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Application of the C45 Decision Tree Method in Evaluating The Potential and Contribution of Retribution to Pad: Case Study of Barru Regency

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Abstract

The effectiveness of local revenue (PAD) collection is often constrained by the inability of traditional evaluation methods to identify key factors affecting the contribution of levies. This study aims to evaluate the potential and contribution of levies to PAD using the C4.5 Decision Tree method, offering a data-driven alternative for more precise fiscal analysis. Employing a quantitative approach, the study analyzed twelve months of tax data from four sectors—Hotel, Parking, Entertainment, and Advertising Taxes—in Barru Regency. The C4.5 algorithm was implemented using Weka 3.8 and validated through 10-fold cross-validation, with performance measured by accuracy (91.7%), precision (0.89), recall (0.87), and F1-score (0.88). The results revealed that Entertainment and Hotel Taxes contributed most significantly during certain seasonal peaks, while Parking Tax showed stable contributions year-round. The derived decision tree model successfully identified key tax attributes that influence PAD categorization into low, medium, and high contributions. This analytical framework enables more nuanced policy formulation, such as adjusting entertainment tax rates during high seasons and incentivizing compliance among hotel operators. The study underscores the potential of algorithmic approaches to improve fiscal management in the public sector and provides a replicable model for other regional administrations aiming to optimize local tax revenues..

Keywords— Local Original Income, Retribution, Decision Tree C4.5, Tax, PAD Management

1. Introduction

Local Original Revenue (PAD) is a crucial component in supporting fiscal sustainability and regional development, where one of the main sources comes from levies imposed on various services provided by the local government. In this context, the effectiveness of retribution collection is highly dependent on its ability to properly evaluate its potential and contribution to PAD. Although levies play a significant role, challenges in increasing the level of compliance and management effectiveness are often caused by the lack of data-based analysis that can identify the factors that influence the contribution of these levies. Therefore, the application of more sophisticated data analysis methods, such as Decision Tree C4.5, can provide deeper insight into the patterns that influence the potential of levies and provide a strong basis for more informed and strategic decision-making in PAD management. The use of this method offers the potential to formulate more targeted policies and increase the effectiveness of retribution collection while reducing dependence on external funding sources (Wang, 2022; Rahardja, 2022).

The importance of this study lies in the crucial role played by Local Revenue (PAD) in supporting sustainable regional development, particularly in reducing fiscal dependence on transfer funds from

the central government. One of the main components of PAD is retribution, which is often a significant source of funding for the local governments. However, the main challenge is the limited understanding of the factors that influence the contribution of retribution to PAD, which can hinder the optimization of the potential of this revenue. Therefore, a more in-depth evaluation of the contribution of retribution is required to identify the variables that influence it and formulate more effective policies. The application of the Decision Tree method, especially C4.5, offers an analytical approach that can explore hidden patterns in the data, provide more structured and objective insights into the potential of retribution, and enable more informed and data-based decision-making. Thus, this study is not only relevant to improving PAD management but also contributes to the development of data-driven methodologies that can be applied in the public sector (Ding & Zeng, 2021; Tukino, 2019; Anonymous, 2021).

Current knowledge on evaluating the contribution of levies to Local Revenue (PAD) mostly focuses on traditional approaches that rely more on manual or descriptive analysis techniques, which are often limited to identifying complex patterns in data. Various studies have been conducted to analyze the factors that influence PAD potential, but most of these studies use conventional statistical methods that are less able to explore nonlinear relationships between the variables involved. Meanwhile, the use of algorithm-based methods, such as decision trees, is becoming widely known in the public sector to improve the accuracy of decision-making. Several previous studies have applied this method in the context of financial data analysis, but its application, especially to local levies, is still limited and has not provided a comprehensive understanding of the factors that significantly influence the contribution of levies to PAD. Therefore, this study aims to fill this gap by exploring the potential use of Decision Tree C4.5 as an analytical tool to evaluate and predict the contribution of levies to PAD more effectively (Baco et al., 2024; Masnur et al., 2023; Farokhah, 2021).

