

# **RISK ASSESSMENT BY INTERNAL AUDITORS USING PAST RESEARCH ON BANKRUPTCY**

## **APPLYING BANKRUPTCY MODELS**

**by Wanda A. Wallace, Ph.D., CPA, CMA, CIA  
The John N. Dalton Professor of Business Administration  
College of William and Mary**

**April 2004**



**RESEARCH  
FOUNDATION**  
*Understanding, Guiding, Shaping*

[www.theiia.org/research](http://www.theiia.org/research)

**Disclosure**

Copyright © 2004 by The Institute of Internal Auditors Research Foundation (IIARF), 247 Maitland Avenue, Altamonte Springs, Florida 32701-4201. All rights reserved. Printed in the United States of America. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form by any means — electronic, mechanical, photocopying, recording, or otherwise — without prior written permission of the publisher.

The IIARF publishes this document for informational and educational purposes. This document is intended to provide information, but is not a substitute for legal or accounting advice. The IIARF does not provide such advice and makes no warranty as to any legal or accounting results through its publication of this document. When legal or accounting issues arise, professional assistance should be sought and retained.

The Institute of Internal Auditors' (IIA) International Professional Practices Framework for Internal Auditing (IPPF) comprises the full range of existing and developing practice guidance for the profession. The IPPF provides guidance to internal auditors globally and paves the way to world-class internal auditing.

The mission of The IIARF is to expand knowledge and understanding of internal auditing by providing relevant research and educational products to advance the profession globally.

The IIA and The IIARF work in partnership with researchers from around the globe who conduct valuable studies on critical issues affecting today's business world. Much of the content presented in their final reports is a result of IIARF-funded research and prepared as a service to The Foundation and the internal audit profession. Expressed opinions, interpretations, or points of view represent a consensus of the researchers and do not necessarily reflect or represent the official position or policies of The IIA or The IIARF.

ISBN 978-0-89413-653-5

04/04 First Printing

## Contents

Acknowledgments .....	iv
About the Author .....	v
Report Introduction.....	1
• Relevant Dimensions .....	1
• Models' Application .....	2
• Altman's Models.....	3
• Zmijewski's Model .....	8
• Zavgren's Model .....	10
• Wilcox's Model.....	13
• Koh and Tan's Neural Network Model .....	15
• Wallace's Neural Network Analysis .....	17
• Which Model? .....	17
• Other Measures Relevant to Evaluating Bankruptcy .....	19
Appendix A: Application to Levitz Furniture Corporation .....	22
Endnotes .....	29

## **Acknowledgments**

This research has been supported by The Institute of Internal Auditors Research Foundation (IIARF). I appreciate their confidence in the research proposal and their facilitation of this project. The essence of this research is to provide an ease of access to bankruptcy models by the practice community. The endnotes are intended to encourage readers to access the full underlying articles, books, or associated publications. This resource and the resulting accessibility of a set of widely used models and benchmarks would not have been possible without the cooperation of the publishers of the articles and books cited, which I greatly appreciate.

## About the Author

**Wanda A. Wallace, Ph.D., CPA, CMA, CIA**, is the John N. Dalton Professor of Business Administration at the College of William and Mary in Williamsburg, Virginia. She received her Ph.D. from the University of Florida, with an accounting major, finance minor, and statistics research skill. Professor Wallace has been a member of the faculty at the University of Rochester, Southern Methodist University (as The Marilyn R. and Leo F. Corrigan, Jr. Trustee Professor), and Texas A & M University (as The Deborah D. Shelton Systems Professor of Accounting) before joining the College of William and Mary. Dr. Wallace has been the associate dean for academic affairs at the School of Business, College of William and Mary.

She has completed extensive writing on monitoring and controls, as well as modeling. These include the coauthored monograph *The Internal Auditor's Role in Management Reporting on Internal Control*, published by The Institute of Internal Auditors Research Foundation and acknowledged as having been used in formulating Professional Practices Pamphlet 97-2 "Assessing and Reporting on Internal Control." For over a decade, she was the statistical regression consultant to the National Office and World Firm of Price Waterhouse — this involved the design of specifications for statistical modeling and analysis software, consulting with engagement teams, and the development of training materials and instruction of partners and professional staff.

Dr. Wallace has received the Wildman Gold Medal awarded to the most significant literary contribution to the advancement of public accounting over a three-year period by the American Accounting Association (AAA) and Deloitte. She has been awarded a Certificate of Distinguished Performance on the Certified Management Accounting examination and the Highest Achievement Award (Gold Medal) on the international Certified Internal Auditor examination. Dr. Wallace was selected in 1998 to receive the Virginia Society of CPAs Outstanding Accounting Educator Award in recognition of excellence in classroom teaching and for active involvement in the accounting profession. She was selected as the recipient of the Association of Government Accountants' (AGA's) 2002 Cornelius Tierney/Ernst & Young Research Award. In *The International Journal of Accounting* (1990), she was identified as the "Most Prolific Author in the Past Decade in 24 academic accounting journals." She is extremely active in the academic profession, currently serving on the editorial board for nine national and/or international journals and in the past serving as AAA vice president, an officer in the AAA's Auditing Section, chair of the AAA's Government and Nonprofit section, a member of the Board of Regents of The Institute of Internal Auditors, and Visiting Distinguished Faculty member of the Doctoral Consortium, New Faculty Consortium, and Senior Faculty Consortium of the AAA. Dr. Wallace has been a visiting scholar at a number of domestic and international universities, including The University of Manchester in England and the Norwegian School of Economics and Business Administration in Bergen, Norway.

Dr. Wallace joined the Financial Accounting Standards Advisory Council (FASAC) that advises the Financial Accounting Standards Board (FASB) in 1991 and served through 1995. At the invitation of Charles A. Bowsher, Comptroller General of the United States, Dr. Wallace served on the Government Auditing Standards Advisory Council from 1991 through 1996. Among the topical areas involved in such advisory responsibilities are statistical sampling, analytical tools' applications, and research-associated issues, including research design. Dr. Wallace consults with national and international firms, ensuring up-to-date appreciation of current practice problems. Previous expert testimony has involved a number of areas, including: statistical sampling; statistical analysis; surveys; research methods; auditing; market competition; modeling and econometrics; systems and control processes; accounting; finance and valuation; distribution systems; intellectual property; economics; and business operations. Dr. Wallace has authored over 40 books and monographs, including *Mastery of the Financial Accounting Research System (FARS) Through Cases* published by John Wiley & Sons, Inc. and over 200 articles in such journals as the *Harvard Business Review*, *Accounting Review*, *Journal of Accounting Research*, *Auditing: A Journal of Practice & Theory*, *Internal Auditor*, *Financial Executive*, *Corporate Governance: An International Review*, *Journal of Government Financial Management*, and *The Wall Street Journal*.

## Introduction

In evaluating the risk of economic activities, a dimension of relevance is credit risk. Is it the case that the customer to whom you sell the product or extend the service can pay for that obligation? In an economy built on credit, you care about the financial viability of the other side of your transaction. As you make procurement decisions, you expect the supplier will be able to sustain operations and fulfill commitments made. When participating in multi-party transactions, be they financing or hedging in nature, counterparty risks are a key facet of decision-making. Whether your strategic partner will remain a going concern is of far more than passing interest. Well-controlled companies will build an infrastructure that takes the pulse of the parties with whom they transact business. One tool for which they may reach is bankruptcy modeling. The literature is replete with careful analyses of traits that distinguish failing companies from those that flourish. The intent of this executive summary is to provide in easy-to-apply format some of the commonly used models developed over the past four decades. Risk monitoring entails early warning of potential problems, including those related to endurance, persistence, distress, survival, and failure.<sup>1</sup> This paper summarizes a number of bankruptcy models that have been set forth in past literature for ease of reference and application by internal auditors and other professionals interested in assessing bankruptcy risk. References in the endnotes are an added resource for those seeking further details concerning a particular model or related debates regarding relative performance of the models and the context in which they were developed or have been applied.

## Relevant Dimensions

Most of the models developed use financial indicators in the form of ratios. These ratios relate to short-term liquidity and working capital, profitability or returns on investment, capital structure--including market capitalization and debt load, and asset mix--such as the intensity of inventory, receivable, and capital investments.<sup>2</sup> Often the particular measure used varies from the more traditional ratios found in financial statement analysis. Nonetheless, they relate to similar dimensions common in such analyses.<sup>3</sup> Although most models have been constructed using annual data, they have been applied in practice to quarterly<sup>4</sup> and even monthly information<sup>5</sup> as a filtering device and risk assessment tool. Some models require data unique to a particular country<sup>6</sup> (such as value added account balances) or industry<sup>7</sup> (such as agents' balances for insurance), and others require that an entity be public (market capitalization being an input to such analyses).

All of the models presented involve inferences as to the likelihood of failure that involve various computations. Since these models have been developed over a long time frame, in which diverse accounting methods<sup>8</sup> and reporting practices have been in place,<sup>9</sup> questions arise as to their continued applicability. As with any decision aid, the evaluator should consider whether changes are likely to affect the measures used by a particular tool. Sometimes, it will not be possible to apply a given model because it requires information not available for a private company or a specific setting. Judgment is applied in measuring the model components and at times adjustments are needed for information only disclosed in notes to the financial statements<sup>10</sup> or for key events that affect comparability.<sup>11</sup> Specifically, if mergers,<sup>12</sup> takeovers, debt use, or technological changes have occurred, adjustments to model components are often essential. Since business cycles<sup>13</sup> have their effects on models' development and competitive markets, as do legal environments,<sup>14</sup> in constant flux, the decision maker may wish to reach for that model developed in similar circumstances. However, the good news is that many models have been robust in identifying credit risk and have been replicated internationally--tracking with other indicators of risk such as bond ratings,<sup>15</sup> interest rates,<sup>16</sup> market returns,<sup>17</sup> and the types of auditor's reports issued.<sup>18</sup>

## Models' Application

The usual model simply sets forth what are known as coefficients or parameters. These numbers are usually multiplied by defined financial measures. Then, these products are summed, often with what is known as a constant or intercept term, to compute a single overall statistic. That number is then interpreted as to whether an entity is distressed. You can then "work backwards" from a failure model, examine each component of the model, and use these ingredients to identify potential sources of the problems that are correctable.<sup>19</sup> In other words, the term "failure" while commonly used to describe bankruptcy prediction could just as easily be described as a tool for identifying remedial work needed to enhance the endurance of a particular operating unit or entity.

The practical application of the models, will be illustrated using the Levitz Furniture Company, which filed a voluntary petition for bankruptcy in 1997 as described in the company's 10-K filing<sup>i</sup> for fiscal year March 31, 1999:

“On September 5, 1997 (the "Petition Date"), Levitz Furniture Incorporated, a Delaware corporation ("LFI" or the "Company"), and 11 of its subsidiaries (collectively, the "Debtors"), including, Levitz Furniture Corporation, a Florida corporation and wholly-owned subsidiary of LFI ("Levitz"), filed voluntary petitions for relief under Chapter 11, Title 11 of the United States Code (the "Bankruptcy Code") with the United States Bankruptcy Court for the District of Delaware, Wilmington, Delaware (the "Court") under Case No. 97-1842 (MFW). Pursuant to Sections 1107 and 1108 of the Bankruptcy Code, Levitz, as debtor and debtor-in-possession, has continued to manage and operate its assets and businesses pending the confirmation of a reorganization plan or plans and subject to the supervision and orders of the Court. Because Levitz is operating as debtor-in-possession under Chapter 11 of the Bankruptcy Code, the existing directors and officers of Levitz continue to manage the operations of Levitz subject to the supervision and orders of the Court. On July 7, 1999, the Debtors filed a "Disclosure Statement" and a "Joint Plan of Reorganization" ("Plan of Reorganization" or "Plan"), pursuant to Section 1125 of the Bankruptcy Code with the Court. The Disclosure Statement sets forth certain information regarding, among other things, significant events that have occurred during the Debtors' Chapter 11 cases and the anticipated organization, operation and financings of "Reorganized Levitz". ...Although the Plan of Reorganization provides for the Debtors' emergence from bankruptcy, there can be no assurances given that the Plan will be confirmed by the Court, or that such Plan will be consummated. At this time, it is not possible to predict the outcome of the Debtors' Chapter 11 cases or their effect on the Debtors' business...the Report of Independent Public Accountants...indicates the substantial doubt about Levitz's ability to continue as a going concern.”

A press release contained in the company's April 7, 2000 8-K filing bears out the long process of bankruptcy proceedings:

“Levitz Furniture Incorporated and Seaman Furniture Company, Inc. announced today that they are entering into a management agreement and a shared services agreement that are expected to create efficiencies in advertising, merchandising, warehousing, distribution and administration.... These agreements are being entered into in contemplation of a plan of reorganization to be filed by Levitz in its bankruptcy

---

<sup>i</sup> Filed on July 13, 1999 and available on the SEC website [www.sec.gov](http://www.sec.gov)

proceedings. The agreements are subject to bankruptcy court approval, which Levitz anticipates receiving by late summer, and other conditions. As part of the plan of reorganization, it is anticipated that a new holding company will be formed, Levitz Home Furnishing, Inc., which would own all of Levitz and a majority of Seaman. Except as provided in these agreements, Levitz and Seaman would continue to be operated separately.... If the plan [of] reorganization is approved, Resurgence Asset Management, L.L.C. and it[s] affiliated entities are expected to become the largest shareholder of [the] new company by contributing their claims in the Levitz bankruptcy to the new company and exchanging their majority ownership of Seaman for equity in the new company.”

Such disclosure illustrates the types of financial consequences resulting from bankruptcy proceedings, as well as the pervasive uncertainty inherent in such events.

The financial data used in the illustrations is contained in Appendix A. Most of the information was taken from SEC filings, which are readily accessible from the SEC EDGAR database for publicly traded companies.

### Altman's Models

As a simple example, consider one of the oldest models still in common use.<sup>20</sup> Exhibit 1 displays Altman's Model for public companies.<sup>21</sup> The model uses seven readily available financial measures: working capital, retained earnings, earnings before interest and taxes (EBIT), the market value of equity, sales, total assets, and total liabilities. The financial measures are self-explanatory; recall that working capital is computed as current assets minus current liabilities and that market value of equity is the market price per share multiplied by the number of shares of common stock outstanding.

**Exhibit 1**

		<u>Parameter</u>	
	(Working Capital / Total Assets)	x	1.2
Sum of:	(Retained Earnings / Total Assets)	x	1.4
	(EBIT / Total Assets)	x	3.3
	(Market Value of Equity / Total Liabilities)	x	0.6
	(Sales / Total Assets)	x	1

Altman's models are based on what is known as discriminant analysis,<sup>22</sup> which is similar to regression analysis.<sup>23</sup> The sum is known as the z-score and is the final step in the computation. Benchmarks are defined to interpret this z-score, based on analysis of bankrupt companies relative to healthy companies.

