A Comparative Analytical Evaluation of CA Score, Kida, Springate Models For Financial Distress Prediction: The Case of Algeria

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Abstract :
This research aims to utilize various predictive models—CA score, Kida, and Springate—across multiple companies listed on the Algiers Stock Exchange between 2015 and 2019. The findings revealed that the CA score model demonstrated greater accuracy compared to the other two models. In contrast, both the Springate and Kida models exhibited lower accuracy and generated confused and conflicting results across several company statuses.

Mots clés:
Mot clé.1: Détresses financières
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Résumé :
Cette recherche vise à utiliser divers modèles prédictifs – score CA, Kida et Springate – dans plusieurs sociétés cotées à la Bourse d'Alger entre 2015 et 2019. Les résultats ont révélé que le modèle de score CA a démontré une plus grande précision par rapport aux deux autres modèles. En revanche, les modèles Springate et Kida présentaient une précision moindre et généraient des résultats confus et contradictoires dans plusieurs statuts d'entreprise.

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1- The introduction

The topic of predicting financial distress and attempting to distinguish between distressed and non-distressed companies dates back to a long history of research in the accounting and financing field, by relying on the companies financial information. This topic has witnessed many attempts aimed at building an effective model that can predict financial distress in advance.

These attempts continued to develop until more accurate and complex statistical models were built, which were presented by Beaver and Altman, where their studies considered a basic and pioneering pillar in this field, due to the results accuracy of the two models, where their outputs showed great consistency with the actual financial situation. This is what prompted the academic community to redouble the interest in this topic, as the process of forecasting financial distress and developing predictive modeling has become a major issue for academics.

Thus, light was shed on how to develop these statistical models and fill their gaps by reducing the error rate in prediction and estimation, especially since this topic will undoubtedly receive greater attention than before for all interested parties, including owners, creditors and investors, where the success of previous studies in discovering the areas of imbalances led to assisting companies in maintaining their continuity, and supporting the financial system of all the country in general

The study problem can be formulated in the following main question: How well can traditional statistical models predict financial distress in Algerian companies?

The main motive of this study depends on the importance of predicting financial distress, which is considered a critical problem in economics and finance, as predicting distress on time and preventing default, may allow adopting some measures to restore the sound financial position of companies, thus shortening a lot of wasted time and avoiding catastrophic losses that cause damage to the distressed company in particular and to the economy in general, would advance the development wheel and pave the way for the state forward, and achieve expansion and prosperity, and avoid wasting more important opportunities, by avoiding preoccupation with phenomena that can be eliminated before spreading with minimal efforts and costs.

This research aims to apply several models for predicting financial distress at once to the companies that are active within the Algerian work environment in different fields of activity, and we look forward to identify the most accurate and effective model in anticipating financial distress, and estimating the level of financial performance provided by these companies,

and that by comparing the outputs of the various models on the one hand, and comparing the financial status of the companies under study on the other hand, and trying to reach results and recommendations that would direct those concerned towards taking the appropriate measures, by warning companies of potential risks, especially since the risks of financial distress are formed in gradual and secret way, then quickly moves to advanced stages, reaching the point of bankruptcy and liquidation.

2- Literature review

Financial distress occurs when a company faces an inability to meet its obligations, whether in any form or due to its liabilities outweighing its assets (Omelka, Beranova, & Tabas, 2013). In the Oxford Dictionary, "Distress" refers to pain, sorrow, inability, lack of financial resources. (Kasgari, Salehnezhad, & Ebadi, 2013). The precise meaning of financial distress remains undecided. In theoretical terms, it encompasses various levels. A minor financial distress could involve short-term cash flow difficulty, such as issues like insolvency or default. At its most severe, it culminates in business failure or bankruptcy (Shi & Li, 2019). Financial distress can lead to various outcomes, with bankruptcy being just one possibility. It primarily involves legal nature and doesn't have a specific and clear-cut economic significance (Sabek & Saihi, 2021).

