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Exploring and weighting features for financially distressed construction companies using Swarm Inspired Projection algorithm

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ABSTRACT

Financial crisis has raised concerns for years and its effect on companies influence economies globally. The ability to accurately identify the features responsible for business failure is an important issue in financial decision-making. There is clear need for accurate decision support for both credit granting and monitoring of ongoing health of credit customers. The financial ratios involved provide useful quantitative financial information to both investors and analysts so that they can evaluate the operation of a firm and analyze its position within a sector. This research brings awareness to managers as to which features they have to focus on. All the ratios involved each play a crucial role. In this paper, the Swarm Inspired Projection (SIP) algorithm as a new analysis tool is combined with the Principal Component Analysis (PCA) to determine the weights of the features and to adjust these weights to suit the profitability of these construction companies. The study made use of 1615 effective financial reports from 55 construction companies over the last decade. Based on the 25 ratios used, the PCA incorporating the SIP algorithm gives us an average accuracy rate of 90%. This method provides better reliability in the identification of the principal features in bankruptcy analysis. Corporate financial distress is a major concern to business sectors worldwide; therefore using both clustering and statistical techniques is a better basis in mitigating bankruptcy to both practitioners and researchers.

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1. Introduction

The impact of the economy due to corporate failure is huge, especially for the stakeholders of public-held companies. A Firm's financial status remains in distress prior to a corporate failure. This propels the need to come up with methods to identify corporate financial distress as early as possible to avoid Bankruptcy. Studies performed to solve this issue are of considerable interest to investors, creditors, auditors and other stakeholders. Business failures in general, have serious negative economic and social consequences, therefore should be seriously treated. The impact of financial distress is an area of research carried out by bank economist and government officers. Economic cost of business failures is significant [1]. It affects the national economy as a whole, influencing the trends of major economic indicators such as sales, exports and production. Furthermore every company, to a greater or lesser degree and in difficult ways, influences and is influenced by various stakeholders such as investors, customers, employees and suppliers.

Hence, the suppliers of capital, investors and creditors, as well as management and employees, are severely affected by business failures. There is a clear need for accurate decision support for both credits granting and monitoring of the ongoing health of credit customers. An improvement in accuracy of even a fraction of a percent translates into significant future savings for the credit industry [2]. The search for the most effective way to solve financial problems has become a major issue because the economic consequence of corporate failure is enormous, especially for the distressed construction companies in Taiwan within the period mentioned earlier. During this period companies in Taiwan have gone through severe financial constraints leading to some of them declaring bankruptcy. In Taiwan, domestic and foreign capital markets have developed rapidly in recent years, gradually giving people the idea of making a financial investment. Nevertheless, Procomp. and Cdbank Corporation bankruptcy events have also caused tremendous disorder in the financial market and related industries are also affected by these economic shocks [3]. We need weights to match the correct ratios and weightings to the goals set in this case, the gross profit and the return on equity.

In this paper, we suggest that it would be better to incorporate hybrid intelligence techniques in our statistical techniques for

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better model performance. In most of the cases reviewed models that use operations research techniques alone or are in combination with statistical methods forecast failures better than statistical models alone. In fact, hybrid intelligence systems, combining several individual techniques, have recently become popular. Researchers have used statistical techniques to weight factors for the distressed. This in most cases yields low forecast percentages, which indicates insufficient forecast accuracies. In previous studies, data mining techniques were used to identify five useful financial ratios, among which are, tax rates, and continuous four quarterly Earnings Per Share (EPS) [4]. In seeking medium-term prediction, Probabilistic Neural Networks (PNN) is used and resulted in 10 of 16 companies being classified correctly under the 4-category scheme, yielding a 62.5% accuracy rate [5]. The rate was even stronger, at 81.25%, under the 2-category scheme, with 13 of 16 test companies correctly classified. Principal Component Analysis (PCA) was used to classify the ratio of firms using orthogonal varimax rotation and the results explained as much as 78.0% of the total variance which is still minimal-less than 80% [6]. This research is motivated by the urge to enhance profitability through feature selection and weighting of financial variables to identify those that affect company progress to the point of bankruptcy. The responsible variables weights were adjusted to meet significant percentages.

The objectives of this research are to determine the weights for the financially distressed features (variables) so that the emphasis is on profitability, also to identify which variables are responsible for bankruptcy of these companies. The responsible variables then are adjusted and achieved by both clustering and statistical techniques-using the Swarm Inspired Projection (SIP) algorithm and PCA.