The cut-off values for the z-score involve three zones that permit one to assess whether this model identifies the company as safe, in the gray area, or troubled.

Cut-off Values Public Company Model

Z value greater than or equal to 2.99 is considered Safe  
 Z value between 1.82 and 2.98 is in the Gray Area  
 Z value below 1.81 is considered a Troubled Company

Exhibit 2 shows the application of the model to the Levitz case study using the 1997 financial data contained in Appendix A. To apply the model, the values for each of the financial measures for the entity of interest are inserted (in like units of measure) and the mathematical operations performed as indicated. A [companion EXCEL spreadsheet](#) is provided for ease of use (depicted herein as Exhibit 4). The sum is known as the z-score. The cut-off values highlighted permit one to assess whether this model identifies the company as safe, in the gray area, or troubled.

**Exhibit 2**

<u>Working Capital*</u>		<u>Total Assets</u>					<u>Z-Score</u>	
\$ -61,020	/	\$931,955	=	<u>-0.065473859</u>	x	1.2	= <u>-0.0786</u>	
<u>Retained Earnings</u>		<u>Total Assets</u>						
\$-155,389	/	\$931,975	=	<u>-0.166730867</u>	x	1.4	= <u>-0.2334</u>	
<u>EBIT**</u>		<u>Total Assets</u>						
\$16,148	/	\$931,975	=	<u>0.017326645</u>	x	3.3	= <u>0.0572</u>	
<u>Market Value of Equity***</u>		<u>Total Liabilities</u>						
\$263,000	/	\$1,029,547	=	<u>.002554522</u>	x	0.6	= <u>.00153</u>	
<u>Sales</u>		<u>Total Assets</u>						
\$966,855	/	\$931,975	=	<u>1.037425897</u>	x	1	= <u>1.0374</u>	
							Σ <u>.78414</u>	
<u>Cutoff Values</u>		Z value greater than or equal to 2.99 is considered Safe Z value between 1.82 and 2.98 is in the Gray Area Z value below 1.81 is considered a Troubled Company						<b>-Troubled-</b>

\*Working Capital = Current Asset (\$220,560) – Current Liabilities (\$281,580)

\*\* EBIT = Earnings Before Interest and Taxes

\*\*\* Market Value of Equity = \$2.63 per share x 1000 shares (in 000's)

Since the Altman model was largely directed toward manufacturing companies, the literature<sup>24</sup> has recommended that when applying the analysis to nonmanufacturing organizations, the same framework be applied, except that the sales to total assets variable be omitted. In that case, the zones' interpretations change to: a 2.60 and above representing a low probability of bankruptcy; an above 1.10 to 2.60 requiring careful monitoring in the so-called gray zone; and a score of 1.10 and below representing a likelihood of insolvency within 12 months.

Given Altman's model for public companies was originally developed in 1968, research has refitted the same set of financial measures to data in a later time frame (1985 to 1987) to generate an updated set of coefficients.<sup>25</sup> As Exhibit 3 displays, three alternative sets of parameters are available for use, with column A having the largest number of sample points, B using a subset of 910 entities, and column C focusing only on industrial companies. The cut-off values originally defined for Altman's public company model continue to apply. If an evaluator is interested in an industrial company, then column C would be expected to have greater relevance in generating the z-score.

**Exhibit 3**

	<b>A</b>	<b>B</b>	<b>C</b>
	972 companies 86 bankrupt 148 distressed	910 companies	555 Industrial Companies*
Working Capital / Total Assets	0.058	-0.301	-0.386
Retained Earnings / Total Assets	1.504	1.599	2.067
EBIT / Total Assets	2.073	2.6271	1.385
Market Value of Equity / Total Liabilities	-0.014	-0.033	-0.005
Sales / Total Assets	-0.058	-0.157	-0.069

*\*Defined as companies with SIC codes 2000 - 3999*

The [companion EXCEL spreadsheet](#) is programmed to automatically calculate all variations by simply entering the financial input variables where indicated. To apply the model, insert the values for each of the financial measures for the entity of interest at the top of the spreadsheet where indicated. Then the spreadsheet is set to multiply those values by the corresponding coefficient and add the products. The EXCEL Exhibit 4 displays Altman's Model for public companies<sup>26</sup> using Levitz 1997 financial data in Appendix A.

**Exhibit 4**

Enter Input Variables	
Total Assets	\$931,975 ←
Total Liabilities	\$1,029,547 ←
Retained Earnings	-\$155,389 ←
Working Capital	-\$61,020 ←
EBIT*	\$16,148 ←
Market Value of Equity	\$2,630 ←
Sales	\$966,855 ←

\* Earnings Before Interest and Taxes

-0.065473859 = working capital/total assets  
 -0.166730867 = retained earnings/total assets  
 0.017326645 = earnings before interest and taxes (EBIT)/total assets  
 0.002554522 = market value of equity/total liabilities  
 1.037425897 = sales/total assets

	Altman Re-estimated By Grice								
	Altman Original		972 Companies including 148 distressed and 86 bankrupt		910 companies		555 Industrial companies (SIC Code 2000 - 3999)		
	coeff.	Score	coeff.	Score	coeff.	Score	coeff.	Score	
working capital/total assets =	-0.065473859	1.20000	-0.07856863	0.05800	-0.00379748	-0.30100	0.01970763	-0.38600	0.02527291
retained earnings/total assets =	-0.166730867	1.40000	-0.23342321	1.50400	-0.25076322	1.59900	-0.26660266	2.06700	-0.34463270
earnings before interest and taxes (EBIT)/total assets =	0.017326645	3.30000	0.05717793	2.07300	0.03591814	2.62710	0.04551883	1.38500	0.02399740
market value of equity/total liabilities =	0.002554522	0.60000	0.00153271	-0.01400	-0.00003576	-0.03300	-0.00008430	-0.00500	-0.00001277
sales/total assets =	1.037425897	1.00000	1.03742590	-0.05800	-0.06017070	-0.15700	-0.16287587	-0.06900	-0.07158239
z-score		0.78414469		-0.27884904		-0.36433636		-0.36695755	
CUT-OFF VALUES: z value greater than or equal to 2.99 is considered safe z value between 1.82 and 2.98 is gray area z value below 1.81 is troubled company		<b>Troubled</b>		<b>Troubled</b>		<b>Troubled</b>		<b>Troubled</b>	

Since you may wish to evaluate a private company and, therefore, would not have available the market value of equity, Altman also developed two models for private company application as shown in Exhibit 5.<sup>27</sup> The private models can use five or four variables, and again the financial measures are self-explanatory, with the book value of equity being the difference in total assets and total liabilities. Simply replace the parameters and substitute the book value of equity to book value of liabilities ratio for the market value of equity to total liability calculation. The summation of the products is the z value, interpreted using the following cut-off values for the private [4-variable] models:

Cut-off Values Private Company Models

- Z value greater than or equal to 2.90 [2.60] is considered Safe
- Z value between 1.20 and 2.89 [1.10 and 2.59] is in the Gray Area
- Z value below 1.20 [1.10] is considered a Troubled Company

**Exhibit 5**

	Private Model Parameters	Four Variable Model Parameters
Working Capital / Total Assets	0.717	6.56
Retained Earnings / Total Assets	0.847	3.26
EBIT / Total Assets	3.107	6.72
Book Value of Total Book Value of Equity / Liabilities	0.42	1.05
Sales / Total Assets	0.998	Omitted

Again, a [companion EXCEL spreadsheet](#) is provided for ease of use. Simply insert the measures indicated; the spreadsheet will generate the scores for the five-variable model and the four-variable model. The summation of the products is the z value interpreted for each model--again, the 1997 Levitz information is included in Exhibit 6.

**Exhibit 6**

Enter Input Variables					
Total Assets		\$931,975			←←
Total Liabilities		\$1,029,547			←←
Retained Earnings		-\$155,389			←←
Working Capital		-\$61,020			←←
EBIT*		\$16,148			←←
Book Value of Equity**		-\$97,572			←←
Sales		\$966,855			←←

\* Earnings Before Interest and Taxes  
\*\* Total Assets - Total Liabilities

-0.065473859 = working capital/total assets  
 -0.166730867 = retained earnings/total assets  
 0.017326645 = earnings before interest and taxes (EBIT)/total assets  
 -0.094771778 = book value of equity/total liabilities  
 1.037425897 = sales/total assets

	Private Model		Four Variable Model	
	coeff.	Score	coeff.	Score
working capital/total assets =	-0.065473859	0.71700	-0.04694476	6.56000
retained earnings/total assets =	-0.166730867	0.84700	-0.14122104	3.26000
earnings before interest and taxes (EBIT)/total assets =	0.017326645	3.10700	0.05383389	6.72000
book value of equity/total liabilities =	-0.094771778	0.42000	-0.03980415	1.05000
sales/total assets =	1.037425897	0.99800	1.03535104	Omitted
z-score		0.86121498		-0.95612646

	Private Model	Four Variable Model
	<b>Troubled</b>	<b>Troubled</b>

Private Model	Four Variable Model
CUT-OFF VALUES: z value > 2.90 is considered safe z value between 1.20 and 2.89 is gray area z value < 1.20 is troubled company	CUT-OFF VALUES: >2.60 is considered safe z value between 1.10 and 2.59 is gray area z value < 1.10 is troubled company

## Zmijewski's Model

The more parsimonious Zmijewski model, requires only three financial measures<sup>28</sup>:

- Return on Assets = Net Income / Total Assets
- Financial Leverage = Total Debt / Total Assets
- Liquidity = Current Assets / Current Liabilities

The application of the model is slightly more complex due to the methodology used to generate the parameters. Zmijewski's models, as reflected in Exhibit 7, are based on what is known as probit analysis,<sup>29</sup> which is why two steps are required beyond those applied for discriminant analysis-based models such as the previously presented Altman Model. First, the constant and each parameter of the model must be multiplied by 1.8138 and then multiplied by the financial measure. Two alternative sets of parameters are provided, either of which can be used for estimation--weighted measures are based on varying proportions of bankrupt and nonbankrupt firms.

**Exhibit 7**

	UNWEIGHTED ORIGINAL		Adjusted Parameter	WEIGHTED ORIGINAL		Adjusted Parameter
Net Income / Total Assets	-4.513	x1.8138	-8.1857	-3.599	x1.8138	-6.5279
Total Debt / Total Assets	5.679	x1.8138	10.3006	5.406	x1.8138	9.8054
Current Assets / Current Liabilities	.004	x1.8138	.0073	-0.100	x1.8138	-0.1814
Constant	-4.336	x1.8138	-7.8646	-4.803	x1.8138	-8.7117

Exhibit 8 applies the model using Zmijewski's original unweighted parameters and Levitz's 1997 financial data.

**Exhibit 8**

$$\begin{array}{r}
 \frac{\text{Net Income}}{\$ -26,453} \div \frac{\text{Total Assets}}{\$ 931,975} = -0.02838 \times -8.18568 = 0.23234 \\
 \\
 \frac{\text{Total Debt}^*}{\$ 690,034} \div \frac{\text{Total Assets}}{\$ 931,975} = 0.7404 \times 10.30057 = 7.62653 \\
 \\
 \frac{\text{Current Assets}}{\$ 220,560} \div \frac{\text{Current Liabilities}}{\$ 281,580} = 0.783294 \times 0.007255 = 0.00568 \\
 \\
 \text{Adjusted Constant} = -7.86463 \\
 \text{Adjusted Score} = \underline{\underline{\Sigma -0.000085}}
 \end{array}$$

\* Total Debt = Current Portion of Long-Term Debt (\$11,193) + Current Portion of Capital Lease Obligation (\$3,398) + Long-Term Debt Net Current Portion (\$273,976) + Obligation Under Capital Lease (\$74,466) + Obligation Under Account Purchase Agreement (\$327,000)

After multiplying the financial measure by the adjusted parameter, the products are aggregated to a quantity referred to as an Adjusted Score. The Adjusted Score is then translated into a measure of probability by the following formula:

$$\text{Probability}_{\text{Bankruptcy}} = 1 / (1 + \exp(-\text{Adjusted Score}))$$

The translation of the score results in a probability that will lie between 0 and 1 and be interpretable in terms of likelihood. The use of the 50 percent cut-off suggests that when failure is more likely than not, the appropriate interpretation is that the entity is distressed. In other words, if probability lies at or above 50 percent, then distress is indicated.<sup>30</sup>

$$1 / (1 + \exp(-\text{Adjusted Score})) = \text{Probability}$$

$\geq .5$  is classified as *Bankrupt*  
 $< .5$  classified as *Not Bankrupt*

**Bankrupt**

The resiliency of the Zmijewski Model was examined in the later time frame from 1985 through 1987 and the coefficients were updated, as reported in Exhibit 9.<sup>31</sup> The same approach as in Exhibit 7 applies, except that the new parameter choices relate to a total sample of 1,048 companies (A), 791 industrial companies (B), or 990 bankrupt companies (C). Note that the primary adjustment is a greater emphasis on the current ratio rather than debt load when the coefficients for bankrupt companies are applied.

**Exhibit 9**

	1,048 Companies	<u>A</u>	Adjusted Parameters	791 Industrial Companies	<u>B</u>	Adjusted Parameters	990 Companies	<u>C</u>	Adjusted Parameters
Return on Assets	-4.341	x1.8138	-7.8737	-4.325	x1.8138	-7.8447	-4.076	x1.8138	-7.3930
Financial Leverage	2.106	x1.8138	3.8199	2.194	x1.8138	3.9795	1.921	x1.8138	3.4843
Liquidity	.0092	x1.8138	0.1669	0.077	x1.8138	0.1397	0.991	x1.8138	1.7975
Constant	-2.559	x1.8138	-4.6416	-2.481	x1.8138	-4.5000	-2.654	x1.8138	-4.8138

The [companion EXCEL spreadsheet](#) is programmed to automatically calculate all variations (see Exhibit 10). Specifically, each parameter of the model is multiplied by the constant of 1.8138 and then multiplied by the corresponding financial measure. The constant term must likewise be multiplied by 1.8138. The sum of these products is a quantity referred to as an adjusted score, which is then translated into a probability of bankruptcy. A practical application of the EXCEL spreadsheet using 1997 financial data from the Levitz case is contained in Exhibit 10.