(Husein & Pambekt, 2014) sought to anticipate bankruptcy by employing various models such as Altman, Springate, Zmijewski, and Grover. They gathered data from 132 companies spanning from 2009 to 2012. The analysis utilized binary logistic regression and revealed that all models were effective in predicting bankruptcy. Nevertheless, the Zmijewski proved to be the most suitable model. (Tanjung, 2020) sought to utilize various models by Altman, Springate, Ohlson, and Zmijewski to forecast financial distress within (9) pharmaceutical firms. Their investigation ultimately found that the Altman model proved to be the most precise in anticipating financial distress. (Bessai Epse Kessouh, 2020) aimed to highlight the significance of assessing banks' performance and identifying key measurement indicators. Research focused on Algerian banks revealed that private banks outperform public ones due to challenges faced by the latter, primarily non-performing loans.

(Tahi et al, 2021) sought to measure the market risk in Algeria by computing non-parametric VaR and CVaR for a portfolio of four Algerian companies from April 28, 2019, to April 26, 2020, using daily returns with equal weights. Additionally, they assessed VaR and CVaR for the same portfolio with optimal weights. Their findings suggest that these methods effectively gauge portfolio risk and can be influenced by portfolio optimization. (Larbes & Bouzar, 2021) explored how merging banks to create financial conglomerates can pose risks to the financial system. It

examines the impact of these large entities and discusses measures taken by regulators to address these risks. Using a descriptive analytical approach, the study emphasizes the drawbacks of concentrated banking and advocates for more regulation in this sector due to its negative effects on financial stability. (Sabek, 2023) compared two different types of artificial neural networks with logistic regression to prove that not all types of neural networks are better than logistic regression. (Khelifa & Trari, 2023) aimed to analyze the factors of Islamic banks' stability compared to conventional ones in Gulf countries from 2008 to 2018. Analyzing 15 banks from each sector, it finds that Islamic banks are less stable according to Z-score measurements. To bolster their stability, the study suggests boosting Islamic banks' capital and market presence. (Sabek & Horak, 2023) optimized the hyperparameters of the Gaussian Process Regression to extract the optimal model for predicting financial distress. (Sabek & Saihi, 2023) compared the performance of artificial neural networks and logistic regression in predicting financial distress in Algerian and Saudi companies. (Rainarli & Sabek, 2023) utilized methods like downsampling and filling missing values with the average of nearest neighbors during data preparation prior to training the prediction model. Their efforts in handling missing values and balancing the dataset led to a significant 30% enhancement in the F1 score of the Random Forest prediction model.

In 1991, researchers developed the "CA score Model" by analyzing a group of Canadian small and medium-sized businesses that had been active for more than five years and had turnovers ranging from one to twenty million dollars. This model, also known as the CA score 1991, was created with the following formula: (St-Cyr & Pinsonneault, 1997)

$$\text{CA score} = 4.5913R1 + 4.5080R2 + 0.3936R3 - 2.7616$$

whereas:

R1 = Equity / Total Assets;

R2 = Earnings before interest and taxes / Total assets;

R3 = Sales / Total Assets.

CA values above 0 indicate the company's good health, while values between 0 and -0.6 are uncertain and make predicting bankruptcy difficult. Values lower than -0.6 suggest a high likelihood of bankruptcy.

The Kida Model 1980 employed discriminatory analysis with 20 financial ratios and a dataset comprising 40 institutions. This sample consisted of an equal number of distressed and non-distressed entities. The study occurred over a brief period, from 1974 to 1975, and its findings aligned with Altman's study results regarding ratios capable of forecasting financial distress (Rahiche, 2021). The formula of the Kida model is as follows: (Babela & Mohammed, 2016)

$$Z= -1.042X1 - 0.427X2 - 0.461X3 - 0.463X4 + 0.271X5$$

Where:

X1 = net income / total assets ;
X2 = total shareholders' equity / total debt ;
X3 = quick assets / current liabilities ;
X4 = sales (revenue) / total assets ;
X5= cash / total assets.

Kida's model suggests that companies with a Z-score above 0.38 indicate a positive outlook for success, while those with a Z-score below 0.38 might face significant issues and struggle to continue (Alkhatib & Al Bzour, 2011).

The Springate Model, created in 1978 by Gorgon L.V. Springate, employs a step-by-step multiple discriminate analysis, akin to Altman's approach. It identifies four out of 19 common financial ratios to differentiate between companies in either bankruptcy or a secure financial position (Tanjung, 2020). The formula of the Springate model is as follows: (Pakdaman, 2018)

$$Z = 1.03X1+ 3.07X2+ 0.66X3 + 0.4X4$$

X1 = ratio of working capital to total assets ;
X2= ratio of profit before deduction of interest and expenses on total assets ;
X3 = ratio of net profit before tax to current debt ;
X4 = ratio of sales to total assets.

