
Variable	Bankrupt	Nonbankrupt
Constant	-0.15620	-0.90788
M_SHROUT	-6.0381E-7	-1.3142E-6
M_PRC	0.03592	0.12008
M_VOL	6.70847E-7	1.65622E-6
M_HILOBIDASKSPREAD	0.02972	-0.05339

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	115	21	136
	84.56	15.44	100.00
Nonbankrupt	53	63	116
	45.69	54.31	100.00
Total	168	84	252
	66.67	33.33	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.1544	0.4569	0.3057
Priors	0.5000	0.5000	

YEAR 4

Observations	195	DF Total	194
Variables	4	DF Within Classes	193
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	85	85.0000	0.435897	0.500000
Nonbankrupt	Nonbankrupt	110	110.0000	0.564103	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
4	57.29326

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	0.53979
Nonbankrupt	0.53979	0

LINEAR DISCRIMINANT FUNCTION

Linear Discriminant Function for BANKRUPTCY		
Variable	Bankrupt	Nonbankrupt
Constant	-0.25703	-1.00358
M_SHROUT	3.21477E-7	-3.079E-7
M_PRC	0.04342	0.08958
M_VOL	-5.4745E-7	4.30144E-7
M_HILOBIDASKSPREAD	0.05049	0.05113

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	67	18	85
	78.82	21.18	100.00
Nonbankrupt	58	52	110
	52.73	47.27	100.00
Total	125	70	195
	64.10	35.90	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.2118	0.5273	0.3695
Priors	0.5000	0.5000	

YEAR 5

Observations	168	DF Total	167
Variables	4	DF Within Classes	166
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	70	70.0000	0.416667	0.500000
Nonbankrupt	Nonbankrupt	98	98.0000	0.583333	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
4	55.60270

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	0.48330
Nonbankrupt	0.48330	0

LINEAR DISCRIMINANT FUNCTION

Linear Discriminant Function for BANKRUPTCY		
Variable	Bankrupt	Nonbankrupt
Constant	-0.23238	-0.89786
M_SHROUT	9.80841E-7	4.47579E-7
M_PRC	0.03036	0.06769
M_VOL	-9.1498E-7	1.15496E-7
M_HILOBIDASKSPREAD	0.11001	0.13359

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	55	15	70
	78.57	21.43	100.00
Nonbankrupt	45	53	98
	45.92	54.08	100.00
Total	100	68	168
	59.52	40.48	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.2143	0.4592	0.3367
Priors	0.5000	0.5000	

Results of Linear Discriminant Analysis : Market variables without bid ask spread and hi lo bid ask spread

YEAR 1

Observations	13	DF Total	12
Variables	4	DF Within Classes	11
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	10	10.0000	0.769231	0.500000
Nonbankrupt	Nonbankrupt	3	3.0000	0.230769	0.500000

Pooled Covariance Matrix Information

Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
4	32.02790

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	4.38366
Nonbankrupt	4.38366	0

LINEAR DISCRIMINANT FUNCTION

Linear Discriminant Function for BANKRUPTCY		
Variable	Bankrupt	Nonbankrupt
Constant	-2.76775	-2.96839
M_SHROUT	0.0004948	0.0002658
M_PRC	0.11450	0.09712
M_VOL	0.0005243	-0.0002326
M_SPREAD	3.30951	9.65757

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	9 90.00	1 10.00	10 100.00
Nonbankrupt	0 0.00	3 100.00	3 100.00
Total	9 69.23	4 30.77	13 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.1000	0.0000	0.0500
Priors	0.5000	0.5000	

YEAR 4

Observations	8	DF Total	7
Variables	4	DF Within Classes	6
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	7	7.0000	0.875000	0.500000
Nonbankrupt	Nonbankrupt	1	1.0000	0.125000	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
4	32.64361

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	20.01507
Nonbankrupt	20.01507	0

LINEAR DISCRIMINANT FUNCTION

Linear Discriminant Function for BANKRUPTCY		
Variable	Bankrupt	Nonbankrupt
Constant	-15.70441	-0.73522
M_SHROUT	0.00193	0.0003658
M_PRC	-6.69821	-1.27927
M_VOL	-0.0009417	-0.0001405
M_SPREAD	29.72955	6.22165

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	7 100.00	0 0.00	7 100.00
Nonbankrupt	0 0.00	1 100.00	1 100.00
Total	7 87.50	1 12.50	8 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0000	0.0000
Priors	0.5000	0.5000	

YEAR 5

Observations	12	DF Total	11
Variables	4	DF Within Classes	10
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	9	9.0000	0.750000	0.500000
Nonbankrupt	Nonbankrupt	3	3.0000	0.250000	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
4	35.50994

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	1.97567
Nonbankrupt	1.97567	0

LINEAR DISCRIMINANT FUNCTION

Linear Discriminant Function for BANKRUPTCY		
Variable	Bankrupt	Nonbankrupt
Constant	-3.34527	-0.90619
M_SHROUT	0.0000820	0.0000611
M_PRC	-0.13147	-0.02655
M_VOL	0.0001999	0.0000167
M_SPREAD	10.97710	6.06596

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	6 66.67	3 33.33	9 100.00
Nonbankrupt	1 33.33	2 66.67	3 100.00
Total	7 58.33	5 41.67	12 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.3333	0.3333	0.3333
Priors	0.5000	0.5000	

Results of Linear Discriminant Analysis : Top 3 Account and Market variables

YEAR 1

Observations	104	DF Total	103
Variables	6	DF Within Classes	102
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	7	7.0000	0.067308	0.500000
Nonbankrupt	Nonbankrupt	97	97.0000	0.932692	0.500000

Pooled Covariance Matrix Information

Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
6	-10.80012

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	1.21252
Nonbankrupt	1.21252	0

LINEAR DISCRIMINANT FUNCTION

Variable	Bankrupt	Nonbankrupt
Constant	-6.55211	-5.22930
M_QUICKASSETSTOTOTALASSTS	16.80650	15.92397
M_LTLIABTOTOTASSET	12.56471	10.39807
M_CASHTOTOTALASSETS	-2.63099	-3.59411
M_PRC	-0.01314	0.09108
M_HILOBIDASKSPREAD	0.87001	0.12567
M_BIDASKSPREAD	11.05879	13.52051

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	6	1	7
	85.71	14.29	100.00
Nonbankrupt	23	74	97
	23.71	76.29	100.00
Total	29	75	104
	27.88	72.12	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.1429	0.2371	0.1900
Priors	0.5000	0.5000	

YEAR 2

Observations	100	DF Total	99
Variables	6	DF Within Classes	98
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	7	7.0000	0.070000	0.500000
Nonbankrupt	Nonbankrupt	93	93.0000	0.930000	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
6	-9.97322

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	1.58188
Nonbankrupt	1.58188	0

LINEAR DISCRIMINANT FUNCTION

Variable	Bankrupt	Nonbankrupt
Constant	-13.06377	-8.34462
M_QUICKASSETSTOTOTALASSTS	31.54882	26.14597
M_LTLIABTOTOTASSET	28.69393	21.37375
M_CASHTOTOTALASSETS	-3.57459	-4.92930
M_PRC	0.13754	0.14330
M_HILOBIDASKSPREAD	-0.17835	-0.16421
M_BIDASKSPREAD	12.93141	13.30320

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	6	1	7
	85.71	14.29	100.00
Nonbankrupt	23	70	93
	24.73	75.27	100.00
Total	29	71	100
	29.00	71.00	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.1429	0.2473	0.1951
Priors	0.5000	0.5000	

YEAR 3

Observations	90	DF Total	89
Variables	6	DF Within Classes	88
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	3	3.0000	0.033333	0.500000
Nonbankrupt	Nonbankrupt	87	87.0000	0.966667	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
6	-7.30000

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	3.38909
Nonbankrupt	3.38909	0

LINEAR DISCRIMINANT FUNCTION

Variable	Bankrupt	Nonbankrupt
Constant	-13.59752	-8.21522
M_QUICKASSETSTOTOTALASSTS	34.81509	24.38655
M_LTLIABTOTOTASSET	24.11595	20.88755
M_CASHTOTOTALASSETS	-2.53731	-0.90059
M_PRC	0.06785	0.10697
M_HILOBIDASKSPREAD	0.09159	0.05053
M_BIDASKSPREAD	4.85112	7.29986

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	3 100.00	0 0.00	3 100.00
Nonbankrupt	19 21.84	68 78.16	87 100.00
Total	22 24.44	68 75.56	90 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.2184	0.1092
Priors	0.5000	0.5000	

Results of Linear Discriminant Analysis : Top 3 Account and Market logarithmic variables

YEAR 1

Observations	82	DF Total	81
Variables	6	DF Within Classes	80
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	4	4.0000	0.048780	0.500000
Nonbankrupt	Nonbankrupt	78	78.0000	0.951220	0.500000

Pooled Covariance Matrix Information

Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
6	0.84296

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	2.63756
Nonbankrupt	2.63756	0

LINEAR DISCRIMINANT FUNCTION

Linear Discriminant Function for BANKRUPTCY		
Variable	Bankrupt	Nonbankrupt
Constant	-84.13757	-74.82504
M_LOG_CASHTOCURLIABILITIES	-2.20271	-1.35251
M_LOG_NETINCOMETOTOTALDEBT	-8.35535	-7.97391
M_LOG_TOTALDEBT	-10.21895	-9.89800
M_LOG_VOL	-0.84229	-1.79058
M_LOG_HILOBIDASKSPREAD	12.69352	12.24994
M_LOG_SHROUT	17.63940	17.90549

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	3 75.00	1 25.00	4 100.00
Nonbankrupt	17 21.79	61 78.21	78 100.00
Total	20 24.39	62 75.61	82 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.2500	0.2179	0.2340
Priors	0.5000	0.5000	

YEAR 2

Observations	80	DF Total	79
Variables	6	DF Within Classes	78
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	3	3.0000	0.037500	0.500000
Nonbankrupt	Nonbankrupt	77	77.0000	0.962500	0.500000

Pooled Covariance Matrix Information

Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
6	0.82818

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	1.45415
Nonbankrupt	1.45415	0

LINEAR DISCRIMINANT FUNCTION

Linear Discriminant Function for BANKRUPTCY

Variable	Bankrupt	Nonbankrupt
Constant	-73.35527	-63.42261
M_LOG_CASHTOCURLIABILITIES	-2.31427	-1.66690
M_LOG_NETINCOMETOTOTALDEBT	-5.89715	-6.04658
M_LOG_TOTALDEBT	-8.59159	-8.24209
M_LOG_VOL	-2.35394	-2.30403
M_LOG_HILOBIDASKSPREAD	5.57258	5.72041
M_LOG_SHROUT	17.39879	16.29230

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	2	1	3
	66.67	33.33	100.00
Nonbankrupt	18	59	77
	23.38	76.62	100.00
Total	20	60	80
	25.00	75.00	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.3333	0.2338	0.2835
Priors	0.5000	0.5000	

YEAR 3

Observations	75	DF Total	74
Variables	6	DF Within Classes	73
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	1	1.0000	0.013333	0.500000
Nonbankrupt	Nonbankrupt	74	74.0000	0.986667	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
6	0.46670

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	3.47549
Nonbankrupt	3.47549	0

LINEAR DISCRIMINANT FUNCTION

Linear Discriminant Function for BANKRUPTCY		
Variable	Bankrupt	Nonbankrupt
Constant	-89.44037	-76.37517
M_LOG_CASHTOCURLIABILITIES	-0.75524	-1.40711
M_LOG_NETINCOMETOTOTALDEBT	-11.56473	-9.85061
M_LOG_TOTALDEBT	-12.35136	-10.75579
M_LOG_VOL	-0.15926	-0.67424
M_LOG_HILOBIDASKSPREAD	10.23674	9.33632
M_LOG_SHROUT	17.53023	16.70143

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	1 100.00	0 0.00	1 100.00
Nonbankrupt	11 14.86	63 85.14	74 100.00
Total	12 16.00	63 84.00	75 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.1486	0.0743
Priors	0.5000	0.5000	

Results of Linear Discriminant Analysis : Variables (Price, Standard deviation, bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

YEAR 1

Observations	184	DF Total	183
Variables	6	DF Within Classes	182
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	85	85.0000	0.461957	0.500000
Nonbankrupt	Nonbankrupt	99	99.0000	0.538043	0.500000

Pooled Covariance Matrix Information

Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
6	-1.60984

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	1.61073
Nonbankrupt	1.61073	0

LINEAR DISCRIMINANT FUNCTION

Variable	Bankrupt	Nonbankrupt
Constant	-4.32807	-3.80474
M_PRC	0.11810	0.15330
M_SDRETURN	2.41645	2.05412
M_BIDASKSPREAD	9.73147	3.22090
M_NETINCOMETOSALES	-0.02259	0.01054
M_WCTOTOTALASSETS	5.41778	7.32059
M_CURLIABTOTOTASSET	12.11498	10.67717

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	59	26	85
	69.41	30.59	100.00
Nonbankrupt	12	87	99
	12.12	87.88	100.00
Total	71	113	184
	38.59	61.41	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.3059	0.1212	0.2135
Priors	0.5000	0.5000	

Observations	90	DF Total	89
Variables	6	DF Within Classes	88
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	66	66.0000	0.733333	0.500000
Nonbankrupt	Nonbankrupt	24	24.0000	0.266667	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
6	7.08780

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	1.74309
Nonbankrupt	1.74309	0

LINEAR DISCRIMINANT FUNCTION

Variable	Bankrupt	Nonbankrupt
Constant	-3.93720	-4.10002
M_PRC	0.08345	0.13114
M_SDRETURN	0.79504	0.53044
M_BIDASKSPREAD	6.29447	-0.26534
M_NETINCOMETOSALES	-0.0006198	0.0003090
M_WCTOTOTALASSETS	6.21393	6.30264
M_CURLIABTOTOTASSET	11.70673	14.19433

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	50	16	66
	75.76	24.24	100.00
Nonbankrupt	4	20	24
	16.67	83.33	100.00
Total	54	36	90
	60.00	40.00	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.2424	0.1667	0.2045
Priors	0.5000	0.5000	

YEAR 5

Observations	43	DF Total	42
Variables	6	DF Within Classes	41
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	27	27.0000	0.627907	0.500000
Nonbankrupt	Nonbankrupt	16	16.0000	0.372093	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
6	-0.52399

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	1.38511
Nonbankrupt	1.38511	0

LINEAR DISCRIMINANT FUNCTION

Variable	Bankrupt	Nonbankrupt
Constant	-4.57820	-3.57903
M_PRC	0.06467	0.09664
M_SDRETURN	2.45660	1.90797
M_BIDASKSPREAD	5.62832	1.17144
M_NETINCOMETOSALES	-0.01887	-0.00846
M_WCTOTOTALASSETS	6.82650	5.81797
M_CURLIABTOTOTASSET	15.37149	14.10884

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	21	6	27
	77.78	22.22	100.00
Nonbankrupt	2	14	16
	12.50	87.50	100.00
Total	23	20	43
	53.49	46.51	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.2222	0.1250	0.1736
Priors	0.5000	0.5000	

Results of Linear Discriminant Analysis : Variables (Price, Standard deviation, hi lo bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

YEAR 1

Observations	185	DF Total	184
Variables	6	DF Within Classes	183
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	86	86.0000	0.464865	0.500000
Nonbankrupt	Nonbankrupt	99	99.0000	0.535135	0.500000

Pooled Covariance Matrix Information

Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
6	6.60198

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	1.40346
Nonbankrupt	1.40346	0

LINEAR DISCRIMINANT FUNCTION

Variable	Bankrupt	Nonbankrupt
Constant	-3.78217	-3.81762
M_PRC	0.10704	0.16872
M_SDRETURN	2.74784	2.11682
M_HILOBIDASKSPREAD	0.02652	-0.05729
M_NETINCOMETOSALES	-0.01368	0.01312
M_WCTOTOTALASSETS	5.86099	7.52057
M_CURLIABTOTOTASSET	11.99349	10.62886

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	62	24	86
	72.09	27.91	100.00
Nonbankrupt	14	85	99
	14.14	85.86	100.00
Total	76	109	185
	41.08	58.92	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.2791	0.1414	0.2102
Priors	0.5000	0.5000	

YEAR 4

Observations	90	DF Total	89
Variables	6	DF Within Classes	88
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	66	66.0000	0.733333	0.500000
Nonbankrupt	Nonbankrupt	24	24.0000	0.266667	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
6	11.72874

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	0.58867
Nonbankrupt	0.58867	0

LINEAR DISCRIMINANT FUNCTION

Variable	Bankrupt	Nonbankrupt
Constant	-3.44353	-4.29162
M_PRC	0.11406	0.18214
M_SDRETURN	0.71053	0.59407
M_HILOBIDASKSPREAD	-0.21427	-0.36226
M_NETINCOMETOSALES	0.0000734	0.0004625
M_WCTOTOTALASSETS	7.17306	7.08585
M_CURLIABTOTOTASSET	13.96813	14.83277

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	54 81.82	12 18.18	66 100.00
Nonbankrupt	15 62.50	9 37.50	24 100.00
Total	69 76.67	21 23.33	90 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.1818	0.6250	0.4034
Priors	0.5000	0.5000	

YEAR 5

Observations	45	DF Total	44
Variables	6	DF Within Classes	43
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	29	29.0000	0.644444	0.500000
Nonbankrupt	Nonbankrupt	16	16.0000	0.355556	0.500000

Pooled Covariance Matrix Information	
Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
6	3.77731

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0	0.64545
Nonbankrupt	0.64545	0

LINEAR DISCRIMINANT FUNCTION

Variable	Bankrupt	Nonbankrupt
Constant	-3.86992	-3.76312
M_PRC	0.02450	0.06279
M_SDRETURN	2.72330	2.02694
M_HILOBIDASKSPREAD	0.49479	0.49539
M_NETINCOMETOSALES	-0.01455	-0.00591
M_WCTOTOTALASSETS	5.12025	5.03768
M_CURLIABTOTOTASSET	16.80802	14.95241

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	20	9	29
	68.97	31.03	100.00
Nonbankrupt	7	9	16
	43.75	56.25	100.00
Total	27	18	45
	60.00	40.00	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.3103	0.4375	0.3739
Priors	0.5000	0.5000	

quadratic MDA does so for nonbankrupt firms. For overall accuracy, the nonparametric MDA slightly outperforms the linear MDA, consistent with the previously used sets of variables.

We must highlight the two most interesting findings. First, overall accuracy in classifying bankrupt firms (minimizing Type I error) is found through the use of market variables alone. This is important since it is much more costly to incorrectly classify an actual bankrupt firm than it is to do so with an actual nonbankrupt firm. This strikes a divergence from the previous literature. Most research has highlighted the value of adding market variables to bankruptcy prediction models, but concludes that accounting ratios are still important in bankruptcy prediction. Our results lead us to conclude that forward-looking market variables alone, without backward-looking accounting ratios, are sufficient to accurately forecast bankruptcy. Notably, by adding price, standard deviation of returns, and the bid-ask spread to the model, the model outperforms a model of just accounting ratios. This ties together a vast array of literature. The behavior of price, standard deviation of returns, and, recently, the bid-ask spread, has been documented to contain information. Therefore, it is promising that these variables show discriminatory power.

For correctly classifying nonbankrupt firms, which is of less importance than doing so with bankrupt firms, the mix of accounting ratios and market variables are better predictors than just the market variables. An explanation for this is the fact that the accounting ratios are not deteriorating, and this pattern alone may be able to demonstrate that these firms are not falling into distress. During non-financial crisis periods, the

findings will probably be stronger. While market variables are generally noisier variables, the stability of accounting ratios is consistent with a firm that is not under distress. This highlights why it is still important to include accounting ratios in any bankruptcy prediction framework or model. They still contain important information, and while correctly classifying bankrupt firms is more pertinent to investors and loan officers, it is still important to lend and invest in firms that will not deteriorate.

The second important finding is the accuracy of the nonparametric MDA. While much research concludes that the assumptions underlying the linear MDA are violated, most researchers still employ parametric models. The improvement in technology and programming languages allows us to use a bevy of models, so we conclude that there is little use in still using the parametric models. While correctly classifying bankrupt firms is more important than doing so with nonbankrupt firms, overall accuracy is still desirable. An investor can be led to not optimally allocate her resources by avoiding investments in certain firms that are incorrectly classified as probable bankrupt firms. The nonparametric model provides the overall accuracy desired. While this has been avoided due to the tradeoff between accuracy and model complexity, this is no longer a reason to avoid these models. This will be further highlighted in the next chapter on neural networks.

Lastly, an out-of-sample nonparametric MDA is performed. We choose to use the nonparametric MDA because it has shown the highest overall accuracy. Using the ratios and variables from five years to two years before bankruptcy, the nonparametric model is estimated. Then, predictions are made as to whether firms are bankrupt or nonbankrupt one year before bankruptcy. While the misclassification rates are important, a prediction

model should perform well using a hold-out sample, a sample not used in the estimation of the model. Since the data for one year before bankruptcy is not used in estimating the model, this will allow us to see how well the model performs at actually predicting bankruptcy.

After estimating the model using only the market variables, the model misclassifies/predicts 29% of the bankrupt firms and 17% of the nonbankrupt firms. For an out-of-sample prediction, the model is fairly accurate. However, higher classification rates are desirable in terms of the bankrupt firms. The cost of misclassifying bankrupt firms is much higher than that of doing so with nonbankrupt firms. Therefore, the misclassification rates should ideally be equal or lower than those for nonbankrupt firms. Using the current model, more than one in four bankrupt firms are incorrectly labeled.