2. Literature review

The risk of bankruptcy was and is the subject of studies aiming to identify the time of bankruptcy, competing factors to achieve this state, the main financial criteria which best expresses this orientation, the bankruptcy, etc. [7]. The ability to accurately identify the features responsible for business failure is an important issue in financial decision-making. Incorrect decision-making in unprecedented global economic development culminating in the current economic crisis demonstrates that the results of research studies on weighting factors to salvage bankruptcy risk are insufficient. Moreover, the financial crisis increases the risks that affect the proper functioning of a company. This increase can be translated by an increase in uncertainty about its ability to continue working [8]. A review of predictive models of bankruptcy risk is imperative. Use of financial ratios to assess a firm's performance has been going on for a long time and a simple literature search reveals literally thousands of publications on this topic. The underlying studies often differentiate themselves from the rest by developing and using different independent variables (financial ratios) and/or employing different statistical or machine learning based analysis techniques. The development of financial ratios ought to be a unique product of the evolution of accounting procedures and practices in the U.S. [9]. The author further states that the origin of financial ratios and their initial use goes back to the late 19th century. The emphasis upon financial ratios does not imply that ratios are the only predictors of failure. The primary concern is not with the ratios as a form of presenting financial statement data but rather with the underlying predictive ability of the prediction tools themselves [10]. The ability to accurately forecast business failure is an important issue in financial decision-making. Incorrect decision-making in financial institutions is likely to cause financial crises and distress [11]. As a result improved weighting models;

variable weighting and adjusting should be built to prevent bankruptcy. The construction industry has been one of the most endangered business sectors. It is relatively an important contributor to the economy, not only in terms of the Gross Domestic Product and employment, but also in all aspects of the infrastructure, more precisely transportation. In most cases in this industry, the most frequent sources of insolvency in financial decision making are debt-equity ratio, lack of operating capital and sufficient assets, problems with claims and financial inflexibility enforceability, coupled with the frequent decline in sales. Most researchers use clustering of financial ratio as a means to come up with high prediction percentages [12–19]. A previous study developed a hybrid knowledge-sharing model, which integrates the concepts of the self-organizing feature map optimization, fuzzy logic control, and hyper-rectangular composite neural networks, to provide 32 rules that suggest performing or not performing foreign construction investment [20]. Companies in the construction trade tend to face a high degree of uncertainty. Such uncertainty may come from technical or managerial difficulties, disputes, safety issues, surges in cash outflow, or even manipulation of financial leverage. The uncertainty enhances the likelihood of financial distress which can be revealed in financial statements [10]. The SIP algorithm similar to other algorithms of swarm optimization [21–26] is a population based stochastic optimization technique, inspired by social behavior of bird flocking or fish schooling.

This algorithm-swarm intelligence, a form of artificial intelligence, is the emergent collective intelligence of groups of simple agents [27]. This technique makes use of cluster analysis, which is a basic tool amongst other tools used for the analysis and investigation of data structure. It answers the 'how' question – i.e. how a particular company has failed. It is applied in a wide variety of engineering and scientific disciplines, from psychology to image processing. From earlier studies, for example cluster analysis was combined with classifier ensembles to predict financial distress-and the author defines clustering as a method used to arrange a given collection of unlabeled input patterns into natural groupings or meaningful clusters based on measure of similarity [11]. The author further stated that pattern clustering which results in a number of well separated clusters in the feature space provide a summarization and visualization of data in the given collection. They used two clustering techniques – the Self Organizing Maps (SOM) and K-means. In another study, the author used a fuzzy relations clustering method to identify representative financial ratios. Twenty-two financial ratios from four shipping companies were used [28]. The objective is to provide a new approach to resolve tie-breaks in clustering outcomes. Other researchers used clustering techniques as partitioning techniques to come up with similarity traits in data analysis [28–32].

3. Methodology

This section includes the collection of data, data screening, and analysis failure diagnosis and weighting and adjusting. The data used were derived from the Taiwan Economic Journal (TEJ) as mentioned earlier. In this research, two analysis techniques were used; the SIP algorithm and PCA. In the techniques, the companies under analysis were both normal and failed companies. There are twenty-five features used in this research. TEJ provides historical financial data and corporate information in financial markets in Asia. It offers financial information on various countries, such as Taiwan, Thailand, China, Singapore, Hong Kong, Malaysia, Korea, the Philippines, and Japan. The company also provides TEJ Plus software that provides a history of financial statements, stock prices, corporate actions, and shareholders to analyze various companies in Asia by accessing TEJ's database of companies throughout Asia. It serves

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