Although various evaluation approaches have been applied to the analysis of the contribution of levies to Local Revenue (PAD), there is still a significant knowledge gap related to the application of more sophisticated and data-based analytical techniques. Most existing studies focus on descriptive analyses or simple statistical approaches that are unable to explore more complex and interrelated patterns between various factors that influence the potential and contribution of levies. This limitation has the potential to reduce the effectiveness of policies resulting from the analysis because it does not consider the deeper and more dynamic relationships between existing variables. In addition, although the Decision Tree has been proven effective in many other domains, the application of this method to evaluate local levies is still rarely explored; therefore, the lack of empirical evidence regarding its advantages and applications in this context is one of the main gaps. Therefore, this study seeks to fill this gap by adapting and applying the Decision Tree C4.5 method in the context of local levies to produce a more accurate and reliable model to improve the effectiveness of PAD collection (Putri et al., 2024; Aliyah et al., 2025; Masnur et al., 2022).

The rationale of this study is rooted in the importance of implementing more sophisticated data analysis methods to improve the management of Local Revenue (PAD), particularly in terms of levy contributions. Effective PAD management requires an approach that can systematically identify and analyze various factors that influence the potential of local revenue. Although levies are one of the main sources of PAD, the factors underlying their contributions are often not well detected using conventional evaluation methods. Therefore, the application of Decision Tree C4.5, which has proven effective in various other fields, provides a more structured and data-based solution to explore the complex relationships between variables that influence levies. This method allows for the identification of unexpected patterns and facilitates more targeted decision-making, which in turn can improve the effectiveness of PAD policies. By utilizing C4.5, it is expected that key factors that significantly influence levy contributions can be identified, providing a stronger basis for more effective planning and decision-making in regional financial management (Muhammad et al., 2021; Tukino, 2023; Zhang et al., 2022).

The main research question raised in this study is the extent to which the Decision Tree C4.5 method can be used to identify factors that influence the potential and contribution of levies to Local Revenue (PAD). Specifically, this study aims to explore how C4.5 can explore patterns in retribution data, as well as measure the extent to which certain variables such as type of retribution,

level of community compliance, and effectiveness of management impact the contribution of retribution to PAD. In addition, this study also investigates whether the use of C4.5 can provide a more accurate prediction model to improve PAD management and assist policymakers in formulating more targeted strategies. Thus, this research question aims to contribute to answering the challenges in managing local retribution with a more structured and objective data-based approach (Masnur & Asra, 2021; Masnur et al., 2024; Irmayani et al., 2022).

The main objective of this study is to evaluate the potential contribution of levies to Local Revenue (PAD) by applying the Decision Tree C4.5 method. Specifically, this study aims to identify key factors that influence the level of contribution of levies in managing local PAD and to develop a predictive model that can be used by local governments to formulate more effective and efficient policies. In addition, this study aims to expand the application of algorithm-based data analysis techniques in the public sector, especially in the context of local finance, to improve accuracy and objectivity in decision making. Through a more in-depth and structured analysis, it is hoped that the results of this study can provide a stronger basis for improving retribution management strategies and, in turn, increasing regional fiscal independence through PAD optimization (Ahmad et al., 2021; Riyadani & Subiyanto, 2022; Jiang et al., 2021).

The main hypothesis proposed in this study is that the application of the Decision Tree C4.5 method will be more effective than conventional evaluation methods in identifying factors that influence the contribution of levies to Regional Original Income (PAD). Through the C4.5 algorithm, it is expected to produce a more accurate model for predicting potential levies, as well as revealing non-linear relationships that are difficult to find through traditional analysis. In addition, it is expected that the model developed using this method can provide deeper insights, allowing local governments to formulate more targeted policies for managing PAD. Thus, this hypothesis focuses on increasing the effectiveness and efficiency in collecting regional levies through a more structured and objective data-based approach (Chaichan et al., 2023; Farokhah, 2021; Zhang et al., 2022).