Furthermore, even though the mix of accounting ratios and market variables (price, standard deviation of price, bid-ask spread, net income to sales, working capital to total assets, and current liabilities to total assets) performed very well using the in-sample procedure, the error rates are higher using the out-of-sample procedure. The misclassification rates are 38% for the bankrupt firms and 15% for the nonbankrupt firms. When the bid-ask spread is replaced by the high-low bid-ask spread, the error rate for the bankrupt firms slightly improves (31%), but that for the nonbankrupt firms substantially deteriorates (37%). While the bankrupt misclassification rate is lower, the nonbankrupt misclassification rate is much higher. The decrease in the bankrupt misclassication rate is not high enough to justify using the high-low bid-ask spread.

Overall, MDA still performs relatively well in bankruptcy prediction. However, as has been noted in the past, the stringent underlying assumptions cause issues that are

difficult to correct. The nonparametric MDA is an improvement, but more technical models are needed. This has led to the use of neural networks, which we discuss in Chapter 4.

Furthermore, the out-of-sample model estimated with only market variables shows much higher predictive power than that of the model estimated with market variables and accounting ratios. While this deviates from prior findings, it is an important addition to literature. This alone highlights the need to use forward-looking variables in any predictive framework. However, one caveat is the sample period we use. Much has been documented about the accounting ratios of firms over the past couple of decades, namely off-balance sheet transactions. This, mixed with the fact that a financial crisis loomed during our sample period (not the off-balance sheet transactions and the financial crisis are mutually exclusive), makes it more difficult for the accounting ratios to discriminate between firms. More evidence is needed during expansionary and normal market cycles.

Table 8

Results of Quadratic Discriminant Analysis : Accounting variables

YEAR 1

Observations	101	DF Total	100
Variables	17	DF Within Classes	99
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	6	6.0000	0.059406	0.500000
Nonbankrupt	Nonbankrupt	95	95.0000	0.940594	0.500000

Within Covariance Matrix Information		
BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	5	-187.89108
Nonbankrupt	17	-25.49897

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	-187.89108	11.83408
Nonbankrupt	11266946	-25.49897

CLASSIFICATION SUMMARY

	Number of Observations and Percent Classified into BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	6 100.00	0 0.00	6 100.00
Nonbankrupt	0 0.00	95 100.00	95 100.00
Total	6 5.94	95 94.06	101 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0000	0.0000
Priors	0.5000	0.5000	

YEAR 2

Observations	99	DF Total	98
Variables	17	DF Within Classes	97
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	6	6.0000	0.060606	0.500000
Nonbankrupt	Nonbankrupt	93	93.0000	0.939394	0.500000

Within Covariance Matrix Information		
BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	5	-173.21001
Nonbankrupt	17	-10.03209

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	-173.21001	-6.67155
Nonbankrupt	15873260	-10.03209

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	6 100.00	0 0.00	6 100.00
Nonbankrupt	0 0.00	93 100.00	93 100.00
Total	6 6.06	93 93.94	99 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0000	0.0000
Priors	0.5000	0.5000	

YEAR 3

Observations	88	DF Total	87
Variables	17	DF Within Classes	86
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	2	2.0000	0.022727	0.500000
Nonbankrupt	Nonbankrupt	86	86.0000	0.977273	0.500000

Within Covariance Matrix Information		
BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	1	-238.93864
Nonbankrupt	17	-8.66762

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	-238.93864	0.71480
Nonbankrupt	103908349	-8.66762

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	2 100.00	0 0.00	2 100.00
Nonbankrupt	0 0.00	86 100.00	86 100.00
Total	2 2.27	86 97.73	88 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0000	0.0000
Priors	0.5000	0.5000	

Results of Quadratic Discriminant Analysis : Market variables

YEAR 1

Observations	249	DF Total	248
Variables	5	DF Within Classes	247
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	133	133.0000	0.534137	0.500000
Nonbankrupt	Nonbankrupt	116	116.0000	0.465863	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	5	48.91501
Nonbankrupt	5	51.79354

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	48.91501	54.55474
Nonbankrupt	52.55099	51.79354

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	119	14	133
	89.47	10.53	100.00
Nonbankrupt	67	49	116
	57.76	42.24	100.00
Total	186	63	249
	74.70	25.30	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.1053	0.5776	0.3414
Priors	0.5000	0.5000	

YEAR 4

Observations	194	DF Total	193
Variables	5	DF Within Classes	192
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	84	84.0000	0.432990	0.500000
Nonbankrupt	Nonbankrupt	110	110.0000	0.567010	0.500000

Within Covariance Matrix Information		
BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	5	45.28909
Nonbankrupt	5	54.30022

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	45.28909	59.38781
Nonbankrupt	48.90719	54.30022

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	78	6	84
	92.86	7.14	100.00
Nonbankrupt	72	38	110
	65.45	34.55	100.00
Total	150	44	194
	77.32	22.68	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0714	0.6545	0.3630
Priors	0.5000	0.5000	

YEAR 5

Observations	161	DF Total	160
Variables	5	DF Within Classes	159
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	64	64.0000	0.397516	0.500000
Nonbankrupt	Nonbankrupt	97	97.0000	0.602484	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	5	46.92654
Nonbankrupt	5	51.52546

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	46.92654	60.74987
Nonbankrupt	49.99313	51.52546

CLASSIFICATION SUMMARY

	Number of Observations and Percent Classified into BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	59 92.19	5 7.81	64 100.00
Nonbankrupt	59 60.82	38 39.18	97 100.00
Total	118 73.29	43 26.71	161 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0781	0.6082	0.3432
Priors	0.5000	0.5000	

Results of Quadratic Discriminant Analysis : Market variables without spread and hi lo bid ask spread

YEAR 1

Observations	249	DF Total	248
Variables	4	DF Within Classes	247
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	133	133.0000	0.534137	0.500000
Nonbankrupt	Nonbankrupt	116	116.0000	0.465863	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	4	45.00183
Nonbankrupt	4	51.63759

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	45.00183	52.61127
Nonbankrupt	48.38619	51.63759

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	122	11	133
	91.73	8.27	100.00
Nonbankrupt	83	33	116
	71.55	28.45	100.00
Total	205	44	249
	82.33	17.67	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0827	0.7155	0.3991
Priors	0.5000	0.5000	

YEAR 4

Observations	194	DF Total	193
Variables	4	DF Within Classes	192
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	84	84.0000	0.432990	0.500000
Nonbankrupt	Nonbankrupt	110	110.0000	0.567010	0.500000

Within Covariance Matrix Information		
BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	4	44.44756
Nonbankrupt	4	51.13029

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	44.44756	56.17319
Nonbankrupt	47.95322	51.13029

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	78 92.86	6 7.14	84 100.00
Nonbankrupt	73 66.36	37 33.64	110 100.00
Total	151 77.84	43 22.16	194 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0714	0.6636	0.3675
Priors	0.5000	0.5000	

YEAR 5

Observations	161	DF Total	160
Variables	4	DF Within Classes	159
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	64	64.0000	0.397516	0.500000
Nonbankrupt	Nonbankrupt	97	97.0000	0.602484	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	4	45.68770
Nonbankrupt	4	49.86151

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	45.68770	58.80715
Nonbankrupt	48.73746	49.86151

CLASSIFICATION SUMMARY

	Number of Observations and Percent Classified into BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	59	5	64
	92.19	7.81	100.00
Nonbankrupt	61	36	97
	62.89	37.11	100.00
Total	120	41	161
	74.53	25.47	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0781	0.6289	0.3535
Priors	0.5000	0.5000	

Results of Quadratic Discriminant Analysis : Market variables without spread and bid ask spread

YEAR 1

Observations	252	DF Total	251
Variables	4	DF Within Classes	250
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	136	136.0000	0.539683	0.500000
Nonbankrupt	Nonbankrupt	116	116.0000	0.460317	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	4	52.72158
Nonbankrupt	4	56.81245

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	52.72158	59.26423
Nonbankrupt	56.34264	56.81245

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	124 91.18	12 8.82	136 100.00
Nonbankrupt	75 64.66	41 35.34	116 100.00
Total	199 78.97	53 21.03	252 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0882	0.6466	0.3674
Priors	0.5000	0.5000	

YEAR 4

Observations	195	DF Total	194
Variables	4	DF Within Classes	193
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	85	85.0000	0.435897	0.500000
Nonbankrupt	Nonbankrupt	110	110.0000	0.564103	0.500000

Within Covariance Matrix Information		
BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	4	48.72453
Nonbankrupt	4	59.13656

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	48.72453	59.51742
Nonbankrupt	52.30193	59.13656

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	80 94.12	5 5.88	85 100.00
Nonbankrupt	77 70.00	33 30.00	110 100.00
Total	157 80.51	38 19.49	195 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0588	0.7000	0.3794
Priors	0.5000	0.5000	

YEAR 5

Observations	168	DF Total	167
Variables	4	DF Within Classes	166
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	70	70.0000	0.416667	0.500000
Nonbankrupt	Nonbankrupt	98	98.0000	0.583333	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	4	50.05742
Nonbankrupt	4	56.92958

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	50.05742	57.29045
Nonbankrupt	53.08211	56.92958

CLASSIFICATION SUMMARY

	Number of Observations and Percent Classified into BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	65	5	70
	92.86	7.14	100.00
Nonbankrupt	74	24	98
	75.51	24.49	100.00
Total	139	29	168
	82.74	17.26	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0714	0.7551	0.4133
Priors	0.5000	0.5000	

Results of Quadratic Discriminant Analysis : Market variables without bid ask spread and hi lo bid ask spread

YEAR 1

Observations	13	DF Total	12
Variables	4	DF Within Classes	11
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	10	10.0000	0.769231	0.500000
Nonbankrupt	Nonbankrupt	3	3.0000	0.230769	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	4	29.90733
Nonbankrupt	2	-0.30956

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	29.90733	91487822
Nonbankrupt	34.53467	-0.30956

CLASSIFICATION SUMMARY

	Number of Observations and Percent Classified into BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	10 100.00	0 0.00	10 100.00
Nonbankrupt	0 0.00	3 100.00	3 100.00
Total	10 76.92	3 23.08	13 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0000	0.0000
Priors	0.5000	0.5000	

YEAR 5

Observations	12	DF Total	11
Variables	4	DF Within Classes	10
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	9	9.0000	0.750000	0.500000
Nonbankrupt	Nonbankrupt	3	3.0000	0.250000	0.500000

Within Covariance Matrix Information		
BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	4	36.17780
Nonbankrupt	2	-6.31841

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	36.17780	387580929
Nonbankrupt	37.93887	-6.31841

CLASSIFICATION SUMMARY

	Number of Observations and Percent Classified into BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	9 100.00	0 0.00	9 100.00
Nonbankrupt	0 0.00	3 100.00	3 100.00
Total	9 75.00	3 25.00	12 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0000	0.0000
Priors	0.5000	0.5000	

Results of Quadratic Discriminant Analysis : Top 3 Account and Market variables

YEAR 1

Observations	104	DF Total	103
Variables	6	DF Within Classes	102
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	7	7.0000	0.067308	0.500000
Nonbankrupt	Nonbankrupt	97	97.0000	0.932692	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	6	-22.70273
Nonbankrupt	6	-10.79765

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	-22.70273	-9.60572
Nonbankrupt	80.62950	-10.79765

CLASSIFICATION SUMMARY

	Number of Observations and Percent Classified into BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	7 100.00	0 0.00	7 100.00
Nonbankrupt	5 5.15	92 94.85	97 100.00
Total	12 11.54	92 88.46	104 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0515	0.0258
Priors	0.5000	0.5000	

YEAR 2

Observations	100	DF Total	99
Variables	6	DF Within Classes	98
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	7	7.0000	0.070000	0.500000
Nonbankrupt	Nonbankrupt	93	93.0000	0.930000	0.500000

Within Covariance Matrix Information		
BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	6	-21.56348
Nonbankrupt	6	-9.98246

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	-21.56348	-8.36049
Nonbankrupt	806.37144	-9.98246

CLASSIFICATION SUMMARY

	Number of Observations and Percent Classified into BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	7 100.00	0 0.00	7 100.00
Nonbankrupt	7 7.53	86 92.47	93 100.00
Total	14 14.00	86 86.00	100 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0753	0.0376
Priors	0.5000	0.5000	

YEAR 3

Observations	90	DF Total	89
Variables	6	DF Within Classes	88
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	3	3.0000	0.033333	0.500000
Nonbankrupt	Nonbankrupt	87	87.0000	0.966667	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	2	-83.35910
Nonbankrupt	6	-7.25899

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	-83.35910	-3.89454
Nonbankrupt	753748767	-7.25899

CLASSIFICATION SUMMARY

	Number of Observations and Percent Classified into BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	3 100.00	0 0.00	3 100.00
Nonbankrupt	0 0.00	87 100.00	87 100.00
Total	3 3.33	87 96.67	90 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0000	0.0000
Priors	0.5000	0.5000	

Results of Quadratic Discriminant Analysis : Top 3 Account and Market logarithmic variables

YEAR 1

Observations	82	DF Total	81
Variables	6	DF Within Classes	80
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	4	4.0000	0.048780	0.500000
Nonbankrupt	Nonbankrupt	78	78.0000	0.951220	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	3	-50.22638
Nonbankrupt	6	0.90059

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	-50.22638	3.51367
Nonbankrupt	153457811	0.90059

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	4 100.00	0 0.00	4 100.00
Nonbankrupt	0 0.00	78 100.00	78 100.00
Total	4 4.88	78 95.12	82 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0000	0.0000
Priors	0.5000	0.5000	

YEAR 2

Observations	80	DF Total	79
Variables	6	DF Within Classes	78
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	3	3.0000	0.037500	0.500000
Nonbankrupt	Nonbankrupt	77	77.0000	0.962500	0.500000

Within Covariance Matrix Information		
BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	2	-60.33946
Nonbankrupt	6	0.83121

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	-60.33946	2.33795
Nonbankrupt	6967642	0.83121

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	3 100.00	0 0.00	3 100.00
Nonbankrupt	0 0.00	77 100.00	77 100.00
Total	3 3.75	77 96.25	80 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0000	0.0000
Priors	0.5000	0.5000	

Results of Quadratic Discriminant Analysis : Variables (Price, Standard deviation, bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

YEAR 1

Observations	184	DF Total	183
Variables	6	DF Within Classes	182
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	85	85.0000	0.461957	0.500000
Nonbankrupt	Nonbankrupt	99	99.0000	0.538043	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	6	0.08497
Nonbankrupt	6	-12.56568

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0.08497	517.44508
Nonbankrupt	1.46675	-12.56568

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	46	39	85
	54.12	45.88	100.00
Nonbankrupt	8	91	99
	8.08	91.92	100.00
Total	54	130	184
	29.35	70.65	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.4588	0.0808	0.2698
Priors	0.5000	0.5000	

YEAR 2

Observations	201	DF Total	200
Variables	6	DF Within Classes	199
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	95	95.0000	0.472637	0.500000
Nonbankrupt	Nonbankrupt	106	106.0000	0.527363	0.500000

Within Covariance Matrix Information		
BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	6	3.55063
Nonbankrupt	6	1.58352

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	3.55063	3.52813
Nonbankrupt	4.87329	1.58352

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	33 34.74	62 65.26	95 100.00
Nonbankrupt	11 10.38	95 89.62	106 100.00
Total	44 21.89	157 78.11	201 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.6526	0.1038	0.3782
Priors	0.5000	0.5000	

YEAR 3

Observations	173	DF Total	172
Variables	6	DF Within Classes	171
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	74	74.0000	0.427746	0.500000
Nonbankrupt	Nonbankrupt	99	99.0000	0.572254	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	6	0.30543
Nonbankrupt	6	-3.09270

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0.30543	-1.46368
Nonbankrupt	1.21219	-3.09270

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	26	48	74
	35.14	64.86	100.00
Nonbankrupt	9	90	99
	9.09	90.91	100.00
Total	35	138	173
	20.23	79.77	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.6486	0.0909	0.3698
Priors	0.5000	0.5000	

YEAR 4

Observations	90	DF Total	89
Variables	6	DF Within Classes	88
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	66	66.0000	0.733333	0.500000
Nonbankrupt	Nonbankrupt	24	24.0000	0.266667	0.500000

Within Covariance Matrix Information		
BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	6	7.45623
Nonbankrupt	6	-12.86147

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	7.45623	292901
Nonbankrupt	9.10716	-12.86147

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	29	37	66
	43.94	56.06	100.00
Nonbankrupt	0	24	24
	0.00	100.00	100.00
Total	29	61	90
	32.22	67.78	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.5606	0.0000	0.2803
Priors	0.5000	0.5000	

YEAR 5

Observations	43	DF Total	42
Variables	6	DF Within Classes	41
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	27	27.0000	0.627907	0.500000
Nonbankrupt	Nonbankrupt	16	16.0000	0.372093	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	6	0.52974
Nonbankrupt	6	-16.60573

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	0.52974	14699
Nonbankrupt	1.71635	-16.60573

CLASSIFICATION SUMMARY

	Number of Observations and Percent Classified into BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	18 66.67	9 33.33	27 100.00
Nonbankrupt	0 0.00	16 100.00	16 100.00
Total	18 41.86	25 58.14	43 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.3333	0.0000	0.1667
Priors	0.5000	0.5000	

Results of Quadratic Discriminant Analysis : Variables (Price, Standard deviation, hi lo bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

YEAR 1

Observations	185	DF Total	184
Variables	6	DF Within Classes	183
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	86	86.0000	0.464865	0.500000
Nonbankrupt	Nonbankrupt	99	99.0000	0.535135	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	6	8.41196
Nonbankrupt	6	-7.22763

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	8.41196	508.07273
Nonbankrupt	9.82853	-7.22763

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	39	47	86
	45.35	54.65	100.00
Nonbankrupt	7	92	99
	7.07	92.93	100.00
Total	46	139	185
	24.86	75.14	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.5465	0.0707	0.3086
Priors	0.5000	0.5000	

YEAR 2

Observations	201	DF Total	200
Variables	6	DF Within Classes	199
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	95	95.0000	0.472637	0.500000
Nonbankrupt	Nonbankrupt	106	106.0000	0.527363	0.500000

Within Covariance Matrix Information		
BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	6	8.34547
Nonbankrupt	6	6.98046

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	8.34547	8.48245
Nonbankrupt	9.37163	6.98046

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	26 27.37	69 72.63	95 100.00
Nonbankrupt	6 5.66	100 94.34	106 100.00
Total	32 15.92	169 84.08	201 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.7263	0.0566	0.3915
Priors	0.5000	0.5000	

YEAR 3

Observations	174	DF Total	173
Variables	6	DF Within Classes	172
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	75	75.0000	0.431034	0.500000
Nonbankrupt	Nonbankrupt	99	99.0000	0.568966	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	6	6.58269
Nonbankrupt	6	2.51630

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	6.58269	3.52036
Nonbankrupt	6.94238	2.51630

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	21	54	75
	28.00	72.00	100.00
Nonbankrupt	7	92	99
	7.07	92.93	100.00
Total	28	146	174
	16.09	83.91	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.7200	0.0707	0.3954
Priors	0.5000	0.5000	

YEAR 4

Observations	90	DF Total	89
Variables	6	DF Within Classes	88
Classes	2	DF Between Classes	1

Class Level Information					
BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	66	66.0000	0.733333	0.500000
Nonbankrupt	Nonbankrupt	24	24.0000	0.266667	0.500000

Within Covariance Matrix Information		
BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	6	11.88973
Nonbankrupt	6	-7.10209

Generalized Squared Distance to BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	11.88973	251943
Nonbankrupt	12.70240	-7.10209

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	21	45	66
	31.82	68.18	100.00
Nonbankrupt	0	24	24
	0.00	100.00	100.00
Total	21	69	90
	23.33	76.67	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.6818	0.0000	0.3409
Priors	0.5000	0.5000	

YEAR 5

Observations	45	DF Total	44
Variables	6	DF Within Classes	43
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	29	29.0000	0.644444	0.500000
Nonbankrupt	Nonbankrupt	16	16.0000	0.355556	0.500000

Within Covariance Matrix Information

BANKRUPTCY	Covariance Matrix Rank	Natural Log of the Determinant of the Covariance Matrix
Bankrupt	6	4.66785
Nonbankrupt	6	-10.97919

Generalized Squared Distance to BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt
Bankrupt	4.66785	13174
Nonbankrupt	5.37322	-10.97919

CLASSIFICATION SUMMARY

	Number of Observations and Percent Classified into BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	12 41.38	17 58.62	29 100.00
Nonbankrupt	0 0.00	16 100.00	16 100.00
Total	12 26.67	33 73.33	45 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.5862	0.0000	0.2931
Priors	0.5000	0.5000	

Table 9

Results of Non-parametric Discriminant Analysis : Accounting variables

YEAR 1

Observations	101	DF Total	100
Variables	17	DF Within Classes	99
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	6	6.0000	0.059406	0.500000
Nonbankrupt	Nonbankrupt	95	95.0000	0.940594	0.500000

CLASSIFICATION SUMMARY

	Number of Observations and Percent Classified into BANKRUPTCY		
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	6 100.00	0 0.00	6 100.00
Nonbankrupt	4 4.21	91 95.79	95 100.00
Total	10 9.90	91 90.10	101 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0421	0.0211
Priors	0.5000	0.5000	

YEAR 2

Observations	99	DF Total	98
Variables	17	DF Within Classes	97
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	6	6.0000	0.060606	0.500000
Nonbankrupt	Nonbankrupt	93	93.0000	0.939394	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	6	0	6
	100.00	0.00	100.00
Nonbankrupt	12	81	93
	12.90	87.10	100.00
Total	18	81	99
	18.18	81.82	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.1290	0.0645
Priors	0.5000	0.5000	