The Springate model employs a standard evaluation where a company with a value of $S>0.0862$ is considered financially robust, whereas those with $S<0.0862$ are categorized as at risk of potential bankruptcy (Sinarti & Sembiring, 2015).

3- Sample & Methods

In this research, it was relied on the financial statements of (4) companies listed on the Algerian Stock Exchange, in order to conduct the practical study and apply the selected models. This is related to the “Saidal” company, "Aurassi" company, "Biopharm" company and the "Rouiba" for company. Noting that the financial statements of these companies are publicly published

The research relied mainly on the descriptive analytical method in order to build the theoretical part, and thus we aspired to give a comprehensive concept about the term of financial distress and its predictive models. As for the practical part, we relied on the applied comparative analytical method between the applied models, by evaluating their ability to accurately predict the financial distress. On the other hand, we look forward to comparing the financial performance levels of the companies under study.

4- Results & Discussion

Through the following, we will apply the selected statistical models on the companies under study. Table 1 shows the application of the CA Score, Kida, Springate models on the "Aurassi" company:

Table NO 01: Models results - "Aurassi" company

CA score 1991					
Statement	2015	2016	2017	2018	2019
R_1	0.382	0.392	0.421	0.436	-0.066
R_2	0.065	0.043	0.064	0.061	-0.025
R_3	0.238	0.226	0.244	0.239	0.116
CA	**-0.621**	**-0.679**	**-0.444**	**-0.391**	**-3.131**
Kida 1980					
X_1	0.061	0.034	0.057	0.047	-0.025
X_2	0.382	0.392	0.421	0.436	-0.070
X_3	2.811	2.275	2.421	1.996	4.431
X_4	0.238	0.226	0.244	0.239	0.116
X_5	0.133	0.108	0.105	0.067	0.065
Z	**-1.146**	**-0.924**	**-0.964**	**-0.780**	**-2.134**
Springate 1978					
X_1	0.219	0.171	0.185	0.151	0.154
X_2	0.073	0.046	0.069	0.072	-0.025
X_3	0.568	0.272	0.479	0.368	-0.574
X_4	0.266	0.241	0.265	0.280	0.116
Z	**0.930**	**0.593**	**0.824**	**0.731**	**-0.253**

We note from Table 1 that the results of the CA score model indicate the imbalance of the financial position of the "Aurassi" company, since most of the CA values were located in the risk zone, especially with the result of 2019, which indicates a significant imbalance.

According to the CA score model, the "Aurassi" company went through three basic phases throughout the study period, and as we have already said, the company was characterized by the imbalance of the financial situation in the first phase, which lasted from 2015 to 2016, where the values of the CA in this period were located in the risk zone. In the second phase, which lasted from 2017 to 2018, where the value of CA was far from the levels of risk, but not enough to make the company's classification outside the gray area.

As for the third phase, it was limited to the year of 2019, where the value of CA indicated a terrible deterioration in the value indicating the possibility of bankruptcy, knowing that the value of CA amounted to -3.131, and this value ranks it within the third level, and it is easy to say in this case that the company has chances in bankruptcy, because the CA value declines below -0.6.

When we move to the Kida outputs, we find that the Z values were negative and less than zero in all years of study, but with varying degrees, so the company is considered at risk of bankruptcy.

The results of the third model Springate almost confirm the results of the second model, not absolutely, but closer in general. Referring to the "Aurassi" company, the results showed that the company went through two phases throughout the study period, beginning with the first phase in 2015, when the company was far from the risk of bankruptcy, but it was very close to the minimum risk of 0.862, and this confirms the financial confusion of the company starting from this year, and it can be said that this case reflects the existence of a financial distress that gradually penetrated the company, to develop after that in the coming years, and this was confirmed by the results of the second phase between 2016 and 2019, where the value of Z fell into the second level according to Springate classification with the presence of the bankruptcy possibility, but with different degrees, it was more dangerous in 2016 and 2019.