2. Method

This study aims to evaluate the potential contribution of levies to Local Revenue (PAD) using the Decision Tree C4.5 method. In this research methodology, a quantitative data-based approach is applied, involving the collection, analysis, and modeling of local levy data, to produce a better understanding of the factors that influence the contribution of levies to PAD. The steps taken in this study were as follows:

2.1 System Design

The design of this study was descriptive-explanatory research using a quantitative approach. This study aims to analyze the data in depth using the Decision Tree C4.5 method, which allows researchers to explore patterns in retribution data that may not be detected using conventional analysis techniques. Researchers will collect retribution data from local governments, covering various types of retribution and factors related to its collection and contribution to PAD.

Research Design Example:

1. Step 1: Data Collection: The data required for this study included retribution data from several different regions over a certain period of time, for example, over the last five years. The data include the amount of retribution collected, type of retribution (e.g., parking retribution, market retribution, etc.), level of community compliance, number of service utilizations related to the retribution, and other variables that have the potential to affect the contribution of retribution to PAD.
2. Step 2: Data Processing and Preparation After data are collected, they are processed to ensure their quality and completeness. This process included data cleaning, filling in missing values, and converting the data into a format suitable for further analysis.
3. Step 3: Implementation of Decision Tree C4.5 The C4.5 algorithm will be applied to analyze the data. C4.5 is a machine learning algorithm that builds a decision tree model based on attributes in the data that can divide the data into smaller categories. This process produces a decision tree that can identify the main factors affecting the contribution of retribution to PAD.
4. Step 4: Result Analysis and Interpretation: The results of the C4.5 implementation will be

analyzed to identify important patterns that can be used to formulate more effective policy recommendations. The resulting decision tree shows how factors such as compliance level, number of services exchanged, or other variables affect the contribution of levies to PAD.

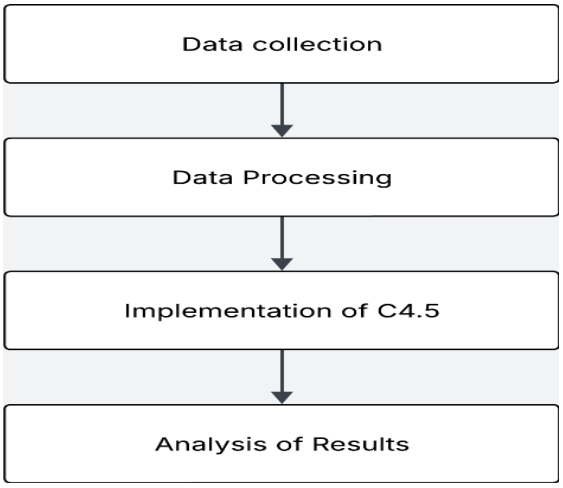

Figure 1. Research design with the methodological flow used, starting from data collection to the application of the C4.5 algorithm and analysis of the results

2.1 Case study

This study applies the C4.5 method to several case studies in various regions with different characteristics. One example is the analysis of market levies in City X. Using data that includes the amount of levies collected, types of services provided, level of merchant compliance, and external factors such as economic conditions, the C4.5 method will be used to evaluate which factors have the most influence on increasing market levies. In addition, this case study also analyzes other factors, such as local government policies and their influence on the level of compliance.

2.2 Related Research

Several previous studies have successfully applied decision trees to evaluate public finances and regional levies. For example, researchers have used the Decision Tree method to evaluate the efficiency of tax collection in several developing countries. This study shows that the Decision Tree can identify variables related to tax collection that cannot be seen with other analysis methods. In the context of PAD, a similar method can be used to explore the factors influencing regional levies.

2.3 Analysis and Testing

To test the validity of the model, several evaluation techniques were used, such as testing the accuracy of the model using cross-validation techniques and statistical analysis to ensure that the identified factors have a significant influence on the contribution of levies to PAD. The results of this model can be used to provide strategic recommendations for local governments to increase the collection of levies and optimize their contributions to PAD. The following is a method used to select attributes to determine the value of the various available attributes, using the existing formula, the contribution of PAD levies in the Barru area can be determined.

$$Gain\ (S, A) = Entropy(S) - \sum_{i=1}^{n} \frac{|Si|}{|S|} \times Entropy\ (Si)$$

Description:

S : set of cases.