YEAR 3

Observations	88	DF Total	87
Variables	17	DF Within Classes	86
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	2	2.0000	0.022727	0.500000
Nonbankrupt	Nonbankrupt	86	86.0000	0.977273	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	2 100.00	0 0.00	2 100.00
Nonbankrupt	5 5.81	81 94.19	86 100.00
Total	7 7.95	81 92.05	88 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0581	0.0291
Priors	0.5000	0.5000	

Results of Non-parametric Discriminant Analysis : Market variables

YEAR 1

Observations	249	DF Total	248
Variables	5	DF Within Classes	247
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	133	133.0000	0.534137	0.500000
Nonbankrupt	Nonbankrupt	116	116.0000	0.465863	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	117 87.97	16 12.03	133 100.00
Nonbankrupt	17 14.66	99 85.34	116 100.00
Total	134 53.82	115 46.18	249 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1203	0.1466	0.1334
Priors	0.5000	0.5000	

YEAR 2

Observations	240	DF Total	239
Variables	5	DF Within Classes	238
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	128	128.0000	0.533333	0.500000
Nonbankrupt	Nonbankrupt	112	112.0000	0.466667	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	108	20	128
	84.38	15.63	100.00
Nonbankrupt	17	95	112
	15.18	84.82	100.00
Total	125	115	240
	52.08	47.92	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1563	0.1518	0.1540
Priors	0.5000	0.5000	

YEAR 3

Observations	218	DF Total	217
Variables	5	DF Within Classes	216
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	107	107.0000	0.490826	0.500000
Nonbankrupt	Nonbankrupt	111	111.0000	0.509174	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	88	19	107
	82.24	17.76	100.00
Nonbankrupt	23	88	111
	20.72	79.28	100.00
Total	111	107	218
	50.92	49.08	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1776	0.2072	0.1924
Priors	0.5000	0.5000	

YEAR 4

Observations	194	DF Total	193
Variables	5	DF Within Classes	192
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	84	84.0000	0.432990	0.500000
Nonbankrupt	Nonbankrupt	110	110.0000	0.567010	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	70	14	84
	83.33	16.67	100.00
Nonbankrupt	14	96	110
	12.73	87.27	100.00
Total	84	110	194
	43.30	56.70	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1667	0.1273	0.1470
Priors	0.5000	0.5000	

YEAR 5

Observations	161	DF Total	160
Variables	5	DF Within Classes	159
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	64	64.0000	0.397516	0.500000
Nonbankrupt	Nonbankrupt	97	97.0000	0.602484	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	48	16	64
	75.00	25.00	100.00
Nonbankrupt	3	94	97
	3.09	96.91	100.00
Total	51	110	161
	31.68	68.32	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.2500	0.0309	0.1405
Priors	0.5000	0.5000	

Results of Non-parametric Discriminant Analysis : Market variables without spread and hi lo bid ask spread

YEAR 1

Observations	249	DF Total	248
Variables	4	DF Within Classes	247
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	133	133.0000	0.534137	0.500000
Nonbankrupt	Nonbankrupt	116	116.0000	0.465863	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	114 85.71	19 14.29	133 100.00
Nonbankrupt	20 17.24	96 82.76	116 100.00
Total	134 53.82	115 46.18	249 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1429	0.1724	0.1576
Priors	0.5000	0.5000	

YEAR 2

Observations	240	DF Total	239
Variables	4	DF Within Classes	238
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	128	128.0000	0.533333	0.500000
Nonbankrupt	Nonbankrupt	112	112.0000	0.466667	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	108	20	128
	84.38	15.63	100.00
Nonbankrupt	17	95	112
	15.18	84.82	100.00
Total	125	115	240
	52.08	47.92	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1563	0.1518	0.1540
Priors	0.5000	0.5000	

YEAR 3

Observations	218	DF Total	217
Variables	4	DF Within Classes	216
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	107	107.0000	0.490826	0.500000
Nonbankrupt	Nonbankrupt	111	111.0000	0.509174	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	85	22	107
	79.44	20.56	100.00
Nonbankrupt	16	95	111
	14.41	85.59	100.00
Total	101	117	218
	46.33	53.67	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.2056	0.1441	0.1749
Priors	0.5000	0.5000	

YEAR 4

Observations	194	DF Total	193
Variables	4	DF Within Classes	192
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	84	84.0000	0.432990	0.500000
Nonbankrupt	Nonbankrupt	110	110.0000	0.567010	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	70	14	84
	83.33	16.67	100.00
Nonbankrupt	14	96	110
	12.73	87.27	100.00
Total	84	110	194
	43.30	56.70	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1667	0.1273	0.1470
Priors	0.5000	0.5000	

YEAR 5

Observations	161	DF Total	160
Variables	4	DF Within Classes	159
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	64	64.0000	0.397516	0.500000
Nonbankrupt	Nonbankrupt	97	97.0000	0.602484	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	46 71.88	18 28.13	64 100.00
Nonbankrupt	6 6.19	91 93.81	97 100.00
Total	52 32.30	109 67.70	161 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.2813	0.0619	0.1716
Priors	0.5000	0.5000	

Results of Non-parametric Discriminant Analysis : Market variables without spread and bid ask spread

YEAR 1

Observations	252	DF Total	251
Variables	4	DF Within Classes	250
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	136	136.0000	0.539683	0.500000
Nonbankrupt	Nonbankrupt	116	116.0000	0.460317	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	117	19	136
	86.03	13.97	100.00
Nonbankrupt	24	92	116
	20.69	79.31	100.00
Total	141	111	252
	55.95	44.05	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1397	0.2069	0.1733
Priors	0.5000	0.5000	

YEAR 2

Observations	241	DF Total	240
Variables	4	DF Within Classes	239
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	129	129.0000	0.535270	0.500000
Nonbankrupt	Nonbankrupt	112	112.0000	0.464730	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	106	23	129
	82.17	17.83	100.00
Nonbankrupt	40	72	112
	35.71	64.29	100.00
Total	146	95	241
	60.58	39.42	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1783	0.3571	0.2677
Priors	0.5000	0.5000	

YEAR 3

Observations	219	DF Total	218
Variables	4	DF Within Classes	217
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	108	108.0000	0.493151	0.500000
Nonbankrupt	Nonbankrupt	111	111.0000	0.506849	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	87	21	108
	80.56	19.44	100.00
Nonbankrupt	26	85	111
	23.42	76.58	100.00
Total	113	106	219
	51.60	48.40	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1944	0.2342	0.2143
Priors	0.5000	0.5000	

YEAR 4

Observations	195	DF Total	194
Variables	4	DF Within Classes	193
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	85	85.0000	0.435897	0.500000
Nonbankrupt	Nonbankrupt	110	110.0000	0.564103	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	66	19	85
	77.65	22.35	100.00
Nonbankrupt	21	89	110
	19.09	80.91	100.00
Total	87	108	195
	44.62	55.38	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.2235	0.1909	0.2072
Priors	0.5000	0.5000	

YEAR 5

Observations	168	DF Total	167
Variables	4	DF Within Classes	166
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	70	70.0000	0.416667	0.500000
Nonbankrupt	Nonbankrupt	98	98.0000	0.583333	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	47	23	70
	67.14	32.86	100.00
Nonbankrupt	11	87	98
	11.22	88.78	100.00
Total	58	110	168
	34.52	65.48	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.3286	0.1122	0.2204
Priors	0.5000	0.5000	

Results of Non-parametric Discriminant Analysis : Market variables without bid ask spread and hi lo bid ask spread

YEAR 1

Observations	13	DF Total	12
Variables	4	DF Within Classes	11
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	10	10.0000	0.769231	0.500000
Nonbankrupt	Nonbankrupt	3	3.0000	0.230769	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	8 80.00	2 20.00	10 100.00
Nonbankrupt	0 0.00	3 100.00	3 100.00
Total	8 61.54	5 38.46	13 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.2000	0.0000	0.1000
Priors	0.5000	0.5000	

YEAR 2

Observations	12	DF Total	11
Variables	4	DF Within Classes	10
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	6	6.0000	0.500000	0.500000
Nonbankrupt	Nonbankrupt	6	6.0000	0.500000	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	6 100.00	0 0.00	6 100.00
Nonbankrupt	1 16.67	5 83.33	6 100.00
Total	7 58.33	5 41.67	12 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.1667	0.0833
Priors	0.5000	0.5000	

YEAR 3

Observations	10	DF Total	9
Variables	4	DF Within Classes	8
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	7	7.0000	0.700000	0.500000
Nonbankrupt	Nonbankrupt	3	3.0000	0.300000	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	6 85.71	1 14.29	7 100.00
Nonbankrupt	0 0.00	3 100.00	3 100.00
Total	6 60.00	4 40.00	10 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1429	0.0000	0.0714
Priors	0.5000	0.5000	

YEAR 4

Observations	8	DF Total	7
Variables	4	DF Within Classes	6
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	7	7.0000	0.875000	0.500000
Nonbankrupt	Nonbankrupt	1	1.0000	0.125000	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	7 100.00	0 0.00	7 100.00
Nonbankrupt	0 0.00	1 100.00	1 100.00
Total	7 87.50	1 12.50	8 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0000	0.0000
Priors	0.5000	0.5000	

YEAR 5

Observations	12	DF Total	11
Variables	4	DF Within Classes	10
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	9	9.0000	0.750000	0.500000
Nonbankrupt	Nonbankrupt	3	3.0000	0.250000	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	3 33.33	6 66.67	9 100.00
Nonbankrupt	0 0.00	3 100.00	3 100.00
Total	3 25.00	9 75.00	12 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.6667	0.0000	0.3333
Priors	0.5000	0.5000	

Results of Non-parametric Discriminant Analysis : Top 3 Account and Market variables

YEAR 1

Observations	104	DF Total	103
Variables	6	DF Within Classes	102
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	7	7.0000	0.067308	0.500000
Nonbankrupt	Nonbankrupt	97	97.0000	0.932692	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	7 100.00	0 0.00	7 100.00
Nonbankrupt	10 10.31	87 89.69	97 100.00
Total	17 16.35	87 83.65	104 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.1031	0.0515
Priors	0.5000	0.5000	

YEAR 2

Observations	100	DF Total	99
Variables	6	DF Within Classes	98
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	7	7.0000	0.070000	0.500000
Nonbankrupt	Nonbankrupt	93	93.0000	0.930000	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	7 100.00	0 0.00	7 100.00
Nonbankrupt	8 8.60	85 91.40	93 100.00
Total	15 15.00	85 85.00	100 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0860	0.0430
Priors	0.5000	0.5000	

YEAR 3

Observations	90	DF Total	89
Variables	6	DF Within Classes	88
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	3	3.0000	0.033333	0.500000
Nonbankrupt	Nonbankrupt	87	87.0000	0.966667	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	3 100.00	0 0.00	3 100.00
Nonbankrupt	8 9.20	79 90.80	87 100.00
Total	11 12.22	79 87.78	90 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0920	0.0460
Priors	0.5000	0.5000	

Results of Non-parametric Discriminant Analysis : Top 3 Account and Market logarithmic variables

YEAR 1

Observations	82	DF Total	81
Variables	6	DF Within Classes	80
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	4	4.0000	0.048780	0.500000
Nonbankrupt	Nonbankrupt	78	78.0000	0.951220	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	4 100.00	0 0.00	4 100.00
Nonbankrupt	6 7.69	72 92.31	78 100.00
Total	10 12.20	72 87.80	82 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0769	0.0385
Priors	0.5000	0.5000	

YEAR 2

Observations	80	DF Total	79
Variables	6	DF Within Classes	78
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	3	3.0000	0.037500	0.500000
Nonbankrupt	Nonbankrupt	77	77.0000	0.962500	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	3 100.00	0 0.00	3 100.00
Nonbankrupt	5 6.49	72 93.51	77 100.00
Total	8 10.00	72 90.00	80 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0649	0.0325
Priors	0.5000	0.5000	

YEAR 3

Observations	75	DF Total	74
Variables	6	DF Within Classes	73
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	1	1.0000	0.013333	0.500000
Nonbankrupt	Nonbankrupt	74	74.0000	0.986667	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	1 100.00	0 0.00	1 100.00
Nonbankrupt	4 5.41	70 94.59	74 100.00
Total	5 6.67	70 93.33	75 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0541	0.0270
Priors	0.5000	0.5000	

Results of Non-parametric Discriminant Analysis : Variables (Price, Standard deviation, bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

YEAR 1

Observations	184	DF Total	183
Variables	6	DF Within Classes	182
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	85	85.0000	0.461957	0.500000
Nonbankrupt	Nonbankrupt	99	99.0000	0.538043	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	68	17	85
	80.00	20.00	100.00
Nonbankrupt	10	89	99
	10.10	89.90	100.00
Total	78	106	184
	42.39	57.61	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.2000	0.1010	0.1505
Priors	0.5000	0.5000	

YEAR 2

Observations	201	DF Total	200
Variables	6	DF Within Classes	199
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	95	95.0000	0.472637	0.500000
Nonbankrupt	Nonbankrupt	106	106.0000	0.527363	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	82	13	95
	86.32	13.68	100.00
Nonbankrupt	18	88	106
	16.98	83.02	100.00
Total	100	101	201
	49.75	50.25	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1368	0.1698	0.1533
Priors	0.5000	0.5000	

YEAR 3

Observations	173	DF Total	172
Variables	6	DF Within Classes	171
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	74	74.0000	0.427746	0.500000
Nonbankrupt	Nonbankrupt	99	99.0000	0.572254	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	55	19	74
	74.32	25.68	100.00
Nonbankrupt	9	90	99
	9.09	90.91	100.00
Total	64	109	173
	36.99	63.01	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.2568	0.0909	0.1738
Priors	0.5000	0.5000	

YEAR 4

Observations	90	DF Total	89
Variables	6	DF Within Classes	88
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	66	66.0000	0.733333	0.500000
Nonbankrupt	Nonbankrupt	24	24.0000	0.266667	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	42	24	66
	63.64	36.36	100.00
Nonbankrupt	0	24	24
	0.00	100.00	100.00
Total	42	48	90
	46.67	53.33	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.3636	0.0000	0.1818
Priors	0.5000	0.5000	

YEAR 5

Observations	43	DF Total	42
Variables	6	DF Within Classes	41
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	27	27.0000	0.627907	0.500000
Nonbankrupt	Nonbankrupt	16	16.0000	0.372093	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	24 88.89	3 11.11	27 100.00
Nonbankrupt	4 25.00	12 75.00	16 100.00
Total	28 65.12	15 34.88	43 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1111	0.2500	0.1806
Priors	0.5000	0.5000	

Results of Non-parametric Discriminant Analysis : Variables (Price, Standard deviation, hi lo bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

YEAR 1

Observations	185	DF Total	184
Variables	6	DF Within Classes	183
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	86	86.0000	0.464865	0.500000
Nonbankrupt	Nonbankrupt	99	99.0000	0.535135	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	65	21	86
	75.58	24.42	100.00
Nonbankrupt	9	90	99
	9.09	90.91	100.00
Total	74	111	185
	40.00	60.00	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.2442	0.0909	0.1675
Priors	0.5000	0.5000	

YEAR 2

Observations	201	DF Total	200
Variables	6	DF Within Classes	199
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	95	95.0000	0.472637	0.500000
Nonbankrupt	Nonbankrupt	106	106.0000	0.527363	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	72	23	95
	75.79	24.21	100.00
Nonbankrupt	18	88	106
	16.98	83.02	100.00
Total	90	111	201
	44.78	55.22	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.2421	0.1698	0.2060
Priors	0.5000	0.5000	

YEAR 3

Observations	174	DF Total	173
Variables	6	DF Within Classes	172
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	75	75.0000	0.431034	0.500000
Nonbankrupt	Nonbankrupt	99	99.0000	0.568966	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	43	32	75
	57.33	42.67	100.00
Nonbankrupt	10	89	99
	10.10	89.90	100.00
Total	53	121	174
	30.46	69.54	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.4267	0.1010	0.2638
Priors	0.5000	0.5000	

YEAR 4

Observations	90	DF Total	89
Variables	6	DF Within Classes	88
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	66	66.0000	0.733333	0.500000
Nonbankrupt	Nonbankrupt	24	24.0000	0.266667	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	36	30	66
	54.55	45.45	100.00
Nonbankrupt	0	24	24
	0.00	100.00	100.00
Total	36	54	90
	40.00	60.00	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.4545	0.0000	0.2273
Priors	0.5000	0.5000	

YEAR 5

Observations	45	DF Total	44
Variables	6	DF Within Classes	43
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	29	29.0000	0.644444	0.500000
Nonbankrupt	Nonbankrupt	16	16.0000	0.355556	0.500000

CLASSIFICATION SUMMARY

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	23	6	29
	79.31	20.69	100.00
Nonbankrupt	5	11	16
	31.25	68.75	100.00
Total	28	17	45
	62.22	37.78	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.2069	0.3125	0.2597
Priors	0.5000	0.5000	

Table 10

Non Parametric Discriminant analysis results for Out of sample validation : Accounting variables

Observations	274	DF Total	273
Variables	17	DF Within Classes	272
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	8	8.0000	0.029197	0.500000
Nonbankrupt	Nonbankrupt	266	266.0000	0.970803	0.500000

Classification summary

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	8 100.00	0 0.00	8 100.00
Nonbankrupt	8 3.01	258 96.99	266 100.00
Total	16 5.84	258 94.16	274 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0301	0.0150
Priors	0.5000	0.5000	

Classification summary for Test Data

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	3	3	6
	50.00	50.00	100.00
Nonbankrupt	3	92	95
	3.16	96.84	100.00
Total	6	95	101
	5.94	94.06	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.5000	0.0316	0.2658
Priors	0.5000	0.5000	

Non Parametric Discriminant analysis results for Out of sample validation :Market variables

Observations	813	DF Total	812
Variables	5	DF Within Classes	811
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	383	383.0000	0.471095	0.500000
Nonbankrupt	Nonbankrupt	430	430.0000	0.528905	0.500000

Classification summary

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	310	73	383
	80.94	19.06	100.00
Nonbankrupt	58	372	430
	13.49	86.51	100.00
Total	368	445	813
	45.26	54.74	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1906	0.1349	0.1627
Priors	0.5000	0.5000	

Classification summary for Test Data

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	94	39	133
	70.68	29.32	100.00
Nonbankrupt	20	96	116
	17.24	82.76	100.00
Total	114	135	249
	45.78	54.22	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.2932	0.1724	0.2328
Priors	0.5000	0.5000	

Non Parametric Discriminant analysis results for Out of sample validation : Market variables without spread and hi lo bid ask spread

Observations	813	DF Total	812
Variables	4	DF Within Classes	811
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	383	383.0000	0.471095	0.500000
Nonbankrupt	Nonbankrupt	430	430.0000	0.528905	0.500000

Classification summary

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	318 83.03	65 16.97	383 100.00
Nonbankrupt	55 12.79	375 87.21	430 100.00
Total	373 45.88	440 54.12	813 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1697	0.1279	0.1488
Priors	0.5000	0.5000	

Classification summary for Test Data

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	87	46	133
	65.41	34.59	100.00
Nonbankrupt	22	94	116
	18.97	81.03	100.00
Total	109	140	249
	43.78	56.22	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.3459	0.1897	0.2678
Priors	0.5000	0.5000	

Non Parametric Discriminant analysis results for Out of sample validation : Market variables without spread and bid ask spread

Observations	823	DF Total	822
Variables	4	DF Within Classes	821
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	392	392.0000	0.476306	0.500000
Nonbankrupt	Nonbankrupt	431	431.0000	0.523694	0.500000

Classification summary

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	316 80.61	76 19.39	392 100.00
Nonbankrupt	78 18.10	353 81.90	431 100.00
Total	394 47.87	429 52.13	823 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1939	0.1810	0.1874
Priors	0.5000	0.5000	

Classification summary for Test Data

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	90	46	136
	66.18	33.82	100.00
Nonbankrupt	49	67	116
	42.24	57.76	100.00
Total	139	113	252
	55.16	44.84	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.3382	0.4224	0.3803
Priors	0.5000	0.5000	

Non Parametric Discriminant analysis results for Out of sample validation : Market variables without bid ask spread and hi lo bid ask spread

Observations	42	DF Total	41
Variables	4	DF Within Classes	40
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	29	29.0000	0.690476	0.500000
Nonbankrupt	Nonbankrupt	13	13.0000	0.309524	0.500000

Classification summary

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	13 44.83	16 55.17	29 100.00
Nonbankrupt	0 0.00	13 100.00	13 100.00
Total	13 30.95	29 69.05	42 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.5517	0.0000	0.2759
Priors	0.5000	0.5000	

Classification summary for Test Data

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	1	9	10
	10.00	90.00	100.00
Nonbankrupt	1	2	3
	33.33	66.67	100.00
Total	2	11	13
	15.38	84.62	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.9000	0.3333	0.6167
Priors	0.5000	0.5000	

Non Parametric Discriminant analysis results for Out of sample validation : Top 3 Account and Market Ratios

Observations	277	DF Total	276
Variables	6	DF Within Classes	275
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	10	10.0000	0.036101	0.500000
Nonbankrupt	Nonbankrupt	267	267.0000	0.963899	0.500000

Classification summary

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	10 100.00	0 0.00	10 100.00
Nonbankrupt	12 4.49	255 95.51	267 100.00
Total	22 7.94	255 92.06	277 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0449	0.0225
Priors	0.5000	0.5000	