Finally, it can be said that the results of the three models were decisive for the year 2019, as they all agreed on the existence of a very high bankruptcy probability. Table 2 shows the application of the CA Score, Kida, Springate models on the "Biopharm" company:

Table 2: Models results - "Biopharm" company

CA score 1991					
Statement	2015	2016	2017	2018	2019
R_1	0.504	0.578	0.578	0.597	0.565
R_2	0.156	0.182	0.171	0.159	0.140
R_3	1.346	1.378	1.198	1.147	1.014
CA	**0.785**	**1.254**	**1.134**	**1.147**	**0.862**
Kida 1980					
X_1	0.149	0.180	0.164	0.164	0.140
X_2	0.504	0.578	0.578	0.597	0.565
X_3	1.897	2.214	2.202	2.240	2.327
X_4	1.346	1.378	1.198	1.147	1.014
X_5	0.139	0.137	0.118	0.056	0.053
Z	**-1.093**	**-1.191**	**-1.124**	**-1.126**	**-1.144**
Springate 1978					
X_1	0.430	0.496	0.500	0.508	0.522
X_2	0.159	0.184	0.173	0.166	0.149
X_3	0.317	0.446	0.399	0.417	0.378
X_4	1.372	1.397	1.215	1.196	1.073
Z	**1.689**	**1.928**	**1.795**	**1.786**	**1.673**

We note from Table 2 that the results of the CA score model indicate the strength and solidity of the financial position of the "Biopharm" company, and in general, it can be said that the company is completely sound and financially comfortable in all years of study.

The results of the Kida model indicated that the financial position of the "Biopharm" company, in general, belongs to the level that confirms the existence of the bankruptcy possibility, especially since all Z-values were below 0, and in degrees lower than the results obtained when applying the same model on the "Aurassi" company. We notice that the higher the CA values, the lower the Z-value of the Kida model, which is very strange, the more the results of the CA score show that the companyis in appropriate financial position, the more the Kida model indicates the opposite.

After reaching completely contradictory results between the first and second models, we will rely on the results of the third model to judge the case of the "Biopharm" company, and as an unexpected result, the outputs of the Springate model confirmed the results of the CA score model with 100%, especially since the Springate model was in agreement with the model Kida in Table 1, and unusually, a case of inconsistency between them was recorded when applying on the "Biopharm" company, where all Z values indicated the solidity of the financial position of the company in all years of study. Table 3 shows the application of the CA Score, Kida, Springate models on the "Rouiba" company:

Table 3: Models results - "Rouiba" company

CA score 1991					
Statement	2015	2016	2017	2018	2019
R_1	0.247	0.223	0.157	0.251	-0.068
R_2	0.052	0.034	-0.049	-0.005	-0.360
R_3	0.906	0.863	0.680	0.573	0.443
CA	**-1.036**	**-1.245**	**-1.994**	**-1.406**	**-1.625**
Kida 1980					
X_1	0.030	0.016	-0.090	-0.032	-0.405
X_2	0.247	0.223	0.157	0.251	-0.068
X_3	0.967	0.825	0.669	0.591	0.226
X_4	0.906	0.863	0.680	0.573	0.443
X_5	0.027	0.012	0.014	0.024	0.019
Z	**-0.722**	**-0.666**	**-0.647**	**-0.459**	**-0.549**
Springate 1978					
X_1	-0.012	-0.081	-0.186	-0.244	-0.726
X_2	0.053	0.034	-0.049	-0.006	-0.375
X_3	0.080	0.035	-0.163	-0.055	-0.448
X_4	0.912	0.868	0.692	0.584	0.462
Z	**0.567**	**0.391**	**-0.172**	**-0.072**	**-2.009**

We note from the above table that the CA values indicated a terrible deterioration in the value indicating the possibility of bankruptcy in all years of study.

According to the Z-values, the position of the "Rouiba" company was classified within the second level, which indicates a high probability of bankruptcy, the year 2015 was the most dangerous among all years, then the situation gradually began to improve, but without going out of the restricted area.