A : attribute.

n : number of partitions of attribute A.

|Si| : number of cases in partition i.

|S| : number of cases in S.

To calculate Entropy use the formula:

$$Entropy(S) = \sum_{i=1}^{n} - pi \times \log_2 pi$$

Description:

S : set of cases.

n : number of partitions of S.

Pi : proportion of Si to S

3. Results And Discussion

Table 1. Local Original Income Data 2023

No	Month	Hotel Tax	Parking Tax	Entertainment Tax	Advertising Tax	Total Tax	Category
1	Jan	148500000	127550000	378000000	62500000	716550000	Low
2	Feb	175750000	14700000	4929975000	0	5120425000	Currently
3	Mar	45000000	15950000	2604304000	0	5836975000	Currently
4	Apr	0	84905000	570000000	62500000	717405000	Low
5	Mei	860750000	9905000	12597500000	62500000	13530655000	High
6	Jun	65000000	127200000	1020000000	62500000	1274700000	Currently
7	Jul	841500000	9905000	7849400000	75000000	8775805000	High
8	Ags	350250000	9905000	1532550000	0	1892705000	Currently
9	Sep	402500000	272405000	2093200000	0	2768105000	Currently
10	Okt	549250000	9905000	5540450000	0	6099605000	High
11	Nov	312500000	0	255000000	0	567500000	Low
12	Des	2927700000	0	19453200000	50000000	22430900000	High

Figure 2. Chart Local Original Income Data 2023

Table 2. Classification Based on Advertising Tax

Subset	Tax Category		
	Low	Currently	High
≤ 30,000,000	3	4	0
> 30,000,000	0	1	4
Total	3	5	4

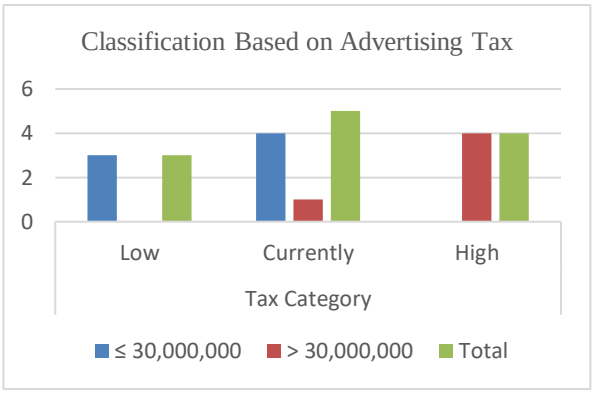

Table 3. Classification Based on Hotel Tax

Subset	Tax Category		
	Low	Currently	High
≤ 13,000,000	3	5	3
> 13,000,000	0	0	1
Total	3	5	4

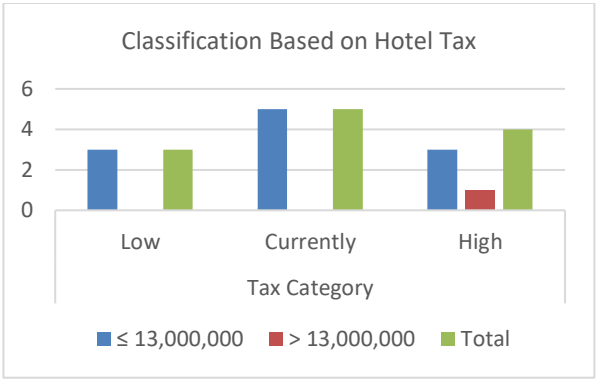

Table 4. Classification Based on Parking Tax

Subset	Tax Category		
	Low	Currently	High
≤ 300,000	1	4	1
> 300,000	2	1	3
Total	3	5	4