Classification summary for Test Data

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	4	3	7
	57.14	42.86	100.00
Nonbankrupt	14	83	97
	14.43	85.57	100.00
Total	18	86	104
	17.31	82.69	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.4286	0.1443	0.2865
Priors	0.5000	0.5000	

Non Parametric Discriminant analysis results for Out of sample validation : Top 3 account and market logarithmic ratios

Observations	218	DF Total	217
Variables	6	DF Within Classes	216
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	4	4.0000	0.018349	0.500000
Nonbankrupt	Nonbankrupt	214	214.0000	0.981651	0.500000

Classification summary

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	4 100.00	0 0.00	4 100.00
Nonbankrupt	7 3.27	207 96.73	214 100.00
Total	11 5.05	207 94.95	218 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.0000	0.0327	0.0164
Priors	0.5000	0.5000	

Classification summary for Test Data

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	2	2	4
	50.00	50.00	100.00
Nonbankrupt	3	75	78
	3.85	96.15	100.00
Total	5	77	82
	6.10	93.90	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.5000	0.0385	0.2692
Priors	0.5000	0.5000	

Non Parametric Discriminant analysis results for Out of sample validation : Variables (Price, Standard deviation, bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

Observations	507	DF Total	506
Variables	6	DF Within Classes	505
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	262	262.0000	0.516765	0.500000
Nonbankrupt	Nonbankrupt	245	245.0000	0.483235	0.500000

Classification summary

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	225 85.88	37 14.12	262 100.00
Nonbankrupt	31 12.65	214 87.35	245 100.00
Total	256 50.49	251 49.51	507 100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.1412	0.1265	0.1339
Priors	0.5000	0.5000	

Classification summary for Test Data

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	53	32	85
	62.35	37.65	100.00
Nonbankrupt	15	84	99
	15.15	84.85	100.00
Total	68	116	184
	36.96	63.04	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.3765	0.1515	0.2640
Priors	0.5000	0.5000	

Non Parametric Discriminant analysis results for Out of sample validation : Variables (Price, Standard deviation, hi lo bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

Observations	510	DF Total	509
Variables	6	DF Within Classes	508
Classes	2	DF Between Classes	1

Class Level Information

BANKRUPTCY	Variable Name	Frequency	Weight	Proportion	Prior Probability
Bankrupt	Bankrupt	265	265.0000	0.519608	0.500000
Nonbankrupt	Nonbankrupt	245	245.0000	0.480392	0.500000

Classification summary

Number of Observations and Percent Classified into BANKRUPTCY

From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	206	59	265
	77.74	22.26	100.00
Nonbankrupt	48	197	245
	19.59	80.41	100.00
Total	254	256	510
	49.80	50.20	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY

	Bankrupt	Nonbankrupt	Total
Rate	0.2226	0.1959	0.2093
Priors	0.5000	0.5000	

Classification summary for Test Data

Number of Observations and Percent Classified into BANKRUPTCY			
From BANKRUPTCY	Bankrupt	Nonbankrupt	Total
Bankrupt	59	27	86
	68.60	31.40	100.00
Nonbankrupt	37	62	99
	37.37	62.63	100.00
Total	96	89	185
	51.89	48.11	100.00
Priors	0.5	0.5	

Error Count Estimates for BANKRUPTCY			
	Bankrupt	Nonbankrupt	Total
Rate	0.3140	0.3737	0.3438
Priors	0.5000	0.5000	

3.6 Summary and Conclusions

Bankruptcy prediction research, especially that employing discriminant analysis, has been around for decades. The early research focuses on the ability of the linear MDA at correctly classifying firms as bankrupt or non-bankrupt. It has been shown that MDA does a good job (better than univariate analysis) at predicting bankruptcy. The subsequent literature focuses on the model specifications, testing the underlying assumptions of the models. It has been clearly documented that the underlying assumptions are often (if not always) violated. Furthermore, most early research employs accounting ratios, which are backward-looking, as the predictors of bankruptcy. Over time, the importance of market variables, which are forward-looking, has been documented. The consensus has been that a mix of accounting ratios and some market variables are best at predicting bankruptcy.

Through the use of linear, quadratic, and nonparametric MDA, along with using sets of only market variables and two different sets of a mix of accounting ratios and market variables, we have two main findings. First, market variables alone are best at correctly classifying bankrupt firms. This is consistent with the hypothesis that market variables should be better in a predictive model since they take into account future prospects, whereas accounting ratios are only a snapshot in time and are always reported after they have taken effect. This finding is consistent when performing an out-of-sample procedure. Second, the nonparametric MDA displays the highest overall accuracy at correctly classifying firms, no matter which set of variables is used. This is important because it allows us to predict bankruptcy without necessarily having to worry about the underlying assumptions.

CHAPTER 4: NEURAL NETWORKS

4.1 Introduction

While bankruptcy prediction has been a very fruitful area of research for decades, it is still in its infancy in terms of accuracy. Most models that are used for bankruptcy prediction hinge on the assumption that the data independent and normally distributed. Even though it has been documented that many of the models used in previous studies are incompatible with the data, there still have not been many solutions. We have demonstrated in the previous chapter that the assumptions are violated for many variables, whether they are accounting ratios or market and microstructure variables. Therefore, traditional models, while somewhat accurate, are not the final solution.

There is always the trade-off between the complexity and accuracy of the model. However, with the improvement in technology, some of the more complicated models are much easier to use now. Therefore, settling for simpler models is less acceptable now. This has led to the application of neural networks in many areas, specifically in bankruptcy prediction.

The use of neural networks has been a positive turning point. Most relations between variables are much more complex than allowed by traditional models. Using this methodology, along with proper and broader variable selection, promising results shall follow. We will apply the neural network methodology, which has shown to be a more robust prediction methodology than older models to bankruptcy prediction, using both forward-looking variables (market and microstructure variables) and backward-looking variables (accounting ratios). While neural networks have been used previously, this will be the first study to use all of these variables.

The most important findings are that the neural networks greatly outperform the traditional models. Furthermore, the neural network performs best five years before bankruptcy. In terms of prediction, this is an improvement when compared to the univariate analysis and the multivariate discriminant analysis. Five years before bankruptcy, the neural network using certain subsets of variables is able to correctly classify bankrupt 97% of the firms. A mix of market variables and accounting ratios leads to the highest classification rates. Namely, the market variables price, the standard deviation of the price, and the bid-ask spread, along with the accounting ratios net income to sales, working capital to total assets, and current liabilities to total assets are best at correctly classifying bankrupt firms and also show the lowest overall misclassification rates.

This study attempts to describe and distinguish these two groups. The remainder of this paper is organized as follows: Section 4.2 reviews the previous literature associated with bankruptcy univariate analysis. Section 4.3 discusses the data used in this study. Section 4.4 describes the methodology. Section 4.5 discusses the results, and Section 1.6 summarizes and concludes.

4.2 Literature Review

Salchenberger et al. (1992) study the ability of neural networks to predict the probability of failure of savings and loan associations, and compare the performance of neural networks with that of traditional models. They conclude that neural networks outperform the traditional models at correctly classifying firms as failed or nonfailed.

Following these results and the prior literature that has found that the assumptions underlying most traditional models are violated when studying bankruptcy

prediction, Coats and Fant (1993) use neural networks to test whether or not this model can outperform Altman's traditional Z score model using the five same ratios as Altman. While the MDA performs better during the year of the going-concern opinion, the neural network performs better in the year leading up to it. Therefore, the neural network is more desirable since earlier prediction is always preferable to later prediction.

Boritz and Kennedy (1995) test different neural network models and also compare these models to the traditional bankruptcy prediction models. The predictive ability of the neural networks vary across different techniques, and the predictive power is highly sensitive to the set of predictors used and to sampling error. Leshno and Spector (1996) perform a similar study and confirm so of the previous findings. They also find that including financial data from periods outside of the bankruptcy period enhance the predictive ability of the model. Also, if an enhancement model is used, which makes the model very strong, then the model becomes too specific to the data used, rather than as a predictive model.

Jo et al. (1997) compare the accuracy of neural networks and multivariate discriminant analysis at predicting bankruptcy of Korean firms. Using different specifications and variables selection methods, they find that neural networks outperform the traditional multivariate discriminant analysis.

Yang et al. (1999) study different neural network models and also compare them to the traditional predictive models. Unlike the prior literature on bankruptcy prediction employing neural networks, they find that discriminant analysis outperformed the neural network models, especially at correctly classifying bankrupt firms.

4.3 Data

The list of bankrupt firms was obtained from bankruptcydata.com. The list includes companies the filed for bankruptcy from January 1995 to December 2010. The subsample of non-bankrupt firms comes from the entire database of Compustat, consisting of firms that did not file for bankruptcy during our sample period. The accounting ratios for all firms, bankrupt and non-bankrupt, are obtained from Compustat. The market variables for these firms were obtained from CRSP.

4.4 Methodology

A neural network is a collection of elements that are connected by nodes. It is designed after the human brain. Unlike traditional models that require stringent assumptions, the neural network tries to find connections between the input and output variables, regardless the distribution of the variables. A weighted combination of the inputs is created, called NET. The output can be a weighted combination of the inputs or a nonlinear transformation of the NET. Two types of neural networks are used: multi-layer perceptron and radial basis function networks. Like all neural networks, these types of neural networks make no assumptions about the underlying probability density functions.

The multi-layer perceptron consists of three or more layers: an input and output layer with one or more hidden layers. Each node in a layer connects with a specific weight to every node in the proceeding layer. This is followed by a learning process. The weights change every time a new piece of data is processed, and this is based on the amount of error in the output when compared to the expected result. This is done through backpropagation, which minimizes the objective function. This optimization process is

most useful for neural networks that do not have any feedback. The radial basis functions are similar, but they are a more specialized activation function.

4.5. Empirical Results

Since the set of market variables and two subsets of accounting and market variables have proven to be the best in the previous chapters, we will focus on those in this chapter. We begin with the Multi-Layer Perceptron results, and then follow with the Radial basis functions.

Starting with the market variables, the multi-layer perceptron correctly classifies bankrupt firms 86%, 81%, 80%, 92%, and 87% of the time in years one through five, and 88%, 81%, 77%, 88%, and 92% for nonbankrupt firms in years one through five. The classification rates are higher than those for traditional models, but more important, the model is better at classifying both bankrupt and non-bankrupt firms five years before bankruptcy than it is at classifying firms one year before bankruptcy. As a predictive model, this is desirable. The overall misclassification rates are 12.5% and 10% in years one and five, respectively.

This is promising on two fronts. First, as mentioned above, market variables are forward-looking variables. Therefore, in a predictive framework, the input variables should be those that contain information about the future. Accounting ratios are not useless, but they do contain mostly stale information. The above results validate this. Second, a less stringent yet more technical model is desirable because financial distress, and the path taken to get there, is not a simple, clear path. Univariate analysis and multivariate discriminant analysis are not poor statistical techniques for certain studies,

but they lack the precision and breadth that the neural network allows. This is also evident in the following results

Table 11

Results of Multi Layer Perceptron : Accounting variables

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	17
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	140
DFM	Model Degrees of Freedom.	115
_NW_	Number of Estimated Weights.	115
AIC	Akaike's Information Criterion.	239.105
SBC	Schwarz's Bayesian Criterion.	646.351
ASE	Average Squared Error.	0.003
MAX	Maximum Absolute Error.	0.496
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.059
SSE	Sum of Squared Errors.	1.755
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.009
MSE	Mean Squared Error.	0.006
RFPE	Root Final Prediction Error.	0.095
RMSE	Root Mean Squared Error.	0.079
AVERR	Average Error Function.	0.018
ERR	Error Function.	9.105
MISC	Misclassification Rate.	0
WRONG	Number of Wrong Classifications.	0

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	100	100	138	54.1176
NONBANKRUPT	NONBANKRUPT	100	100	117	45.8824

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	17
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	127
DFM	Model Degrees of Freedom.	115
_NW_	Number of Estimated Weights.	115
AIC	Akaike's Information Criterion.	233.523
SBC	Schwarz's Bayesian Criterion.	634.751
ASE	Average Squared Error.	0.002
MAX	Maximum Absolute Error.	0.476
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.04
SSE	Sum of Squared Errors.	0.792
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.005
MSE	Mean Squared Error.	0.003
RFPE	Root Final Prediction Error.	0.068
RMSE	Root Mean Squared Error.	0.056
AVERR	Average Error Function.	0.007
ERR	Error Function.	3.523
MISC	Misclassification Rate.	0
WRONG	Number of Wrong Classifications.	0

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	100	100	129	53.3058
NONBANKRUPT	NONBANKRUPT	100	100	113	46.6942

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	17
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	104
DFM	Model Degrees of Freedom.	115
_NW_	Number of Estimated Weights.	115
AIC	Akaike's Information Criterion.	244.337
SBC	Schwarz's Bayesian Criterion.	634.081
ASE	Average Squared Error.	0.006
MAX	Maximum Absolute Error.	0.486
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.079
SSE	Sum of Squared Errors.	2.699
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.02
MSE	Mean Squared Error.	0.013
RFPE	Root Final Prediction Error.	0.141
RMSE	Root Mean Squared Error.	0.114
AVERR	Average Error Function.	0.033
ERR	Error Function.	14.337
MISC	Misclassification Rate.	0
WRONG	Number of Wrong Classifications.	0

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	100	100	108	49.3151
NONBANKRUPT	NONBANKRUPT	100	100	111	50.6849

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	17
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	80
DFM	Model Degrees of Freedom.	115
_NW_	Number of Estimated Weights.	115
AIC	Akaike's Information Criterion.	242.227
SBC	Schwarz's Bayesian Criterion.	618.622
ASE	Average Squared Error.	0.006
MAX	Maximum Absolute Error.	0.465
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.078
SSE	Sum of Squared Errors.	2.385
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.024
MSE	Mean Squared Error.	0.015
RFPE	Root Final Prediction Error.	0.154
RMSE	Root Mean Squared Error.	0.122
AVERR	Average Error Function.	0.031
ERR	Error Function.	12.227
MISC	Misclassification Rate.	0
WRONG	Number of Wrong Classifications.	0

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	100	100	85	43.5897
NONBANKRUPT	NONBANKRUPT	100	100	110	56.4103

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	17
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	53
DFM	Model Degrees of Freedom.	115
_NW_	Number of Estimated Weights.	115
AIC	Akaike's Information Criterion.	238.324
SBC	Schwarz's Bayesian Criterion.	597.58
ASE	Average Squared Error.	0.004
MAX	Maximum Absolute Error.	0.373
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.065
SSE	Sum of Squared Errors.	1.422
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.023
MSE	Mean Squared Error.	0.013
RFPE	Root Final Prediction Error.	0.15
RMSE	Root Mean Squared Error.	0.116
AVERR	Average Error Function.	0.025
ERR	Error Function.	8.324
MISC	Misclassification Rate.	0
WRONG	Number of Wrong Classifications.	0

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	100	100	70	41.6667
NONBANKRUPT	NONBANKRUPT	100	100	98	58.3333

Results of Multi Layer Perceptron : Market variables

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	5
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	212
DFM	Model Degrees of Freedom.	43
_NW_	Number of Estimated Weights.	43
AIC	Akaike's Information Criterion.	254.472
SBC	Schwarz's Bayesian Criterion.	406.746
ASE	Average Squared Error.	0.102
MAX	Maximum Absolute Error.	0.937
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.319
SSE	Sum of Squared Errors.	51.802
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.143
MSE	Mean Squared Error.	0.122
RFPE	Root Final Prediction Error.	0.378
RMSE	Root Mean Squared Error.	0.35
AVERR	Average Error Function.	0.33
ERR	Error Function.	168.472
MISC	Misclassification Rate.	0.125
WRONG	Number of Wrong Classifications.	32

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	86.3014	91.3043	126	49.4118
NONBANKRUPT	BANKRUPT	13.6986	17.094	20	7.8431
BANKRUPT	NONBANKRUPT	11.0092	8.6957	12	4.7059
NONBANKRUPT	NONBANKRUPT	88.9908	82.906	97	38.0392

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	5
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	199
DFM	Model Degrees of Freedom.	43
_NW_	Number of Estimated Weights.	43
AIC	Akaike's Information Criterion.	297.655
SBC	Schwarz's Bayesian Criterion.	447.679
ASE	Average Squared Error.	0.139
MAX	Maximum Absolute Error.	0.912
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.373
SSE	Sum of Squared Errors.	67.439
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.2
MSE	Mean Squared Error.	0.169

RFPE	Root Final Prediction Error.	0.447
RMSE	Root Mean Squared Error.	0.412
AVERR	Average Error Function.	0.437
ERR	Error Function.	211.655
MISC	Misclassification Rate.	0.19
WRONG	Number of Wrong Classifications.	46

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	81.203	83.7209	108	44.6281
NONBANKRUPT	BANKRUPT	18.797	22.1239	25	10.3306
BANKRUPT	NONBANKRUPT	19.2661	16.2791	21	8.6777
NONBANKRUPT	NONBANKRUPT	80.7339	77.8761	88	36.3636

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	5
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	176
DFM	Model Degrees of Freedom.	43
_NW_	Number of Estimated Weights.	43
AIC	Akaike's Information Criterion.	287.3
SBC	Schwarz's Bayesian Criterion.	433.03
ASE	Average Squared Error.	0.153
MAX	Maximum Absolute Error.	0.923
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.391
SSE	Sum of Squared Errors.	66.834
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.227

MSE	Mean Squared Error.	0.19
RFPE	Root Final Prediction Error.	0.477
RMSE	Root Mean Squared Error.	0.436
AVERR	Average Error Function.	0.46
ERR	Error Function.	201.3
MISC	Misclassification Rate.	0.21
WRONG	Number of Wrong Classifications.	46

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	80.3922	75.9259	82	37.4429
NONBANKRUPT	BANKRUPT	19.6078	18.018	20	9.1324
BANKRUPT	NONBANKRUPT	22.2222	24.0741	26	11.8721
NONBANKRUPT	NONBANKRUPT	77.7778	81.982	91	41.5525

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	5
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	152
DFM	Model Degrees of Freedom.	43
_NW_	Number of Estimated Weights.	43
AIC	Akaike's Information Criterion.	190.354
SBC	Schwarz's Bayesian Criterion.	331.093
ASE	Average Squared Error.	0.081
MAX	Maximum Absolute Error.	0.941
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.285
SSE	Sum of Squared Errors.	31.766
SUMW	Sum of Case Weights Times Freq.	390

FPE	Final Prediction Error.	0.128
MSE	Mean Squared Error.	0.104
RFPE	Root Final Prediction Error.	0.357
RMSE	Root Mean Squared Error.	0.323
AVERR	Average Error Function.	0.268
ERR	Error Function.	104.354
MISC	Misclassification Rate.	0.097
WRONG	Number of Wrong Classifications.	19

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	92.3077	84.7059	72	36.9231
NONBANKRUPT	BANKRUPT	7.6923	5.4545	6	3.0769
BANKRUPT	NONBANKRUPT	11.1111	15.2941	13	6.6667
NONBANKRUPT	NONBANKRUPT	88.8889	94.5455	104	53.3333

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	5
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	125
DFM	Model Degrees of Freedom.	43
_NW_	Number of Estimated Weights.	43
AIC	Akaike's Information Criterion.	186.053
SBC	Schwarz's Bayesian Criterion.	320.384
ASE	Average Squared Error.	0.092
MAX	Maximum Absolute Error.	0.954
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.303
SSE	Sum of Squared Errors.	30.768

SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.155
MSE	Mean Squared Error.	0.123
RFPE	Root Final Prediction Error.	0.393
RMSE	Root Mean Squared Error.	0.351
AVERR	Average Error Function.	0.298
ERR	Error Function.	100.053
MISC	Misclassification Rate.	0.101
WRONG	Number of Wrong Classifications.	17

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	87.3239	88.5714	62	36.9048
NONBANKRUPT	BANKRUPT	12.6761	9.1837	9	5.3571
BANKRUPT	NONBANKRUPT	8.2474	11.4286	8	4.7619
NONBANKRUPT	NONBANKRUPT	91.7526	90.8163	89	52.9762

Results of Multi Layer Perceptron : Market variables without spread and hi lo bid ask spread

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	218
DFM	Model Degrees of Freedom.	37
_NW_	Number of Estimated Weights.	37
AIC	Akaike's Information Criterion.	296.65
SBC	Schwarz's Bayesian Criterion.	427.676
ASE	Average Squared Error.	0.141
MAX	Maximum Absolute Error.	0.959
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.376
SSE	Sum of Squared Errors.	72.028
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.189
MSE	Mean Squared Error.	0.165
RFPE	Root Final Prediction Error.	0.435
RMSE	Root Mean Squared Error.	0.406
AVERR	Average Error Function.	0.437
ERR	Error Function.	222.65
MISC	Misclassification Rate.	0.196
WRONG	Number of Wrong Classifications.	50

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	83.8462	78.9855	109	42.7451
NONBANKRUPT	BANKRUPT	16.1538	17.9487	21	8.2353
BANKRUPT	NONBANKRUPT	23.2	21.0145	29	11.3725
NONBANKRUPT	NONBANKRUPT	76.8	82.0513	96	37.6471

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	205
DFM	Model Degrees of Freedom.	37
_NW_	Number of Estimated Weights.	37
AIC	Akaike's Information Criterion.	305.497
SBC	Schwarz's Bayesian Criterion.	434.588
ASE	Average Squared Error.	0.155
MAX	Maximum Absolute Error.	0.919
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.394
SSE	Sum of Squared Errors.	74.984
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.211
MSE	Mean Squared Error.	0.183
RFPE	Root Final Prediction Error.	0.459
RMSE	Root Mean Squared Error.	0.428
AVERR	Average Error Function.	0.478
ERR	Error Function.	231.497
MISC	Misclassification Rate.	0.211
WRONG	Number of Wrong Classifications.	51

