Scientax
Jurnal Kajian Ilmiah Perpajakan Indonesia

djp

VOLUME 7 NO. 1 | OCTOBER 2025 Journal Page: ejurnal.pajak.go.id ISSN 2686-5718

Data Mining Innovation to Predict the Duration of Tax Disputes: A Case Study in Indonesia

Donny Maha Putra[a,b]
[a] Kementerian Keuangan Republik Indonesia, Jakarta, Indonesia. Email: donnymp@kemenkeu.go.id
[b] UPN Veteran Jakarta, Jakarta, Indonesia. Email: donny.mp@upnvj.ac.id
* Corresponding author: donny.mp@upnvj.ac.id

ABSTRACT

The resolution of complex tax disputes poses a significant challenge to Indonesia's tax system, impacting administrative efficiency and taxpayer certainty. This study develops prediction models for tax dispute resolution duration using machine learning techniques: Decision Tree, Random Forest, and Support Vector Machine (SVM). The analysis covers 16,223 dispute cases from 2016 to 2023, employing data mining to identify critical factors influencing resolution times. Results indicate that Random Forest and SVM models achieve high accuracy (99.7%), significantly outperforming traditional methods. The Random Forest excels in interpretability, whereas the SVM delivers stable predictions compared to the Decision Tree. These findings imply potential improvements in dispute resolution speed, resource optimization, administrative transparency, and automation, thereby reducing case backlogs and enhancing taxpayer confidence. The primary contribution lies in applying machine learning to enhance Indonesia's tax dispute resolution efficiency, providing an accurate, objective, and data-driven method. This research also suggests future opportunities to develop advanced prediction models using ensemble learning or deep learning techniques. Such developments could further enhance the fairness and transparency of the tax system.

Keywords: tax disputes, random forest, support vector machine, duration prediction, data mining

1. INTRODUCTION

Tax disputes are a significant global problem, disrupting the efficiency of the tax system and potentially causing large losses in state revenues (Atadoga et al., 2024). Like other countries, Indonesia faces an increase in tax dispute cases that burden the judicial system and can erode public trust (Afiyati et al., 2022; Benzarti & Wallossek, 2023). Recent data compiled from various unpublished sources and processed by the authors indicate a significant upward trend in the number of unresolved tax disputes. Compared to previous years, the cases have increased by approximately 70–80% over the last four years, and the trend suggests a continued rise in the coming years. This increase is attributed to various factors, including the complexity of tax regulations, particularly in determining tax subjects, objects, and rates (Siregar & Suharto, 2018). Additionally, the limited resources of tax authorities and the low awareness of taxpayers about their rights and obligations can also contribute to the rise in tax dispute cases in Indonesia (Siregar & Suharto, 2018).

The long duration of tax dispute resolution in Indonesia, especially for substantive disputes, is a crucial issue that requires attention (Ballesteros, 2023; Hikmah & Nugroho, 2015). This long process not only lowers taxpayers' confidence in a fair and

DOI: 10.52869/st.v7i1.1006
Received: February 19, 2025; Revised: May 13, 2025; Accepted: May 27, 2025; Published: October 31, 2025

Scientax: Jurnal Kajian Ilmiah Perpajakan Indonesia is Sinta 3 Journal (https://sinta.kemdikbud.go.id/journals/profile/9121)
How to Cite:
Putra, D. M. (2025). Data mining innovation to predict the duration of tax disputes: A case study in Indonesia. *Scientax: Jurnal Kajian Ilmiah Perpajakan Indonesia, 7*(1), 1-15. https://doi.org/10.52869/st.v7i1.1006

effective tax system (Afiyati et al., 2022; Ballesteros, 2023; Perrou, 2020) but also creates uncertainty for the business world, potentially hindering investment and economic growth (Benzarti & Wallossek, 2023). Furthermore, protracted dispute resolution can have a negative impact on the investment climate, for instance, by downgrading Indonesia's Ease of Doing Business rating, particularly on the Paying Taxes indicator, which can ultimately reduce foreign investor interest. Conversely, the delay in tax revenue due to unresolved disputes is detrimental to the Government because it hinders state revenues that should be allocated for public services and infrastructure development, thereby hindering national development progress (de la Feria, 2020).

Although efforts to automate the process through the e-tax court have been carried out, in some aspects, the manual process still dominates the Indonesian Tax Court. The use of suboptimal information technology, including inefficient case management systems, has been identified as the main cause of the slow resolution of tax disputes (Ballesteros, 2023). Such technological limitations contribute to the accumulation of case files, which subsequently complicates the tracking of case progress and increases the risk of human error, thereby prolonging resolution times (Clementino-Moningka & Rasji, 2023; Mushawirya, 2020). On the other hand, the ongoing transformation in the Tax Court needs to be accompanied by comprehensive evaluation and innovative strategies to address these structural weaknesses and ensure fair and timely dispute resolution (Afiyati et al., 2022; Clementino-Moningka & Rasji, 2023; Mushawirya, 2020; Siimon & Lukason, 2021; Siregar & Patunru, 2021; Siregar & Suharto, 2018).

In this context, machine learning has emerged as a potential solution proposal that has not been widely explored to improve the efficiency and effectiveness of tax dispute resolution in Indonesia. Although the application of machine learning in taxation has shown promising results, such as in tax risk assessment (Battiston et al., 2020), financial risk prevention (Hao, 2021; Li, 2020), and tax behaviour analysis (Zheng et al., 2024), its application in predicting the duration of tax dispute resolution remains limited (Alarie et al., 2019; Black et al., 2022; Scantamburlo et al., 2019; Tsurel et al., 2023).