**Exhibit 10**

Enter Input Variables	
Current Assets	\$220,560.00 ←
Total Assets	\$931,975.00 ←
Current Liabilities	\$281,580.00 ←
Total Debt	\$690,033.00 ←
Net Income	-\$26,453.00 ←

  

-0.028383809 = Net Income / Total Assets  
 0.740398616 = Total Debt / Total Assets  
 0.783294268 = Current Assets / Current Liabilities

	Probit Adjustment	Zmijewski Original		Zmijewski Model Re-estimated By Grace								
		Unweighted Original	Weighted Original	1,048 companies		761 industrial companies		990 companies				
		coeff.	Score Adjusted for Probit	coeff.	Score Adjusted for Probit	coeff.	Score Adjusted for Probit	coeff.	Score Adjusted for Probit	coeff.	Score Adjusted for Probit	
Net Income / Total Assets =	-0.028383809	1.8138	-4.51300	0.23234076	-3.58900	0.185286	-4.34100	0.223486	-4.32500	0.222662	-4.07600	0.208843
Total Debt / Total Assets =	0.740398616	1.8138	5.67900	7.62652792	5.40600	7.259907	2.10600	2.828221	2.19400	2.946399	1.92100	2.579778
Current Assets / Current Liabilities =	0.783294268	1.8138	0.00400	0.00568296	-0.10000	-0.142074	0.09200	0.130708	0.07700	0.108997	0.99100	1.407952
CONSTANT		1.8138	-4.33600	-7.8646368	-4.80300	-8.711681	-2.55900	-4.641514	-2.48100	-4.500038	-2.65400	-4.813825
			-0.000085		-1.408563		-1.459099		-1.221579		-0.616252	
			Pr(Bkrpt)	0.499979	Pr(Bkrpt)	0.196461	Pr(Bkrpt)	0.188605	Pr(Bkrpt)	0.227659	Pr(Bkrpt)	0.350634
			<b>Bankrupt</b>		<b>Not Bankrupt</b>		<b>Not Bankrupt</b>		<b>Not Bankrupt</b>		<b>Not Bankrupt</b>	

Cutoff guidance: A probability (Pr(Bkrpt)) of .5 (rounding result to the first decimal) and above is classified as bankrupt .

**Zavgren's Model**

A model that considers the predictive capabilities five years in advance of distress is reported in Exhibit 11.<sup>32</sup>

**Exhibit 11**

	Years Prior to Failure				
	1	2	3	4	5
Intercept	-0.23883	-2.6106	-1.5115	-5.9457	-6.8766
Avg. Inventories/ Net Sales	0.00108	0.04185	0.06257	0.09157	0.08835
Avg. Receivables/ Avg. Inventories	0.01583	0.02215	0.00829	0.01667	0.00692
(Cash + Marketable Securities)/ Short-term assets + Long-term assets + Intangibles	0.1078	0.11231	0.4248	0.05917	0.15786
(Cash + Marketable Securities)/ Current Liabilities	-0.03074	-0.0269	-0.01549	-0.0041	0.00018
Income before discontinued operations and extraordinary	-0.00486	-0.0144	0.00519	0.0195	-0.02301

items/Long-Term Liabilities + Stockholders' Equity					
Long-Term Debt/(Total Equities - Short-Term Debt)	0.0435	0.04464	0.01822	0.041	0.04371
Net Sales/(Fixed Assets+Net Working Capital)	-0.0011	0.00063	0.00002	0.00363	0.00798

Zavgren's models are based on what is known as logit analysis.<sup>33</sup> In this case, the result of applying the coefficients to the input and adding them to the intercept again must be translated to a probability. The presence of five years of analysis permits one to assess whether the company is consistently deteriorating over time.<sup>34</sup>

The [companion EXCEL spreadsheet](#) is programmed to calculate all years prior to failure. The required financial data are input in the top half of the spreadsheet for each year and the following ratios calculated:

- Average Inventories/Net Sales
- Average Receivables/Average Inventories
- (Cash + Marketable Securities)/Short-term assets + Long-term Assets + Intangibles
- (Cash + Marketable Securities)/Current Liabilities
- IBDOEI\*/Long-Term Liabilities + Stockholders' Equity
- Long-Term Debt/(Total Equities - Short-Term Debt)
- Net Sales/(Fixed Assets + Net Working Capital)

\* *IBDOEI = Income Before Discontinued Operations and Extraordinary Items*

These ratios are each multiplied by 100. Then the approach is to multiply the coefficients for year 1 by those values, add the products with the intercept, and then solve for the probability of bankruptcy. The same approach is used for each of the remaining years, through the fifth year prior to bankruptcy.

Applying the model in the Levitz case example using the [companion EXCEL Spreadsheet](#) yielded the results reported in Exhibit 12. In the illustration, 1997 financial data presented in Exhibit A is entered for each year. In actual field applications to Levitz, the year 2 should be 1996 data, year 3 should be 1995, year 4 should be 1994, and year 5 should be 1993. In other words, for any application of Exhibit 12, align the historical data relative to the point of prediction.

Note that the computations leading to the 1997 inputs described in Exhibit 12 include:

Fixed Assets = Plant Property & Equipment (\$214,626) – Land (\$47731)

Long-Term Liabilities = Long-Term Debt (\$273,976) + Capital Lease Obligations (\$74,466) + Purchase Agreement Obligations (\$327,000) + Other Noncurrent Liabilities (\$24,424) + Deferred Taxes (\$48,101);

Net Working Capital = Current Assets (\$220,560) – Current Liabilities (\$281580)

**Exhibit 12**

Enter Input Variables	Years Prior to Bankruptcy									
	Year 1		Year 2		Year 3		Year 4		Year 5	
Cash	\$	9,267	\$	9,267	\$	9,267	\$	9,267	\$	9,267
Marketable Securities	\$	-	\$	-	\$	-	\$	-	\$	-
Beginning Receivables	\$	37,358	\$	37,358	\$	37,358	\$	37,358	\$	37,358
Ending Receivables	\$	34,025	\$	34,025	\$	34,025	\$	34,025	\$	34,025
Beginning Inventory	\$	140,918	\$	140,918	\$	140,918	\$	140,918	\$	140,918
Ending Inventory	\$	169,488	\$	169,488	\$	169,488	\$	169,488	\$	169,488
Short-Term Assets	\$	220,560	\$	220,560	\$	220,560	\$	220,560	\$	220,560
Long-Term Assets	\$	333,703	\$	333,703	\$	333,703	\$	333,703	\$	333,703
Fixed Assets	\$	166,895	\$	166,895	\$	166,895	\$	166,895	\$	166,895
Intangibles	\$	377,712	\$	377,712	\$	377,712	\$	377,712	\$	377,712
Current Liabilities	\$	281,580	\$	281,580	\$	281,580	\$	281,580	\$	281,580
Long-Term Liabilities	\$	747,967	\$	747,967	\$	747,967	\$	747,967	\$	747,967
Short-Term Debt	\$	281,580	\$	281,580	\$	281,580	\$	281,580	\$	281,580
Long-Term Debt	\$	273,976	\$	273,976	\$	273,976	\$	273,976	\$	273,976
Total Equities	\$	931,975	\$	931,975	\$	931,975	\$	931,975	\$	931,975
Net Working Capital	\$	(61,020)	\$	(61,020)	\$	(61,020)	\$	(61,020)	\$	(61,020)
Stockholders' Equity	\$	(97,572)	\$	(97,572)	\$	(97,572)	\$	(97,572)	\$	(97,572)
Net Sales	\$	966,855	\$	966,855	\$	966,855	\$	966,855	\$	966,855
IBDOEI*	\$	(24,451)	\$	(24,451)	\$	(24,451)	\$	(24,451)	\$	(24,451)

\* Income before discontinued operations and extraordinary items

	Year 1	(x100)	Year 2	(x100)	Year 3	(x100)	Year 4	(x100)	Year 5	(x100)
Average Inventories/Net Sales	0.160524	16.0523553	0.160524	16.0523553	0.160524	16.052355	0.160524	16.052355	0.160524	16.052355
Average Receivables/Average Inventories	0.229967	22.996656	0.229967	22.996656	0.229967	22.996656	0.229967	22.996656	0.229967	22.996656
(Cash+Marketable Securities)/Short-Term assets + Long-Term assets + Intangibles	0.009943	0.99433998	0.009943	0.99433998	0.009943	0.99434	0.009943	0.99434	0.009943	0.99434
(Cash+Marketable Securities)/Current Liabilities	0.032911	3.29107181	0.032911	3.29107181	0.032911	3.2910718	0.032911	3.2910718	0.032911	3.2910718
IBDOEI/Long-Term Liabilities + Stockholders' Equity	-0.037594	-3.75940774	-0.037594	-3.7594077	-0.037594	-3.759408	-0.037594	-3.759408	-0.037594	-3.759408
Long-Term Debt/(Total Equities - Short-Term Debt)	0.421246	42.1245551	0.421246	42.1245551	0.421246	42.124555	0.421246	42.124555	0.421246	42.124555
Net Sales/(Fixed Assets+Net Working Capital)	9.132043	913.20425	9.132043	913.20425	9.132043	913.20425	9.132043	913.20425	9.132043	913.20425

	Years Prior to Failure									
	Year 1		Year 2		Year 3		Year 4		Year 5	
	<i>Intercept</i>	-0.23883	<i>Intercept</i>	-2.6106	<i>Intercept</i>	-1.5115	<i>Intercept</i>	-5.9457	<i>Intercept</i>	-6.8766
Average Inventories/Net Sales	0.00108	0.017336544	0.04185	0.67179107	0.06257	1.00439587	0.09157	1.46991418	0.08835	1.41822559
Average Receivables/Average Inventories	0.01583	0.364037064	0.02215	0.50937593	0.00829	0.19064228	0.01667	0.38335426	0.00692	0.15913686
(Cash+Marketable Securities)/Short-Term assets + Long-Term assets + Intangibles	0.1078	0.10718985	0.11231	0.111674323	0.4248	0.42239562	0.05917	0.0588351	0.15786	0.15696651
(Cash+Marketable Securities)/Current Liabilities	-0.03074	-0.101167547	-0.0269	-0.08852983	-0.01549	-0.0509787	-0.0041	-0.0134934	0.00018	0.00059239
IBDOEI/Long-Term Liabilities + Stockholders' Equity	-0.00486	0.018270722	-0.0144	0.054135472	0.00519	-0.0195113	0.0195	-0.0733085	-0.02301	0.08650397
Long-Term Debt/(Total Equities - Short-Term Debt)	0.0435	1.832418146	0.04464	1.880440139	0.01822	0.76750939	0.041	1.72710676	0.04371	1.8412643
Net Sales/(Fixed Assets+Net Working Capital)	-0.0011	-1.004524675	0.00063	0.575318678	0.00002	0.01826409	0.00363	3.31493143	0.00798	7.28736992
	S	0.994730102	S	1.103605779	S	0.82121722	S	0.92163987	S	4.07345955
		<b>0.730021193</b>		<b>0.75093511</b>		<b>0.694494662</b>		<b>0.715376123</b>		<b>0.983266369</b>
Cutoff guidance: A probability (Pr(Bkrupt)) of .5 (rounding result to the first decimal) and above is classified as bankrupt .		<b>Bankrupt</b>		<b>Bankrupt</b>		<b>Bankrupt</b>		<b>Bankrupt</b>		<b>Bankrupt</b>

## Wilcox's Model

The Gambler's Ruin Model has been applied to the area of failure prediction. The idea of this theory is that the gambler begins the game with an arbitrary amount of money and then wins a dollar with probability p or loses a dollar with probability 1-p, with the game continuing until the gambler loses all of his money or another loses his. The approach quantifies the probability of ultimate ruin, gain, loss, and duration of the game. In the financial application, the firm is viewed as the gambler with bankruptcy occurring when net worth falls to zero. The gambler's ruin approach<sup>35</sup> is depicted in Exhibit 13.

**Exhibit 13**

Cash including Marketable Securities	1
Current Assets Other Than Cash	0.7
Long-term Assets	0.5
Liabilities, including Contingencies	-1
Adjusted Cash Position (summation of input * weight)	
Net income - dividends	1
Period-to-period increase in noncash current assets	-0.3
Period-to-period increase in long-term assets	-0.5
Stock issued in a merger or acquisition	1
Adjusted Cash Flow (summation of input * weight)	
Net income	1
Capital Expense-Depreciation	-0.5
Increase in Other Current Assets	-0.3
Dividends	1
Adjusted Cash Flow Alternative (summation of input * weight)	

The weights are applied to the inputs and then summed, for multiple years--preferably using five or six observations. The resulting adjusted cash flow figures are averaged to derive a mean value and a variance. These inputs permit three computations that are input to the derivation of the probability of bankruptcy:

$$a=[(\text{mean adjusted cash flow})^2+\text{variance of adjusted cash flow}]^{1/2}$$

$$N=\text{Adjusted Cash Position}/a$$

$$X=\text{mean adjusted cash flow}/a$$

The interpretation of Wilcox's Gambler Ruin Model is relative to the value of X, in that a value below zero indicates distress and above zero health. However, in addition, a probability is attached to this cut-off, as depicted in the following formulas:

$$\text{Pr}(\text{failure})=1 \text{ if } X<0$$

$$\text{Pr}(\text{failure}) \text{ if } X>0=((1-X)/(1+X))^N$$

As shown in Exhibit 14, the [companion EXCEL spreadsheet](#) is programmed to calculate a single year's value by deriving the mean and variance amounts from the two alternative computations of adjusted cash flow. Once the inputs are entered for Levitz, the formulas are applied to derive the probability of bankruptcy. In this illustration, the X value is below zero, implying a probability of failure of 1. Note that if multiple years of data were accessed, the means and variances can be expanded, rather than using the worksheet's proxy.