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	77.0833	86.0465	111	45.8678
NONBANKRUPT	BANKRUPT	22.9167	29.2035	33	13.6364
BANKRUPT	NONBANKRUPT	18.3673	13.9535	18	7.438
NONBANKRUPT	NONBANKRUPT	81.6327	70.7965	80	33.0579

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	182
DFM	Model Degrees of Freedom.	37
_NW_	Number of Estimated Weights.	37
AIC	Akaike's Information Criterion.	281.888
SBC	Schwarz's Bayesian Criterion.	407.284
ASE	Average Squared Error.	0.157
MAX	Maximum Absolute Error.	0.95
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.396
SSE	Sum of Squared Errors.	68.587
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.22
MSE	Mean Squared Error.	0.188
RFPE	Root Final Prediction Error.	0.469
RMSE	Root Mean Squared Error.	0.434
AVERR	Average Error Function.	0.475
ERR	Error Function.	207.888
MISC	Misclassification Rate.	0.219
WRONG	Number of Wrong Classifications.	48

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	75.8621	81.4815	88	40.1826
NONBANKRUPT	BANKRUPT	24.1379	25.2252	28	12.7854
BANKRUPT	NONBANKRUPT	19.4175	18.5185	20	9.1324
NONBANKRUPT	NONBANKRUPT	80.5825	74.7748	83	37.8995

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	158
DFM	Model Degrees of Freedom.	37
_NW_	Number of Estimated Weights.	37
AIC	Akaike's Information Criterion.	200.982
SBC	Schwarz's Bayesian Criterion.	322.083
ASE	Average Squared Error.	0.102
MAX	Maximum Absolute Error.	0.965
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.319
SSE	Sum of Squared Errors.	39.801
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.15
MSE	Mean Squared Error.	0.126
RFPE	Root Final Prediction Error.	0.387
RMSE	Root Mean Squared Error.	0.355
AVERR	Average Error Function.	0.326
ERR	Error Function.	126.982
MISC	Misclassification Rate.	0.128
WRONG	Number of Wrong Classifications.	25

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	84.8837	85.8824	73	37.4359
NONBANKRUPT	BANKRUPT	15.1163	11.8182	13	6.6667
BANKRUPT	NONBANKRUPT	11.0092	14.1176	12	6.1538
NONBANKRUPT	NONBANKRUPT	88.9908	88.1818	97	49.7436

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	131
DFM	Model Degrees of Freedom.	37
_NW_	Number of Estimated Weights.	37
AIC	Akaike's Information Criterion.	176.618
SBC	Schwarz's Bayesian Criterion.	292.205
ASE	Average Squared Error.	0.094
MAX	Maximum Absolute Error.	0.971
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.307
SSE	Sum of Squared Errors.	31.688
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.148
MSE	Mean Squared Error.	0.121
RFPE	Root Final Prediction Error.	0.384
RMSE	Root Mean Squared Error.	0.348
AVERR	Average Error Function.	0.305
ERR	Error Function.	102.618
MISC	Misclassification Rate.	0.119
WRONG	Number of Wrong Classifications.	20

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	84.7222	87.1429	61	36.3095
NONBANKRUPT	BANKRUPT	15.2778	11.2245	11	6.5476
BANKRUPT	NONBANKRUPT	9.375	12.8571	9	5.3571
NONBANKRUPT	NONBANKRUPT	90.625	88.7755	87	51.7857

Results of Multi Layer Perceptron : Market variables without spread and bid ask spread

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	218
DFM	Model Degrees of Freedom.	37
_NW_	Number of Estimated Weights.	37
AIC	Akaike's Information Criterion.	293.559
SBC	Schwarz's Bayesian Criterion.	424.586
ASE	Average Squared Error.	0.137
MAX	Maximum Absolute Error.	0.954
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.37
SSE	Sum of Squared Errors.	69.776
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.183
MSE	Mean Squared Error.	0.16
RFPE	Root Final Prediction Error.	0.428
RMSE	Root Mean Squared Error.	0.4
AVERR	Average Error Function.	0.431
ERR	Error Function.	219.559
MISC	Misclassification Rate.	0.196
WRONG	Number of Wrong Classifications.	50

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	78.9474	86.9565	120	47.0588
NONBANKRUPT	BANKRUPT	21.0526	27.3504	32	12.549
BANKRUPT	NONBANKRUPT	17.4757	13.0435	18	7.0588
NONBANKRUPT	NONBANKRUPT	82.5243	72.6496	85	33.3333

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	205
DFM	Model Degrees of Freedom.	37
_NW_	Number of Estimated Weights.	37
AIC	Akaike's Information Criterion.	349.622
SBC	Schwarz's Bayesian Criterion.	478.712
ASE	Average Squared Error.	0.195
MAX	Maximum Absolute Error.	0.854
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.442
SSE	Sum of Squared Errors.	94.617
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.266
MSE	Mean Squared Error.	0.231
RFPE	Root Final Prediction Error.	0.516
RMSE	Root Mean Squared Error.	0.48
AVERR	Average Error Function.	0.569
ERR	Error Function.	275.622
MISC	Misclassification Rate.	0.298
WRONG	Number of Wrong Classifications.	72

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	67.7019	84.4961	109	45.0413
NONBANKRUPT	BANKRUPT	32.2981	46.0177	52	21.4876
BANKRUPT	NONBANKRUPT	24.6914	15.5039	20	8.2645
NONBANKRUPT	NONBANKRUPT	75.3086	53.9823	61	25.2066

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	182
DFM	Model Degrees of Freedom.	37
_NW_	Number of Estimated Weights.	37
AIC	Akaike's Information Criterion.	324.718
SBC	Schwarz's Bayesian Criterion.	450.113
ASE	Average Squared Error.	0.197
MAX	Maximum Absolute Error.	0.803
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.444
SSE	Sum of Squared Errors.	86.423
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.278
MSE	Mean Squared Error.	0.237
RFPE	Root Final Prediction Error.	0.527
RMSE	Root Mean Squared Error.	0.487
AVERR	Average Error Function.	0.572
ERR	Error Function.	250.718
MISC	Misclassification Rate.	0.297
WRONG	Number of Wrong Classifications.	65

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	67.2	77.7778	84	38.3562
NONBANKRUPT	BANKRUPT	32.8	36.9369	41	18.7215
BANKRUPT	NONBANKRUPT	25.5319	22.2222	24	10.9589
NONBANKRUPT	NONBANKRUPT	74.4681	63.0631	70	31.9635

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	158
DFM	Model Degrees of Freedom.	37
_NW_	Number of Estimated Weights.	37
AIC	Akaike's Information Criterion.	267.887
SBC	Schwarz's Bayesian Criterion.	388.988
ASE	Average Squared Error.	0.169
MAX	Maximum Absolute Error.	0.902
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.411
SSE	Sum of Squared Errors.	65.74
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.248
MSE	Mean Squared Error.	0.208
RFPE	Root Final Prediction Error.	0.498
RMSE	Root Mean Squared Error.	0.456
AVERR	Average Error Function.	0.497
ERR	Error Function.	193.887
MISC	Misclassification Rate.	0.262
WRONG	Number of Wrong Classifications.	51

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	67.7083	76.4706	65	33.3333
NONBANKRUPT	BANKRUPT	32.2917	28.1818	31	15.8974
BANKRUPT	NONBANKRUPT	20.202	23.5294	20	10.2564
NONBANKRUPT	NONBANKRUPT	79.798	71.8182	79	40.5128

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	131
DFM	Model Degrees of Freedom.	37
_NW_	Number of Estimated Weights.	37
AIC	Akaike's Information Criterion.	229.214
SBC	Schwarz's Bayesian Criterion.	344.801
ASE	Average Squared Error.	0.153
MAX	Maximum Absolute Error.	0.974
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.391
SSE	Sum of Squared Errors.	51.495
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.24
MSE	Mean Squared Error.	0.197
RFPE	Root Final Prediction Error.	0.49
RMSE	Root Mean Squared Error.	0.443
AVERR	Average Error Function.	0.462
ERR	Error Function.	155.214
MISC	Misclassification Rate.	0.226
WRONG	Number of Wrong Classifications.	38

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	72.8571	72.8571	51	30.3571
NONBANKRUPT	BANKRUPT	27.1429	19.3878	19	11.3095
BANKRUPT	NONBANKRUPT	19.3878	27.1429	19	11.3095
NONBANKRUPT	NONBANKRUPT	80.6122	80.6122	79	47.0238

Results of Multi Layer Perceptron : Market variables without bid ask spread and hi lo bid ask spread

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	218
DFM	Model Degrees of Freedom.	37
_NW_	Number of Estimated Weights.	37
AIC	Akaike's Information Criterion.	354.963
SBC	Schwarz's Bayesian Criterion.	485.989
ASE	Average Squared Error.	0.189
MAX	Maximum Absolute Error.	0.902
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.434
SSE	Sum of Squared Errors.	96.281
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.253
MSE	Mean Squared Error.	0.221
RFPE	Root Final Prediction Error.	0.503
RMSE	Root Mean Squared Error.	0.47
AVERR	Average Error Function.	0.551
ERR	Error Function.	280.963
MISC	Misclassification Rate.	0.275
WRONG	Number of Wrong Classifications.	70

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	71.7949	81.1594	112	43.9216
NONBANKRUPT	BANKRUPT	28.2051	37.6068	44	17.2549
BANKRUPT	NONBANKRUPT	26.2626	18.8406	26	10.1961
NONBANKRUPT	NONBANKRUPT	73.7374	62.3932	73	28.6275

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	205
DFM	Model Degrees of Freedom.	37
_NW_	Number of Estimated Weights.	37
AIC	Akaike's Information Criterion.	360.782
SBC	Schwarz's Bayesian Criterion.	489.873
ASE	Average Squared Error.	0.206
MAX	Maximum Absolute Error.	0.767
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.454
SSE	Sum of Squared Errors.	99.646
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.28
MSE	Mean Squared Error.	0.243
RFPE	Root Final Prediction Error.	0.529
RMSE	Root Mean Squared Error.	0.493
AVERR	Average Error Function.	0.593
ERR	Error Function.	286.782
MISC	Misclassification Rate.	0.318
WRONG	Number of Wrong Classifications.	77

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	67.5676	77.5194	100	41.3223
NONBANKRUPT	BANKRUPT	32.4324	42.4779	48	19.8347
BANKRUPT	NONBANKRUPT	30.8511	22.4806	29	11.9835
NONBANKRUPT	NONBANKRUPT	69.1489	57.5221	65	26.8595

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	182
DFM	Model Degrees of Freedom.	37
_NW_	Number of Estimated Weights.	37
AIC	Akaike's Information Criterion.	323.336
SBC	Schwarz's Bayesian Criterion.	448.732
ASE	Average Squared Error.	0.196
MAX	Maximum Absolute Error.	0.796
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.442
SSE	Sum of Squared Errors.	85.738
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.275
MSE	Mean Squared Error.	0.236
RFPE	Root Final Prediction Error.	0.525
RMSE	Root Mean Squared Error.	0.485
AVERR	Average Error Function.	0.569
ERR	Error Function.	249.336
MISC	Misclassification Rate.	0.279
WRONG	Number of Wrong Classifications.	61

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	69.4215	77.7778	84	38.3562
NONBANKRUPT	BANKRUPT	30.5785	33.3333	37	16.895
BANKRUPT	NONBANKRUPT	24.4898	22.2222	24	10.9589
NONBANKRUPT	NONBANKRUPT	75.5102	66.6667	74	33.79

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	158
DFM	Model Degrees of Freedom.	37
_NW_	Number of Estimated Weights.	37
AIC	Akaike's Information Criterion.	281.918
SBC	Schwarz's Bayesian Criterion.	403.019
ASE	Average Squared Error.	0.183
MAX	Maximum Absolute Error.	0.925
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.428
SSE	Sum of Squared Errors.	71.309
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.268
MSE	Mean Squared Error.	0.226
RFPE	Root Final Prediction Error.	0.518
RMSE	Root Mean Squared Error.	0.475
AVERR	Average Error Function.	0.533
ERR	Error Function.	207.918
MISC	Misclassification Rate.	0.262
WRONG	Number of Wrong Classifications.	51

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	68.4783	74.1176	63	32.3077
NONBANKRUPT	BANKRUPT	31.5217	26.3636	29	14.8718
BANKRUPT	NONBANKRUPT	21.3592	25.8824	22	11.2821
NONBANKRUPT	NONBANKRUPT	78.6408	73.6364	81	41.5385

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	131
DFM	Model Degrees of Freedom.	37
_NW_	Number of Estimated Weights.	37
AIC	Akaike's Information Criterion.	252.594
SBC	Schwarz's Bayesian Criterion.	368.181
ASE	Average Squared Error.	0.182
MAX	Maximum Absolute Error.	0.932
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.427
SSE	Sum of Squared Errors.	61.217
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.285
MSE	Mean Squared Error.	0.234
RFPE	Root Final Prediction Error.	0.534
RMSE	Root Mean Squared Error.	0.483
AVERR	Average Error Function.	0.532
ERR	Error Function.	178.594
MISC	Misclassification Rate.	0.28
WRONG	Number of Wrong Classifications.	47

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	64.9351	71.4286	50	29.7619
NONBANKRUPT	BANKRUPT	35.0649	27.551	27	16.0714
BANKRUPT	NONBANKRUPT	21.978	28.5714	20	11.9048
NONBANKRUPT	NONBANKRUPT	78.022	72.449	71	42.2619

Results of Multi Layer Perceptron : Top 3 Account and Market variables

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	206
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	254.282
SBC	Schwarz's Bayesian Criterion.	427.804
ASE	Average Squared Error.	0.094
MAX	Maximum Absolute Error.	0.947
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.307
SSE	Sum of Squared Errors.	48.082
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.139
MSE	Mean Squared Error.	0.117
RFPE	Root Final Prediction Error.	0.373
RMSE	Root Mean Squared Error.	0.342
AVERR	Average Error Function.	0.306
ERR	Error Function.	156.282
MISC	Misclassification Rate.	0.122
WRONG	Number of Wrong Classifications.	31

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	86.3946	92.029	127	49.8039
NONBANKRUPT	BANKRUPT	13.6054	17.094	20	7.8431
BANKRUPT	NONBANKRUPT	10.1852	7.971	11	4.3137
NONBANKRUPT	NONBANKRUPT	89.8148	82.906	97	38.0392

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	193
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	246.106
SBC	Schwarz's Bayesian Criterion.	417.064
ASE	Average Squared Error.	0.094
MAX	Maximum Absolute Error.	0.972
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.307
SSE	Sum of Squared Errors.	45.516
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.142
MSE	Mean Squared Error.	0.118
RFPE	Root Final Prediction Error.	0.377
RMSE	Root Mean Squared Error.	0.343
AVERR	Average Error Function.	0.306
ERR	Error Function.	148.106
MISC	Misclassification Rate.	0.112
WRONG	Number of Wrong Classifications.	27

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	88.0597	91.4729	118	48.7603
NONBANKRUPT	BANKRUPT	11.9403	14.1593	16	6.6116
BANKRUPT	NONBANKRUPT	10.1852	8.5271	11	4.5455
NONBANKRUPT	NONBANKRUPT	89.8148	85.8407	97	40.0826

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	170
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	232.603
SBC	Schwarz's Bayesian Criterion.	398.667
ASE	Average Squared Error.	0.093
MAX	Maximum Absolute Error.	0.975
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.305
SSE	Sum of Squared Errors.	40.777
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.147
MSE	Mean Squared Error.	0.12
RFPE	Root Final Prediction Error.	0.383
RMSE	Root Mean Squared Error.	0.346
AVERR	Average Error Function.	0.307
ERR	Error Function.	134.603
MISC	Misclassification Rate.	0.105
WRONG	Number of Wrong Classifications.	23

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	89.7196	88.8889	96	43.8356
NONBANKRUPT	BANKRUPT	10.2804	9.9099	11	5.0228
BANKRUPT	NONBANKRUPT	10.7143	11.1111	12	5.4795
NONBANKRUPT	NONBANKRUPT	89.2857	90.0901	100	45.6621

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	146
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	168.74
SBC	Schwarz's Bayesian Criterion.	329.117
ASE	Average Squared Error.	0.057
MAX	Maximum Absolute Error.	0.858
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.239
SSE	Sum of Squared Errors.	22.291
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.096
MSE	Mean Squared Error.	0.076
RFPE	Root Final Prediction Error.	0.309
RMSE	Root Mean Squared Error.	0.276
AVERR	Average Error Function.	0.181
ERR	Error Function.	70.74
MISC	Misclassification Rate.	0.072
WRONG	Number of Wrong Classifications.	14

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	93.8272	89.4118	76	38.9744
NONBANKRUPT	BANKRUPT	6.1728	4.5455	5	2.5641
BANKRUPT	NONBANKRUPT	7.8947	10.5882	9	4.6154
NONBANKRUPT	NONBANKRUPT	92.1053	95.4545	105	53.8462

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	119
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	169.834
SBC	Schwarz's Bayesian Criterion.	322.908
ASE	Average Squared Error.	0.066
MAX	Maximum Absolute Error.	0.941
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.256
SSE	Sum of Squared Errors.	22.103
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.12
MSE	Mean Squared Error.	0.093
RFPE	Root Final Prediction Error.	0.346
RMSE	Root Mean Squared Error.	0.305
AVERR	Average Error Function.	0.214
ERR	Error Function.	71.834
MISC	Misclassification Rate.	0.083
WRONG	Number of Wrong Classifications.	14

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	88.8889	91.4286	64	38.0952
NONBANKRUPT	BANKRUPT	11.1111	8.1633	8	4.7619
BANKRUPT	NONBANKRUPT	6.25	8.5714	6	3.5714
NONBANKRUPT	NONBANKRUPT	93.75	91.8367	90	53.5714

Results of Multi Layer Perceptron : Top 3 Account and Market logarithmic variables

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	206
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	286.941
SBC	Schwarz's Bayesian Criterion.	460.463
ASE	Average Squared Error.	0.113
MAX	Maximum Absolute Error.	0.972
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.336
SSE	Sum of Squared Errors.	57.618
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.167
MSE	Mean Squared Error.	0.14
RFPE	Root Final Prediction Error.	0.408
RMSE	Root Mean Squared Error.	0.374
AVERR	Average Error Function.	0.37
ERR	Error Function.	188.941
MISC	Misclassification Rate.	0.137
WRONG	Number of Wrong Classifications.	35

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	87.5912	86.9565	120	47.0588
NONBANKRUPT	BANKRUPT	12.4088	14.5299	17	6.6667
BANKRUPT	NONBANKRUPT	15.2542	13.0435	18	7.0588
NONBANKRUPT	NONBANKRUPT	84.7458	85.4701	100	39.2157

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	193
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	278.68
SBC	Schwarz's Bayesian Criterion.	449.638
ASE	Average Squared Error.	0.118
MAX	Maximum Absolute Error.	0.964
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.344
SSE	Sum of Squared Errors.	57.23
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.178
MSE	Mean Squared Error.	0.148
RFPE	Root Final Prediction Error.	0.422
RMSE	Root Mean Squared Error.	0.385
AVERR	Average Error Function.	0.373
ERR	Error Function.	180.68
MISC	Misclassification Rate.	0.161
WRONG	Number of Wrong Classifications.	39

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	84.0909	86.0465	111	45.8678
NONBANKRUPT	BANKRUPT	15.9091	18.5841	21	8.6777
BANKRUPT	NONBANKRUPT	16.3636	13.9535	18	7.438
NONBANKRUPT	NONBANKRUPT	83.6364	81.4159	92	38.0165

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	170
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	240.753
SBC	Schwarz's Bayesian Criterion.	406.818
ASE	Average Squared Error.	0.101
MAX	Maximum Absolute Error.	0.975
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.318
SSE	Sum of Squared Errors.	44.213
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.159
MSE	Mean Squared Error.	0.13
RFPE	Root Final Prediction Error.	0.399
RMSE	Root Mean Squared Error.	0.361
AVERR	Average Error Function.	0.326
ERR	Error Function.	142.753
MISC	Misclassification Rate.	0.11
WRONG	Number of Wrong Classifications.	24

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	88.1818	89.8148	97	44.2922
NONBANKRUPT	BANKRUPT	11.8182	11.7117	13	5.9361
BANKRUPT	NONBANKRUPT	10.0917	10.1852	11	5.0228
NONBANKRUPT	NONBANKRUPT	89.9083	88.2883	98	44.7489

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	146
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	192.392
SBC	Schwarz's Bayesian Criterion.	352.769
ASE	Average Squared Error.	0.077
MAX	Maximum Absolute Error.	0.981
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.277
SSE	Sum of Squared Errors.	29.947
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.128
MSE	Mean Squared Error.	0.103
RFPE	Root Final Prediction Error.	0.358
RMSE	Root Mean Squared Error.	0.32
AVERR	Average Error Function.	0.242
ERR	Error Function.	94.392
MISC	Misclassification Rate.	0.103
WRONG	Number of Wrong Classifications.	20

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	88.2353	88.2353	75	38.4615
NONBANKRUPT	BANKRUPT	11.7647	9.0909	10	5.1282
BANKRUPT	NONBANKRUPT	9.0909	11.7647	10	5.1282
NONBANKRUPT	NONBANKRUPT	90.9091	90.9091	100	51.2821

