Journal of Applied Mathematics and Computation, 2023, 7(2), 312-316
https://www.hillpublisher.com/journals/JAMC/
ISSN Online: 2576-0653
ISSN Print: 2576-0645

Bank Efficiency Evaluation and Bankruptcy Cause Analysis

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How to cite this paper: Linhong Liu. (2023) Bank Efficiency Evaluation and Bankruptcy Cause Analysis. *Journal of Applied Mathematics and Computation*, 7(2), 312-316.
DOI: 10.26855/jamc.2023.06.013

Received: June 3, 2023
Accepted: June 29, 2023
Published: July 30, 2023

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Abstract

In the country's economic and social development, banks play an important role in decision-making. The bankruptcy of banks will have varying degrees of impact on enterprises and individuals. For the five tasks given in the title, this paper uses PCA combined with optimization algorithm projection pursuit evaluation + hierarchical clustering, variance analysis, machine learning algorithm, FCM clustering and error inspection model to solve the problem, and achieved relatively good results. Good solution. In order to evaluate the bank's efficiency and solve the dividing line of bank failure efficiency, use MATLAB to first reduce the dimension of up to 19,720 lines of big data to 5 using the PCA algorithm, and then use the projection pursuit algorithm combined with simulated annealing to calculate the optimal index weight, and then Further weighted to calculate the evaluation value; then use hierarchical clustering to aggregate the data into two categories, the midpoint between the center points of the two categories, the corresponding data is the cut-off point, and the connection line of each indicator data is the bank failure efficiency score. boundaries.

Keywords

Bank efficiency evaluation, bankruptcy causes, hierarchical clustering

1. Introduction

Banks play an important decision-making role in the country's economic and social development, and bank bankruptcy will have many adverse effects on enterprises and individuals. When a bank fails, it will affect the local economy and lead to deflation. Compared with domestic banks, international banks fail more frequently. In today's globalized and digitalized economic environment, banks, as an important part of the financial system, play a key role in promoting economic development and wealth creation. However, the banking industry is also facing many challenges, including intensified market competition, increased financial risks and a changing regulatory environment. In this context, bank efficiency evaluation and bankruptcy cause analysis have become the focus of academic and industry attention.

Bank efficiency evaluation is the process of measuring and evaluating the bank's operating performance, which involves many aspects such as the bank's internal resource allocation, operation management, and interaction with the external environment [1]. Effectively evaluating bank efficiency can not only help bank management understand its operating conditions, optimize resource allocation, and improve performance, but can also provide government regulators with reference to the overall operating conditions of the banking industry.

At the same time, bankruptcy cause analysis is the process of studying the causes and mechanisms of bank bankruptcy. It helps to identify and understand the risk factors that lead to bank bankruptcy, thereby providing a basis for formulating effective regulatory policies and risk management strategies. Bank failures have serious implications for the financial system and economic stability and thus have important implications for predicting and preventing bank failures [2].

This article aims to discuss the related issues of bank efficiency evaluation and bankruptcy cause analysis, and provide

enlightenment for bank management and supervision. Through the data of 64 indicators of existing or failed banks in Poland from 2017 to 2021, each data indicator has a corresponding explanation. First of all, it is necessary to perform certain preprocessing on the data given in the topic, and then dig out effective information from the processed data to evaluate the bank's efficiency and provide a dividing line for bankruptcy efficiency. Secondly, we will review the relevant literature, summarize the existing research results and methods, we will discuss the index system and method of bank efficiency evaluation, and analyze its limitations. We will then examine the main causes and influencing factors of bank failures and analyze the failure risks of different types of banks. Finally, we will put forward some suggestions on improving bank efficiency and preventing bank failure, in order to provide reference for the sustainable development of the banking industry.

Through in-depth research on bank efficiency evaluation and bankruptcy cause analysis, we can better understand the operating mechanism and risk characteristics of the banking industry, thereby promoting the effectiveness and adaptability of bank management and supervision. This is of great help to maintaining financial stability and ensuring the soundness of the financial system.

2. Model establishment and solution

Use MATLAB programming, use PCA algorithm for dimensionality reduction, first use X-repmat (mpping. mean, [size (x,1) 1]) to decentralize the data, and then use the cov() function to calculate the size as 64*64 covariance matrix, and then use the eig() function to obtain the eigenvector and eigenvalue vector of each indicator, and then use the sum() function to normalize the eigenvalues [3], and then sum up each indicator to obtain the cumulative value of each indicator Contribution rate, set the dimension reduction dimension h=10, get the data after dimension reduction, and then perform projection pursuit to find the optimal weight.