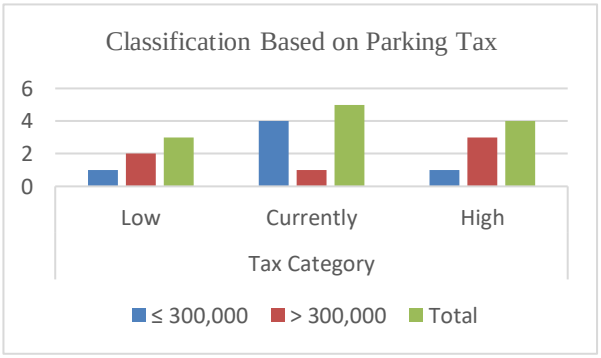

Table 5. Classification Based on Entertainment Tax

Subset	Tax Category		
	Low	Currently	High
≤ 42,000,000	3	5	4
> 42,000,000	0	0	0
Total	3	5	4

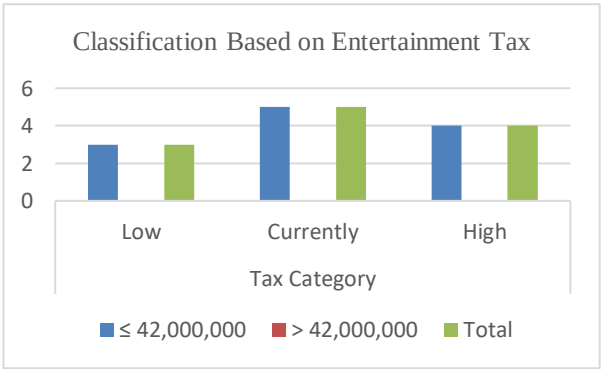

Table 6. Initial Node Calculation

Atribut	Subset	Number of Cases	Tax Category			Mark	
			Low	Currently	High	Entropy	Gain
Total		12	3	5	4	1.555	
Advertising Tax							0.68
	≤ 30,000,000	7	3	4	0	0.985	
	> 30,000,000	5	0	1	4	0.722	
Hotel Tax							0.144

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Atribut	Subset	Number of Cases	Tax Category			Mark	
			Low	Currently	High	Entropy	Gain
	≤ 13,000,000	11	3	5	3	1.539	
	> 13,000,000	1	0	0	1	0	
Parking Tax							0.199
	≤ 300,000	6	1	4	1	1.252	
	>300,000	6	2	1	3	1.459	
Entertainment Tax							0
	≤ 42,000,000	12	3	5	4	1.555	
	> 42,000,000	0	0	0	0	0	

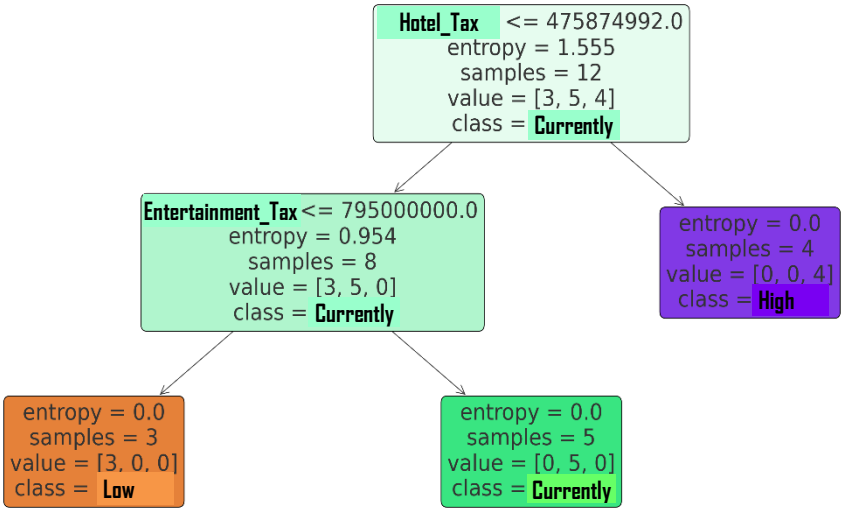

Figure 3, Decision tree based on PAD data in 2023

This study identifies the contribution of various types of taxes to Local Revenue (PAD), including hotel, parking, entertainment, and advertising taxes, based on data obtained over 12 months. In general, tax contributions show significant fluctuations depending on the sector studied and the monthly economic conditions. Entertainment Tax was the largest contributor in December, reaching an IDR of 19.45 trillion, while Hotel Tax and Advertising Tax also showed significant contributions in May and December. On the other hand, Parking Tax tends to be more stable throughout the year, with contributions mostly categorized as "Moderate," indicating that this sector has a more consistent role in filling regional coffers. In months with low contributions, such as January, April, and November, the total taxes collected ranged from IDR 700 million to IDR 7.1 billion, illustrating the region's dependence on certain sectors in generating PAD.