This research aims to develop a data mining and predictive modelling approach that is specifically tailored to the context of tax disputes in Indonesia. Using machine learning models, that is, Decision Trees, Random Forests, and Support Vector Machines (SVMs), the study not only identifies the key factors that determine the duration of tax disputes but also generates more accurate predictions. The results of this study are expected to help the Tax Court manage its caseload more proactively. Additionally, the study's findings are expected to provide recommendations on the types of cases that can be resolved upstream, allowing for more effective and efficient resource allocation, which in turn impacts the sense of justice in the tax dispute resolution process.

2. LITERATURE REVIEW

2.1 Transaction Cost Economics (TCE) Theory

This research is based on the Transaction Cost Economics (TCE) Theory, developed by Williamson (1985), which posits that the higher the transaction costs in a system, the slower and less efficient the dispute resolution process will be. In the context of taxation, these transaction costs include regulatory complexity, legal uncertainty, and limited tax administration resources (Siregar & Suharto, 2018). Unresolved tax disputes can reduce public confidence in the tax system and create uncertainty in the business world (Afiyati et al., 2022; Artemyeva et al., 2016; Ballesteros, 2023). Furthermore, these delays can also negatively impact the Ease of Doing Business rating, discourage foreign investment, and delay tax revenues that should be allocated for development (Benzarti & Wallossek, 2023; de la Feria, 2020).

2.2 Challenges of Tax Dispute Resolution in Indonesia

Indonesia has experienced a significant increase in tax disputes, from 23,218 cases in 2018 to 41,224 cases in 2022, with a projection of 63,320 cases in

2026 (Tax Court Secretariat, 2024). The main causes are regulatory complexity, limited court resources, and a low understanding of taxpayers' rights and obligations (Afiyati et al., 2022; Clementino-Moningka & Rasji, 2023). Digitalization efforts through *the e-Tax Court* have not been fully effective because there are still many manual processes, suboptimal case management systems, and technological limitations in managing tax disputes efficiently (Ballesteros, 2023). Therefore, more innovative technology-based solutions are needed to accelerate the resolution of tax disputes.

2.3 Machine Learning for Predicting Tax Dispute Resolution

Machine learning technology has been widely applied in taxation, such as assessing tax risk (Battiston et al., 2020), preventing financial risks (Hao, 2021), and analysing taxpayer behaviour (Zheng et al., 2024). However, its use in predicting the duration of tax dispute resolution is still limited (Alarie et al., 2019; Black et al., 2022; Scantamburlo et al., 2019). In this study, three main models are used, namely Decision Tree, Random Forest, and Support Vector Machine (SVM), which will be evaluated based on accuracy, precision, recall, and F1-score to determine the best model (Jin, 2024). The most accurate model will help the Tax Court manage its caseload and allocate resources more effectively, thereby accelerating dispute resolution and improving the efficiency of the tax justice system in Indonesia.

3. RESEARCH METHODS

This study adopts a quantitative analytical approach using data mining techniques (Alolayan & Alhamed, 2024; Aprilia & Agustiani, 2021; Kumar & Govindarajan, 2019) to analyse tax dispute data and predict the duration of its resolution. The dataset consists of 16,223 entries covering the period from 2016 to 2023, which includes various important parameters. To evaluate the performance of the predictive models, the study further employs standard evaluation metrics, namely the Receiver Operating Characteristic (ROC) curve and the Confusion Matrix, which are widely used in machine learning model validation (Data Science StackExchange, 2018).

3.1 Data pre-processing

The data pre-processing stage plays a crucial role in ensuring the quality and consistency of the dataset before further analysis. This stage involves several systematic steps. First, *data cleansing and deletion* are performed to remove invalid or inconsistent records. Second, *data imputation* is conducted to handle missing values using appropriate techniques. Third, *data normalisation* is applied to standardise variable values so they can be compared consistently across different variables. Fourth, *data transformation* is carried out to convert the dataset into a suitable format and prepare it for modelling. Finally, *data exploration* is conducted to understand the dataset's characteristics, supported by data visualisation and descriptive statistical analysis (Furqon, 2024).

The measurements carried out include the types of variables, data distribution, and potential relationships between variables. Tests of concentration measures, such as the mean and median, as well as dispersion measures, including standard deviation and range, are also conducted to assess the variability of the data.

3.2 Machine Learning Model

In this study, we are using three different machine learning algorithm models to predict the duration of tax dispute resolution. These models are: Decision Tree, a model that builds a tree-shaped structure to map features into target classifications, resulting in decision rules that can be interpreted easily; Random Forest, an ensemble method that combines multiple decision trees to improve model accuracy and robustness; and Support Vector Machine, a machine learning algorithm that identifies the optimal hyperplane to separate data points into specific classes, effective in handling high-dimensional data and non-linear (Jin, 2024).

3.3 Model Evaluation

The model's performance is evaluated using several key metrics. Accuracy measures the proportion of correct predictions to the total data, precision measures the extent to which the model can correctly identify positive cases, and recall measures the model's ability to find all positive cases in the dataset. Furthermore, the F1-score is used to calculate the harmonic mean between precision and recall, thereby balancing the two metrics (Xin, 2023).

In addition to these four metrics, this study also employs the Area Under the Curve (AUC) and the Matthews Correlation Coefficient (MCC) to strengthen the evaluation. AUC reflects the model's ability to discriminate between positive and negative classes, while MCC provides a balanced measure by considering true and false positives and negatives simultaneously. Both metrics are especially useful in dealing with imbalanced datasets, where accuracy alone may provide misleading conclusions (Chicco & Jurman, 2020).