The projection pursuit solution process is as follows:

Step 1: Import the data and check whether the overall data has been normalized. If it has not been normalized, it needs to be normalized;

Step 2: Set the initial temperature, the number of iterations, and generate an initial solution;

Step 3: Set the external circulation condition to a temperature value greater than 0.01;

Step 4: Enter the inner loop and randomly generate the initial value to avoid the algorithm from falling into local optimum;

Step 5: Calculate the objective function value and compare it with the previous historical function value. If the objective function value is greater than the historical function value [4], update the current objective function value, otherwise it will not be updated;

Step 6: Cool down with the fire reduction parameter value of 0.99, and jump out of the loop until the temperature value does not meet the conditions of the outer loop, and the obtained projection vector is the weight value vector

Step 7: The data processed in Step1 is weighted with the weight vector to obtain the comprehensive evaluation score of each evaluation object.

The solution of the hierarchical clustering model is as follows:

First use the mapminmax() function for normalization, then use the pdist() function to calculate the Euclidean distance [5], then use MATLAB's built-in hierarchical clustering function linkage() to generate a new clustering matrix, obtain the hierarchical clustering tree, and finally calculate the two The midpoint between the class center points is the dividing line of bank failure efficiency.

Projection Pursuit Evaluation Results, the calculated optimal weights are as follows:

Table 1. Optimal weight

Index	X2	X22	X29	X38	X3
Weights	0.5302	0.2271	0.1475	0.0560	0.0392

Use MATLAB to calculate the efficiency evaluation value of each bank as follows:

Table 2. List of Bank Efficiency Evaluation Values

Year	Evaluation value	Year	Evaluation value	Year	Evaluation value
2017	0.397	2018	0.361	2019	0.328
2017	0.299	2018	0.305	2019	0.285

2017	0.264	2018	0.261	2019	0.287
2017	0.261	2018	0.274	2019	0.397
2017	0.292	2018	0.390	2019	0.253
2017	0.374	2018	0.349	2019	0.375
2017	0.300	2018	0.290	2019	0.366
2017	0.349	2018	0.319	2019	0.330
2020	0.383	2021	0.398		
2020	0.303	2021	0.382		
2020	0.387	2021	0.335		
2020	0.305	2021	0.264		
2020	0.428	2021	0.302		
2020	0.256	2021	0.331		
2020	0.382	2021	0.291		
2020	0.324	2021	0.267		
…	…	…	…		

Observing the above table, most of the evaluation values are in the (0.2,0.4) interval, and the data is visualized as follows:

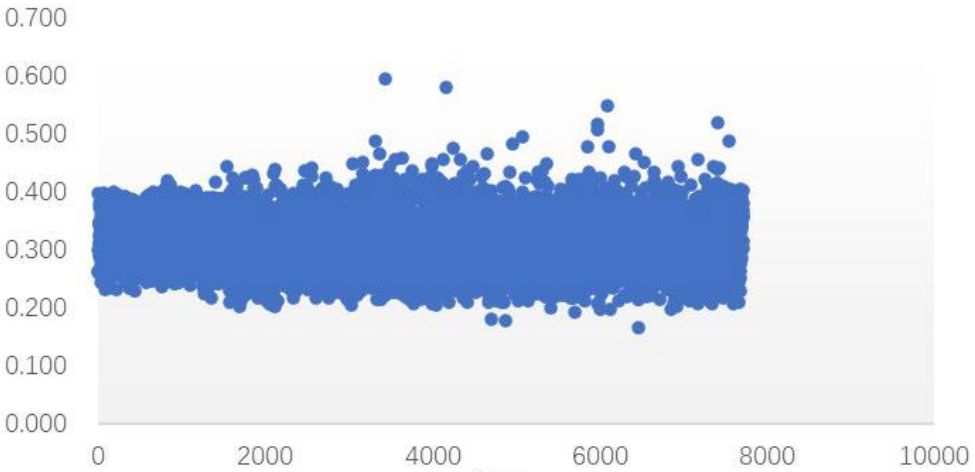

Figure 1. Scatter diagram of bank efficiency evaluation value.

It is not difficult to see from the above figure that most of the evaluation values are indeed in the range of (0.2,0.4), and the efficiency of some banks has played a leading role. Of course, there are also some banks that are slightly inferior in efficiency compared to other banks [6].

Then use hierarchical clustering to get the cut-off points of the main indicators as shown in the following table:

Table 3. Index cut-off point

Index	X2	X22	X29	X38	X3
Weights	0.2938	0.5453	0.4693	0.7548	0.6303

As shown in the above table, the line connecting all the values corresponding to the cut-off point is the cut-off line of bank failure efficiency.