**Exhibit 14**

Enter Input Variables		Enter Input Variables	
Cash (beginning)	\$12,755 <==	Net Income	-\$26,453 <==
Cash (ending)	\$9,267 <==	Capital Expenditures	\$11,008 <==
Marketable Securities	\$0 <==	Depreciation	\$15,703 <==
Current Assets (beginning)	\$191,518 <==	Dividends	\$0 <==
Current Assets (ending)	\$220,560 <==	Stock Issued In Merger or	<==
Long-Term Assets (beginning)	\$408,726 <==	Acquisition	\$0 <==
Long-Term Assets (ending)	\$711,415 <==		
Liabilities & Contingencies	\$1,029,547 <==		

  

		<i>x coeff</i>	
Cash including Marketable Securities =	\$9,267	1.0	9267
Current Assets Other Than Cash =	\$211,293	0.7	147905.1
Long-Term Assets =	\$711,415	0.5	355707.5
Liabilities, including Contingencies =	\$1,029,547	-1.0	-1029547
		<i>Adjusted Cash Position</i>	-516667.4
Net income - dividends =	-\$26,453	1.0	-26453
Period-to-period increase in non-cash current assets =	\$32,530	-0.3	-9759
Period-to-period increase in long-term assets =	\$302,689	-0.5	-151344.5
Stock issued in a merger or acquisition =	\$0	1.0	0
		<i>Adjusted Cash Flow</i>	-187556.5
Net income =	-\$26,453	1.0	-26453
Capital Expenditures-Depreciation =	-\$4,695	-0.5	2347.5
Increase in Other Current Assets =	\$211,293	-0.3	-63387.9
Dividends =	\$0	1.0	0
		<i>Adjusted Cash Flow Alternative</i>	-87493.4

  

	Mean Adjusted Cash Flow	-137,524.95 <i>Consider Using 5 years</i>
	Mean Adjusted Cash Flow <sup>2</sup>	18,913,111,873
	Variance of adjusted cash flow	5,006,311,991 <i>Consider Using 5 years</i>
<b>Cut-Off Guidance</b>	$a = [(\text{mean adjusted cash flow})^2 + \text{variance of adjusted cash flow}]^{\frac{1}{2}}$	154,659.0568
<i>X &lt; zero</i>	$N = \text{Adjusted Cash Position} / a$	-3.340686349
<i>indicated distress</i>	$X = \text{mean adjusted cash flow} / a$	-0.889213686
<i>X &gt; zero</i>		
<i>indicated health</i>		

  

$Pr(\text{failure}) = 1 \text{ if } X < 0$	1.0000000000	<b>Distress</b>
$Pr(\text{failure}) \text{ if } X > 0 = ((1-X)/(1+X))^N$		

  

**Note:**  
 Mean adjusted cash flow is the statistical mean over a number of observations of the adjusted cash flow, while the variance is intended likewise.  
 Six years of balance sheet and five years of earnings data are suggested.  
 Empirically, net income includes special or extraordinary, dividends refer only to cash, and other stock issues or redemptions are ignored beyond merger or acquisition issuances.

## Koh and Tan's Neural Network Model

Neural networks, developed over the past half century, are analogous to neurobiological systems--indeed they have been likened to the structure of neurons in the brain which has given them their name. The neural network approach differs from other artificial intelligence approaches in its absence of sequential instructions or inference paths for computation--learning from parallel processing of data to search for close matches and good solutions. Such a model can take a form similar to discriminant, logit, or probit models, or be more complex with multiple equations that act as "nodes" to compute combinations that lead to the prediction of interest.<sup>36</sup> The neural network<sup>37</sup> for predicting whether an entity is a going concern is provided in Exhibit 15.

**Exhibit 15**

Quick assets to current liabilities	Market value of equity to total assets	Total liabilities to total assets	Interest payments to earnings before interest and tax	Net income to total assets	Retained earnings to total assets
Node 1	Node 2	Node 3	Node 4	Node 5	Node 6
-1.7131	-0.7445	1.0923	0.7894	-1.219	1.4748
2.409	0.4731	0.9675	1.4973	1.5736	0.0608
-4.7666	-0.6464	-0.4594	1.1811	-3.0948	1.1088
2.4481	1.5166	-1.9108	-1.0374	3.4716	-1.7151
-1.8592	0.832	0.5539	-0.3472	-3.8518	1.0478
2.3792	-1.6206	0.9388	0.9583	0.5343	-1.4635
-0.3777	-1.9838	4.7112	0.3435	-4.162	0.2471
0.7749	0.068	-3.0032	-0.903	3.8518	2.9925
0.1082	-2.7006	0.8004	2.8183	-1.4552	-1.5489
-1.4331	-3.8039	1.5506	-1.5812	-1.5487	1.68
-1.069	1.174	1.8209	3.2994	1.9189	-1.3918
-3.4508	1.6278	1.5102	-1.2572	-1.474	-3.2479
1.586	-1.8089	1.3851	3.2692	-0.9288	-1.7903

The [companion EXCEL spreadsheet](#), shown in Exhibit 16, is programmed to perform a series of related computations, once inputs are inserted. The six ratios are calculated using the financial data. The weights in Exhibit 15 are fixed to relate to the nodes estimated within the software. The computations then proceed, to the point that the following weights are applied per node:

Weights Hidden to Output	
Node 1	-0.2511
Node 2	0.2906
Node 3	-1.9166
Node 4	2.4069
Node 5	-1.036
Node 6	1.145
Node 7	-4.027
Node 8	4.5182
Node 9	-0.7421
Node 10	-2.4982
Node 11	1.3286
Node 12	-3.545
Node 13	0.4856

Then a final prediction can be derived, by multiplying, taking the summation, and applying two formulas as indicated, thereby quantifying the status of the company as a non-going concern equal to zero or a going concern equal to one. This illustration shows how the probability being estimated conforms with the manner in which the original research was structured--in this setting the probability of being a going concern is estimated.

**Exhibit 16**

Enter Input Variables			Enter Input Variables		
Cash	\$9,267	←	Retained Earnings	-\$155,389	←
Marketable Securities	\$0	←	Market Value of Equity	\$2,630	←
Accounts Receivable	\$37,358	←	Interest Payments	\$54,053	←
Total Assets	\$931,975	←	EBIT	\$16,148	←
Current Liabilities	\$281,580	←	Net Income	-\$26,453	←
Total Liabilities	\$1,029,547	←			

  

0.165583493 = Quick Assets to Current Liabilities  
 0.002821964 = Market Value of Equity to Total Assets  
 1.104693795 = Total Liabilities to Total Assets  
 3.347349517 = Interest Payments to Earnings Before Interest and Tax  
 -0.028383809 = Net Income to Total Assets  
 -0.166730867 = Retained Earnings to Total Assets

Input Values	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6
Quick assets to current liabilities	0.16558349	0.002821964	1.1046938	3.347349517	-0.02838381	-0.166731
Market value of equity to total assets						
Total liabilities to total assets						
Interest payments to EBIT						
Net income to total assets						
Retained earnings to total assets						

  

Weights to Hidden Fit	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6
	-1.7131	-0.7445	1.0923	0.7894	-1.219	1.4748
	2.409	0.4731	0.9675	1.4973	1.5736	0.0608
	-4.7666	-0.6464	-0.4594	1.1811	-3.0948	1.1088
	2.4481	1.5166	-1.9108	-1.0374	3.4716	-1.7151
	-1.8592	0.832	0.5539	-0.3472	-3.8518	1.0478
	2.3792	-1.6206	0.9388	0.9583	0.5343	-1.4635
	-0.3777	-1.9838	4.7112	0.3435	-4.162	0.2471
	0.7749	0.068	-3.0032	-0.903	3.8518	2.9925
	0.1082	-2.7006	0.8004	2.8183	-1.4552	-1.5489
	-1.4331	-3.8039	1.5506	-1.5812	-1.5487	1.68
	-1.069	1.174	1.8209	3.2994	1.9189	-1.3918
	-3.4508	1.6278	1.5102	-1.2572	-1.474	-3.2479
	1.586	-1.8089	1.3851	3.2692	-0.9288	-1.7903

  

Input Values Multiplied by Weights to Hidden Fit	Node 1	Node 2	Node 3	Node 4	Node 5	Node 6	Sum Nodes 1 to 6	Hidden Output =1/(1+EXP(-sum))	Hidden Output Weights	Weights x Hidden Outputs		
	-0.28366108	-0.002100952	1.206657	2.642397709	0.03459986	-0.245895	>>> Sum=	3.35199789	0.966170198	Node 1	-0.2511	-0.24260534
	0.39889063	0.001335071	1.0687912	5.011986432	-0.04466476	-0.010137	>>> Sum=	6.42620139	0.988384028	Node 2	0.2906	0.290130399
	-0.78927028	-0.001824118	-0.5074963	3.953554514	0.08784221	-0.184871	>>> Sum=	2.55793481	0.928104777	Node 3	-1.9166	-1.77880562
	0.40536495	0.004279791	-2.1108489	-3.472540389	-0.09853723	0.2859601	>>> Sum=	-4.98632167	0.006784402	Node 4	2.4069	0.016329376
	-0.30785283	0.002347874	0.6118899	-1.162199752	0.10932875	-0.174701	>>> Sum=	-0.92118666	0.284716165	Node 5	-1.036	-0.29496595
	0.39395625	-0.004573275	1.0370865	3.207765042	-0.01516547	0.2440106	>>> Sum=	4.8630797	0.992332592	Node 6	1.145	1.136220818
	-0.06254089	-0.005598212	5.2044334	1.149814559	0.11813341	-0.041199	>>> Sum=	6.36304308	0.998278855	Node 7	-4.027	-4.02006895
	0.12831065	0.000191894	-3.3176164	-3.022656614	-0.10932875	-0.498942	>>> Sum=	-6.82004135	0.001090485	Node 8	4.5182	0.004927031
	0.01791613	-0.007620996	0.8841969	9.433835144	0.04130412	0.2582494	>>> Sum=	10.6278808	0.99997577	Node 9	-0.7421	-0.74208202
	-0.2372977	-0.010734469	1.7129382	-5.292829056	0.043958	-0.280108	>>> Sum=	-4.06407288	0.016888778	Node 10	-2.4982	-0.04219155
	-0.17700875	0.003312986	2.0115369	11.044245	-0.05446569	0.232056	>>> Sum=	13.0596765	0.999997871	Node 11	1.3286	1.328597171
	-0.57139552	0.004593593	1.6683086	-4.208287813	0.04183773	0.5415252	>>> Sum=	-2.52341825	0.074232693	Node 12	-3.545	-0.2631549
	0.26261542	-0.005104651	1.5301114	10.94315504	0.02636288	0.2984983	>>> Sum=	13.0556383	0.999997862	Node 13	0.4856	0.485598962
												-4.12207056
												exp (-sum) = 61.68683618

  

A typical cutoff interpretation would be a probability (Pr(Going Concern)) of <.5 is classified as distressed.

Prediction: 1/(1+exp(-sum)) = 0.01595231  
 Distress

## Wallace's Neural Network Analysis

I estimated a neural network from the mean values of key ratios reported in past bankruptcy studies. The most common ratios identified across studies include:

- (1) working capital to total assets (WC/TA),
- (2) cash flow to total debt (CF/TD),
- (3) net income to total assets (NI/TA),
- (4) total debt to total assets (TD/TA),
- (5) current assets to current liabilities (CA/CL), and
- (6) quick assets to current liabilities (QA/CL).

The neural model is based on a set of 65 mean values for the bankrupt and healthy companies analyzed in the respective original studies. The resulting model (with an estimated 6 percent misclassification rate<sup>38</sup>) quantifies the ratios' relative contribution. In descending order of importance, the NI/TA profitability measure contributes 26%; the WC/TA liquidity measure 21%; the TD/TA leverage measure 15%; the CA/CL liquidity measure 13%; the CF/TD liquidity relative to leverage assessment 13%; and the QA/CL liquidity measure 12%. Analysis can be performed using proprietary software such as NeuroShell2 software sold by Ward Systems Group, Inc.

## Which Model?

A triangulation approach, whereby multiple methods are applied in the monitoring process has merit. Many models exist beyond those described herein.<sup>39</sup> Research suggests that an expectation between 5% and 30% overall misclassification—i.e., overall error<sup>40</sup> in either predicting nonbankrupt companies to be bankrupt or predicting bankrupt companies to be nonbankrupt-- is the range of the models' accuracy when applied to new data not used in deriving the original relationships.<sup>41</sup> This is to be expected if one considers a number of traits commonly not incorporated in the models, such as management's abilities, the quality of underlying assets, and the random events of an environment, as well as regulatory and legal developments.

As Exhibit 17 reports, a number of models available in past literature were estimated for a company that went bankrupt: Levitz Furniture.<sup>ii</sup> The terms "gray area," troubled, failed, bankrupt, non-going concern, distress, and deterioration are all signs of various degrees of risk that an entity will not endure. Effectively all of the models signal risk exposure, although some variations among versions of models are observed—for example, the original Zmijewski model appears to outperform both the weighted version and the re-estimated models. The manufacturing only estimates for the Ohlson<sup>42</sup> model predict far lower probabilities of bankruptcy than does the original Ohlson model. This, of course, makes sense given the focus is on a nonmanufacturing entity: Levitz Furniture. As you scan the summary, note the diverse methods of modeling indicated by letter in the first column, as well as the different years of model development and reestimation reflected (all citations appear in the endnotes). This summary should give you comfort as to the usefulness of the models described herein and your ability to select from among such alternatives for the context in which you have an interest, with an expectation of relatively robust results.

---

<sup>ii</sup>See Appendix A. You can use the check figures in Exhibit 17 to compare the results of your spreadsheet analyses in applying the respective monitoring tools. Analyses precede the date bankruptcy was filed, September 5, 1997.

Somewhat encouraging are repeated findings that ratio-based prediction models yield very similar bankruptcy probabilities,<sup>43</sup> suggesting that the use of other ratio-based models<sup>44</sup> beyond those detailed herein likely would yield consistent results. Furthermore, *Dun's Review*<sup>45</sup> reports that analysts' application of both the Altman model and the Wilcox ruin model have confirmed the various academic results in predicting bankruptcy, providing an early warning at least two to three years before bankruptcy.