The results of the three models are compared to choose the most reliable model in predicting the duration of tax dispute resolution. After the pre-processed dataset consisting of 16,223 entries was tested using three predictive models, the model with the best performance based on evaluation metrics was selected. This best-performing model was then applied to the same dataset to conduct further analysis and identify the key factors influencing the duration of tax dispute resolution. The results of this analysis are interpreted and visualized using Orange Data Mining to provide insight into the efficiency of the Tax Court, as well as areas that need improvement in the tax dispute resolution process.

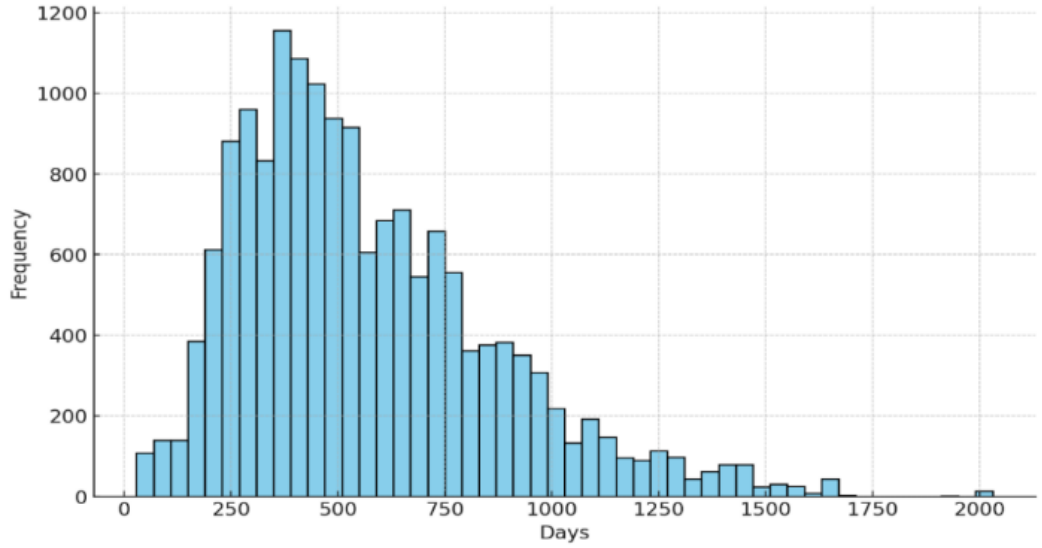
4. RESULTS AND DISCUSSIONS

4.1 Distribution of Dispute Resolution Duration

The distribution of the duration of tax dispute resolution in the Indonesian Tax Court exhibits a right-skewed pattern with a wide range, as illustrated in Figure 1. The majority of cases (approximately 66%) are resolved within the 200- to 750-day range, with a peak frequency of around 250 days. This indicates that most disputes are resolved within a relatively moderate timeframe, which reflects a certain level of efficiency in the tax justice system.

Figure 1

DRD Distribution



Note. Source: Processed by Author (2025)

However, this distribution also exhibits a long tail, where a significant proportion of cases take longer than 750 days to resolve, and some extreme cases even exceed 1,500 days. This phenomenon underscores the substantial delay in dispute resolution for most cases, which has the potential to cause disincentives for taxpayers and affect tax compliance (Clementino-Moningka & Rasji, 2023). The average duration of dispute resolution was recorded at 567 days, which is significantly higher than the median of 420 days. This gap confirms that outlier cases contribute substantially to the mean value, thereby highlighting inefficiencies in certain instances of dispute resolution.

Several predictor factors can explain the variability of dispute resolution duration. The complexity of tax regulations in Indonesia, which is characterised by dynamic changes and diverse interpretations, often extends the duration of disputes compared to jurisdictions with simpler regulations and a more homogeneous taxpayer population. Resource constraints, including a shortage of competent experts and efficient administrative procedures, also play a role in slowing down the dispute resolution process. In addition, delays from the parties involved, both taxpayers and tax authorities, in providing the necessary evidence or documents can significantly extend the duration of the dispute (Clementino-Moningka & Rasji, 2023).