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	119
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	219.711
SBC	Schwarz's Bayesian Criterion.	372.786
ASE	Average Squared Error.	0.113
MAX	Maximum Absolute Error.	0.916
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.336
SSE	Sum of Squared Errors.	37.897
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.206
MSE	Mean Squared Error.	0.159
RFPE	Root Final Prediction Error.	0.454
RMSE	Root Mean Squared Error.	0.399
AVERR	Average Error Function.	0.362
ERR	Error Function.	121.711
MISC	Misclassification Rate.	0.125
WRONG	Number of Wrong Classifications.	21

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	90.1639	78.5714	55	32.7381
NONBANKRUPT	BANKRUPT	9.8361	6.1224	6	3.5714
BANKRUPT	NONBANKRUPT	14.0187	21.4286	15	8.9286
NONBANKRUPT	NONBANKRUPT	85.9813	93.8776	92	54.7619

Results of Multi Layer Perceptron : Variables (Price, Standard deviation, bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	206
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	259.926
SBC	Schwarz's Bayesian Criterion.	433.448
ASE	Average Squared Error.	0.096
MAX	Maximum Absolute Error.	0.968
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.31
SSE	Sum of Squared Errors.	49.015
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.142
MSE	Mean Squared Error.	0.119
RFPE	Root Final Prediction Error.	0.377
RMSE	Root Mean Squared Error.	0.345
AVERR	Average Error Function.	0.318
ERR	Error Function.	161.926
MISC	Misclassification Rate.	0.106
WRONG	Number of Wrong Classifications.	27

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	90.5109	89.8551	124	48.6275
NONBANKRUPT	BANKRUPT	9.4891	11.1111	13	5.098
BANKRUPT	NONBANKRUPT	11.8644	10.1449	14	5.4902
NONBANKRUPT	NONBANKRUPT	88.1356	88.8889	104	40.7843

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	193
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	280.076
SBC	Schwarz's Bayesian Criterion.	451.034
ASE	Average Squared Error.	0.123
MAX	Maximum Absolute Error.	0.896
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.351
SSE	Sum of Squared Errors.	59.77
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.186
MSE	Mean Squared Error.	0.155
RFPE	Root Final Prediction Error.	0.432
RMSE	Root Mean Squared Error.	0.394
AVERR	Average Error Function.	0.376
ERR	Error Function.	182.076
MISC	Misclassification Rate.	0.165
WRONG	Number of Wrong Classifications.	40

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	83.9695	85.2713	110	45.4545
NONBANKRUPT	BANKRUPT	16.0305	18.5841	21	8.6777
BANKRUPT	NONBANKRUPT	17.1171	14.7287	19	7.8512
NONBANKRUPT	NONBANKRUPT	82.8829	81.4159	92	38.0165

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	170
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	250.47
SBC	Schwarz's Bayesian Criterion.	416.535
ASE	Average Squared Error.	0.109
MAX	Maximum Absolute Error.	0.984
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.331
SSE	Sum of Squared Errors.	47.952
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.173
MSE	Mean Squared Error.	0.141
RFPE	Root Final Prediction Error.	0.415
RMSE	Root Mean Squared Error.	0.376
AVERR	Average Error Function.	0.348
ERR	Error Function.	152.47
MISC	Misclassification Rate.	0.169
WRONG	Number of Wrong Classifications.	37

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	81.4159	85.1852	92	42.0091
NONBANKRUPT	BANKRUPT	18.5841	18.9189	21	9.589
BANKRUPT	NONBANKRUPT	15.0943	14.8148	16	7.3059
NONBANKRUPT	NONBANKRUPT	84.9057	81.0811	90	41.0959

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	146
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	179.296
SBC	Schwarz's Bayesian Criterion.	339.673
ASE	Average Squared Error.	0.061
MAX	Maximum Absolute Error.	0.953
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.248
SSE	Sum of Squared Errors.	23.964
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.103
MSE	Mean Squared Error.	0.082
RFPE	Root Final Prediction Error.	0.32
RMSE	Root Mean Squared Error.	0.286
AVERR	Average Error Function.	0.208
ERR	Error Function.	81.296
MISC	Misclassification Rate.	0.067
WRONG	Number of Wrong Classifications.	13

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	93.9024	90.5882	77	39.4872
NONBANKRUPT	BANKRUPT	6.0976	4.5455	5	2.5641
BANKRUPT	NONBANKRUPT	7.0796	9.4118	8	4.1026
NONBANKRUPT	NONBANKRUPT	92.9204	95.4545	105	53.8462

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	119
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	158.573
SBC	Schwarz's Bayesian Criterion.	311.647
ASE	Average Squared Error.	0.051
MAX	Maximum Absolute Error.	0.973
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.226
SSE	Sum of Squared Errors.	17.199
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.093
MSE	Mean Squared Error.	0.072
RFPE	Root Final Prediction Error.	0.306
RMSE	Root Mean Squared Error.	0.269
AVERR	Average Error Function.	0.18
ERR	Error Function.	60.573
MISC	Misclassification Rate.	0.048
WRONG	Number of Wrong Classifications.	8

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	94.2857	94.2857	66	39.2857
NONBANKRUPT	BANKRUPT	5.7143	4.0816	4	2.381
BANKRUPT	NONBANKRUPT	4.0816	5.7143	4	2.381
NONBANKRUPT	NONBANKRUPT	95.9184	95.9184	94	55.9524

Results of Multi Layer Perceptron : Variables (Price, Standard deviation, hi lo bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	206
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	263.773
SBC	Schwarz's Bayesian Criterion.	437.295
ASE	Average Squared Error.	0.097
MAX	Maximum Absolute Error.	0.991
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.311
SSE	Sum of Squared Errors.	49.443
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.143
MSE	Mean Squared Error.	0.12
RFPE	Root Final Prediction Error.	0.378
RMSE	Root Mean Squared Error.	0.346
AVERR	Average Error Function.	0.325
ERR	Error Function.	165.773
MISC	Misclassification Rate.	0.118
WRONG	Number of Wrong Classifications.	30

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	85.5263	94.2029	130	50.9804
NONBANKRUPT	BANKRUPT	14.4737	18.8034	22	8.6275
BANKRUPT	NONBANKRUPT	7.767	5.7971	8	3.1373
NONBANKRUPT	NONBANKRUPT	92.233	81.1966	95	37.2549

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	193
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	338.131
SBC	Schwarz's Bayesian Criterion.	509.089
ASE	Average Squared Error.	0.164
MAX	Maximum Absolute Error.	0.96
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.405
SSE	Sum of Squared Errors.	79.539
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.248
MSE	Mean Squared Error.	0.206
RFPE	Root Final Prediction Error.	0.498
RMSE	Root Mean Squared Error.	0.454
AVERR	Average Error Function.	0.496
ERR	Error Function.	240.131
MISC	Misclassification Rate.	0.202
WRONG	Number of Wrong Classifications.	49

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	79.8507	82.9457	107	44.2149
NONBANKRUPT	BANKRUPT	20.1493	23.8938	27	11.157
BANKRUPT	NONBANKRUPT	20.3704	17.0543	22	9.0909
NONBANKRUPT	NONBANKRUPT	79.6296	76.1062	86	35.5372

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	170
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	283.966
SBC	Schwarz's Bayesian Criterion.	450.03
ASE	Average Squared Error.	0.137
MAX	Maximum Absolute Error.	0.993
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.37
SSE	Sum of Squared Errors.	59.808
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.215
MSE	Mean Squared Error.	0.176
RFPE	Root Final Prediction Error.	0.464
RMSE	Root Mean Squared Error.	0.419
AVERR	Average Error Function.	0.425
ERR	Error Function.	185.966
MISC	Misclassification Rate.	0.192
WRONG	Number of Wrong Classifications.	42

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	79.4643	82.4074	89	40.6393
NONBANKRUPT	BANKRUPT	20.5357	20.7207	23	10.5023
BANKRUPT	NONBANKRUPT	17.757	17.5926	19	8.6758
NONBANKRUPT	NONBANKRUPT	82.243	79.2793	88	40.1826

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	146
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	246.888
SBC	Schwarz's Bayesian Criterion.	407.265
ASE	Average Squared Error.	0.121
MAX	Maximum Absolute Error.	0.863
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.348
SSE	Sum of Squared Errors.	47.141
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.202
MSE	Mean Squared Error.	0.161
RFPE	Root Final Prediction Error.	0.449
RMSE	Root Mean Squared Error.	0.402
AVERR	Average Error Function.	0.382
ERR	Error Function.	148.888
MISC	Misclassification Rate.	0.123
WRONG	Number of Wrong Classifications.	24

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	85.8824	85.8824	73	37.4359
NONBANKRUPT	BANKRUPT	14.1176	10.9091	12	6.1538
BANKRUPT	NONBANKRUPT	10.9091	14.1176	12	6.1538
NONBANKRUPT	NONBANKRUPT	89.0909	89.0909	98	50.2564

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	119
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	199.844
SBC	Schwarz's Bayesian Criterion.	352.918
ASE	Average Squared Error.	0.094
MAX	Maximum Absolute Error.	0.966
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.307
SSE	Sum of Squared Errors.	31.619
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.172
MSE	Mean Squared Error.	0.133
RFPE	Root Final Prediction Error.	0.414
RMSE	Root Mean Squared Error.	0.364
AVERR	Average Error Function.	0.303
ERR	Error Function.	101.844
MISC	Misclassification Rate.	0.125
WRONG	Number of Wrong Classifications.	21

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	82.6667	88.5714	62	36.9048
NONBANKRUPT	BANKRUPT	17.3333	13.2653	13	7.7381
BANKRUPT	NONBANKRUPT	8.6022	11.4286	8	4.7619
NONBANKRUPT	NONBANKRUPT	91.3978	86.7347	85	50.5952

The next two sets of variables are those six variables that performed best in both the univariate analysis and the multivariate discriminant analysis. The two sets contain price, standard deviation, bid-ask spread, net income to sales, working capital to total assets, and current liabilities to total assets (the second set is the same as the first, but the bid-ask spread is measured by the high-low bid-ask spread).

For the first set, the classification rates for the bankrupt firms are 90%, 84%, 82%, 94%, and 94% in years one through five, and 88%, 83%, 85%, 93%, and 96% in years one through five for the nonbankrupt firms. The overall misclassification rates are 10.6% and 5% in years one and five, respectively.

For the second set, bankrupt firms in years one through five, respectively, have the following classification rates: 86%, 80%, 79%, 85%, and 83%. The classification rates for nonbankrupt firms are 92%, 80%, 82%, 89%, and 91% in years one through five. The misclassification rates ranges are around 12% in both years one and five. The high-low bid-ask spread allows the multi-layer perceptron to correctly classify the nonbankrupt firms better, but it does slightly the opposite for the bankrupt firms. Therefore, the high-low bid ask spread is less desirable than the end-of-day bid-ask spread since correctly classifying bankrupt firms is of higher importance.

It is important to note that by adding a few accounting ratios to the input variables along with price, standard deviation, and bid-ask spread, the model becomes more accurate than it is with only market variables. While market variables are forward-looking and account ratios are backward-looking, accounting ratios still contain information. More importantly, the deterioration and pattern of the account ratios contain certain information that the market variables do not include. Accounting ratios are also

much less noisy than the market variables, not as highly affected by human sentiment and market movements.

We now direct our attention to the radial basis functions. With the market variables as the inputs, the classification rates for the bankrupt firms are 80%, 77%, 76%, 84%, and 82%, whereas those for nonbankrupt firms are 84%, 73%, 70%, 86%, and 88%, from years one to five. The overall misclassification rates are 18% and 15% in years one and five, respectively.

For the first set of mixed variables, the classification rates for the bankrupt firms are 83%, 75%, 81%, 90%, and 97%, whereas those for the nonbankrupt firms are 81%, 82%, 71%, 89%, and 91%. The overall misclassification rates are 18% one year before bankruptcy versus 6.5% five years before bankruptcy. For the second set, the bankruptcy classification rates for years one through five are 88%, 69%, 72%, 80%, and 88%, while those of the nonbankrupt firms are 89%, 64%, 70%, 79%, and 81%. The misclassification rates, overall, are 11.4% and 17% in years one and five, respectively.

While the radial basis function still performs relatively well, the multi-layer perceptron has higher classification rates for all different input sets and years. This is likely due to the fact that the parameters of the multi-layer perceptron are non-linear, while those of the radial basis function are linear. As discussed earlier in this chapter and in previous chapter, the relations between the variables and the likelihood of bankruptcy are not linear. This is consistent with the findings in the literature and the previous chapter.

Table 12

Results of Radial Basis Function Networks : Accounting variables

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	17
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	141
DFM	Model Degrees of Freedom.	114
_NW_	Number of Estimated Weights.	114
AIC	Akaike's Information Criterion.	385.235
SBC	Schwarz's Bayesian Criterion.	788.939
ASE	Average Squared Error.	0.088
MAX	Maximum Absolute Error.	0.919
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.297
SSE	Sum of Squared Errors.	45.05
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.231
MSE	Mean Squared Error.	0.16
RFPE	Root Final Prediction Error.	0.481
RMSE	Root Mean Squared Error.	0.4
AVERR	Average Error Function.	0.308
ERR	Error Function.	157.235
MISC	Misclassification Rate.	0.098
WRONG	Number of Wrong Classifications.	25

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	87.4172	95.6522	132	51.7647
NONBANKRUPT	BANKRUPT	12.5828	16.2393	19	7.451
BANKRUPT	NONBANKRUPT	5.7692	4.3478	6	2.3529
NONBANKRUPT	NONBANKRUPT	94.2308	83.7607	98	38.4314

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	17
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	128
DFM	Model Degrees of Freedom.	114
_NW_	Number of Estimated Weights.	114
AIC	Akaike's Information Criterion.	397.3
SBC	Schwarz's Bayesian Criterion.	795.039
ASE	Average Squared Error.	0.101
MAX	Maximum Absolute Error.	0.914
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.318
SSE	Sum of Squared Errors.	48.799
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.28
MSE	Mean Squared Error.	0.191
RFPE	Root Final Prediction Error.	0.53
RMSE	Root Mean Squared Error.	0.437
AVERR	Average Error Function.	0.35
ERR	Error Function.	169.3
MISC	Misclassification Rate.	0.116
WRONG	Number of Wrong Classifications.	28

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	87.4074	91.4729	118	48.7603
NONBANKRUPT	BANKRUPT	12.5926	15.0442	17	7.0248
BANKRUPT	NONBANKRUPT	10.2804	8.5271	11	4.5455
NONBANKRUPT	NONBANKRUPT	89.7196	84.9558	96	39.6694

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	17
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	105
DFM	Model Degrees of Freedom.	114
_NW_	Number of Estimated Weights.	114
AIC	Akaike's Information Criterion.	450.195
SBC	Schwarz's Bayesian Criterion.	836.549
ASE	Average Squared Error.	0.168
MAX	Maximum Absolute Error.	0.936
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.41
SSE	Sum of Squared Errors.	73.669
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.533
MSE	Mean Squared Error.	0.351
RFPE	Root Final Prediction Error.	0.73
RMSE	Root Mean Squared Error.	0.592
AVERR	Average Error Function.	0.507
ERR	Error Function.	222.195
MISC	Misclassification Rate.	0.233
WRONG	Number of Wrong Classifications.	51

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	70.2128	91.6667	99	45.2055
NONBANKRUPT	BANKRUPT	29.7872	37.8378	42	19.1781
BANKRUPT	NONBANKRUPT	11.5385	8.3333	9	4.1096
NONBANKRUPT	NONBANKRUPT	88.4615	62.1622	69	31.5068

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	17
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	81
DFM	Model Degrees of Freedom.	114
_NW_	Number of Estimated Weights.	114
AIC	Akaike's Information Criterion.	412.793
SBC	Schwarz's Bayesian Criterion.	785.914
ASE	Average Squared Error.	0.158
MAX	Maximum Absolute Error.	0.935
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.398
SSE	Sum of Squared Errors.	61.695
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.603
MSE	Mean Squared Error.	0.381
RFPE	Root Final Prediction Error.	0.777
RMSE	Root Mean Squared Error.	0.617
AVERR	Average Error Function.	0.474
ERR	Error Function.	184.793
MISC	Misclassification Rate.	0.241
WRONG	Number of Wrong Classifications.	47

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	70.6522	76.4706	65	33.3333
NONBANKRUPT	BANKRUPT	29.3478	24.5455	27	13.8462
BANKRUPT	NONBANKRUPT	19.4175	23.5294	20	10.2564
NONBANKRUPT	NONBANKRUPT	80.5825	75.4545	83	42.5641

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	17
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	54
DFM	Model Degrees of Freedom.	114
_NW_	Number of Estimated Weights.	114
AIC	Akaike's Information Criterion.	428.477
SBC	Schwarz's Bayesian Criterion.	784.609
ASE	Average Squared Error.	0.204
MAX	Maximum Absolute Error.	0.778
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.451
SSE	Sum of Squared Errors.	68.479
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	1.064
MSE	Mean Squared Error.	0.634
RFPE	Root Final Prediction Error.	1.032
RMSE	Root Mean Squared Error.	0.796
AVERR	Average Error Function.	0.597
ERR	Error Function.	200.477
MISC	Misclassification Rate.	0.292
WRONG	Number of Wrong Classifications.	49

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	64.3836	67.1429	47	27.9762
NONBANKRUPT	BANKRUPT	35.6164	26.5306	26	15.4762
BANKRUPT	NONBANKRUPT	24.2105	32.8571	23	13.6905
NONBANKRUPT	NONBANKRUPT	75.7895	73.4694	72	42.8571

Results of Radial Basis Function Networks : Market variables

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	5
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	213
DFM	Model Degrees of Freedom.	42
_NW_	Number of Estimated Weights.	42
AIC	Akaike's Information Criterion.	321.332
SBC	Schwarz's Bayesian Criterion.	470.065
ASE	Average Squared Error.	0.147
MAX	Maximum Absolute Error.	0.881
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.383
SSE	Sum of Squared Errors.	74.972
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.205
MSE	Mean Squared Error.	0.176
RFPE	Root Final Prediction Error.	0.453
RMSE	Root Mean Squared Error.	0.42
AVERR	Average Error Function.	0.465
ERR	Error Function.	237.332
MISC	Misclassification Rate.	0.18
WRONG	Number of Wrong Classifications.	46

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	80.2632	88.4058	122	47.8431
NONBANKRUPT	BANKRUPT	19.7368	25.641	30	11.7647
BANKRUPT	NONBANKRUPT	15.534	11.5942	16	6.2745
NONBANKRUPT	NONBANKRUPT	84.466	74.359	87	34.1176

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	5
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	200
DFM	Model Degrees of Freedom.	42
_NW_	Number of Estimated Weights.	42
AIC	Akaike's Information Criterion.	353.263
SBC	Schwarz's Bayesian Criterion.	499.798
ASE	Average Squared Error.	0.185
MAX	Maximum Absolute Error.	0.834
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.43
SSE	Sum of Squared Errors.	89.692
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.263
MSE	Mean Squared Error.	0.224
RFPE	Root Final Prediction Error.	0.513
RMSE	Root Mean Squared Error.	0.474
AVERR	Average Error Function.	0.556
ERR	Error Function.	269.263
MISC	Misclassification Rate.	0.244
WRONG	Number of Wrong Classifications.	59

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	77.3438	76.7442	99	40.9091
NONBANKRUPT	BANKRUPT	22.6563	25.6637	29	11.9835
BANKRUPT	NONBANKRUPT	26.3158	23.2558	30	12.3967
NONBANKRUPT	NONBANKRUPT	73.6842	74.3363	84	34.7107

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	5
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	177
DFM	Model Degrees of Freedom.	42
_NW_	Number of Estimated Weights.	42
AIC	Akaike's Information Criterion.	330.372
SBC	Schwarz's Bayesian Criterion.	472.713
ASE	Average Squared Error.	0.19
MAX	Maximum Absolute Error.	0.872
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.435
SSE	Sum of Squared Errors.	83.046
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.28
MSE	Mean Squared Error.	0.235
RFPE	Root Final Prediction Error.	0.529
RMSE	Root Mean Squared Error.	0.484
AVERR	Average Error Function.	0.562
ERR	Error Function.	246.372
MISC	Misclassification Rate.	0.269
WRONG	Number of Wrong Classifications.	59

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	77.5281	63.8889	69	31.5068
NONBANKRUPT	BANKRUPT	22.4719	18.018	20	9.1324
BANKRUPT	NONBANKRUPT	30	36.1111	39	17.8082
NONBANKRUPT	NONBANKRUPT	70	81.982	91	41.5525

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	5
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	153
DFM	Model Degrees of Freedom.	42
_NW_	Number of Estimated Weights.	42
AIC	Akaike's Information Criterion.	237.763
SBC	Schwarz's Bayesian Criterion.	375.229
ASE	Average Squared Error.	0.119
MAX	Maximum Absolute Error.	0.916
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.345
SSE	Sum of Squared Errors.	46.441
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.184
MSE	Mean Squared Error.	0.152
RFPE	Root Final Prediction Error.	0.429
RMSE	Root Mean Squared Error.	0.39
AVERR	Average Error Function.	0.394
ERR	Error Function.	153.763
MISC	Misclassification Rate.	0.149
WRONG	Number of Wrong Classifications.	29

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	84.1463	81.1765	69	35.3846
NONBANKRUPT	BANKRUPT	15.8537	11.8182	13	6.6667
BANKRUPT	NONBANKRUPT	14.1593	18.8235	16	8.2051
NONBANKRUPT	NONBANKRUPT	85.8407	88.1818	97	49.7436