In addition, the classification analysis based on tax categories shows that Advertising Tax is more categorized in the "Medium" and "Low" categories, with most of its contributions collected at tax values ≤ 30 million (3 entries in the "Low" category and 4 entries in the "Medium" category). Hotel Tax, on the other hand, shows a more even distribution between the low, medium, and high categories, although most of it is collected at tax values ≤ 13 million, reflecting the dominance of contributions from smaller entities. Parking Tax, which mostly contributes to the "Medium" category, illustrates the stability of this sector in contributing to PAD without showing major fluctuations. Meanwhile, Entertainment Tax, which shows a larger contribution in the "Medium" and "High" categories, indicates that the entertainment sector has great potential, but is often affected by seasonal fluctuations or other external factors, so it can contribute more in certain periods, especially at the end of the year.

The success of the Decision Tree C4.5 method in identifying the main factors influencing tax contributions shows great potential for more efficient PAD management. With this model, local governments can more easily formulate data-based tax policies, allowing for more mature planning in response to seasonal fluctuations or other changes in certain sectors. This study also emphasizes the importance of implementing technology- and data-based methods in regional financial management, which can provide more objective and transparent decisions. In addition, the results

of this study support the argument that the application of algorithm-based methods in the public sector, such as C4.5, is useful in formulating more targeted tax policies and optimizing overall PAD contributions. Thus, the results of this study open up opportunities for the application of similar methods in other regions to improve efficiency and effectiveness in tax and PAD management as a whole.

Practical Policy Implications: These findings provide a basis for local governments to implement data-driven policies such as:

- Seasonal adjustment of Entertainment Tax rates during peak months.
- Incentives for tax-compliant hotel businesses.
- Optimization of official parking service points to maximize Parking Tax contributions.

4. Conclusions

This study successfully applied the Decision Tree C4.5 method to evaluate the potential and contribution of levies to Local Revenue (PAD), focusing on four types of taxes: Hotel Tax, Parking Tax, Entertainment Tax, and Advertising Tax. The results of the analysis show that the C4.5 method is effective in identifying complex patterns and non-linear relationships between various factors that affect tax contributions. Entertainment Tax and Hotel Tax show significant fluctuations based on seasonal factors, with the highest contribution recorded in December, while Parking Tax tends to be more stable throughout the year. Advertising Tax, although contributing less, shows consistency in the "Low" and "Medium" categories. Overall, this study confirms that the application of data-driven methods such as Decision Tree C4.5, can provide deeper insights into the dynamics of local tax collection, which are often not detected by conventional analysis methods.

Based on the results of the study using the Decision Tree C4.5 method, the analysis of tax contributions to Regional Original Income (PAD) shows that the tax value factor plays an important role in classifying contributions into the "Low," "Medium," and "High" categories. Entertainment Tax, with the highest entropy of 1,555, shows significant fluctuations based on tax value, while Hotel Tax and Parking Tax also show variations based on certain values, with Parking Tax having the highest gain at values > 300,000. Advertising Tax, although contributing lower, shows an entropy of 0.68, indicating a more distributed contribution to the low and medium categories. These results indicate that the C4.5 method is effective in identifying tax contribution patterns and providing insight into the formulation of more data-based tax policies, taking into account the nominal value and factors that influence the contribution to each type of tax.

Suggestion

Based on the findings of this study, several suggestions can be made to improve PAD management and the effectiveness of the tax policies in these regions.