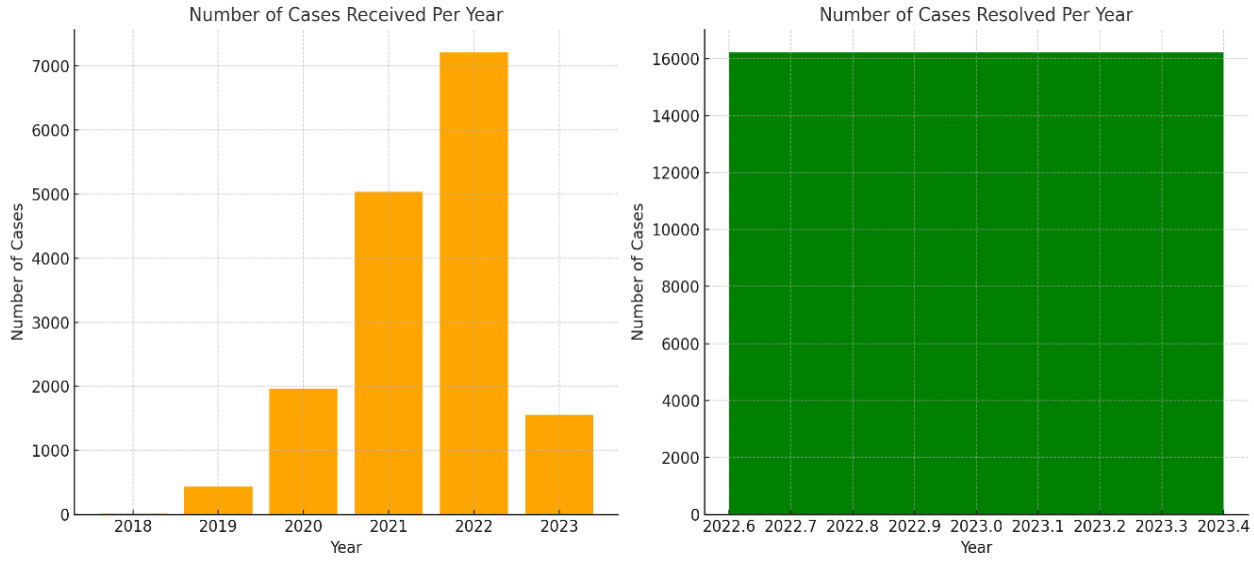
4.2 Tax Dispute Case Resolution

The surge in tax dispute cases occurred in 2022 (see Figure 2). This condition reflects the complex dynamics of taxation in Indonesia. Several factors contributed to this surge, including changes in tax regulations that often trigger confusion and disputes (Benzarti & Wallossek, 2023), fluctuations in economic conditions that encourage taxpayers to seek ways to reduce their tax burden (de la Feria, 2020), and increased awareness among taxpayers of their rights and appeal pathways (Bianco & Neto, 2021).

Although the Tax Court showed an improvement in case settlement performance in 2023, as illustrated in Figure 2, the projection of incoming cases up to 2026 indicates a continuing surge based on trend analysis. This condition highlights the need for continuous capacity building. Capacity-building strategies include staff additions and training (Babcock, 2005), administrative digitisation for efficiency (Evans et

Figure 2

Tax Dispute Case Resolution



Note. Source: Processed by Author (2025)

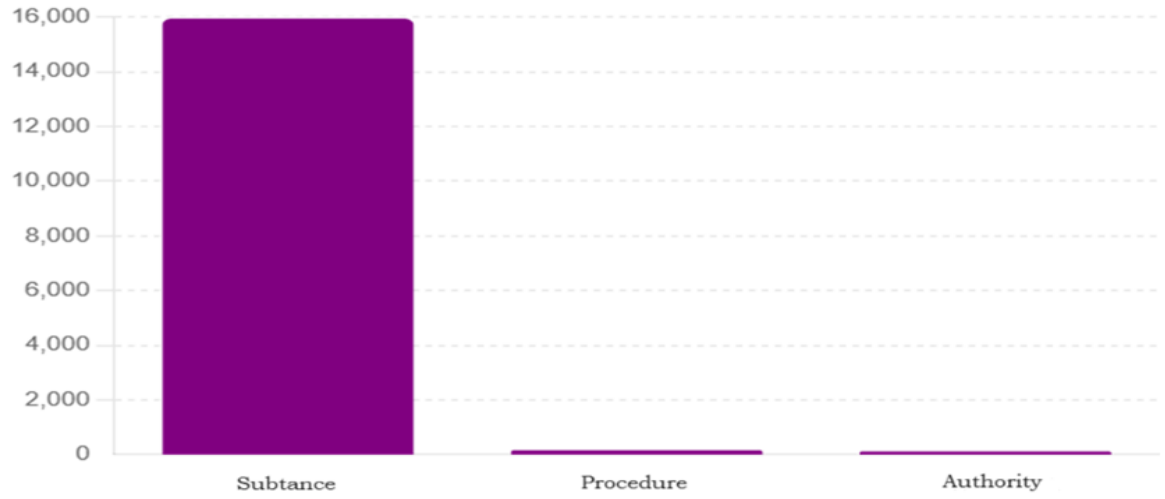
al., 2022; Habib et al., 2022; Kamil, 2022), and optimisation of work processes.

4.3 Dispute Criteria

The analysis of 16,223 tax dispute cases shows the dominance of Substance disputes (15,941 cases, 98.26%) compared to Procedure (161 cases, 0.99%) and Authority (121 cases, 0.75%) as shown in Figure 3. The dominance of Substance disputes indicates the complexity of tax regulations, which often cause differences in interpretation and a lack of understanding of taxpayers (Dwianika et al., 2023). Therefore, it is necessary to simplify regulations, provide comprehensive taxpayer education, and improve easily accessible consultation and dispute resolution services to reduce disputes and improve the tax system's efficiency.

Figure 3

Dispute Frequency Based on Criteria



Note. Source: Processed by Author (2025)

4.4 Statistical Analysis of Dispute Criteria

Based on Table 1, Authority disputes have the fastest resolution duration, with an average of 285.64 days and the lowest variability (standard deviation of 82.82 days). The efficiency and consistency in settling these cases indicate that the mechanisms implemented for handling disputes related to jurisdictional and tax authority decisions have been effective. Meanwhile, Procedure disputes have an average resolution duration of 381.99 days, with moderate variability (standard deviation of 121.16 days), which suggests that the process of handling procedural problems is relatively standardised and can be predicted accurately.

In contrast, Substance disputes, which account for the majority of cases (98.26%), exhibit the longest resolution duration, with an average of

Table 1

Tax Dispute Statistics Based on Criteria

Dispute Criteria	Number of Cases	Average (Days)	Std. Dev (Day)	Min (Day)	Max (Days)
Authority	121	285.64	82.82	161	686
Procedure	161	381.99	121.16	199	644
Substance	15,941	570.70	302.45	29	2,030

Note. Source: Processed by Author (2025)

570.70 days and the highest level of variability (standard deviation of 302.45 days). This type of dispute reflects the complexity of tax regulations and differences in legal interpretation, which are often the primary factors in dispute resolution (Silalahi, 2023). To address this, strategic steps are necessary, including simplifying tax regulations, enhancing taxpayer education to improve understanding of their rights and obligations, and providing more effective support services to expedite the resolution of substance disputes and reduce uncertainty in the tax system.