**Exhibit 17**  
**Comparison of Model Results for Levitz Furniture Application**

<b>Literature Citation for Model: Discriminant Analysis (D); Probit (P); Logit (L); Neural Network (N)</b>	<b>Levitz Furniture Result Numerically</b>	<b>Interpretation of Levitz Furniture Status Per Model</b>
Altman 1968 (D)	1996: 1.3757 1997: .7841	1996 troubled entity 1997 troubled entity
Auchterlonie 1997 Altman nonmanufacturing (D)	1996: -0.2680 1997: -0.2533	Likelihood of insolvency within 12 months 1996 and 1997
Altman 1983 Altman private company (D)	1996: 1.5108 1997: .8612	1996 gray area 1997 troubled entity
Altman 1983 Altman 4-variable model (D)	1996: -.8558 1997: -.9561	Troubled company 1996 Troubled company 1997
Moyer 1977 (D) Re-estimates Altman Model	1997: .315 one-year prior 1997: .8179 one-year prior stepwise 1996: .2405 two years prior 1996: .9065 two years prior stepwise	Troubled company 1996 Troubled company 1997
Moyer 1977 Decomposition Model (D)	1997 ratio is -.00 1996 ratio is .01	Suggesting deterioration over time as an entity moves closer to bankruptcy
Grice 1997 Altman Reestimated 1985-1987 (D) 972 companies	1996 z-score of -.3623 1997 z-score of -.2788	Troubled company 1996 and 1997
Grice 1997 Altman Reestimated 1985-198 (D) 910 companies	1996 of -.5104 1997 of -.3643	Troubled company 1996 and 1997
Grice 1997 Altman Reestimated 1985-1987 manufacturing only (D)	1996 z-score -.4971 1997 z-score -.3670	Troubled company for 1996 and 1997
Zmijewski 1984 (P)	1996 score -1.085663 pr (BR)=.25 1997 score -0.000085 pr(BR)=.50	No bankrupt in 1996 but does exceed the > or = .5 threshold indicating bankruptcy in 1997
Zmijewski Weighted 1984, Grice 1997 Zmijewski Reestimated 1985- 1987, Manufacturing only reestimated, and Bankruptcy only reestimated, (P)	1996 -2.4666 pr .08 1997 -1.4086 pr .20 1996 -1.81 pr .14 1997 -1.46 pr .19 1996 -1.59 pr .17 1997 -1.22 pr .23 1996 -.81 pr .31 1997 -.62 pr .35	None indicate a problem relative to the .50 usual threshold for either 1996 or 1997
Deakin 1972 (D)	-.3947 for 2 years before failure -.1942 for 1 year before failure	Failed firm indicator 1996 Failed firm indicator 1997
Deakin 1977 applies a reduced model derived from Libby 1975, as reported in Altman and Sametz 1977 (D)	.0036848 in 1997	Failing group classification

Literature Citation for Model: Discriminant Analysis (D); Probit (P); Logit (L); Neural Network (N)	Levitz Furniture Result Numerically	Interpretation of Levitz Furniture Status Per Model
Ohlson 1980 (L)	.9323 for 1996 2 years before .9110 for 1997 1 year before	Predicts Bankruptcy 1996 Predicts Bankruptcy 1997
Grice 1997 reestimated Ohlson 1985-1987, Bankruptcy only reestimated, and Manufacturing only reestimated (L)	1996 1 year before failure .491 1997 1 year before failure .517 1996 1 year before failure .706 1997 1 year before failure .613 1996 1 year before failure .351 1997 1 year before failure .411	Failed firm indicated when probabilities are .5 or greater (The manufacturing model indicates no failure, as does the reestimated model for one-year before if that is assumed to be 1996.)
Zavgren 1985 (L)	1997 1 year before failure .73 1996 2 years before failure .93	Predicts failure in 1996 and 1997 relative to the usual .50 threshold
Wilcox (1973) Gambler Ruin Model	1997 probability of failure=1	Distress Indicated
Koh and Tan 1999 (N)	1997 0.015952312 Note that pr (going concern=1)	1997 prediction of non-going concern Distress relative to .5 threshold
Wallace 2000 developed herein (N)	1997 .83785 pr (bankruptcy) 1996 .80885 pr (bankruptcy)	1996 and 1997 predicted bankruptcy
Gentry, Newbold, and Whitford 1985 (L)	4.508 logit score Pr(BR)= .9891	1997 troubled company

## Other Measures Relevant to Evaluating Bankruptcy

Free Cash Flow theory, reflective of agency theory, suggests that if shareholders permit firms to retain cash, they provide those managers with an opportunity to misuse cash in terms of spending the resources on non value adding investments or on various perquisites.<sup>46</sup> The other side of the story is that retained earnings is a means of internal financing for firms who can avoid the costs associated with attracting new capital. Importantly, it can help managers address uncertainty. Increased leverage or increased dividends are indicators of manager efficiency that lower the cost of asymmetry of information between managers and shareholders. The implication is that free cash flow which is defined as the after tax cash flow in excess of the amount needed to fund positive net present value projects ought to be disbursed as dividends in order to maximize a firm's value. A measure of the free cash flow metric in empirical work has been the ratio of retained earnings to total assets. The theoretical implication of the Free Cash Flow theory would be that a higher level of free cash flow would increase the probability of abuse.

A tool used in past research to assess the set of investment opportunities available for an individual firm is Tobin's q, computed as the (market value of common equity + value of long-term debt)/gross assets.<sup>47</sup> The gross assets are used as replacement costs in order to incorporate both the assets and the liabilities of a firm, along with the holdings of other firms. A higher Tobin's q would be a sign of better health.

Another tool used to assess investment quality in past research is the market-to-book ratio. Generally, the higher that ratio, the healthier the company is perceived to be in the market. Similarly, the price-earnings ratio has been analyzed,<sup>48</sup> with consideration of both earnings levels and volatility. In addition to using information on the face of the financial statements, the stock market, beyond the market capitalization component in some of the bankruptcy models already described, has been profiled as a potential early warning signal.<sup>49</sup> Benchmarks proposed in past literature include comparison of rate of return behavior for failed and nonfailed firms,<sup>50</sup> as well as the variance in those returns<sup>51</sup> and beta.<sup>52</sup> Stock prices have early warning capabilities.<sup>53</sup>

Nonfinancial measures have been explored such as employee turnover<sup>54</sup> and the degree to which material transactions occur at the end of accounting periods. The number of ways auditors helped a client obtain refinancing has been found to be associated with going concern auditors' reports. The metric used has a range from zero to seven where zero is did nothing and seven means did each of the following:

- (1) made appointment for financing,
- (2) attended a meeting for financing,
- (3) made presentation at financing meeting,
- (4) drafted a loan request,
- (5) drafted pro forma financial statements,
- (6) resisted discouraging other clients from investing in the firm, and
- (7) told other clients about potential investment in this firm.

The entities with a going concern report averaged 1.96 relative to the .82 value observed when no substantial doubt was expressed--a significant difference.

Other qualitative variables considered are the number of aggravating events present: changes in general economic conditions, general industry problems, change in management,<sup>55</sup> cash losses, loss of major client or customer, cash flow problem, accounts receivable change for the worse, accounts payable slowdown or buildup, extent of noncompliance with debt instrument restructuring, extent of allegations or actions brought against client by third parties or regulatory bodies, default on debt, inventory obsolescence, accounts receivable factoring, preferred dividend arrearages, employee strike, Federal tax lien, product obsolescence, lost money on a fixed-price contract, loss of purchase discounts from suppliers, movement into reorganization,<sup>56</sup> or other.<sup>57</sup> Financing problems and operating problems raise going concern issues. The former include both a difficulty in meeting obligations due to liquidity or equity deficiencies, as well as debt default and funds shortage. The latter refers to an apparent lack of operating success as reflected in no net profit for beyond a year, doubtful prospective revenues, legal proceedings or supplier activities to inhibit ability to operate, and poor control over operations, including inattention to problems.<sup>58</sup> It has been suggested that key events can precipitate failure, such as a bank's decision not to renew a line of credit, the initiation or resolution of lawsuits, and union problems.<sup>59</sup> Some association has likewise been hypothesized between continuation and replacement decisions regarding pension plans and the financial condition of a company.<sup>60</sup>

Economic indicators have been linked to the relative incidence of bankruptcies.<sup>61</sup> Research draws on theories associated with leading indicators, savings investment, supply of cost-push, and monetary theory. The measures integrated to evaluate international settings include the Standard & Poor's composite index, gross private domestic investment relative to gross national product (GNP), profits after tax relative to income originating in the corporations, prime rate, ninety-day treasury bill rate, and retail sales relative to GNP. Changes in such indices, GNP, money supply, and new business formation are cited as relevant. Overall, economic growth, credit availability, money market activity, capital markets, and price level changes<sup>62</sup> have relevance to such assessments. Trends<sup>63</sup> and changes<sup>64</sup> therein are critical facets of the monitoring process.<sup>65</sup>

Company-specific practices such as management compensation have also been compared and contrasted for healthy and troubled companies.<sup>66</sup> Outside governance practices, age of the business, years of present management, planned management succession, and various assets' collateral potential are other types of variables demonstrated to have relationships with an entity's distress.<sup>67</sup>

Creditors' decisions to waive violations of accounting-based debt covenants have been modeled as being an alternative to demanding certain conditions, including early payment, increase of interest rate, reduction of borrowing base, or similar steps, as a function of lower bankruptcy probability and a lower

leverage ratio, alongside smaller size and secured debt issues' involvement.<sup>68</sup> The nature of lending covenants can be explored to enhance one's understanding of distress. Research indicates that investing covenants added to renegotiated agreements included limitation on capital expenditures, prohibition against stock repurchase, prohibition of acquisition or merger, sale of non-current assets to repay debt, lender approval for the sale of assets, and no research and development joint ventures. The financing covenants observed to be added included collateral increases, prohibition of additional debt, creditor approval of debt refinancing, no sale-lease back, and additional compensating balances. The accounting covenants added included no consecutive quarterly losses and fixed charge coverage.<sup>69</sup> Private debt covenants have tighter financial restrictions than observed in public debt covenants, which have more nonaccounting-based provisions such as security, sinking fund,<sup>70</sup> and seniority of the debt.<sup>71</sup> Values for collateral or discontinued operations increase as the assets are more general in nature (i.e., have a stronger secondary market available for resell), as distinct from specialized assets.<sup>72</sup> In valuing both collateral and discontinued operations, theory suggests calibrations of an average exit value per dollar of book value: \$.72 for receivables, \$.55 for inventory, and \$.54 for fixed assets.<sup>73</sup>

While numerous qualitative attributes can influence distress, the analyst should be wary of the 'blame game'<sup>74</sup> and try to sort out the reality<sup>75</sup> as well as identify means of addressing the risks and attendant problems.

## APPENDIX A APPLICATION TO LEVITZ FURNITURE CORPORATION

The 8-K filing by Levitz Furniture Corporation on September 12, 1997 reported that a Voluntary Petition Under Chapter 11, Title 11 of the United States Code (the "Bankruptcy Code") had been filed (see beginning of Executive Summary for further background on the company since that date). To demonstrate the application of models presented, Levitz Furniture information, pre-bankruptcy announcement, is used as an example.

In addition to the financial statement information that follows, note that the March 31, 1996 stock price was \$3.30 with 1,000,000 shares outstanding and the March 31, 1997 stock price was \$2.63, with the same number of outstanding shares. [The EXCEL linked spreadsheets display inputs for 1997.]

### 10-K Information: Balance Sheet

#### 10-K for LEVITZ FURNITURE CORPORATION Fiscal Year End 3/31/97 Report Filed 7/14/97 NYSE Company

STANDARD INDUSTRIAL CLASSIFICATION:      RETAIL-FURNITURE STORES [5712]

#### LEVITZ FURNITURE CORPORATION AND SUBSIDIARIES CONSOLIDATED BALANCE SHEETS (Dollars in thousands, except share data)

	MARCH 31,	
	1997	1996
ASSETS		
CURRENT ASSETS:		
Cash and cash equivalents	\$9,267	\$12,755
Receivables	37,358	34,025
Inventories	169,488	140,918
Deposits and prepaid expenses	3,514	3,820
Deferred income taxes	933	-
Total current assets	220,560	191,518
PROPERTY AND EQUIPMENT:		
Land	47,731	47,731
Buildings and building improvements	142,949	144,056
Leasehold improvements	74,469	73,158
Store, warehouse and transportation equipment	83,043	84,089
	348,192	349,034
Less-Accumulated depreciation and amortization	133,566	123,525
	214,626	225,509
Property under capital leases, net of accumulated amortization of \$98,993 in 1997 and \$96,104 in 1996	119,077	134,944
	333,703	360,453

Risk Assessment by Internal Auditors Using Past Research on Bankruptcy  
Appendix A

OTHER ASSETS:		
Receivable under account purchase agreement (See Note 7)	327,000	-
Intangible leasehold interests	15,613	17,053
Deferred financing fees	11,975	6,820
Goodwill	18,177	18,693
Other	4,947	5,707
	-----	-----
	377,712	48,273
	-----	-----
	\$931,975	\$600,244
	=====	=====
LIABILITIES AND STOCKHOLDER'S DEFICIT		
CURRENT LIABILITIES:		
Cash overdrafts	\$19,524	\$17,912
Current portion of long-term debt	11,193	2,441
Current portion of obligations under capital leases	3,398	4,845
Accounts payable, trade	73,044	55,933
Accrued expenses and other liabilities	88,897	79,640
Payable to parent	10,304	5,904
Deferred income taxes	-	4,628
Revolver borrowings (See Note 5)	75,220	52,516
	-----	-----
Total current liabilities	281,580	223,819
	-----	-----
LONG-TERM DEBT, net of current portion	273,976	286,775
	-----	-----
OBLIGATIONS UNDER CAPITAL LEASES, net of current portion	74,466	82,922
	-----	-----
OBLIGATION UNDER ACCOUNT PURCHASE AGREEMENT (See Note 7)	327,000	-
	-----	-----
OTHER NONCURRENT LIABILITIES	24,424	24,423
	-----	-----
DEFERRED INCOME TAXES	48,101	54,041
	-----	-----
COMMITMENTS AND CONTINGENCIES (See Note 12)		
STOCKHOLDER'S DEFICIT:		
Common stock, \$0.40 par; authorized, issued and outstanding 1,000 shares	1	1
Capital in excess of par	58,453	57,853
Retained earnings (deficit)	(155,389)	(128,936)
Minimum pension liability	(637)	(654)
	-----	-----
Total stockholder's deficit	(97,572)	(71,736)
	-----	-----
	\$931,975	\$600,244
	=====	=====

The accompanying notes are an integral part of these financial statements.

**Income Statement**

LEVITZ FURNITURE CORPORATION AND SUBSIDIARIES  
CONSOLIDATED STATEMENTS OF OPERATIONS  
(Dollars in thousands, except share data)

	YEARS ENDED MARCH 31,		
	1997	1996	1995
NET SALES	\$966,855	\$986,622	\$1,047,226
COSTS AND EXPENSES:			
Cost of sales	533,555	534,953	555,860
Selling, general and administrative expenses	381,864	396,236	408,586
Charge for store closings	8,295	-	-
Restructuring expense	-	9,000	-
Depreciation and amortization	26,993	29,272	28,484
	950,707	969,461	992,930
OPERATING INCOME	16,148	17,161	54,296
INTEREST EXPENSE, NET	54,053	51,829	46,832
INCOME (LOSS) BEFORE INCOME TAXES	(37,905)	(34,668)	7,464
INCOME TAX EXPENSE (BENEFIT)	(13,454)	(12,413)	2,736
INCOME (LOSS) BEFORE EXTRAORDINARY ITEMS	(24,451)	(22,255)	4,728
EXTRAORDINARY ITEMS, NET OF TAX BENEFIT OF \$1,090 IN 1997 AND \$983 IN 1995	(2,002)	-	(1,566)
NET INCOME (LOSS)	(\$26,453)	(\$22,255)	\$3,162
INCOME (LOSS) PER COMMON SHARE:			
Income (loss) before extraordinary items	(\$24,451)	(\$22,255)	\$4,728
Extraordinary items	(2,002)	-	(1,566)
NET INCOME (LOSS)	(\$26,453)	(\$22,255)	\$3,162
WEIGHTED AVERAGE NUMBER OF COMMON SHARES OUTSTANDING	1,000	1,000	1,000

The accompanying notes are an integral part of these financial statements.