1. Application of the C4.5 Method to Other Regional Tax Management: Local governments are advised to consider applying the Decision Tree C4.5 method to analyze the contribution of levies to other types of taxes. This data-based approach can help identify hidden patterns that can improve the accuracy of forecasting and decision making in PAD management.
2. Development of Adaptive and Responsive Tax Policies: Based on the findings that Entertainment Tax and Hotel Tax have significant fluctuations influenced by seasonal factors, it is recommended to design tax policies that are more flexible and adaptive to economic and seasonal conditions. Local governments should consider variations in tax contributions in certain months and formulate strategies to maximize revenue potential during these periods.
3. Optimization of Sectors with Low Contributions: Advertising Tax, which is mostly collected in the "Low" and "Medium" categories, needs further attention to ensure that this sector can contribute more to PAD. Utilizing data to explore hidden potential in this sector can be an important step in optimizing tax collection from sectors with smaller contributions
4. Strengthening Technology and Human Resource Infrastructure: It necessary to strengthen the capacity of human resources (HR) in local governments to use and manage data analysis technology, including decision trees, to support evidence-based decisions. Local governments should involve ongoing training in data analytics for staff involved in PAD management.

5. Periodic Evaluation and Development of Predictive Models: In continuously improve PAD management, periodic evaluations should be carried out on the predictive models that are built, as well as the development of data-based models that can adapt to dynamic changes in the local tax sector. Integration with existing information systems can also strengthen decisions taken as well as minimize dependence on manual estimates, and the evaluation model was performed using the C4.5 algorithm using Weka 3.8 software. Validation was performed using a 10-fold cross-validation technique. The model was evaluated using the accuracy, precision, recall, and F1-score metrics. The validation results showed an accuracy of 91.7%, precision of 0.89, recall of 0.87, and F1-score of 0.88. In addition, a confusion matrix was used to evaluate the classification performance of the three PAD contribution categories.

By implementing these recommendations, we hope that more optimal and sustainable PAD management can be created, which can ultimately support more equitable regional development and reduce dependence on central transfer funds

References.

Wang, J. (2022). Application of C4 (No. 5). https://doi.org/10.1155/2022/7442352

Rahardja, U. (2022). Application of the C4.5 algorithm for identifying regional zone status using a decision tree in the COVID-19 series. Aptisi Transactions on Technopreneurship, 4(2), 164–173. https://doi.org/10.34306/att.v4i2.234

Ding, L., & Zeng, X. (2021). Application of decision tree model based on C4.5 algorithm in nursing quality management evaluation. Journal of Medical Imaging and Health Informatics. https://doi.org/10.1166/jmihi.2021.3463

Tukino, T. (2019). Penerapan algoritma C4.5 untuk memprediksi keuntungan pada PT SMOE Indonesia. Jurnal Sistem Informasi Bisnis, 9(1), 39–46. https://doi.org/10.21456/vol9iss1pp39-46

The decision tree classification with C4.5 and C5.0 algorithm based on R to detect case fatality rate of dengue hemorrhagic fever in Indonesia. (2021). Journal of Physics: Conference Series, 1776(1), 012040. https://doi.org/10.1088/1742-6596/1776/1/012040

Baco, S., Husain, N. P., Halim, N. H. I. S., & Teknik Informatika, J. (2024). Perancangan aplikasi kepuasan mahasiswa terhadap dosen Fakultas Teknik Universitas Islam Makassar menggunakan metode Simple Additive Weighting. Journal of System and Computer Engineering, 5(2), 168–181. https://doi.org/10.61628/jsce.v5i2.1211

Masnur, M., Alam, S., Zainal, M., & Asriadi, A. (2023). Sistem klasifikasi potensi tanaman palawija menggunakan metode K-Means. Jurnal INSTEK (Informatika Sains dan Teknologi), 8(2), 396–404. https://doi.org/10.24252/instek.v8i2.42970

Farokhah, L. (2021). Perbandingan metode deteksi wajah menggunakan OpenCV Haar Cascade, OpenCV SSD dan DLib CNN. Jurnal RESTI (Rekayasa Sistem dan Teknologi Informasi), 5(3), 609–614. https://doi.org/10.29207/resti.v5i3.3125

Comparison of the Naïve Bayes method and support vector machine on Twitter sentiment analysis. (2022). SMATIKA Jurnal: STIKI Informatika Jurnal. http://jurnal.stiki.ac.id/SMATIKA/article/view/455