4.5 Duration of Tax Dispute Resolution

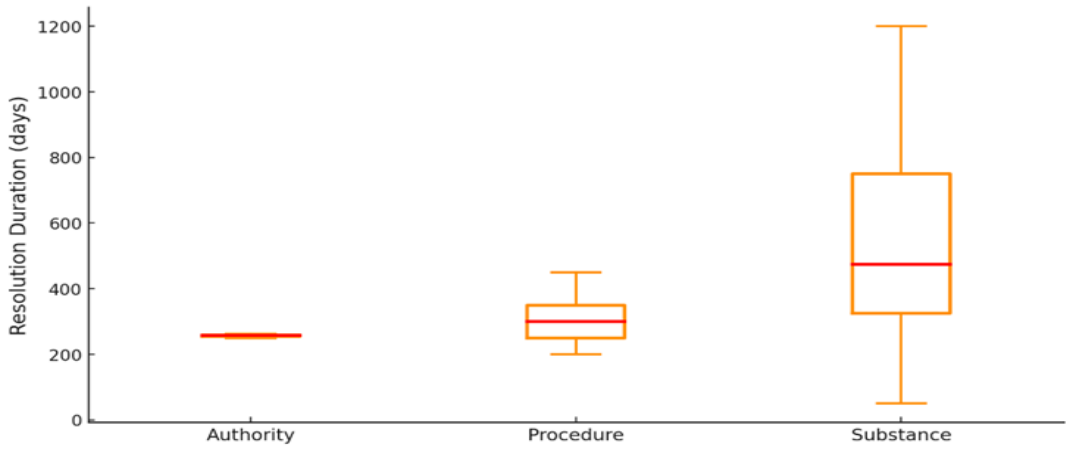
The visualization in Figure 4 provides an overview of the duration of tax dispute resolution based on three main categories: Authority, Procedure, and Substance. *The box plot* in this image displays a variety of key statistics, including minimum, maximum, and median values, as well as the first quartile (Q1 – 25th percentile) and third quartile (Q3 – 75th percentile), which provide insight into dispute resolution time patterns. Authority disputes show the fastest resolution time, with a median of about 285 days. A small Interquartile Range (IQR) indicates low variability, suggesting that the majority of cases in this category are resolved within a relatively consistent time frame. to its simpler nature and more efficient legal procedures, particularly in handling jurisdictional disputes or decisions of tax authorities.

The dispute procedure has a median resolution time of approximately 380 days, with a wider IQR than that of Authority disputes. This range shows that while most cases in this category can be resolved in a relatively predictable timeframe, some cases take longer due to procedural complexity or differences in dispute resolution mechanisms. Nonetheless, dispute resolution times for procedures are still shorter than those of substantive disputes, suggesting that the standard procedures applied in this category are relatively effective. However, there is room for further improvements in efficiency.

As the category with the highest number of cases (98.26% of total cases), Substance disputes have the longest median resolution time, which is approximately 570 days, with the most extensive IQR compared to the other two. This result indicates that disputes in this category not only take a longer time but also have a high degree of variability in their resolution. The complexity of tax regulations and differences in legal interpretation are the primary factors contributing to the prolonged time needed to resolve substance disputes (Silalahi, 2023). Additionally, cases in this category often require more in-depth legal analysis, extensive discussions, and expert

Figure 4

Duration of Tax Dispute Resolution



Note. Source: Processed by Author (2025)

The speed of dispute resolution is most likely due

involvement, which further prolong the resolution process.

The results of this analysis confirm that the type of dispute directly affects the duration of its resolution. Authority disputes have the fastest resolution process, followed by procedure disputes, while substance disputes take the longest and have a higher degree of variation. For the Tax Court, this finding serves as an important reference for identifying areas that need improvement and developing strategies to enhance the efficiency of tax dispute resolution.

As a strategic step, several efforts can be made, including providing employees with specialised training for judges and clerk staff to enhance their competence in handling more complex substance disputes. Additionally, it is necessary to develop dispute resolution guidelines with more structured procedural standards to ensure consistency in resolving high-complexity cases. Alternative mechanisms such as mediation or arbitration can also be explored as an approach to expedite dispute resolution, especially in protracted cases due to significant differences in legal interpretation.

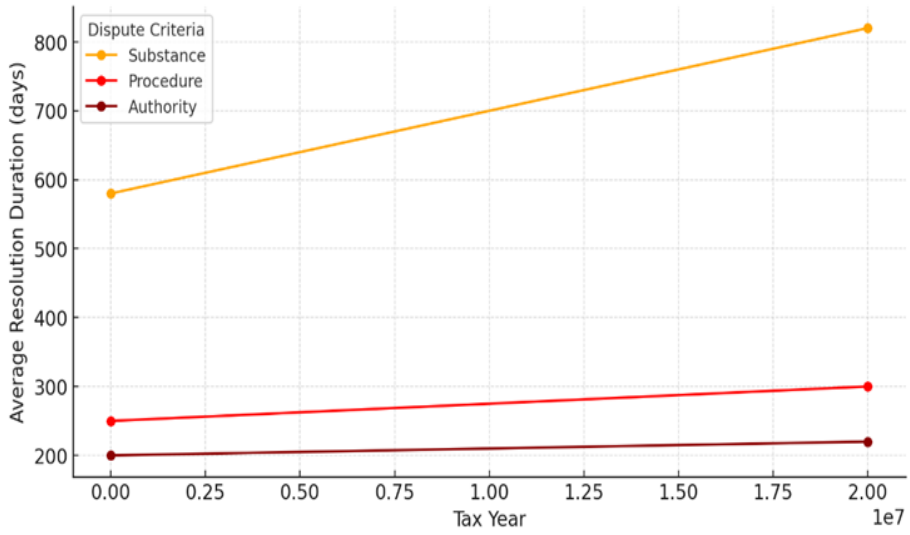
4.6 The trend of Tax Dispute Resolution Duration