**Statement of Stockholders' Equity**

LEVITZ FURNITURE CORPORATION AND SUBSIDIARIES  
CONSOLIDATED STATEMENTS OF STOCKHOLDER'S DEFICIT  
(Dollars in thousands, except share data)

	COMMON STOCK ----- SHARES	AMOUNT -----	CAPITAL IN EXCESS OF PAR -----	RETAINED EARNINGS (DEFICIT) -----	MINIMUM PENSION LIABILITY -----
BALANCE, MARCH 31, 1994	1,000	\$1	\$57,106	(\$109,843)	\$ -
Net income	-	-	-	3,162	-
BALANCE, MARCH 31, 1995	1,000	1	57,106	(106,681)	-
Net loss	-	-	-	(22,255)	-
Capital contribution	-	-	747	-	-
Minimum pension liability	-	-	-	-	(654)
BALANCE, MARCH 31, 1996	1,000	1	57,853	(128,936)	(654)
Net loss	-	-	-	(26,453)	-
Capital contribution	-	-	600	-	-
Minimum pension liability	-	-	-	-	17
BALANCE, MARCH 31, 1997	1,000	\$1	\$58,453	(\$155,389)	(\$637)
	=====	====	=====	=====	=====

The accompanying notes are an integral part of these financial statements.

## Statement of Cash Flows

LEVITZ FURNITURE CORPORATION AND SUBSIDIARIES  
CONSOLIDATED STATEMENTS OF CASH FLOWS  
(Dollars in thousands)

	YEARS ENDED MARCH 31,		
	1997	1996	1995
CASH FLOWS FROM OPERATING ACTIVITIES:			
Net income (loss)	(\$26,453)	(\$22,255)	\$3,162
Adjustments to reconcile net income (loss) to net cash provided by operating activities:			
Depreciation	15,703	16,559	15,953
Amortization	11,290	12,713	12,531
Amortization of deferred financing fees	2,620	2,003	1,876
Pension (income) expense	1,874	(1,779)	5,629
Benefit for deferred taxes	(11,526)	(8,157)	(1,952)
Other	(253)	116	236
Extraordinary loss related to early redemption of debt, before tax benefit	3,092	-	2,549
Change in operating assets and liabilities:			
Decrease (increase) in:			
Receivables	(3,327)	(307)	6,352
Inventories	(28,570)	14,090	(4,301)
Deposits and prepaid expenses	306	3,382	(1,208)
Income taxes receivable	-	-	(3,054)
Other, net	49	129	559
Increase (decrease) in:			
Accounts payable, trade	17,111	(1,680)	(5,820)
Accrued expenses and other liabilities	13,646	6,774	(4,021)
Payable to parent	4,400	(4,091)	6,628
Other noncurrent liabilities	1,203	(2,014)	(1,139)
Total adjustments	27,618	37,738	30,818
NET CASH PROVIDED BY OPERATING ACTIVITIES	1,165	15,483	33,980
CASH FLOWS FROM INVESTING ACTIVITIES:			
Capital expenditures	(11,008)	(12,557)	(33,433)
Proceeds from sale of property and equipment and other assets	3,959	353	165
Proceeds from sale-leaseback transaction	-	22,209	-
Purchase of J.M. Smyth Company, net of cash acquired	-	-	(46,831)
NET CASH PROVIDED BY (USED IN) INVESTING ACTIVITIES	(7,049)	10,005	(80,099)
CASH FLOWS FROM FINANCING ACTIVITIES:			
Borrowings under Senior Secured Facilities/Credit Agreement	1,068,493	325,300	594,900
Repayments under Senior Secured Facilities/Credit Agreement	(1,045,789)	(335,834)	(533,050)
Principal payments on long-term debt	(3,831)	(3,925)	(4,887)
Principal payments under capital lease obligations	(7,222)	(5,184)	(4,930)
Increase (decrease) in cash overdrafts	1,612	609	(921)
Payment of deferred financing fees	(10,867)	-	(4,804)
NET CASH PROVIDED BY (USED IN) FINANCING ACTIVITIES	2,396	(19,034)	46,308
NET INCREASE (DECREASE) IN CASH AND CASH EQUIVALENTS	(3,488)	6,454	189
CASH AND CASH EQUIVALENTS, BEGINNING OF YEAR	12,755	6,301	6,112
CASH AND CASH EQUIVALENTS, END OF YEAR	\$9,267	\$12,755	\$6,301

The accompanying notes are an integral part of these financial statements.

## Quarterly Data

As already indicated, many of the models are applied to quarterly data for monitoring purposes. To facilitate some examples using quarterly data, the note in the 10-K filings which relates to such information is included herein.

SELECTED QUARTERLY FINANCIAL DATA (UNAUDITED):

Risk Assessment by Internal Auditors Using Past Research on Bankruptcy  
Appendix A

The following is a summary of Levitz's unaudited quarterly results of operations for the years ended March 31, 1997 and 1996:

	QUARTER ENDED			
	JUNE 30, 1996	SEPTEMBER 30, 1996	DECEMBER 31, 1996	MARCH 31, 1997
	-----			
	(In thousands, except per share amounts)			
Net sales	\$228,128	\$237,146	\$272,007	\$229,574
Gross profit	101,615	106,819	120,976	103,890
Net loss before extraordinary items	(10,805)(1)	(6,949)	(1,726)	(4,971)
Net loss	(12,807)(2)	(6,949)	(1,726)	(4,971)
Loss per common share:				
Loss before extraordinary iitems	\$(10,805)	\$ (6,949)	\$ (1,726)	\$ (4,971)
Extraordinary items	(2,002)(2)	-	-	-
Net loss per common share	\$(12,807)	\$ (6,949)	\$ (1,726)	\$ (4,971)
	=====	=====	=====	=====

	QUARTER ENDED			
	JUNE 30, 1995	SEPTEMBER 30, 1995	DECEMBER 31, 1995	MARCH 31, 1996
	-----			
	(In thousands, except per share amounts)			
Net sales	\$241,862	\$251,263	\$270,117	\$223,380
Gross profit	113,804	117,140	120,130	100,595
Net loss	(5,185)	(2,742)(1)	(6,947)(1)	(7,381)(3)
Net loss per common share	(5,185)	(2,742)(1)	(6,947)(1)	(7,381)(3)

**Summary Financial Information**

The Electronic Data Gathering and Retrieval Service (EDGAR) provided by the Securities and Exchange Commission includes summary financial information at the end of many of the filings, as follows and can be helpful in preparing comparative gauges for other companies within the industry of interest.

THIS SCHEDULE CONTAINS SUMMARY FINANCIAL INFORMATION EXTRACTED FROM FINANCIAL STATEMENTS FOR THE FISCAL YEAR ENDED MARCH 31, 1997 AND IS QUALIFIED IN ITS ENTIRETY BY REFERENCE TO SUCH FINANCIAL STATEMENTS.

<MULTIPLIER> 1,000

<PERIOD-TYPE>	YEAR
<FISCAL-YEAR-END>	MAR-31-1997
<PERIOD-END>	MAR-31-1997
<CASH>	9,267
<SECURITIES>	0
<RECEIVABLES>	37,358
<ALLOWANCES>	0
<INVENTORY>	169,488
<CURRENT-ASSETS>	220,560
<PP&E>	348,192
<DEPRECIATION>	133,566
<TOTAL-ASSETS>	931,975
<CURRENT-LIABILITIES>	281,580
<BONDS>	273,976
<PREFERRED-MANDATORY>	0
<PREFERRED>	0
<COMMON>	1
<OTHER-SE>	(97,573)
<TOTAL-LIABILITY-AND-EQUITY>	931,975
<SALES>	966,855
<TOTAL-REVENUES>	966,855
<CGS>	533,555
<TOTAL-COSTS>	533,555
<OTHER-EXPENSES>	0
<LOSS-PROVISION>	0
<INTEREST-EXPENSE>	54,053
<INCOME-PRETAX>	(37,905)
<INCOME-TAX>	(13,454)
<INCOME-CONTINUING>	(24,451)
<DISCONTINUED>	0
<EXTRAORDINARY>	(2,002)
<CHANGES>	0
<NET-INCOME>	(26,453)
<EPS-PRIMARY>	(26,453)
<EPS-DILUTED>	0

## Endnotes

- <sup>1</sup> Altman, Edward I., Robert G. Haldeman, and P. Narayanan. "ZETATM Analysis: A New Model to Identify Bankruptcy Risk of Corporations," *Journal of Banking and Finance* (Vol. 1, 1977): 29-54 [Citation with permission from Elsevier Science] discuss the diverse definitions of failure as including non-judicial arrangements, liquidity problems which require creditors or others to take over a business, and bond defaults. Also see Altman, Edward I., "Revisiting the High-Yield Bond Market," *Financial Management* (Volume 21, June 1992): 78-92.
- <sup>2</sup> Johnson, Craig G., "Ratio Analysis and the Prediction of Firm Failure," *The Journal of Finance* (December 1970): 1166-1168; Pinches, G.E., K.A. Mingo, and J.K. Caruthers, "The Stability of Financial Patterns in Industrial Organizations," *Journal of Finance* (May 1973): 389-396; Pinches, G.E., K.A. Mingo, and A.A. Eubank, "The Hierarchical Classification of Financial Ratios," *Journal of Business Research* (October 1975): 295-310; Frydman, Halina, Edward I. Altman, and Duen-Li Kao, "Introducing Recursive Partitioning for Financial Classification: The Case of Financial Distress," *The Journal of Finance* (Vol. XL, No. 1, March 1985): 269-291
- <sup>3</sup> Buchman, Thomas A., "An Effect of Hindsight on Predicting Bankruptcy With Accounting Information," *Accounting, Organizations and Society* (Vol. 10, No. 3, 1985): 267-285; Edmister, Robert O., "An Empirical Test of Financial Ratio Analysis for Small Business Failure Prediction," *Journal of Financial and Quantitative Analysis* (March 1972): 1477-1494
- <sup>4</sup> Altman, Edward I. and Arnold W. Sametz, Editors, *Financial Crises* (New York, New York: John Wiley & Sons, 1977) [Citation permission granted by John Wiley & Sons, Inc.], p. 75 has such an example.
- <sup>5</sup> Akresh, Abraham D. and Wanda A. Wallace, "The Application of Regression Analysis for Limited Review and Audit Planning," *Symposium on Auditing Research IV* (University of Illinois at Urbana-Champaign, 1982), pp. 67-128; 147-161
- <sup>6</sup> Altman, Edward I. and Mario Y. Levallee, "Chapter Ten: Business Failure Classification In Canada," *Journal of Business Administration* (Fall 1980): 147-164; Taffler, Richard J., "Empirical Models for the Monitoring of UK Corporations," *Journal of Banking and Finance* (Vol. 8, 1984): 199-227 [Citation with permission from Elsevier Science]; Castagna, A.D. and Z.P. Matolcsy, "The Prediction of Corporate Failure: Testing the Australian Experience," *Australian Journal of Management* (Volume 6, Number 1, June 1981): 23-50; Izan, H. Y., "Identifying Corporate Distress in Australia: An Industry Relative Analysis," *Journal of Banking and Finance* (Volume 8, Number 2, June 1984), Special Issue on Company and Country Risk Assessment: 303-320; Altman, Edward I., Tara K. Baidya, and Luis Maoel Ribeiro Dias, "Assessing Potential Financial Problems for Firms in Brazil," *Journal of International Business Studies* (Fall 1979): 9-24; Altman, Edward I., Giancarlo Marco, Franco Varetto, "Corporate Distress Diagnosis: Comparisons Using Linear Discriminant Analysis and Neural Networks (The Italian Experience)," *Journal of Banking & Finance* (Vol.18, No. 3, May 1994): 505-529; Sung, Tae Kyung, Namsik Chang, and Gunhee Lee, "Dynamics of Modeling in Data Mining: Interpretive Approach to Bankruptcy Prediction," *Journal of Management Information Systems* (Summer 1999): 63-85
- <sup>7</sup> As examples, see Altman, Edward I. and Bettina Loris, "A Financial Early Warning System for Over-the-Counter Broker-Dealers," *The Journal of Finance* (Vol. XXXI, No. 4, September 1976): 1201-1217; Wallace, Wanda A., "Accounting Policies and the Measurement of Urban Fiscal Strain," *Research in Governmental and Non-profit Accounting* (Vol. 1, 1985), pp. 181-212; Chen, Kevin C.W. and Chi-Wen Jevons Lee, "Financial Ratios and Corporate Endurance: A Case of the Oil and Gas Industry," *Contemporary Accounting Research* (Vol. 9, No. 2, Spring 1993): 667-694; Borenstein, Severin and Nancy L. Rose, "Bankruptcy and Pricing Behavior in U.S. Airline Markets," *The American Economic Review* (Volume 85, No. 2, Papers and Proceedings of the Hundredth and Seventh Annual Meeting of the American Economic Association Washington, D.C., January 6-8, 1995, May 1995): 397-402; Barniv, Ran, John Hathorn, Abraham Mehrez, and Douglas Kline, "Confidence Intervals for the Probability of Insolvency in the Insurance Industry," *Journal of Risk and Insurance* (Volume 66, Issue 1, March 1999): 125-138; Brockett, Patrick L., William W. Cooper, Linda L. Golden, and Utai Pitakong, "A Neural Network Method for Obtaining an Early Warning of Insurer Insolvency," *Journal of Risk and Insurance* (Volume 61, Issue 3, September 1994): 402-424; Altman, Edward I. and Anthony Saunders, "Credit Risk Measurement: Developments Over the Last 20 Years," *Journal of Banking & Finance* (Vol. 21, No. 11-12, December 1997): 1721-1742; Witkowska, Dorota, "Applying Artificial Neural Networks to Bank-Decision Simulations," *International Advances in Economic Research* (August 1999): 350; Altman, E.I. and Heather J. Suggitt, "Default Rates in the Syndicated Bank Loan Market: A Mortality Analysis," *Journal of Banking and Finance* (Vol. 24, Issue 1-2, January 2000): 229-253