The results of the Springate model indicate that the "Rouiba" company is not characterized by financial soundness, especially in 2019, where the value of Z reached the bottom, if not completely bankrupt, especially since the company achieved successive losses starting from the years 2015 and 2016, where the profitability ratios indicated very small values, and this is evidence of a financial distress formation that led the company directly to financial failure in 2017 and 2018, after realizing direct losses in net profit, to eventually reach a very clear bankruptcy confirmed by the very low Z value, and therefore we conclude that the CA model's results were the closest to the Springate model results. Table 4 shows the application of the CA Score, Kida, Springate models on the "Saidal" company:

Table 4: Models results - "Saidal" company

CA score 1991					
Statement	2015	2016	2017	2018	2019
R_1	0.586	0.592	0.616	0.550	0.538
R_2	0.041	0.045	0.032	0.032	0.024
R_3	0.285	0.226	0.214	0.267	0.259
CA	**0.225**	**0.247**	**0.294**	**0.012**	**-0.081**
Kida 1980					
X_1	0.041	0.045	0.032	0.031	0.019
X_2	0.586	0.592	0.616	0.550	0.538
X_3	2.866	2.118	2.031	2.166	2.205
X_4	0.285	0.226	0.214	0.267	0.259
X_5	0.171	0.110	0.104	0.079	0.047
Z	**-1.117**	**-0.755**	**-0.715**	**-0.837**	**-0.877**
Springate 1978					
X_1	0.465	0.284	0.259	0.338	0.244
X_2	0.053	0.070	0.052	0.055	0.032
X_3	0.216	0.278	0.209	0.182	0.130
X_4	0.372	0.354	0.345	0.452	0.342
Z	**0.933**	**0.832**	**0.702**	**0.817**	**0.572**

Through Table 4, we note that the results of the CA Score model indicate that the "Sidal" company has a strong financial position throughout the study years, but despite this, the gradual deterioration in the value of CA in the last years, indicates that the company suffers from imbalances active

within its financial system, but silently and confidentially, and this is what appears on the CA value in 2019.

As for the Kida model results, we note the continuation of the same idea, where the model indicated the probability of bankruptcy in all companies, and this applies to the "Sidal" company as well, where the Z values according to it indicates a risk of bankruptcy, especially in 2015, but the situation improved gradually, 2016 and 2017, then decreased again 2018 and 2019, and this is further evidence confirmed that the company suffers from imbalances that gradually developed, and therefore the Kida and Ca Score models agreed that the financial performance level in the "Sidal" company suffers from imbalances.

According to the Springate model, the "Sidal" company went through two phases, the first phase in which the value of Z indicated the financial position safety of the company in 2015, but in the second phase, the value of Z started decreasing from 2016.The models predictive accuracy can be tested by comparing their outputs with the actual financial status of companies under study as shown in Table 5:

Table 5: The predictive accuracy

	CA score		**Kida**		**Springate**	
	0	**1**	**0**	**1**	**0**	**1**
0	4	1	5	0	5	0
1	4	11	15	0	8	7
Accuracy	75%		25%		60%	

We note from Table 5 that the CA score model is characterized by the appropriate classification accuracy of 75%, where it was able to identify (4) cases of financial distress with a total of 80%, but it misclassified (1) case of financial distress, and in return was able to diagnose (11) cases of non-distress correctly, but it misclassified (4) cases of non-distress.

We note from the same table that the Kida model is characterized by a very low classification accuracy of 25%, as it was able to correctly identify all the (5) cases of financial distress with a total of 100%, but in return it was unable to classify all the cases of financial distress.

We also note that the Springate model is characterized by a very average classification accuracy of 60%, where it was able to identify all the cases of financial distress with a total of 100%, and in return was able to diagnose (7) cases of non-distress correctly, but it misclassified (8) cases of non-distress.

5- Conclusion

Finally, we reached many valuable results that would providing the expected contribution. The CA score model is considered the best in terms of results accuracy with a classification accuracy of 75%, in the second place is the Springate model, with a classification accuracy of 60%, and the Springate model ranked last with a classification accuracy of 25%. Although the structure of the CA score model includes only three financial ratios, it was able to achieve very appropriate results compared to the other two models, and although the Kida model is considered the most cited model by researchers on the one hand, and the most applied in in the field on the other hand, this did not make it achieve appropriate results. Rouiba's financial position reflects on reality the theoretical phases that the bankrupt company is going through, starting from the phase of financial distress, which was diagnosed in 2015 and 2016, and this imbalance developed towards the phase of financial failure in 2017 and 2018, and thus the company achieved successive losses that pushed it towards bankruptcy. Biopharm's financial position was characterized by balance and strength compared to other companies, as it showed very satisfactory results according to Springate and CA score, which indicates the soundness of its financial position.