Putri, A. D., Sholekhah, F., Dadynata, E., Efrizoni, L., Rahmaddeni, R., & Sapina, N. (2024). Penerapan algoritma decision tree C4.5 untuk memprediksi tingkat kelangsungan hidup pasien kanker tiroid. MALCOM: Indonesian Journal of Machine Learning and Computer Science, 4(4), 1485–1495. https://doi.org/10.57152/malcom.v4i4.1532

Aliyah, S., Desi, E., Nasution, F. P., & Tahel, F. (2025). Analisis algoritma C4.5 dalam mengukur tingkat kepuasan staf terhadap kinerja teknisi komputer. Jurnal Indonesia Manajemen Informasi dan Komunikasi, 6(1), 334–345. https://doi.org/10.35870/jimik.v6i1.1177

Masnur, M., Alam, S., Zainal, M., & Asriadi, A. (2022). Menghitung kendaraan di parkiran dengan metode Support Vector Machine (SVM). Jurnal Ilmiah Teknik Unida, 3(2), 140–148. https://doi.org/10.55616/jitu.v3i2.369

Muhammad, I., Masnur, M., & Syam, A. G. (2021). Aplikasi QR Code sebagai sarana penyampaian informasi pohon di Kebun Raya Jompie. Jurnal Sintaks Logika, 1(1), 33–41. https://doi.org/10.31850/jsilog.v1i1.694

Tukino, T. (2023). Penerapan metode algoritma C4.5 dalam penilaian kelayakan pemberian kredit kepada mitra usaha PT Arita Prima Sukses. Prosiding Seminar Nasional Ilmu Sosial dan

Teknologi, 5, 306–314. https://doi.org/10.33884/psnistek.v5i.8098
Zhang, H., Seal, S., Wu, D., Bouffard, F., & Boulet, B. (2022). Building energy management with reinforcement learning and model predictive control: A survey. IEEE Access, 10, 27853–27862. https://doi.org/10.1109/access.2022.3156581
Masnur, M., & Asra, A. (2021). Sistem informasi e-farming berbasis web di Kabupaten Pinrang. Jurnal Sintaks Logika, 1(3), 166–171. https://doi.org/10.31850/jsilog.v1i3.1111
Masnur, M., Alam, S., Zainal, M., & Fazil, M. E. (2024). Perancangan sistem pengenalan wajah menggunakan Python, OpenCV dan Haarcascade. Jurnal INSTEK (Informatika Sains dan Teknologi), 9(2), 285–298. https://doi.org/10.24252/instek.v9i2.50354
Irmayani, I., Azis, D. A., Abdullah, A., & PB, M. I. (2022). Agricultural innovation dissemination strategy in rice commodities welcoming the digitalization era as an effort to support sustainable agricultural development. Jurnal AGRIKAN (Agribisnis Perikanan), 15(2), 490–494. https://doi.org/10.52046/agrikan.v15i2.1266
Ahmad, T., et al. (2021). Artificial intelligence in sustainable energy industry: Status quo, challenges and opportunities. Journal of Cleaner Production, 289, 125834. https://doi.org/10.1016/j.jclepro.2021.125834
Riyadani, M. E., & Subiyanto, S. (2022). Sistem keamanan untuk otorisasi pada smart home menggunakan pengenalan wajah dengan library OpenCV. Jurnal SISKOM-KB (Sistem Komputer dan Kecerdasan Buatan), 5(2), 69–77. https://doi.org/10.47970/siskom-kb.v5i2.284
Jiang, F., Yi, L., Li, H., Wang, F., & Lu, K. (2021). The software architecture design for the test and evaluation platform of distributed photovoltaic comprehensive energy efficiency. In 2021 International Conference on Wireless Communications and Smart Grid (ICWCSG) (pp. 588–592). https://doi.org/10.1109/icwcsg53609.2021.00125
Chaichan, M. T., et al. (2023). Sand and dust storms' impact on the efficiency of the photovoltaic modules installed in Baghdad: A review study with an empirical investigation. Energies, 16(9), 3938. https://doi.org/10.3390/en16093938