- <sup>8</sup> Wallace, Wanda A., "Management Activities in Financial Reports: Debates and Understanding Standard-setters' International Harmonization Effort," *European Management Journal* (Vol. 17, No. 6, December 1999), pp. 609-614
- <sup>9</sup> Beneish, Messod D., "Detecting GAAP Violation: Implications for Assessing Earnings Management Among Firms With Extreme Financial Performance," *Journal of Accounting and Public Policy* (16, 1997): 271-309 [Citation with permission from Elsevier Science]; Dechow, Patricia M., Richard G. Sloan, and Amy P. Sweeney, "Causes and Consequences of Earnings Manipulation: An Analysis of Firms Subject to Enforcement Actions by the SEC," *Contemporary Accounting Research* (Vol. 13, No. 1, Spring 1996): 1-36; Jiambalvo, James, "Discussion of 'Causes and Consequences of Earnings Manipulation: An Analysis of Firms Subject to Enforcement Actions by the SEC'," *Contemporary Accounting Research* (Vol. 13, No. 1, Spring 1996): 37-47; Wallace, Wanda A., "The Value Relevance of Accounting: The Rest of the Story," *European Management Journal* (Volume 18, No. 6, December 2000), pp. 675-682
- <sup>10</sup> Elam, R., "The Effect of Lease Data on the Predictive Ability of Financial Ratios," *The Accounting Review* (January 1975): 25-43
- <sup>11</sup> Heath, Loyd C., *Accounting Research Monograph # 3: Financial Reporting and the Evaluation of Solvency* (New York, New York: American Institute of Certified Public Accountants, 1978)
- <sup>12</sup> Pastena, Victor and William Ruland, "The Merger/Bankruptcy Alternative," *The Accounting Review* (Vol. LXI, No. 2, April 1986): 288-301
- <sup>13</sup> Platt, D.H. and Platt, M.B., "Development of a Class of Stable Predictive Variables: The Case of Bankruptcy Prediction," *Journal of Business Finance and Accounting* (Spring 1990): 31-51--they specify how to convert all ratios to industry-relative ratios (jth industry minus relative ratio of the ith firm)
- <sup>14</sup> Grice, Sr., John Stephen and Robert W. Ingram, "Tests of the Generalizability of Altman's Bankruptcy Prediction Model," Working Paper, The University of Alabama (June 1997), forthcoming in *Journal of Business Research*
- <sup>15</sup> Altman, Edward I. and D.L. Kao, "The Implication of Corporate Bond Rating Drift," *Financial Analysts Journal* (May/June 1992): 64-75; Bi, Keqian and Haim Levy, "Market Reaction to Bond Downgradings Followed by Chapter 11 Filings," *Financial Management* (Financial Distress Special Issue, September 1993): 156-164; Falkenstein, Eric, "Validating Commercial Risk Grade Mappings: Why and How," *The Journal of Lending & Credit Risk Management* (February 2000): 26-36
- <sup>16</sup> Kihn, John, "The Financial Performance of Low-Grade Municipal Bond Funds," *Financial Management* (June 1996): 52-76; Dichev, Ilija D., "Is the Risk of Bankruptcy a Systematic Risk?" *Journal of Finance* (Volume 53, No. 3, June 1998): 1131-1148
- <sup>17</sup> Altman, Edward I. and Menachem Brenner, "Information Effects and Stock Market Response to Signs of Firm Deterioration," *Journal of Financial and Quantitative Analysis* (Volume XVI, No. 1, March 1981): 35-51; Katz, Steven, Steven Lilien, and Bert Nelson, "Stock Market Behavior Around Bankruptcy Model Distress and Recovery Predictions," *Financial Analysts Journal* (January-February, 1985): 70-73; Browne, Mark J. and Robert E. Hoyt, "Economic and Market Predictors of Insolvencies in the Property-Liability Insurance Industry," *Journal of Risk and Insurance* (Volume 62, Issue 2, June 1995): 309-327; Kim, Yong-Duck, Dan R. Anderson, Terry L. Amburgey, and James C. Hickman, "The Use of Event History Analysis to Examine Insurer Insolvencies," *Journal of Risk and Insurance* (Volume 62, Issue 1, March 1995): 94-110; Rimbey, James N., Seth C. Anderson, and Jeffrey A. Born, "Shareholder Wealth Responses to Bankruptcy Filing Announcements Under the Chandler and Reform Acts," *The Financial Review* (1995): 1; Eberhart, Allan C., Edward I. Altman, and Reena Aggarwal, "The Equity Performance of Firms Emerging From Bankruptcy," *Journal of Finance* (Volume 54, No. 5, October 1999): 1855-1868
- <sup>18</sup> Kida, Thomas, "An Investigation into Auditors' Continuity and Related Qualification Judgments," *Journal of Accounting Research* (Vol. 18, No. 2, Autumn 1980): 506-523; Elliott, John A. "'Subject to' Audit Opinions and Abnormal Security Returns--Outcomes and Ambiguities," *Journal of Accounting Research* (Vol. 20, No. 2, Pt. II, Autumn 1982): 617-638; Dodd, Peter, Nicholas Dopuch, Robert Holthausen, and Richard Leftwich, "Qualified Audit Opinions and Stock Prices: Information Content, Announcement Dates, and Concurrent Disclosures," *Journal of Accounting and Economics* (Vol. 6, 1984): 3-38 [Citation with permission from Elsevier Science]; Dopuch, Nicholas, Robert W. Holthausen, and Richard W. Leftwich, "Predicting Audit Qualifications with Financial and Market Variables," *The Accounting Review* (Vol. LXII, No. 3, July 1987): 431-454; Dopuch, Nicholas, "Abnormal Stock Returns Associated With Media Disclosures of 'Subject To' Qualified Audit Opinions," *Journal of Accounting and Economics* (Volume 8, 1986): 93-117 [Citation with permission from Elsevier Science]; Dichev, I., "Predicting Audit Qualifications with Financial and Market Variables," *The Accounting Review* (July 1987): 431-454; Koh, Hian Chye, "Model Predictions and Auditor Assessments of Going Concern Status," *Accounting and Business Research* (Vol. 21, No. 84, 1991): 331-338; Chen, K.C.W. and B.K. Church, "Default on

Debt Obligations and the Issuance of Going Concern Opinions," *Auditing: A Journal of Practice and Theory* (Fall, 1992): 30-49; Chen, K.C.W. and B.K. Church, "Going Concern Opinions and the Market's Reaction to Bankruptcy," *The Accounting Review* (January 1996): 117-128; Rama, Dasaratha V., K. Raghunandan, and Marshall A. Geiger, "Audit Reports and Bankruptcies," *Collected Abstracts American Accounting Association Annual Meeting August 17-20, 1997* in Dallas, Texas (Sarasota, Florida: American Accounting Association, 1997): 152

<sup>19</sup> Ball, Michael, "Z Factor: Rescue by the Numbers," *Inc.* (December 1980): 45-48

<sup>20</sup> As an example of its widespread use, the z-score is provided for companies on the Standard & Poor's (S & P) Research Insight Compustat PC database. The profile of the z-scores across the data set of active companies for which this value is reported, for 1993 through 2003 follows:

<b>Z-SCORE PROFILES AVAILABLE IN S&amp;P's RESEARCH INSIGHT DATABASE</b>											
Z-Score	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
>3.0	53%	50%	51%	54%	52%	43%	44%	41%	37%	34%	45%
Between	18%	19%	18%	19%	18%	18%	17%	16%	16%	16%	18%
<1.81	29%	31%	31%	28%	30%	39%	39%	42%	47%	50%	37%
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Count	3,821	4,204	4,859	5,310	5,593	6,281	6,943	7,341	7,268	6,786	1,364

Described in October 2003 Data set as a Z score equal to  
 $1.2(WCAP/AT)-1.4(RE/AT)+3.3(EBIT/AT+.6(@VALUE(PRCCF*CSHO.CEQ)+PSTK)/(AT-CEQ-PSTK)+.999(SALE/AT)$   
 Edward Altman's bankruptcy prediction model using less than 1.81 as a high probability of bankruptcy, with a greater than 3.0 being a low probability of bankruptcy.  
 The item definition suggests the design is to forecast failure in the short-term, up to two years.

As expected based on the economic times, the profile in the 1990s has fewer troubled entities indicated relative to that analyzed at the start of the millennium. Of interest is that in the early 1990s, both Enron and Worldcom were in either the troubled company zone or the gray zone, based on the z-scores, as depicted in the following summary:

<i>Companies' Z-Scores for Calendar:</i>	1993	1994	1995	1996
ENRON CORP	1.417	1.564	1.611	1.685
WORLD COM INC-CONSOLIDATED	1.918	1.48	1.001	1.39
WORLD COM INC-WORLD COM GROUP	2.762	1.958	1.624	2.269

<sup>21</sup> Altman, Edward I., "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy," *The Journal of Finance* (Vol. XXIII, No. 4, September 1968): 589-609

<sup>22</sup> Joy, O. Maurice and John O. Tollefson, "On the Financial Applications of Discriminant Analysis," *Journal of Financial and Quantitative Analysis* (December 1975): 723-739; Marks, Sidney and Olive Jean Dunn, "Discriminant Functions When Covariance Matrices Are Unequal," *Journal of the American Statistical Association* (Volume 69, Number 346, June 1974): 555-559 [Citation with permission from the Journal of the American Statistical Association. Copyright 1974 by the American Statistical Association. All Rights reserved.] In evaluating discriminant models, one rule of thumb is that the total number of observations in all groups should be at least two or preferably three times as large as the number of variables used, with no fewer observations in the smallest group than the number of variables used [Tatsuoka, M.M., *Discriminant Analysis, The Study of Group Differences*, Selected Topics in Advanced Statistics, An Elementary Approach, No. 6 (Champaign, Illinois: Institute for Personality and Ability Testing, Inc., 1970)]. Also see Heckman, J.J., "Sample Selection Bias as a Specification Error," *Econometrica* 47 (January 1979): 153-161.

<sup>23</sup> See Dhrymes, P. *Econometrics* (New York: Springer-Verlag, 1974; corrected reprint of 1970 ed. published by Harper & Row, New York)--pp. 74-76 for a description of their computational equivalence--cited by Zavgren, Christine V., "The Prediction of Corporate Failure: The State of the Art," *Journal of Accounting Literature* (Vol. 2,

1983): 1-38. Also see the discussion of differences between the interpretation of coefficients in Eisenbeis, R. A., "Pitfalls in the Application of Discriminant Analysis in Business and Economics," *The Journal of Finance* (June 1977): 875-900, especially pp. 882-883. Resources relevant to regression analysis can be found in Scott, David A. and Wanda A. Wallace, "Analytical Procedures," *The CPA Journal* (December 1994), pp. 64, 66; "A Second Look At An Old Tool: Analytical Procedures," *The CPA Journal* (March 1994), pp. 30-35; and Scott, David A. and Wanda A. Wallace, "Practical Experiences with Regression Analysis," *The 1992 Deloitte & Touche/University of Kansas Symposium on Auditing Problems* (May 21-22, 1992), Auditing Symposium XI: Proceedings of the 1992 Deloitte & Touche/University of Kansas Symposium on Auditing Problems, edited by Rajendra P. Srivastava (The University of Kansas, School of Business, 1993), pp. 141-169.

<sup>24</sup> Auchterlonie, David L., "A Paeon to the Z-Score and Its Commercial Bankruptcy Prediction," *The Journal of Lending & Credit Risk Management* (Volume 80, No. 1, September 1997): 50-52

<sup>25</sup> Grice, Sr., John Stephen, "An Empirical Study of SAS No. 59 and Bankruptcy Prediction Models for Auditors' Going Concern Decisions," A Dissertation in the Culverhouse School of Accountancy in the Graduate School of The University of Alabama (Tuscaloosa, Alabama 1997)

<sup>26</sup> Altman, Edward I., "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy," *The Journal of Finance* (Vol. XXIII, No. 4, September 1968): 589-609

<sup>27</sup> Altman, Edward I., *Corporate Financial Distress: A Complete Guide to Predicting, Avoiding, and Dealing with Bankruptcy* (New York, New York: John Wiley & Sons, 1983) [Citation permission granted by John Wiley & Sons, Inc.]

<sup>28</sup> Zmijewski, Mark E., "Essays on Corporate Bankruptcy," Ph.D. Dissertation, State University of New York at Buffalo (1983)

<sup>29</sup> Amemiya, T., "Qualitative Response Models: A Survey," *Journal of Economic Literature* (Vol. 19, 1981): 1483-1536; Finney, D. J. *Probit Analysis*, Second Edition (Cambridge University Press, New York, 1952)

<sup>30</sup> Hsieh, S., "A Note on the Optimal Cutoff Point in Bankruptcy Prediction Models," *Journal of Business Finance & Accounting* (April 1993): 457-465

<sup>31</sup> Grice, *op. cit.*

<sup>32</sup> Zavgren, Christine V., "Assessing the Vulnerability to Failure of American Industrial Firms: A Logistic Analysis," *Journal of Business Finance and Accounting* (Vol. 12, No. 1, Spring 1985): 19-45 Also see Dugan, Michael T. and Christine V. Zavgren, "Bankruptcy Prediction Research: A Valuable Instructional Tool," *Issues in Accounting Education* (Vol. 3, No. 1, 1988): 48-64.

<sup>33</sup> Lo, A. W., "Essays in Financial and Quantitative Economics," Unpublished Ph.D. Dissertation (Harvard University, Cambridge, MA, 1984), cited in Lo, Andrew W., "Logit Versus Discriminant Analysis: A Specification Test and Application to Corporate Bankruptcies," *Journal of Econometrics* (Vol. 31, 1986): 151-178-- Lo concludes that discriminant analysis and logit are equivalent as available tools.

<sup>34</sup> Attention can likewise be directed toward key events (e.g., omitting or reducing dividend payments) or states of distress--see Lau, Amy Hing-Ling, "A Five-State Financial Distress Prediction Model," *Journal of Accounting Research* (Vol. 25, No. 1, Spring 1987): 127-138. Also see DeAngelo, Harry and Linda DeAngelo, "Dividend Policy and Financial Distress: An Empirical Investigation of Troubled NYSE Firms," *The Journal of Finance* (Vol. XLV, No. 5, December 1990): 1415-1417.

<sup>35</sup> Wilcox, J., "A Gambler's Ruin Prediction of Business Failure Using Accounting Data," *Sloan Management Review* (Spring 1971), by permission of publisher. Copyright 1971 by Sloan Management Review Association. All rights reserved; Wilcox, Jarrod W., "The Gambler's Ruin Approach to Business Risk," *Sloan Management Review* (Fall 1976): 33-46), by permission of publisher. Copyright 1971 by Sloan Management Review Association. All rights reserved. Another relevant article by this same author is Wilcox, Jarrod W., "A Prediction of Business Failure Using Accounting Data," *Empirical Research in Accounting: Special Studies 1973, Supplement to Journal of Accounting Research* 1973:163-179. An example of survival analysis is provided in Lane, William R., Stephen W. Looney, and James W. Wansley, "An Application of the Cox Proportional Hazards Model to Bank Failure," *Journal of Banking and Finance* (Volume 10, 1986): 511-531 [Citation with permission from Elsevier Science].