3. Error Analysis

In order to ensure the effectiveness of PCA data dimensionality reduction, it is necessary to conduct a mean test on the corresponding evaluation values of bankrupt and non-bankrupt banks. Since the larger the evaluation value, it means that there are fewer bankruptcies [7]. From the perspective of the original data distribution, the number of bankruptcy If the proportion is very small, the average value of the evaluation value should be relatively large. The average value of the five-year evaluation value is averaged, and the average value of the evaluation value is as follows:

Table 4. Evaluation value mean

Year	Class=0	Class=1	Year	Class=0	Class=1
2017	0.4072	0.4049	2020	0.3954	0.4093
2018	0.3931	0.4136	2021	0.3895	0.4194
2019	0.4025	0.3905	overall	0.3966	0.4351

4. Discussion

With the continuous development of financial business and the continuous change of financial environment, bank efficiency evaluation and bankruptcy cause analysis also need to be further improved and studied in depth. In future research, the following aspects can serve as areas of focus:

Establish a more comprehensive evaluation index system of bank efficiency: The current evaluation index system of bank efficiency mainly focuses on economic efficiency and scale efficiency, but ignores aspects such as risk efficiency and technological innovation efficiency. Future research can explore how to construct a more comprehensive indicator system to more accurately evaluate the overall efficiency and performance of banks.

Bank efficiency evaluation combined with artificial intelligence and big data technology: The rapid development of artificial intelligence and big data technology provides new opportunities for bank efficiency evaluation. Future research can explore how to use machine learning and data mining techniques to extract valuable information from huge bank data to more precisely evaluate bank efficiency and performance [8].

Consider the differences in efficiency evaluation of different types of banks: different types of banks (such as commercial banks, investment banks, policy banks, etc.) have different business models and objectives, so their efficiency evaluation methods and indicators should also be different. Future research can deeply explore the characteristics and efficiency evaluation methods of different types of banks, and provide personalized efficiency evaluation tools and guidance for different types of banks.

Strengthen the prediction and prevention of bank failure risks: Bank failure has a serious impact on the financial system and economic stability, so the research on the prediction and prevention of bank failure is very important. Future research can explore how to use multiple data sources such as macroeconomic indicators, bank financial indicators, and market risk indicators to establish more accurate bank bankruptcy prediction models and propose corresponding risk management strategies.

Strengthen the formulation and implementation of regulatory policies: Regulatory policies are crucial to the stability and development of the banking industry. Future research can focus on how to improve the formulation and implementation of regulatory policies to better deal with the challenges and risks facing the banking industry. This includes improving the regulatory framework and strengthening supervision.

Bank efficiency evaluation and bankruptcy cause analysis are important areas of bank management and supervision, and provide key references for the stability and sustainable development of the banking industry. The following are some suggestions for bank efficiency evaluation and failure analysis:

Strengthen data quality and reliability: The accuracy and reliability of bank efficiency evaluation and failure cause analysis depend on the quality of data. Therefore, banks should strengthen internal data management and monitoring to ensure data integrity, accuracy and consistency. At the same time, regulators should formulate corresponding data reporting and disclosure requirements to urge banks to provide high-quality data for effective evaluation and analysis.

Introduce a comprehensive evaluation method: Bank efficiency evaluation should adopt a comprehensive evaluation method, combining different efficiency indicators and models, in order to more comprehensively evaluate the bank's operating efficiency. Methods such as data envelopment analysis (DEA), stochastic frontier analysis (SFA) and multivariate efficiency analysis can be considered to comprehensively consider the efficiency performance of different aspects and incorporate them into the evaluation system.

Pay attention to risk management and capital adequacy: In the evaluation of bank efficiency, the impact of risk

management and capital adequacy on bank performance should be fully considered. Banking business faces various risks, including credit risk, market risk and operational risk, etc. These risks have an important impact on the bank's operating efficiency and bankruptcy risk. Therefore, when evaluating bank efficiency, indicators of risk management level and capital adequacy should be considered comprehensively and incorporated into the efficiency evaluation model.

Introduce innovative evaluation indicators: With the continuous advancement of technology and the rapid development of financial innovation, traditional evaluation indicators may not be able to fully adapt to changes in the banking industry. Therefore, consideration should be given to introducing new evaluation indicators, such as the degree of digitization, innovation capabilities, and customer experience, to more comprehensively evaluate the efficiency and performance of banks.

Exploring the systemic risk of bank failure: Bank failure is not only related to internal factors of individual banks, but also affected by the entire financial system. Future research should pay more attention to the systemic risk and contagion effect of bank failure, and carry out related research to better prevent risks.

This paper evaluates the indicators and uses the simulated annealing algorithm to optimize the weight, which makes the evaluation effect more realistic; it is suitable for such a large-scale model training, and it is excellent in predicting the training effect of the model; due to the large amount of data, using simulated annealing It takes a long time to solve the projection pursuit algorithm; the idea of error testing can provide certain ideas for the construction of feature engineering in the field of data science.

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