Figure 5 presents the average trend of tax dispute resolution duration based on Substance, Procedure, and Authority categories over several tax years. Substance disputes have shown a significant increase in resolution duration, with some cases exceeding 800 days in recent years.

This increase reflects the growing complexity of tax regulations and the need for more in-depth legal analysis and extensive discussions before decisions can be made. In contrast, the Dispute Procedure shows a more stable pattern, with resolution durations ranging from 300 to 500 days. This relative efficiency can be attributed to clearer procedural standards and more organized mechanisms in handling administrative disputes. Meanwhile, Authority disputes have the shortest resolution duration, which is 200 to 300 days, and remain stable from year to year. The speed of dispute resolution is due to its lower complexity and more straightforward procedures in dealing with jurisdictional issues and tax authorities.

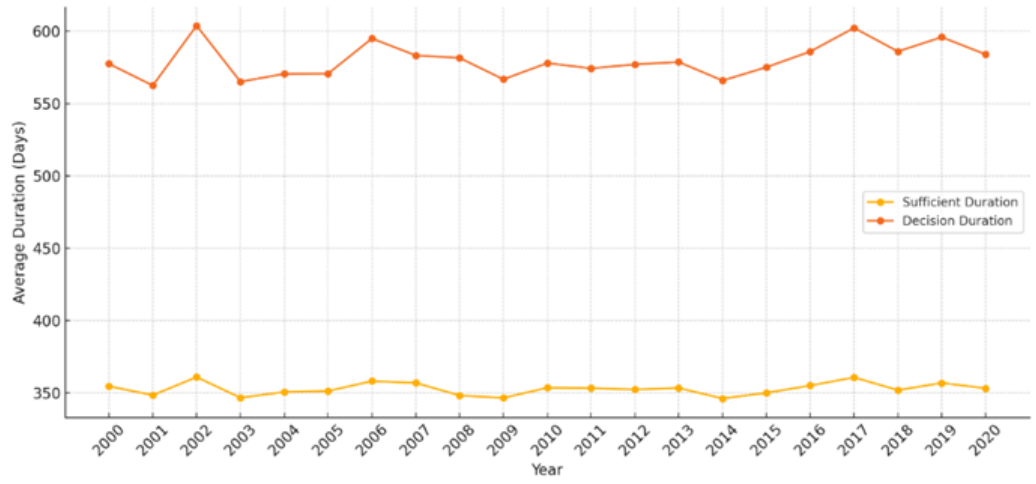
Figure 5

The trend of Tax Dispute Resolution Duration



Note. Source: Processed by Author (2025)

Figure 6
Trend of Tax Dispute Duration



Note. Source: Processed by Author (2025)

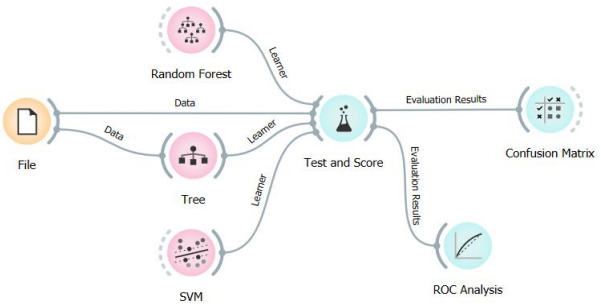
The visualisation in Figure 6 further reveals the Sufficient Duration pattern, which represents the time required to meet the initial criteria for dispute resolution. Meanwhile, Decision Duration is the time needed to reach a final decision. The Sufficient Duration pattern has remained relatively stable for many years, with an average of 352.78 days, indicating that the initial stages of dispute resolution have not undergone significant changes. In contrast, Decision Duration exhibits higher variability and an increasing trend, with an average of 579.80 days, suggesting that the final decision-making process is taking longer. This increase is most likely due to the increasing complexity of regulations, a surge in case volume, and inefficiencies in tax dispute resolution procedures.

The comparison between Sufficient Duration and Decision Duration reveals that the time required to reach a final decision is significantly longer than the time needed to meet the initial requirements. The results of the T-statistic (- 93.54) and p-value (0.0) test support the conclusion that there is a substantial difference in the duration of the two stages. These findings underscore the importance of optimising the tax dispute resolution system to expedite decision-making and alleviate uncertainty for taxpayers.

4.7 Prediction Model

This study develops a prediction model for the duration of tax dispute resolution using a data mining approach with the Orange Data Mining tool. Figure 7 shows the data analysis flow, which includes four main stages.

Figure 7
Model Analysis Flow



Note. Source: Processed by Author (2025)

The first stage is Data Import, which involves entering the dataset into the analysis system. Next, the model-building stage involves building a model using three main algorithms: Random Forest, Decision Tree, and Support Vector Machine (SVM). After the model is built, the Model Evaluation stage is carried out using the "Test and Score" method, which aims to measure the performance of each model. Finally, the evaluation results are presented in the form of a confusion matrix, which provides an overview of the prediction accuracy of each of the tested models.