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	5
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	126
DFM	Model Degrees of Freedom.	42
_NW_	Number of Estimated Weights.	42
AIC	Akaike's Information Criterion.	219.788
SBC	Schwarz's Bayesian Criterion.	350.995
ASE	Average Squared Error.	0.122
MAX	Maximum Absolute Error.	0.913
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.349
SSE	Sum of Squared Errors.	40.892
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.203
MSE	Mean Squared Error.	0.162
RFPE	Root Final Prediction Error.	0.45
RMSE	Root Mean Squared Error.	0.403
AVERR	Average Error Function.	0.404
ERR	Error Function.	135.788
MISC	Misclassification Rate.	0.149
WRONG	Number of Wrong Classifications.	25

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	81.6901	82.8571	58	34.5238
NONBANKRUPT	BANKRUPT	18.3099	13.2653	13	7.7381
BANKRUPT	NONBANKRUPT	12.3711	17.1429	12	7.1429
NONBANKRUPT	NONBANKRUPT	87.6289	86.7347	85	50.5952

Results of Radial Basis Function Networks : Market variables without spread and hi lo bid ask spread

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	219
DFM	Model Degrees of Freedom.	36
_NW_	Number of Estimated Weights.	36
AIC	Akaike's Information Criterion.	334.768
SBC	Schwarz's Bayesian Criterion.	462.253
ASE	Average Squared Error.	0.169
MAX	Maximum Absolute Error.	0.879
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.411
SSE	Sum of Squared Errors.	86.194
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.225
MSE	Mean Squared Error.	0.197
RFPE	Root Final Prediction Error.	0.474
RMSE	Root Mean Squared Error.	0.444
AVERR	Average Error Function.	0.515
ERR	Error Function.	262.768
MISC	Misclassification Rate.	0.259
WRONG	Number of Wrong Classifications.	66

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	74	80.4348	111	43.5294
NONBANKRUPT	BANKRUPT	26	33.3333	39	15.2941
BANKRUPT	NONBANKRUPT	25.7143	19.5652	27	10.5882
NONBANKRUPT	NONBANKRUPT	74.2857	66.6667	78	30.5882

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	206
DFM	Model Degrees of Freedom.	36
_NW_	Number of Estimated Weights.	36
AIC	Akaike's Information Criterion.	314.49
SBC	Schwarz's Bayesian Criterion.	440.092
ASE	Average Squared Error.	0.162
MAX	Maximum Absolute Error.	0.89
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.403
SSE	Sum of Squared Errors.	78.621
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.219
MSE	Mean Squared Error.	0.191
RFPE	Root Final Prediction Error.	0.468
RMSE	Root Mean Squared Error.	0.437
AVERR	Average Error Function.	0.501
ERR	Error Function.	242.49
MISC	Misclassification Rate.	0.231
WRONG	Number of Wrong Classifications.	56

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	76.6423	81.3953	105	43.3884
NONBANKRUPT	BANKRUPT	23.3577	28.3186	32	13.2231
BANKRUPT	NONBANKRUPT	22.8571	18.6047	24	9.9174
NONBANKRUPT	NONBANKRUPT	77.1429	71.6814	81	33.4711

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	183
DFM	Model Degrees of Freedom.	36
_NW_	Number of Estimated Weights.	36
AIC	Akaike's Information Criterion.	309.794
SBC	Schwarz's Bayesian Criterion.	431.801
ASE	Average Squared Error.	0.182
MAX	Maximum Absolute Error.	0.92
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.427
SSE	Sum of Squared Errors.	79.835
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.254
MSE	Mean Squared Error.	0.218
RFPE	Root Final Prediction Error.	0.504
RMSE	Root Mean Squared Error.	0.467
AVERR	Average Error Function.	0.543
ERR	Error Function.	237.794
MISC	Misclassification Rate.	0.269
WRONG	Number of Wrong Classifications.	59

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	76.9231	64.8148	70	31.9635
NONBANKRUPT	BANKRUPT	23.0769	18.9189	21	9.589
BANKRUPT	NONBANKRUPT	29.6875	35.1852	38	17.3516
NONBANKRUPT	NONBANKRUPT	70.3125	81.0811	90	41.0959

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	159
DFM	Model Degrees of Freedom.	36
_NW_	Number of Estimated Weights.	36
AIC	Akaike's Information Criterion.	220.204
SBC	Schwarz's Bayesian Criterion.	338.032
ASE	Average Squared Error.	0.115
MAX	Maximum Absolute Error.	0.936
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.339
SSE	Sum of Squared Errors.	44.913
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.167
MSE	Mean Squared Error.	0.141
RFPE	Root Final Prediction Error.	0.409
RMSE	Root Mean Squared Error.	0.376
AVERR	Average Error Function.	0.38
ERR	Error Function.	148.204
MISC	Misclassification Rate.	0.154
WRONG	Number of Wrong Classifications.	30

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	83.1325	81.1765	69	35.3846
NONBANKRUPT	BANKRUPT	16.8675	12.7273	14	7.1795
BANKRUPT	NONBANKRUPT	14.2857	18.8235	16	8.2051
NONBANKRUPT	NONBANKRUPT	85.7143	87.2727	96	49.2308

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	132
DFM	Model Degrees of Freedom.	36
_NW_	Number of Estimated Weights.	36
AIC	Akaike's Information Criterion.	203.775
SBC	Schwarz's Bayesian Criterion.	316.238
ASE	Average Squared Error.	0.118
MAX	Maximum Absolute Error.	0.934
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.344
SSE	Sum of Squared Errors.	39.754
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.183
MSE	Mean Squared Error.	0.151
RFPE	Root Final Prediction Error.	0.428
RMSE	Root Mean Squared Error.	0.388
AVERR	Average Error Function.	0.392
ERR	Error Function.	131.775
MISC	Misclassification Rate.	0.137
WRONG	Number of Wrong Classifications.	23

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	83.0986	84.2857	59	35.119
NONBANKRUPT	BANKRUPT	16.9014	12.2449	12	7.1429
BANKRUPT	NONBANKRUPT	11.3402	15.7143	11	6.5476
NONBANKRUPT	NONBANKRUPT	88.6598	87.7551	86	51.1905

Results of Radial Basis Function Networks : Market variables without spread and bid ask spread

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	219
DFM	Model Degrees of Freedom.	36
_NW_	Number of Estimated Weights.	36
AIC	Akaike's Information Criterion.	310.732
SBC	Schwarz's Bayesian Criterion.	438.218
ASE	Average Squared Error.	0.149
MAX	Maximum Absolute Error.	0.916
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.386
SSE	Sum of Squared Errors.	75.953
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.198
MSE	Mean Squared Error.	0.173
RFPE	Root Final Prediction Error.	0.445
RMSE	Root Mean Squared Error.	0.416
AVERR	Average Error Function.	0.468
ERR	Error Function.	238.732
MISC	Misclassification Rate.	0.2
WRONG	Number of Wrong Classifications.	51

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	79.1946	85.5072	118	46.2745
NONBANKRUPT	BANKRUPT	20.8054	26.4957	31	12.1569
BANKRUPT	NONBANKRUPT	18.8679	14.4928	20	7.8431
NONBANKRUPT	NONBANKRUPT	81.1321	73.5043	86	33.7255

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	206
DFM	Model Degrees of Freedom.	36
_NW_	Number of Estimated Weights.	36
AIC	Akaike's Information Criterion.	368.383
SBC	Schwarz's Bayesian Criterion.	493.984
ASE	Average Squared Error.	0.212
MAX	Maximum Absolute Error.	0.799
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.461
SSE	Sum of Squared Errors.	102.671
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.286
MSE	Mean Squared Error.	0.249
RFPE	Root Final Prediction Error.	0.535
RMSE	Root Mean Squared Error.	0.499
AVERR	Average Error Function.	0.612
ERR	Error Function.	296.383
MISC	Misclassification Rate.	0.326
WRONG	Number of Wrong Classifications.	79

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	65.625	81.3953	105	43.3884
NONBANKRUPT	BANKRUPT	34.375	48.6726	55	22.7273
BANKRUPT	NONBANKRUPT	29.2683	18.6047	24	9.9174
NONBANKRUPT	NONBANKRUPT	70.7317	51.3274	58	23.9669

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	183
DFM	Model Degrees of Freedom.	36
_NW_	Number of Estimated Weights.	36
AIC	Akaike's Information Criterion.	335.846
SBC	Schwarz's Bayesian Criterion.	457.853
ASE	Average Squared Error.	0.208
MAX	Maximum Absolute Error.	0.807
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.457
SSE	Sum of Squared Errors.	91.289
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.29
MSE	Mean Squared Error.	0.249
RFPE	Root Final Prediction Error.	0.539
RMSE	Root Mean Squared Error.	0.499
AVERR	Average Error Function.	0.602
ERR	Error Function.	263.846
MISC	Misclassification Rate.	0.297
WRONG	Number of Wrong Classifications.	65

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	66.4122	80.5556	87	39.726
NONBANKRUPT	BANKRUPT	33.5878	39.6396	44	20.0913
BANKRUPT	NONBANKRUPT	23.8636	19.4444	21	9.589
NONBANKRUPT	NONBANKRUPT	76.1364	60.3604	67	30.5936

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	159
DFM	Model Degrees of Freedom.	36
_NW_	Number of Estimated Weights.	36
AIC	Akaike's Information Criterion.	289.662
SBC	Schwarz's Bayesian Criterion.	407.49
ASE	Average Squared Error.	0.19
MAX	Maximum Absolute Error.	0.925
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.436
SSE	Sum of Squared Errors.	74.08
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.276
MSE	Mean Squared Error.	0.233
RFPE	Root Final Prediction Error.	0.525
RMSE	Root Mean Squared Error.	0.483
AVERR	Average Error Function.	0.558
ERR	Error Function.	217.662
MISC	Misclassification Rate.	0.277
WRONG	Number of Wrong Classifications.	54

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	67.4157	70.5882	60	30.7692
NONBANKRUPT	BANKRUPT	32.5843	26.3636	29	14.8718
BANKRUPT	NONBANKRUPT	23.5849	29.4118	25	12.8205
NONBANKRUPT	NONBANKRUPT	76.4151	73.6364	81	41.5385

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	132
DFM	Model Degrees of Freedom.	36
_NW_	Number of Estimated Weights.	36
AIC	Akaike's Information Criterion.	267.413
SBC	Schwarz's Bayesian Criterion.	379.876
ASE	Average Squared Error.	0.199
MAX	Maximum Absolute Error.	0.877
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.446
SSE	Sum of Squared Errors.	66.699
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.307
MSE	Mean Squared Error.	0.253
RFPE	Root Final Prediction Error.	0.554
RMSE	Root Mean Squared Error.	0.503
AVERR	Average Error Function.	0.582
ERR	Error Function.	195.413
MISC	Misclassification Rate.	0.292
WRONG	Number of Wrong Classifications.	49

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	65.6716	62.8571	44	26.1905
NONBANKRUPT	BANKRUPT	34.3284	23.4694	23	13.6905
BANKRUPT	NONBANKRUPT	25.7426	37.1429	26	15.4762
NONBANKRUPT	NONBANKRUPT	74.2574	76.5306	75	44.6429

Results of Radial Basis Function Networks : Market variables without bid ask spread and hi lo bid ask spread

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	219
DFM	Model Degrees of Freedom.	36
_NW_	Number of Estimated Weights.	36
AIC	Akaike's Information Criterion.	362.741
SBC	Schwarz's Bayesian Criterion.	490.227
ASE	Average Squared Error.	0.194
MAX	Maximum Absolute Error.	0.888
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.44
SSE	Sum of Squared Errors.	98.93
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.258
MSE	Mean Squared Error.	0.226
RFPE	Root Final Prediction Error.	0.508
RMSE	Root Mean Squared Error.	0.475
AVERR	Average Error Function.	0.57
ERR	Error Function.	290.741
MISC	Misclassification Rate.	0.294
WRONG	Number of Wrong Classifications.	75

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	76.0331	66.6667	92	36.0784
NONBANKRUPT	BANKRUPT	23.9669	24.7863	29	11.3725
BANKRUPT	NONBANKRUPT	34.3284	33.3333	46	18.0392
NONBANKRUPT	NONBANKRUPT	65.6716	75.2137	88	34.5098

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	206
DFM	Model Degrees of Freedom.	36
_NW_	Number of Estimated Weights.	36
AIC	Akaike's Information Criterion.	373.013
SBC	Schwarz's Bayesian Criterion.	498.615
ASE	Average Squared Error.	0.216
MAX	Maximum Absolute Error.	0.76
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.465
SSE	Sum of Squared Errors.	104.485
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.291
MSE	Mean Squared Error.	0.254
RFPE	Root Final Prediction Error.	0.54
RMSE	Root Mean Squared Error.	0.504
AVERR	Average Error Function.	0.622
ERR	Error Function.	301.013
MISC	Misclassification Rate.	0.326
WRONG	Number of Wrong Classifications.	79

CLASSIFICATON SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	67.8571	73.6434	95	39.2562
NONBANKRUPT	BANKRUPT	32.1429	39.823	45	18.595
BANKRUPT	NONBANKRUPT	33.3333	26.3566	34	14.0496
NONBANKRUPT	NONBANKRUPT	66.6667	60.177	68	28.0992

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	183
DFM	Model Degrees of Freedom.	36
_NW_	Number of Estimated Weights.	36
AIC	Akaike's Information Criterion.	347.577
SBC	Schwarz's Bayesian Criterion.	469.584
ASE	Average Squared Error.	0.219
MAX	Maximum Absolute Error.	0.807
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.468
SSE	Sum of Squared Errors.	95.907
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.305
MSE	Mean Squared Error.	0.262
RFPE	Root Final Prediction Error.	0.552
RMSE	Root Mean Squared Error.	0.512
AVERR	Average Error Function.	0.629
ERR	Error Function.	275.577
MISC	Misclassification Rate.	0.32
WRONG	Number of Wrong Classifications.	70

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	66.1017	72.2222	78	35.6164
NONBANKRUPT	BANKRUPT	33.8983	36.036	40	18.2648
BANKRUPT	NONBANKRUPT	29.703	27.7778	30	13.6986
NONBANKRUPT	NONBANKRUPT	70.297	63.964	71	32.4201

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	159
DFM	Model Degrees of Freedom.	36
_NW_	Number of Estimated Weights.	36
AIC	Akaike's Information Criterion.	293.73
SBC	Schwarz's Bayesian Criterion.	411.558
ASE	Average Squared Error.	0.194
MAX	Maximum Absolute Error.	0.936
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.441
SSE	Sum of Squared Errors.	75.726
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.282
MSE	Mean Squared Error.	0.238
RFPE	Root Final Prediction Error.	0.531
RMSE	Root Mean Squared Error.	0.488
AVERR	Average Error Function.	0.569
ERR	Error Function.	221.73

MISC	Misclassification Rate.	0.277
WRONG	Number of Wrong Classifications.	54

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	69.1358	65.8824	56	28.7179
NONBANKRUPT	BANKRUPT	30.8642	22.7273	25	12.8205
BANKRUPT	NONBANKRUPT	25.4386	34.1176	29	14.8718
NONBANKRUPT	NONBANKRUPT	74.5614	77.2727	85	43.5897

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	4
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	132
DFM	Model Degrees of Freedom.	36
_NW_	Number of Estimated Weights.	36
AIC	Akaike's Information Criterion.	275.095
SBC	Schwarz's Bayesian Criterion.	387.558
ASE	Average Squared Error.	0.209
MAX	Maximum Absolute Error.	0.846
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.457
SSE	Sum of Squared Errors.	70.293
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.323
MSE	Mean Squared Error.	0.266
RFPE	Root Final Prediction Error.	0.569
RMSE	Root Mean Squared Error.	0.516
AVERR	Average Error Function.	0.604

ERR	Error Function.	203.095
MISC	Misclassification Rate.	0.315
WRONG	Number of Wrong Classifications.	53

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	61.9718	62.8571	44	26.1905
NONBANKRUPT	BANKRUPT	38.0282	27.551	27	16.0714
BANKRUPT	NONBANKRUPT	26.8041	37.1429	26	15.4762
NONBANKRUPT	NONBANKRUPT	73.1959	72.449	71	42.2619

Results of Radial Basis Function Networks : Top 3 Account and Market variables

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	207
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	332.364
SBC	Schwarz's Bayesian Criterion.	502.345
ASE	Average Squared Error.	0.148
MAX	Maximum Absolute Error.	0.891
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.385
SSE	Sum of Squared Errors.	75.428
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.216
MSE	Mean Squared Error.	0.182
RFPE	Root Final Prediction Error.	0.465
RMSE	Root Mean Squared Error.	0.427
AVERR	Average Error Function.	0.463
ERR	Error Function.	236.364
MISC	Misclassification Rate.	0.216
WRONG	Number of Wrong Classifications.	55

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	74.8503	90.5797	125	49.0196
NONBANKRUPT	BANKRUPT	25.1497	35.8974	42	16.4706
BANKRUPT	NONBANKRUPT	14.7727	9.4203	13	5.098
NONBANKRUPT	NONBANKRUPT	85.2273	64.1026	75	29.4118

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	194
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	319.177
SBC	Schwarz's Bayesian Criterion.	486.646
ASE	Average Squared Error.	0.144
MAX	Maximum Absolute Error.	0.868
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.379
SSE	Sum of Squared Errors.	69.58
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.215
MSE	Mean Squared Error.	0.179
RFPE	Root Final Prediction Error.	0.464
RMSE	Root Mean Squared Error.	0.423
AVERR	Average Error Function.	0.461
ERR	Error Function.	223.177

MISC	Misclassification Rate.	0.169
WRONG	Number of Wrong Classifications.	41

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	81.4286	88.3721	114	47.1074
NONBANKRUPT	BANKRUPT	18.5714	23.0088	26	10.7438
BANKRUPT	NONBANKRUPT	14.7059	11.6279	15	6.1983
NONBANKRUPT	NONBANKRUPT	85.2941	76.9912	87	35.9504

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	171
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	302.845
SBC	Schwarz's Bayesian Criterion.	465.52
ASE	Average Squared Error.	0.151
MAX	Maximum Absolute Error.	0.889
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.388
SSE	Sum of Squared Errors.	66.046
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.235
MSE	Mean Squared Error.	0.193
RFPE	Root Final Prediction Error.	0.485
RMSE	Root Mean Squared Error.	0.439
AVERR	Average Error Function.	0.472

ERR	Error Function.	206.845
MISC	Misclassification Rate.	0.192
WRONG	Number of Wrong Classifications.	42

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	79.4643	82.4074	89	40.6393
NONBANKRUPT	BANKRUPT	20.5357	20.7207	23	10.5023
BANKRUPT	NONBANKRUPT	17.757	17.5926	19	8.6758
NONBANKRUPT	NONBANKRUPT	82.243	79.2793	88	40.1826

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	147
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	216.526
SBC	Schwarz's Bayesian Criterion.	373.63
ASE	Average Squared Error.	0.089
MAX	Maximum Absolute Error.	0.955
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.298
SSE	Sum of Squared Errors.	34.648
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.147
MSE	Mean Squared Error.	0.118
RFPE	Root Final Prediction Error.	0.383
RMSE	Root Mean Squared Error.	0.343

AVERR	Average Error Function.	0.309
ERR	Error Function.	120.526
MISC	Misclassification Rate.	0.103
WRONG	Number of Wrong Classifications.	20

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	87.3563	89.4118	76	38.9744
NONBANKRUPT	BANKRUPT	12.6437	10	11	5.641
BANKRUPT	NONBANKRUPT	8.3333	10.5882	9	4.6154
NONBANKRUPT	NONBANKRUPT	91.6667	90	99	50.7692

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	120
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	205.68
SBC	Schwarz's Bayesian Criterion.	355.631
ASE	Average Squared Error.	0.097
MAX	Maximum Absolute Error.	0.954
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.311
SSE	Sum of Squared Errors.	32.574
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.175
MSE	Mean Squared Error.	0.136
RFPE	Root Final Prediction Error.	0.418

RMSE	Root Mean Squared Error.	0.368
AVERR	Average Error Function.	0.326
ERR	Error Function.	109.68
MISC	Misclassification Rate.	0.119
WRONG	Number of Wrong Classifications.	20

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	85.7143	85.7143	60	35.7143
NONBANKRUPT	BANKRUPT	14.2857	10.2041	10	5.9524
BANKRUPT	NONBANKRUPT	10.2041	14.2857	10	5.9524
NONBANKRUPT	NONBANKRUPT	89.7959	89.7959	88	52.381

Results of Radial Basis Function Networks : Top 3 Account and Market logarithmic variables

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	207
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	351.13
SBC	Schwarz's Bayesian Criterion.	521.111
ASE	Average Squared Error.	0.163
MAX	Maximum Absolute Error.	0.884
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.404
SSE	Sum of Squared Errors.	83.249
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.239
MSE	Mean Squared Error.	0.201
RFPE	Root Final Prediction Error.	0.489
RMSE	Root Mean Squared Error.	0.448
AVERR	Average Error Function.	0.5
ERR	Error Function.	255.13
MISC	Misclassification Rate.	0.216
WRONG	Number of Wrong Classifications.	55

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	73.9884	92.7536	128	50.1961
NONBANKRUPT	BANKRUPT	26.0116	38.4615	45	17.6471
BANKRUPT	NONBANKRUPT	12.1951	7.2464	10	3.9216
NONBANKRUPT	NONBANKRUPT	87.8049	61.5385	72	28.2353

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	194
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	356.335
SBC	Schwarz's Bayesian Criterion.	523.804
ASE	Average Squared Error.	0.178
MAX	Maximum Absolute Error.	0.87
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.421
SSE	Sum of Squared Errors.	85.94
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.265
MSE	Mean Squared Error.	0.221
RFPE	Root Final Prediction Error.	0.515
RMSE	Root Mean Squared Error.	0.471
AVERR	Average Error Function.	0.538
ERR	Error Function.	260.335