<sup>36</sup> Trigueiros, Duarte and Richard Taffler, "Neural Networks and Empirical Research in Accounting," *Accounting and Business Research* (Volume 26, No. 4, Autumn 1996): 347-355; Yoon, Youngohc, Geoge Swales, Jr., and Thomas M. Margavio, "A Comparison of Discriminant Analysis Versus Artificial Neural Networks," *Journal of Operational Research Society* (Vol. 44, No. 1, 1993): 51-60

<sup>37</sup> Koh, Hian Chye and Sen Suan Tan, "A Neural Network Approach to the Prediction of Going Concern Status," *Accounting and Business Research* (Vol. 29, No. 3, Summer 1999): 211-216. Also see Zhang, Guoqiang, Michael

---

Y. Hu, B. Eddy Patuwo, and Daniel C. Indro, "Artificial Neural Networks in Bankruptcy Prediction: General Framework and Cross-Validation Analysis," *European Journal of Operational Research* (July 1999): 16-32 and Calderon, Thomas G., "Neural Networks and Preliminary Information Risk Assessment in an Auditing Environment," *Accounting Enquiries* (Spring 1999): 245

<sup>38</sup> The relative cost of misclassification in setting cut-off scores is discussed in Jones, Frederick L., "Current Techniques in Bankruptcy Prediction," *Journal of Accounting Literature* (Vol. 6, 1987): 131-164; also see Koh, Hian Chye, "Model Predictions and Auditor Assessments of Going Concern Status," *Accounting and Business Research* (Vol. 21, No. 84, 1991): 331-338 and Berardi, Victor L. and G. Peter Zhang, "The Effect of Misclassification Costs on Neural Network Classifiers," *Decision Sciences* (Summer 1999): 659-682.

<sup>39</sup> Examples of such additional citations, referenced in Exhibit 9, include: Moyer, R. Charles, "Forecasting Financial Failure: A Re-Examination," *Financial Management* (Spring 1977): 11-17; Zmijewski, Mark E., "Methodological Issues Related to the Estimation of Financial Distress Prediction Models," *Journal of Accounting Research* (Vol. 22, Supplement 1984): 59-82; Deakin, Edward B., "Research Reports: A Discriminant Analysis of Predictors of Business Failure," *Journal of Accounting Research* (Vol. 10, No. 1, Spring 1972): 167-179; Gentry, James A., Paul Newbold, and David T. Whitford, "Classifying Bankrupt Firms with Funds Flow Components," *Journal of Accounting Research* (Vol. 23, No. 1, Spring 1985): 146-160; Gentry, James A., Paul Newbold, and David T. Whitford, "Predicting Bankruptcy: If Cash Flow's Not the Bottom Line, What Is?" *Financial Analysts Journal* (September-October 1985): 47-56.

<sup>40</sup> Lachenbruch, Peter A., "An Almost Unbiased Method of Obtaining Confidence Intervals for the Probability of Misclassification in Discriminant Analysis," *Biometrics* (December 1967): 639-645

<sup>41</sup> Zavgren, *op. cit.*, 1983.

<sup>42</sup> Ohlson, James A., "Financial Ratios and Probabilistic Prediction of Bankruptcy," *Journal of Accounting Research* (Vol. 18, No. 1, Spring 1980): 109-131

<sup>43</sup> Jones, *op. cit.*

<sup>44</sup> Such models can be influenced by the nature of data and will have differing empirical characteristics, as described in the following literature: McLeay, Stuart and Azmi Omar, "The Sensitivity of Prediction Models to the Non-Normality of Bounded and Unbounded Financial Ratios," *British Accounting Review* (Vol. 32, No. 2, June 2000): 213-230 and Mossman, Charles E., Geoffrey G. Bell, L. Mick Swartz, and Harry Turtle, "An Empirical Comparison of Bankruptcy Models," *The Financial Review* (May 1998): 35

<sup>45</sup> "How to Figure Who's Going Bankrupt," *Dun's Review* (October 1975): 63-65

<sup>46</sup> Jensen, Michael, "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers," *AER Papers and Proceedings* (Vol. 76, No. 2, 1986): 323-329; Wells, Brenda P., Larry A. Cox, and Kenneth M. Gaver, "Free Cash Flow in the Life Insurance Industry," *Journal of Risk and Insurance* (Volume 62, Issue 1, March 1995): 50-66; Laitinen, Erkki K. and T. Laitinen, "Cash Management Behavior and Failure Prediction," *Journal of Business Finance and Accounting* (Volume 25, No. 7-8, September-October 1998): 893-920

<sup>47</sup> Opler, Tim and Sheridan Titman, "The Determinants of Leveraged Buyout Activity: Free Cash Flow vs. Financial Distress Costs," *Journal of Finance* (Volume 48, No. 5, December 1993): 1985-1999

<sup>48</sup> Altman, Edward I., Robert B. Avery, Robert A. Eisenbeis, and Joseph F. Sinkey, Jr., *op. cit.*

<sup>49</sup> Andrade, Gregor and Steven N. Kaplan, "How Costly is Financial (Not Economic) Distress? Evidence From Highly Leveraged Transactions That Become Distressed," *Journal of Finance* (Volume 53, No. 5, October 1998): 1443-1494 estimate financial distress costs to be 10 to 20 percent of firm value.

<sup>50</sup> Beaver, William H., "Market Prices, Financial Ratios, and the Prediction of Failure," *Journal of Accounting Research* (Vol. 6, No. 2, Autumn 1968): 179-192

<sup>51</sup> Ahrony, Joseph, Charles P. Jones, and Itzhak Swary, "An Analysis of Risk and Return Characteristics of Corporate Bankruptcy Using Capital Market Data," *The Journal of Finance* (Vol. XXXV, No. 4, September 1980): 1001-1016

<sup>52</sup> Queen, Maggie and Richard Roll, "Firm Mortality: Using Market Indicators to Predict Survival," *Financial Analysts Journal* (May-June 1987): 9-26

<sup>53</sup> Shick, Richard A. and Lawrence F. Sherman, "Bank Stock Prices as an Early Warning System for Changes in Condition," *Journal of Bank Research* (Autumn 1980): 136-146; Wallace, Wanda A., "An Early Warning Signal From the Market: Its Potential as an Audit Tool," *Advances in Accounting: Supplemental Volume* (Supplement 1, 1989): 205-231

- 
- <sup>54</sup> Goodman, Barbara, Daniel N. Braunstein, Alan Reinstein, and George W. Gregory, "Explaining Auditors' Going Concern Decisions: Assessing Management's Capability," *Journal of Applied Business Research* (Vol. 11, Number 3, 1995): 82-93
- <sup>55</sup> Gilson, Stuart C., "Management Turnover and Financial Distress," *Journal of Financial Economics* (Vol. 25, 1989): 241-262 [Citation with permission from Elsevier Science]; Hotchkiss, Edith Shwalb, "Postbankruptcy Performance and Management Turnover," *Journal of Finance* (Volume 50, No. 1, March 1995): 3-22; Beneish, Messod D., "Incentives and Penalties Related to Earnings Overstatements that Violate GAAP," *The Accounting Review* (Volume 74, No. 4, October 1999): 425-457
- <sup>56</sup> Branch, Ben, "Streamlining the Bankruptcy Process," *Financial Management* (Summer 1998): 57-75; Casey, Cornelius J., Victor E. McGee, and Clyde P. Stickney, "Discriminating Between Reorganized and Liquidated Firms in Bankruptcy," *The Accounting Review* (Vol. LXI, No. 2, April 1986): 249-262
- <sup>57</sup> Mutchler, Jane F., "A Multivariate Analysis of the Auditor's Going-Concern Opinion Decision," *Journal of Accounting Research* (Vol. 23, No. 2, Autumn 1985): 668-682
- <sup>58</sup> Carmichael, D. R., *The Auditor's Reporting Obligation, Auditing Research Monograph No. 1* (New York: AICPA, 1972)
- <sup>59</sup> Argenti, J., *Corporate Collapse: The Causes and Symptoms* (London, UK: McGraw-Hill Book Company (UK Ltd. 1976)
- <sup>60</sup> Stone, Mary, "Firm Financial Stress and Pension Plan Continuation/Replacement Decisions," *Journal of Accounting and Public Policy* (Volume 10, Number 3, Fall 1991): 175-206 [Citation with permission from Elsevier Science]
- <sup>61</sup> Rose, Peter S., Wesley T. Andrews, and Gary A. Giroux, "Predicting Business Failure: A Macroeconomic Perspective," *Journal of Accounting, Auditing, & Finance* (Fall 1982): 20-31
- <sup>62</sup> Ketz, F. J., "The Effect of General Price Level Adjustments on the Predictive Ability of Financial Ratios," *Journal of Accounting Research* (Supplement 1978): 273-284
- <sup>63</sup> Cleveland, W.P. and G.C. Tiao, "Decomposition of Seasonal Time Series: A Model for the Census X-11 Program," *Journal of American Statistical Association* (Volume 71, Number 355, September 1976): 581-587 [Citation with permission from the Journal of the American Statistical Association. Copyright 1976 by the American Statistical Association. All Rights reserved.]
- <sup>64</sup> Lev, Baruch, "On the Use of Index Models in Analytical Reviews by Auditors," *Journal of Accounting Research* (Vol. 18, No. 2, Autumn 1980): 524-550
- <sup>65</sup> Sorter, G.H. and George Benston, "Appraising the Defensive Position of a Firm: The Interval Measure," *The Accounting Review* (October 1960): 633-640; Blum, Marc, "Failing Company Discriminant Analysis," *Journal of Accounting Research* (Vol. 12, No. 1, Spring 1974): 1-25; Dambolena, Ismael G. and Sarkis J. Khoury, "Ratio Stability and Corporate Failure," *The Journal of Finance* (Vol. XXXV, No. 4, September 1980): 1017-1026
- <sup>66</sup> Gilson, Stuart C. and Michael R. Vetsuypens, "CEO Compensation in Financial Distressed Firms: An Empirical Analysis," *The Journal of Finance* (Vol. XLVIII, No. 2, June 1993): 425-458
- <sup>67</sup> Abate, Robert P., "Numerical Scoring System for Commercial Loans," *Bankers Monthly Magazine* (January 15, 1969): 38-39, 50
- <sup>68</sup> Chen, Kevin C.W. and K.C. John Wei, "Creditors' Decisions to Waive Violations of Accounting-Based Debt Covenants," *The Accounting Review* (Volume 68, No. 2, April 1993): 218-232
- <sup>69</sup> Beneish, Messod D. and Eric Press, "Costs of Technical Violation of Accounting-Based Covenants," *The Accounting Review* (Volume 68, No. 2, April 1993): 233-257
- <sup>70</sup> Also see Kalotay, Andrew and Bruce Tuckman, "Sinking Fund Prepurchases and the Designation Option," *Financial Management* (1992): 110-126
- <sup>71</sup> El-Gazzar, "Stock Market Effects of the Closeness to Debt Covenant Restrictions Resulting from Capitalization of Leases," *The Accounting Review* (Volume 68, No. 2, April 1993): 258-272
- <sup>72</sup> Ronen, J. and G.H. Sorter, "Relevant Accounting," *Journal of Business* (University of Chicago Press, publisher)(Volume 46, 1973): 258-282
- <sup>73</sup> Berger, Philip G., Eli Ofek, and Itzhak Swary, "Investor Valuation of the Abandonment Option," *Journal of Financial Economics* (Volume 42, 1996): 257-287 [Citation with permission from Elsevier Science]
- <sup>74</sup> Khanna, Naveen and Annette B. Poulsen, "Managers of Financial Distressed Firms: Villains or Scapegoats," *Journal of Finance* (Volume 50, No. 3, July 1995): 919-941
- <sup>75</sup> Arrington, C. Edward, William Hillison, Rhoda C. Icerman, "Research in Analytical Review: The State of the Art," *Journal of Accounting Literature* (Vol. 2, 1983): 151-185; Kreutzfeldt, Richard W. and Wanda A. Wallace, "Error

Characteristics in Audit Populations: Their Profile and Relationship to Environmental Factors," *Auditing: A Journal of Practice & Theory* (Fall 1986): 20-43; Kreutzfeldt, Richard W. and Wanda A. Wallace, "Distinctive Characteristics of Entities with An Internal Audit Department and the Association of the Quality of Such Departments With Errors," *Contemporary Accounting Research* (Vol. 7, No. 2, 1991), pp. 485-512 [Reprinted in *The International Library of Management: Internal Auditing* Edited by A.D. Chambers, published by The Dartmouth Publishing Company Limited, Gower House, England, 1996), pp. 111-138]; Kreutzfeldt, Richard W. and Wanda A. Wallace, "The Relation of Inherent and Control Risks to Audit Adjustments," *Journal of Accounting, Auditing, and Finance* (1995), pp. 459-481; Kreutzfeldt, Richard W. and Wanda A. Wallace, "Control Risk Assessments: Do They Relate to Errors?" University of Waterloo Audit Symposium (November 6, 1987), *Supplement to Auditing: A Journal of Practice & Theory* (Vol. 9, Suppl. 1990), pp. 1-26, as well as "Reply and Extension" (Response to Discussant's and Conference Participants' Suggestions on "Control Risk Assessments: Do They Relate to Errors?"), *Supplement to Auditing: A Journal of Practice & Theory* (Vol. 9, Suppl. 1990), pp. 33-48; Kreutzfeldt, Richard W. and Wanda A. Wallace, "Discussants' Comments on "The Incidence and Detection of Misstatements: A Review and Integration of Archival Research," *Journal of Accounting Literature* (Volume 19, 2000), pp. 44-59; Wallace, Wanda A., "Reporting Practices: Potential Lessons From Cendant," *European Management Journal* (Volume 18, No. 3, June 2000), pp. 328-333; Coakley, James R. and James K. Loebbecke, "The Expectation of Accounting Errors in Medium-Sized Manufacturing Firms," *Advances in Accounting* (Volume 2, 1985): 199-245

## ***UNDERSTAND, SHAPE, ADVANCE***

*The IIA Research Foundation is a 501(c)(3) corporation formed to expand knowledge and understanding of internal auditing by providing relevant research and educational products to advance the profession globally.*

*Through its research reports, Bookstore products, and GAIN Knowledge Services, The Foundation provides resources that help understand, shape, and advance the global profession of internal auditing by initiating and sponsoring intelligence gathering, innovative research, and knowledge-sharing in a timely manner.*

*To learn more, visit [www.theiia.org/research](http://www.theiia.org/research)*

**ISBN 978-0-89413-653-5**

**Item #2008.dl**

**Free to IIA Members**

**Non-members: US\$15**



**RESEARCH  
FOUNDATION**  
*Understanding. Guiding. Shaping*

[www.theiia.org/research](http://www.theiia.org/research)