4.8 Model Performance Evaluation

Table 2 presents the results of the model performance evaluation based on the metrics described in the methodology section, namely Area Under the Curve (AUC), Classification Accuracy (CA), Precision, Recall, F1-score, and Matthews Correlation Coefficient (MCC). The Random Forest model shows the best performance, with an AUC of 0.950 and a CA of 0.997, as well as high precision, recall, and F1-score, indicating its ability to distinguish tax disputes. In contrast, the Decision Tree model records an AUC of 0.469 and a CA of 0.983, while its MCC is 0.000. The near-zero MCC highlights that, despite relatively high accuracy, the model is not suitable for complex classification tasks, particularly when distinguishing among Substance, Procedure, and Authority dispute categories.

4.9 SVM and Decision Tree Model Prediction

The SVM model shows excellent performance in predicting the duration of tax dispute resolution. With an AUC of 0.922 and an accuracy comparable to Random Forest, the model has high precision, recall, and MCC values, which confirms its ability to accurately distinguish tax dispute categories (Vivian et al., 2023; Zhu et al., 2022).

In contrast, the Decision Tree model, despite having a fairly high accuracy (CA of 0.983) and F1-score of 0.974, suffers from limitations in AUC (0.469) and MCC (0.000). These results show that this model is less effective in distinguishing dispute classes and tends to be unstable in making predictions.

These findings align with the general weakness of the Decision Tree, which tends to favour the majority class, in this case, Substance. Upon further evaluation, the Decision Tree model incorrectly predicts all cases as Substance disputes, thereby failing to distinguish between Authority and Procedure disputes accurately. Consequently, this model is ineffective in understanding the factors that influence the duration of tax dispute resolution in Indonesia (Hao, 2021).

4.10 Random Forest Model Prediction

The Random Forest model shows the best performance in predicting the duration of tax dispute resolution, with a high level of accuracy in classifying the majority of cases. This model successfully predicted 103 out of 121 cases of Authority, 134 out of 161 cases of Procedure, and 15,930 out of 15,941 cases of Substance. However, several classification errors occur, particularly in distinguishing between Authority and Procedure, which are sometimes misclassified as Substance (Nugroho et al., 2023).

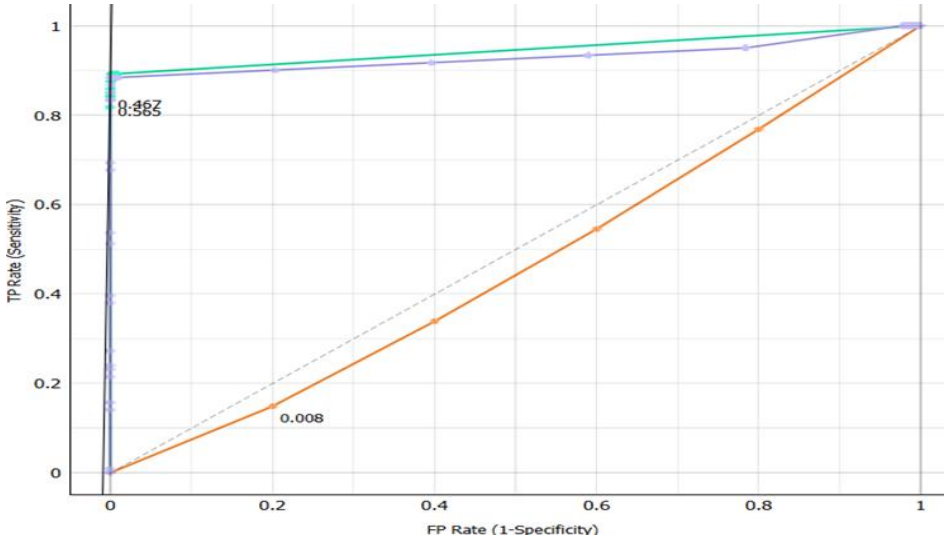
The results of this analysis confirm that the Random Forest model is capable of capturing

Table 2
Confusion Matrix Decision Tree Analysis

Actual Predictions	Authority	Procedure	Substance	Total	Accuracy (%)
Authority	103	0	18	121	85.12%
Procedure	0	134	27	161	83.23%
Substance	3	8	15,930	15,941	99.93%
Total	106	142	15,975	16,223	100%

Note: Source: Processed by Author (2025)

Figure 8
ROC Analysis



Note. Source: Processed by Author (2025)

complex patterns and variations in the data and has great potential to support the resolution of tax disputes in Indonesia. However, some aspects can still be improved, particularly in terms of enhancing prediction accuracy for the Authority and Procedure categories.

4.11 Receiver Operating Characteristic (ROC)

Figure 8 shows the ROC curve for the Random Forest and SVM models, which is used to evaluate each model's ability to distinguish between different categories of tax disputes. The ROC curve for Random Forest shows excellent performance, with a curve that approaches the top left corner of the graph. This result shows that this model has a high true positive rate (TPR) and a low false positive rate (FPR).

The AUC value of 0.952 further emphasizes the superiority of this model in accurately distinguishing tax disputes. The ROC curve for SVM also shows excellent performance, with an AUC of 0.908, although slightly lower than Random Forest. Both models are far superior to random predictions, as indicated by the position of the curve, which is well above the diagonal line of the random prediction. Based on this analysis, it can be concluded that Random Forest has superior performance compared to SVM, but both remain very reliable models in predicting the duration of tax disputes.