MISC	Misclassification Rate.	0.236
WRONG	Number of Wrong Classifications.	57

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	77.2727	79.0698	102	42.1488
NONBANKRUPT	BANKRUPT	22.7273	26.5487	30	12.3967
BANKRUPT	NONBANKRUPT	24.5455	20.9302	27	11.157
NONBANKRUPT	NONBANKRUPT	75.4545	73.4513	83	34.2975

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	171
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	319.649
SBC	Schwarz's Bayesian Criterion.	482.325
ASE	Average Squared Error.	0.167
MAX	Maximum Absolute Error.	0.914
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.408
SSE	Sum of Squared Errors.	73.009
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.26
MSE	Mean Squared Error.	0.213
RFPE	Root Final Prediction Error.	0.51
RMSE	Root Mean Squared Error.	0.462

AVERR	Average Error Function.	0.511
ERR	Error Function.	223.649
MISC	Misclassification Rate.	0.233
WRONG	Number of Wrong Classifications.	51

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	77.6699	74.0741	80	36.5297
NONBANKRUPT	BANKRUPT	22.3301	20.7207	23	10.5023
BANKRUPT	NONBANKRUPT	24.1379	25.9259	28	12.7854
NONBANKRUPT	NONBANKRUPT	75.8621	79.2793	88	40.1826

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	147
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	254.967
SBC	Schwarz's Bayesian Criterion.	412.07
ASE	Average Squared Error.	0.129
MAX	Maximum Absolute Error.	0.876
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.359
SSE	Sum of Squared Errors.	50.317
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.213
MSE	Mean Squared Error.	0.171
RFPE	Root Final Prediction Error.	0.462

RMSE	Root Mean Squared Error.	0.414
AVERR	Average Error Function.	0.408
ERR	Error Function.	158.967
MISC	Misclassification Rate.	0.164
WRONG	Number of Wrong Classifications.	32

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	81.9277	80	68	34.8718
NONBANKRUPT	BANKRUPT	18.0723	13.6364	15	7.6923
BANKRUPT	NONBANKRUPT	15.1786	20	17	8.7179
NONBANKRUPT	NONBANKRUPT	84.8214	86.3636	95	48.7179

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	120
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	259.049
SBC	Schwarz's Bayesian Criterion.	408.999
ASE	Average Squared Error.	0.16
MAX	Maximum Absolute Error.	0.906
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.4
SSE	Sum of Squared Errors.	53.832
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.288
MSE	Mean Squared Error.	0.224

RFPE	Root Final Prediction Error.	0.537
RMSE	Root Mean Squared Error.	0.474
AVERR	Average Error Function.	0.485
ERR	Error Function.	163.049
MISC	Misclassification Rate.	0.25
WRONG	Number of Wrong Classifications.	42

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	68.9189	72.8571	51	30.3571
NONBANKRUPT	BANKRUPT	31.0811	23.4694	23	13.6905
BANKRUPT	NONBANKRUPT	20.2128	27.1429	19	11.3095
NONBANKRUPT	NONBANKRUPT	79.7872	76.5306	75	44.6429

Results of Radial Basis Function Networks : Variables (Price, Standard deviation, bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	207
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	309.809
SBC	Schwarz's Bayesian Criterion.	479.789
ASE	Average Squared Error.	0.13
MAX	Maximum Absolute Error.	0.927
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.361
SSE	Sum of Squared Errors.	66.54
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.191
MSE	Mean Squared Error.	0.161
RFPE	Root Final Prediction Error.	0.437
RMSE	Root Mean Squared Error.	0.401
AVERR	Average Error Function.	0.419
ERR	Error Function.	213.809
MISC	Misclassification Rate.	0.176
WRONG	Number of Wrong Classifications.	45

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	83.4532	84.058	116	45.4902
NONBANKRUPT	BANKRUPT	16.5468	19.6581	23	9.0196
BANKRUPT	NONBANKRUPT	18.9655	15.942	22	8.6275
NONBANKRUPT	NONBANKRUPT	81.0345	80.3419	94	36.8627

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	194
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	335.255
SBC	Schwarz's Bayesian Criterion.	502.724
ASE	Average Squared Error.	0.16
MAX	Maximum Absolute Error.	0.91
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.401
SSE	Sum of Squared Errors.	77.669
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.24
MSE	Mean Squared Error.	0.2
RFPE	Root Final Prediction Error.	0.49
RMSE	Root Mean Squared Error.	0.447
AVERR	Average Error Function.	0.494
ERR	Error Function.	239.255

MISC	Misclassification Rate.	0.223
WRONG	Number of Wrong Classifications.	54

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	74.8344	87.5969	113	46.6942
NONBANKRUPT	BANKRUPT	25.1656	33.6283	38	15.7025
BANKRUPT	NONBANKRUPT	17.5824	12.4031	16	6.6116
NONBANKRUPT	NONBANKRUPT	82.4176	66.3717	75	30.9917

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	171
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	307.717
SBC	Schwarz's Bayesian Criterion.	470.393
ASE	Average Squared Error.	0.157
MAX	Maximum Absolute Error.	0.916
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.397
SSE	Sum of Squared Errors.	68.92
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.246
MSE	Mean Squared Error.	0.202
RFPE	Root Final Prediction Error.	0.496
RMSE	Root Mean Squared Error.	0.449

AVERR	Average Error Function.	0.483
ERR	Error Function.	211.717
MISC	Misclassification Rate.	0.251
WRONG	Number of Wrong Classifications.	55

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	81.1765	63.8889	69	31.5068
NONBANKRUPT	BANKRUPT	18.8235	14.4144	16	7.3059
BANKRUPT	NONBANKRUPT	29.1045	36.1111	39	17.8082
NONBANKRUPT	NONBANKRUPT	70.8955	85.5856	95	43.379

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	147
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	217.585
SBC	Schwarz's Bayesian Criterion.	374.689
ASE	Average Squared Error.	0.092
MAX	Maximum Absolute Error.	0.944
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.303
SSE	Sum of Squared Errors.	35.847
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.152
MSE	Mean Squared Error.	0.122

RFPE	Root Final Prediction Error.	0.39
RMSE	Root Mean Squared Error.	0.349
AVERR	Average Error Function.	0.312
ERR	Error Function.	121.585
MISC	Misclassification Rate.	0.108
WRONG	Number of Wrong Classifications.	21

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	90	84.7059	72	36.9231
NONBANKRUPT	BANKRUPT	10	7.2727	8	4.1026
BANKRUPT	NONBANKRUPT	11.3043	15.2941	13	6.6667
NONBANKRUPT	NONBANKRUPT	88.6957	92.7273	102	52.3077

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	120
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	182.001
SBC	Schwarz's Bayesian Criterion.	331.952
ASE	Average Squared Error.	0.065
MAX	Maximum Absolute Error.	0.957
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.255
SSE	Sum of Squared Errors.	21.908
SUMW	Sum of Case Weights Times Freq.	336

FPE	Final Prediction Error.	0.117
MSE	Mean Squared Error.	0.091
RFPE	Root Final Prediction Error.	0.343
RMSE	Root Mean Squared Error.	0.302
AVERR	Average Error Function.	0.256
ERR	Error Function.	86.001
MISC	Misclassification Rate.	0.065
WRONG	Number of Wrong Classifications.	11

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	96.8254	87.1429	61	36.3095
NONBANKRUPT	BANKRUPT	3.1746	2.0408	2	1.1905
BANKRUPT	NONBANKRUPT	8.5714	12.8571	9	5.3571
NONBANKRUPT	NONBANKRUPT	91.4286	97.9592	96	57.1429

Results of Radial Basis Function Networks : Variables (Price, Standard deviation, hi lo bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

YEAR 1

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	255
DFE	Degrees of Freedom for Error.	207
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	288.321
SBC	Schwarz's Bayesian Criterion.	458.302
ASE	Average Squared Error.	0.109
MAX	Maximum Absolute Error.	0.922
DIV	Divisor for ASE.	510
NOBS	Sum of Frequencies.	255
RASE	Root Average Squared Error.	0.33
SSE	Sum of Squared Errors.	55.555
SUMW	Sum of Case Weights Times Freq.	510
FPE	Final Prediction Error.	0.159
MSE	Mean Squared Error.	0.134
RFPE	Root Final Prediction Error.	0.399
RMSE	Root Mean Squared Error.	0.366
AVERR	Average Error Function.	0.377
ERR	Error Function.	192.321
MISC	Misclassification Rate.	0.114
WRONG	Number of Wrong Classifications.	29

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	88.1119	91.3043	126	49.4118
NONBANKRUPT	BANKRUPT	11.8881	14.5299	17	6.6667
BANKRUPT	NONBANKRUPT	10.7143	8.6957	12	4.7059
NONBANKRUPT	NONBANKRUPT	89.2857	85.4701	100	39.2157

YEAR 2

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	242
DFE	Degrees of Freedom for Error.	194
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	394.503
SBC	Schwarz's Bayesian Criterion.	561.972
ASE	Average Squared Error.	0.214
MAX	Maximum Absolute Error.	0.793
DIV	Divisor for ASE.	484
NOBS	Sum of Frequencies.	242
RASE	Root Average Squared Error.	0.463
SSE	Sum of Squared Errors.	103.587
SUMW	Sum of Case Weights Times Freq.	484
FPE	Final Prediction Error.	0.32
MSE	Mean Squared Error.	0.267
RFPE	Root Final Prediction Error.	0.566
RMSE	Root Mean Squared Error.	0.517
AVERR	Average Error Function.	0.617
ERR	Error Function.	298.503
MISC	Misclassification Rate.	0.331

WRONG	Number of Wrong Classifications.	80

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	69.2913	68.2171	88	36.3636
NONBANKRUPT	BANKRUPT	30.7087	34.5133	39	16.1157
BANKRUPT	NONBANKRUPT	35.6522	31.7829	41	16.9421
NONBANKRUPT	NONBANKRUPT	64.3478	65.4867	74	30.5785

YEAR 3

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	219
DFE	Degrees of Freedom for Error.	171
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	320.465
SBC	Schwarz's Bayesian Criterion.	483.14
ASE	Average Squared Error.	0.175
MAX	Maximum Absolute Error.	0.805
DIV	Divisor for ASE.	438
NOBS	Sum of Frequencies.	219
RASE	Root Average Squared Error.	0.418
SSE	Sum of Squared Errors.	76.519
SUMW	Sum of Case Weights Times Freq.	438
FPE	Final Prediction Error.	0.273
MSE	Mean Squared Error.	0.224
RFPE	Root Final Prediction Error.	0.522
RMSE	Root Mean Squared Error.	0.473
AVERR	Average Error Function.	0.512

ERR	Error Function.	224.465
MISC	Misclassification Rate.	0.292
WRONG	Number of Wrong Classifications.	64

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	72	66.6667	72	32.8767
NONBANKRUPT	BANKRUPT	28	25.2252	28	12.7854
BANKRUPT	NONBANKRUPT	30.2521	33.3333	36	16.4384
NONBANKRUPT	NONBANKRUPT	69.7479	74.7748	83	37.8995

YEAR 4

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	195
DFE	Degrees of Freedom for Error.	147
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	290.569
SBC	Schwarz's Bayesian Criterion.	447.673
ASE	Average Squared Error.	0.161
MAX	Maximum Absolute Error.	0.905
DIV	Divisor for ASE.	390
NOBS	Sum of Frequencies.	195
RASE	Root Average Squared Error.	0.401
SSE	Sum of Squared Errors.	62.726
SUMW	Sum of Case Weights Times Freq.	390
FPE	Final Prediction Error.	0.266
MSE	Mean Squared Error.	0.213
RFPE	Root Final Prediction Error.	0.516
RMSE	Root Mean Squared Error.	0.462

AVERR	Average Error Function.	0.499	
ERR	Error Function.	194.569	
MISC	Misclassification Rate.	0.205	
WRONG	Number of Wrong Classifications.		40

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	80	70.5882	60	30.7692
NONBANKRUPT	BANKRUPT	20	13.6364	15	7.6923
BANKRUPT	NONBANKRUPT	20.8333	29.4118	25	12.8205
NONBANKRUPT	NONBANKRUPT	79.1667	86.3636	95	48.7179

YEAR 5

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	168
DFE	Degrees of Freedom for Error.	120
DFM	Model Degrees of Freedom.	48
_NW_	Number of Estimated Weights.	48
AIC	Akaike's Information Criterion.	228.562
SBC	Schwarz's Bayesian Criterion.	378.513
ASE	Average Squared Error.	0.123
MAX	Maximum Absolute Error.	0.952
DIV	Divisor for ASE.	336
NOBS	Sum of Frequencies.	168
RASE	Root Average Squared Error.	0.351
SSE	Sum of Squared Errors.	41.454
SUMW	Sum of Case Weights Times Freq.	336
FPE	Final Prediction Error.	0.222
MSE	Mean Squared Error.	0.173

RFPE	Root Final Prediction Error.	0.471
RMSE	Root Mean Squared Error.	0.416
AVERR	Average Error Function.	0.395
ERR	Error Function.	132.562
MISC	Misclassification Rate.	0.167
WRONG	Number of Wrong Classifications.	28

CLASSIFICATION SUMMARY

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	87.5	70	49	29.1667
NONBANKRUPT	BANKRUPT	12.5	7.1429	7	4.1667
BANKRUPT	NONBANKRUPT	18.75	30	21	12.5
NONBANKRUPT	NONBANKRUPT	81.25	92.8571	91	54.1667

Table 13

MLP analysis results for Out of sample validation :Market variables

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	824
DFE	Degrees of Freedom for Error.	781
DFM	Model Degrees of Freedom.	43
_NW_	Number of Estimated Weights.	43
AIC	Akaike's Information Criterion.	822.02
SBC	Schwarz's Bayesian Criterion.	1024.73
ASE	Average Squared Error.	0.14
MAX	Maximum Absolute Error.	0.96
DIV	Divisor for ASE.	1648
NOBS	Sum of Frequencies.	824
RASE	Root Average Squared Error.	0.38
SSE	Sum of Squared Errors.	236.61
SUMW	Sum of Case Weights Times Freq.	1648
FPE	Final Prediction Error.	0.16
MSE	Mean Squared Error.	0.15
RFPE	Root Final Prediction Error.	0.4
RMSE	Root Mean Squared Error.	0.39
AVERR	Average Error Function.	0.45
ERR	Error Function.	736.02
MISC	Misclassification Rate.	0.2
WRONG	Number of Wrong Classifications.	164

CLASSIFICATION SUMMARY (YEAR 2 TO 5)

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	79.0816	79.0816	310	37.6214
NONBANKRUPT	BANKRUPT	20.9184	18.9815	82	9.9515
BANKRUPT	NONBANKRUPT	18.9815	20.9184	82	9.9515
NONBANKRUPT	NONBANKRUPT	81.0185	81.0185	350	42.4757

CLASSIFICATION SUMMARY FOR TEST DATA (YEAR 1)

Actual	Predicted		Total
	Bankrupt	Nonbankrupt	
Bankrupt	96 69.57	42 30.43	138
Nonbankrupt	20 17.09	97 82.91	117
Total	116	139	2

MLP analysis results for Out of sample validation : Variables (Price, Standard deviation, bid ask spread, net income to sales, working capital to total assets and current liabilities to total assets)

VARIABLE SUMMARY

ROLE	LEVEL	COUNT
INPUT	INTERVAL	6
TARGET	TARGET	1

FIT STATISTICS

FIT STATISTIC	STATISTIC LABEL	STATISTIC VALUE
DFT	Total Degrees of Freedom.	824
DFE	Degrees of Freedom for Error.	775
DFM	Model Degrees of Freedom.	49
_NW_	Number of Estimated Weights.	49
AIC	Akaike's Information Criterion.	818.71
SBC	Schwarz's Bayesian Criterion.	1049.7
ASE	Average Squared Error.	0.14
MAX	Maximum Absolute Error.	0.96
DIV	Divisor for ASE.	1648
NOBS	Sum of Frequencies.	824
RASE	Root Average Squared Error.	0.37
SSE	Sum of Squared Errors.	230.42
SUMW	Sum of Case Weights Times Freq.	1648
FPE	Final Prediction Error.	0.16
MSE	Mean Squared Error.	0.15
RFPE	Root Final Prediction Error.	0.4
RMSE	Root Mean Squared Error.	0.39
AVERR	Average Error Function.	0.44
ERR	Error Function.	720.71
MISC	Misclassification Rate.	0.18
WRONG	Number of Wrong Classifications.	151

CLASSIFICATION SUMMARY (YEAR 2 TO 5)

TARGET	PREDICT	PERCENT OF TARGET	PERCENT OF PREDICT	COUNT	PERCENT OF TOTAL
BANKRUPT	BANKRUPT	81.6273	79.3367	311	37.7427
NONBANKRUPT	BANKRUPT	18.3727	16.2037	70	8.4951
BANKRUPT	NONBANKRUPT	18.2844	20.6633	81	9.8301
NONBANKRUPT	NONBANKRUPT	81.7156	83.7963	362	43.932

CLASSIFICATION SUMMARY FOR TEST DATA (YEAR 1)

Actual	Predicted		Total
	Bankrupt	Nonbankrupt	
Bankrupt	94 68.12	44 31.88	138
Nonbankrupt	20 17.09	97 82.91	117
Total	114	141	255

4.6 Summary and Conclusions

Traditional models have been extensively used in bankruptcy prediction for over four decades. However, over time, the underlying assumptions of these models have been called into question; many papers in the literature have shown that the distributional assumptions, along with other assumptions, are often violated. This has led to the use of more complex models, namely neural networks.

This has been a fruitful area of research, both because of the importance of early detection of financial distress and the improvement of technology. There is always a trade-off when deciding on using more complex models: practical efficiency versus precision. However, over time the complexity in using these models has subdued.

We test the predictive ability of two neural network models (multi-layer perceptron and radial basis function) on accounting ratios, market variables, and different mixes of both. While market variables alone have high predictive power, we find that the best predictions in terms of both classifying bankrupt firms and overall precision are made with a mix of market variables and accounting ratios. The market variables included in this subset are price, standard deviation of price, and bid-ask spread, and the accounting ratios are net income to sales, working capital to total assets, and current liabilities to total assets.

CHAPTER 5: EVALUATION, COMPARISON OF MODELS, AND CONCLUSION

5.1 Evaluation and comparison of models

Since the goal of this dissertation is to evaluate the predictive ability of different bankruptcy prediction models using different variables, in this chapter we compare the out-of-sample performance of different models, using different sets of variables. We focus on the set of market variables versus the mixed set of market variables and accounting ratios, which are price, standard deviation, bid-ask spread, net income to sales, working capital to total assets, and current liabilities to total assets.

The univariate analysis demonstrates that the best discriminating market variables are the price, standard deviation, and bid-ask spread, while the bid-ask spread is the best at discriminating in the long term. The cash flow ratios display misclassification rates of 20 to 30%, and the net income ratios have misclassification rates of 20 to 40%. Specifically, net income to sales ratio shows 25-33% misclassification rates.

Using the discriminant analysis, the market variables misclassify 29% of bankrupt firms and 17% of nonbankrupt firms. The set, price, standard deviation, bid-ask spread, net income to sales, working capital to total assets, and current liabilities to total assets, misclassify 38% of the bankrupt firms and 15% of nonbankrupt firms.

Employing neural networks, namely the multi-layer perceptron, market variables correctly classify 70% of bankrupt firms and 83% of nonbankrupt firms. The set of six market variables and accounting ratios correctly classify 68% of bankrupt firms and 83% of nonbankrupt firms.

5.2 Conclusion

This dissertation is a comprehensive study of bankruptcy prediction. Traditional approaches such as univariate analysis multivariate discriminant analysis are employed. From the univariate analysis in Chapter 2, market variables, such as price, standard deviation of return, and bid-ask spread, and certain accounting ratios, namely net income to sales, working capital to total assets, and current liabilities to total assets, show the highest ability to distinguish between bankrupt and nonbankrupt firms in a dichotomous classification test. However, since financial distress is a complex process, individual ratios and variables do not tell the whole story.

Multivariate discriminant analysis is employed in chapter 3. After testing for univariate and multivariate normality and finding that the variables and sets of variables are nonnormal, three different forms of discriminant analysis are used: linear, quadratic, and nonparametric analysis. Different combinations of variables and ratios are used in each discriminant analysis: all accounting ratios, all market variables, and different combinations of both. While market variables alone perform well, the combinations perform better at discriminating between bankrupt and nonbankrupt firms. The most important findings are that the nonparametric discriminant analysis is the most accurate and the most accurate set of variables consists of price, standard deviation of return, bid-ask spread, net income to sales, working capital to total assets, and current liabilities to total assets. This is important because the nonparametric discriminant analysis has not been heavily used in the literature, yet it is the most appropriate since the assumptions are often violated. Furthermore, the use of a combination of accounting ratios and market and

microstructure variables shows the need for forward-looking variables in bankruptcy prediction. These findings indicate the need for more complex techniques.

Chapter 4 utilizes neural networks for bankruptcy prediction. Multi-layer perceptron and radial basis function are the two forms of neural networks employed. The use of neural networks has grown in the literature and it is more useful now that the technology needed is available. Multi-layer perceptron is the most accurate technique according to the results, which is consistent with non-linearly related data, and the combination of accounting ratios and market and microstructure variables is found to be the most accurate predictor. The misclassification rates, and more importantly, the ability of the model to correctly classify bankrupt firms, are higher than found using univariate analysis and multivariate discriminant analysis.

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