6- References

Alkhatib, K., Al Bzour, A. E. (2011). Predicting corporate bankruptcy of jordanian listed companies: Using altman and kida models. International Journal of Business and Management, 6(3), 208-215.

Babela, I., Mohammed, R. (2016). Business Failure Prediction using Sherrod and Kida Models: Evidence from Banks Listed on Iraqi Stock Exchange (2011-2014). Humanities Journal of University of Zakho, 4(2), 35-47.

Bessai Epse Kessouh, B. (2020). Analyse De La Performance Des Banques Publiques Et Privées En Algérie. Revue Finance & Marchés, 7(2), 71-87.

Husein, F., Pambekt, G. T. (2014). Precision of the models of Altman, Springate, Zmijewski, and Grover for predicting the financial distress. Journal of Economics Business and Accountancy, 17(3), 405-416.

Kasgari, A. A., Salehnezhad, S. H., & Ebadi, F. (2013). A Review of Bankruptcy and its Prediction. International Journal of Academic Research in Accounting, Finance and Management Sciences, 3(4), 274-277.

Khelifa, H., Trari, Medjaoui. (2023). La Stabilité Financière Des Banques Islamiques: Etude Comparative Avec Les Banques Conventionnelles Dans La Région Du Golfe. Revue Finance & Marchés, 10(2), 143-164.

Larbes, M., Bouzar, C. (2021). Effets De La Formation Des Conglomérats Financiers Sur La Stabilité Financière. Revue Finance & Marchés, 8(3), 115-132.

Omelka, J., Beranova, M., & Tabas, J. (2013). Comparison of the Models of Financial Distress Prediction. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, 61(7), 2587-2592.

Pakdaman, H. (2018). Investigating the Ability of Altman and Springate and Zmijewski and Grover Bankruptcy Prediction Models in Tehran Stock Exchange. Espacios, 39(14), 33-43.

Rahiche, S. (2021). The effectiveness of Kida model for predicting financial failure of insurance companies in Algeria –A field study-. Journal of Economic Growth and Entrepreneurship, 4(5), 19-27.

Rainarli, E., Sabek, A. (2023). Mitigating Challenges: Handling Missing Values and Imbalanced Data in Bankruptcy Prediction Using Machine Learning . Littera Scripta, Economics, Corporate finance, Finance and Valuation, 16(2), 79-96.

Sabek, A. (2023). Unveiling the diverse efficacy of artificial neural networks and logistic regression: A comparative analysis in predicting financial distress. Croatian Review of Economic, Business and Social Statistics (CREBSS), 9(1), 16-32.

Sabek, A., Horak, J. (2023). Gaussian Process Regression´s Hyperparameters Optimization to Predict Financial Distress. Retos, Revista de Ciencias Administrativas y EconA3micas, 13(26), 273-289.

Sabek, A., Saihi, Y. (2023). Crunching Numbers, Making Decisions: Artificial Intelligence and Statistics for Financial Distress Forecasting in Algeria and Saudi Arabia. CAFI, Comptabilité, Actuariat, Finance & Information, 6(2), 183-201.

Sabek, A., Saihi, Y. (2021). Using Artificial Neural Network To Predict The Financial Distress: The Case Of Some Algerian Companies. Journal of

North African Economics, 17(3), 475-492.

Sinarti, S., Sembiring, T. M. (2015). Bankruptcy Prediction Analysis of Manufacturing Companies Listed in Indonesia Stock Exchange. International Journal of Economics and Financial Issues, 5(15), 354-359.

St-Cyr, L., Pinsonneault, D. (1997). Mésure et analyse de risque d'insolvabilité. Montréal: école des hautes études comerciales, 1-21.

Tahi, A., Djebouri, M., Taibi, B. (2021). Market Risk Estimation Using Non-parametric Value At Risk And Conditional Value At Risk An Empirical Study On The Algerian Stock Market. Revue Finance & Marchés, 8(1), 1-15.

Tanjung, P. R. (2020). Comparative Analysis of Altman Z-score, Springate, Zmijewski and Ohlson Models In Predicting Financial Distress. EPRA International Journal of Multidisciplinary Research, 6(3), 126-137.

Shi, Y., Li, X. (2019). An overview of bankruptcy prediction models for corporate firms: A systematic literature review. Intangible Capital Journal, 15(2), 114-127.