4.12 Confusion Matrix Model

The decision tree model has limitations in predicting the duration of tax dispute resolution, especially in distinguishing between the categories of Authority, Procedure, and Substance. This model classifies all cases as substance disputes, thus failing to recognize the specific characteristics of Authority and Procedure disputes. Despite having a high true positive rate for Substance disputes, its inability to classify other categories suggests that the model (Hao, 2021) is not suitable for this analysis.

This misclassification is caused by the Decision Tree's tendency to select the majority class, in this case, Substance, which results in the Authority and Procedure categories not being detected properly. As a result, the model has 0% accuracy for both categories, as shown in Table 3. Because of this drawback, the Decision Tree cannot be used as a reliable tool to understand the factors that affect the duration of tax dispute resolution. The Decision Tree cannot be used as a reliable tool to understand the factors that affect the duration of tax dispute resolution. These results make it clear

Table 3
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Substance	3	8	15,930	15,941	99.93%
Total	106	142	15,975	16,223	100%

Source: Processed by Author (2025)

that the Decision Tree model is not able to distinguish dispute categories well, so it is not reliable in analysing the factors that affect the duration of tax dispute resolution.

4.13 Advantages Model of SVM

The Support Vector Machine (SVM) model demonstrates performance equivalent to that of a Random Forest, yielding highly accurate prediction results for all categories of tax disputes. This model successfully classified 107 out of 121 Authority cases, 136 out of 161 Procedure cases, and 15,935 out of 15,941 Substance cases. The low classification error rate further strengthens the effectiveness and stability of this model in predicting the duration of tax dispute resolution. These results align with previous research highlighting the advantages of SVM in similar applications (Battiston et al., 2020; Evans et al., 2022).

Table 4
Confusion Matrix SVM Analysis

Actual Predictions	Authority	Procedure	Substance	Total	Accuracy (%)
Authority	107	0	14	121	88.43%
Procedure	0	136	25	161	84.47%
Substance	2	4	15.935	15.941	99.96%
Total	109	140	15.974	16.223	100%

Note. Source: Processed by Author (2025)

The results of the evaluation, as shown in Table 4, indicate that the SVM model achieves very high prediction accuracy across all categories of tax disputes. Specifically, the accuracy rates are 88.43% for the Authority category, 84.47% for the Procedure category, and 99.96% for the Substance category, demonstrating the model's ability to distinguish between various dispute categories effectively. This finding proves that Random Forest and SVM have proven to be very accurate and reliable in predicting the duration of tax dispute resolution. In contrast, the Decision Tree model is less suitable for this analysis due to its limitations in distinguishing between dispute categories and providing stable predictions.

5. CONCLUSION

This study demonstrates that machine learning, particularly Random Forest and Support Vector Machine (SVM), holds significant potential in predicting the duration of tax dispute resolution in Indonesia with an accuracy rate of 99.7%. This model has proven superior to traditional methods in capturing the complexity of tax dispute resolution systems, enabling a more accurate and efficient process. Random Forest and SVM can accelerate dispute resolution, optimise resource allocation, prioritise more complex cases, increase transparency, and automate administrative tasks, allowing tax court employees to focus on disputes that require in-depth analysis. In addition, the results of this study can serve as a basis for policymakers to improve tax regulations and

services for taxpayers, ultimately contributing to a reduction in the number of tax disputes in the future.

6. IMPLICATIONS AND LIMITATIONS

This research makes a significant contribution to the field of data analytics and machine learning, particularly in its application to the tax sector. By proving the effectiveness of data mining and machine learning models (Random Forest and SVM) in predicting the duration of tax dispute resolution, this study enriches the literature on advanced analytics in the legal and taxation system (Didimo et al., 2020; Xin, 2023). The findings also validate the potential of machine learning in enhancing the accuracy, efficiency, and transparency of legal processes, which can be applied in various other legal and financial analysis contexts.

From a practical perspective, the *Random Forest* model has great potential in simplifying and accelerating the tax dispute resolution process. With a high level of prediction accuracy (0.997) and strong evaluation results from confusion matrices and ROC analyses, the Random Forest model can assist tax authorities in optimising the tax justice system. These findings are consistent with the results reported by Hao, (2021) and Zheng et al. (2024). The implementation of this model allows for early identification of cases that require faster handling, thereby reducing case buildup and allocating resources more effectively. Thus, tax court employees can focus more on complex cases, while repetitive administrative tasks can be automated to improve operational efficiency.

In addition, the application of this prediction model can increase the transparency of the tax system by providing taxpayers with a more accurate estimate of the duration of dispute resolution. Tax dispute resolution not only reduces uncertainty but also builds taxpayer trust, which can ultimately increase the level of voluntary tax compliance and strengthen state revenue (Bianco & Neto, 2021). Furthermore, the insights gained from this model can serve as the basis for policymakers to develop strategies to simplify tax regulations, reduce the ambiguity of rules, and improve education and services for taxpayers. With this strategy, the number of disputes that go to the Tax Court can be suppressed, creating a more efficient, fair, and transparent tax system.

However, this study has some limitations. First, the dataset used in this study only covers the period from 2016 to 2023, which does not reflect the pattern of tax disputes over a longer period. Second, the model's limitation is that it only focuses on random forest and SVM, without exploring other machine learning models that may be superior in certain aspects. Third, there are limitations in generalisation, as this model was developed based on existing datasets, so the results may not be applicable to all types of tax disputes.

Further research is recommended to enhance the accuracy and usability of the tax dispute prediction model by expanding the dataset, testing the model on more complex cases, exploring alternative machine learning models, and integrating deep learning techniques to improve the accuracy and stability of predictions. With further refinement, the tax dispute prediction system can become a more effective tool for creating a more efficient, fair, and transparent tax system.

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