Chapter 8

Bankruptcy Prediction Using Principal Component Analysis Based Neural Network Models

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ABSTRACT

Industrial bankruptcy is a rampant problem which does not occur overnight and when it occurs can cause acute financial embarrassment to Governments and financial institutions as well as threaten the very viability of the firms. It is therefore essential to help industries identify the impending trouble early. Several statistical and soft computing based bankruptcy prediction models that make use of financial ratios as indicators have been proposed. Majority of these models make use of a selective set of financial ratios chosen according to some appropriate criteria framed by the individual investigators. In contrast, this study considers any number of financial ratios irrespective of the industrial category and size and makes use of Principal Component Analysis to extract their principal components, to be used as predictors, thereby dispensing with the cumbersome selection procedures used by its predecessors. An Evolutionary Neural Network (ENN) and a Backpropagation Neural Network with Levenberg Marquardt’s training rule (BPN) have been employed as classifiers and their performance has been compared using Receiver Operating Characteristics (ROC) analyses. Termed PCA-ENN and PCA-BPN models, the predictive potential of the two models have been analyzed over a financial database (1997-2000) pertaining to 34 sick and 38 non sick Indian manufacturing companies, with 21 financial ratios as predictor variables.

INTRODUCTION

Industrial bankruptcy is a global phenomenon. The phenomenon of industrial sickness, both in large and small industries has become alarming in recent years. The progressive increase in industrial sickness has been causing considerable concern not only to the governments, banks and financial institutions but also financial embarrassment to the industrial units by seriously threatening their very viability. The common effects of such sickness are locking up of financial resources, wastage of capital, loss of

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production and fall in employment. It has become a national problem requiring a comprehensive redress rather than inventing quick fixes to revive sick units (Srivatsava & Yadav, 1986).

More than being a problem, it has proved to be an obstacle in the economic development of a country. Sickness in industries has been viewed differently. To Walter (1957) and Donaldson (1969), it is a technical insolvency. The Financial Bill of India 1977 defines a sick unit as one who’s 50% or more of capital reserves are wiped out by losses. The Reserve Bank of India explains it as an imbalance in the financial structure of an industry, such as cash loss for one year and likely to continue the following year, worsening debt-equity ratio and a current ratio less than 1:1. However, it is a well established fact that sickness in an industry does not occur overnight. It develops gradually overtime. Earlier the trouble is detected, more easily and economically it can be encountered. It thus becomes direly necessary to predict sickness of an industry. In other words, there is an intense need for a forewarning system, which helps in predicting corporate sickness. The significance of such a forewarning system can be more effectively described in the words of Baruch Lev (1974):

...an early warning signal of probable failure will enable both management and investors to take preventive measures in operating policy changes, reorganizing financial structures and even voluntary liquidation will usually shorten the length of time the losses are incurred and thereby improve allocation.

To prevent an industrial unit from going under sickness, an efficient framework on forewarning the impending trouble as an early warning screen becomes crucial and the need of the hour.

In the last three decades, considerable research has been done to suggest that financial ratios can be used to predict industrial sickness with greater reliability, since financial ratios are considered to be the diagnostic indicators of health of a business. A financial ratio is a quotient of two numbers where both the numbers consist of financial statement items computed from the company’s balance sheet. These financial ratios are basically divided into four categories: turnover ratios, liquidity ratios, solvency ratios and profitability ratios.

Several bankruptcy prediction models using financial ratios as predictor variables and employing Statistical techniques and Neural Networks as classifiers have been developed. Among the Statistical approaches for the prediction of industrial bankruptcy, the Univariate Discriminant Analysis (Beaver, 1966), Multivariate Analysis (Altman, 1968), Linear Multi Discriminant Model (Cindy, 1998) and Logit Analysis (Laitenen & Kankaanpaa, 1993) are some of the renowned predictive models. Concurrently, various investigators have attempted the application of Neural Networks (NN) and their hybrid versions, for the prediction of industrial sickness (Back, Laitenen & Sere, 1994; Serrano, Martin & Gallizo, 1993; Wilson & Sharda, 1994; Neophytou, Charitou and Charalambus, 2001; Chauhan, Ravi & Chandra, 2009; Yi-Chung Hu, 2009).

However majority of these models underline the fact of selecting either a subset or a best set of financial ratios. Most of them do not clearly emphasize on how to reduce or select the final set of variables from the initial predictor variable set. In fact it has been asserted that ‘…it is difficult to obtain the best set of variables at one try using Statistical or NN based models’ (Cindy, 1998). Thus be it Statistical or NN based methods, the previous studies concentrated only on a few financial ratios selected according to choice based criteria.

In this background, the investigation by Alici (1995) and Rekha Pai, Vijayalakshmi Pai and Annapoorani (2005) on the application of Principal Component Analysis (PCA) for the prediction of industrial bankruptcy gains importance. They suggested the consideration of principal components of all financial ratios put together, which not only