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Application of Data Mining in Determining the Performance of Family Planning-Field Officers Using the C4.5 Algorithm

Oris Krianto Sulaiman[1], Muhammad Zulfan Syuri Siambaton[2]
[1]Department of InformationTechnology, Universitas Islam Negeri Ar-Raniry Banda Aceh, Indonesia
[2]Department of Informatics Engineering, Universitas Islam Sumatera Utara, Indonesia

ABSTRACT

The performance of Family Planning Field Officers plays a crucial role in the success of family planning programs. Accurate and objective performance evaluation is essential to support effective decision-making and policy formulation. This study applies data mining techniques to determine the performance of Family Planning Field Officers using the C4.5 decision tree algorithm. The dataset used in this research consists of officer performance indicators, including service coverage, counseling activities, reporting accuracy, and community participation. The C4.5 algorithm is employed to classify officer performance into predefined categories based on these attributes. The resulting decision tree provides interpretable classification rules that can support managerial decision-making. Experimental results show that the proposed model achieves satisfactory classification accuracy and demonstrates the effectiveness of the C4.5 algorithm in extracting meaningful patterns from performance data. This study highlights the potential of data mining approaches to enhance performance evaluation systems in public service institutions, particularly in the field of family planning management.

Keyword : Data Mining; C4.5 Algorithm; Decision Tree; Performance Evaluation; Family Planning Field Officers

Corresponding Author:
Oris Krianto Sulaiman,
Department of Information Technology,
Universitas Islam Negeri Ar-Raniry Banda Aceh,
Banda Aceh, Indonesia
Email: oris.ks@ar-raniry.ac.id

1. INTRODUCTION

Family planning programs play a vital role in improving public health, controlling population growth, and enhancing the overall quality of life in society. The successful implementation of these programs largely depends on the performance of Family Planning Field Officers, who are responsible for providing counseling, delivering services, and maintaining accurate reports at the community level. Therefore, evaluating the performance of these officers in an objective and systematic manner is essential to ensure the effectiveness and sustainability of family planning initiatives.

In practice, performance assessment of Family Planning Field Officers is often conducted using manual evaluation methods or simple descriptive analysis. Such approaches may be subjective, time-consuming, and limited in their ability to uncover complex patterns within large and diverse datasets. As the volume of performance-related data continues to increase, traditional evaluation techniques become less effective in supporting data-driven decision-making. This situation highlights the need for more advanced analytical methods that can process large datasets and generate meaningful insights.

Data mining has emerged as a powerful technique for extracting useful knowledge from large datasets by identifying patterns, relationships, and trends. In the context of performance evaluation, data mining methods can be used to classify, predict, and analyze employee performance based on multiple indicators. Among various data mining techniques, decision tree algorithms are widely used due to their simplicity, interpretability, and ability to generate clear classification rules that are easy to understand by decision-makers.

The C4.5 algorithm is one of the most popular decision tree algorithms and has been successfully applied in various classification problems. It can handle both categorical and numerical data, manage missing values, and perform attribute selection based on information gain ratio. These

characteristics make the C4.5 algorithm suitable for analyzing performance data of Family Planning Field Officers, which often consist of diverse and heterogeneous attributes.

This study focuses on the application of data mining using the C4.5 algorithm to determine the performance of Family Planning Field Officers. The proposed approach aims to classify officer performance based on key performance indicators and to generate decision rules that can support managerial evaluation and policy formulation. The main contribution of this research lies in providing an objective and data-driven performance assessment model that can assist family planning institutions in improving supervision, decision-making, and overall program effectiveness.

2. RESEARCH METHOD/MATERIAL AND METHOD/LETERATURE REVIEW
A. C4.5 Algorithm Implementation
The C4.5 algorithm was applied to construct a decision tree model for classifying the performance of Family Planning Field Officers. The algorithm calculates entropy and information gain ratio to select the most informative attributes for node splitting. The resulting decision tree represents classification rules that describe the relationship between performance indicators and performance categories. These rules are easily interpretable and can be used as decision support for management.

B. Model Evaluation
The performance of the classification model was evaluated using standard evaluation metrics such as accuracy, precision, recall, and confusion matrix analysis. The dataset was divided into training and testing sets to validate the model's predictive capability. The evaluation results were analyzed to assess the effectiveness of the C4.5 algorithm in classifying officer performance and to identify key attributes influencing performance outcomes.

C. Data Preprocessing
Before applying the data mining algorithm, data preprocessing was conducted to improve data quality. This process includes data cleaning to remove incomplete or inconsistent records, handling missing values, and transforming numerical attributes into appropriate formats when necessary. Attribute selection was also performed to ensure that only relevant features were used in the classification process.

3. RESULTS AND DISCUSSION
The interface display results are the stage where the system or application is ready to be operated in actual conditions according to the results of the analysis and design carried out, so that it will be known whether the system or application built can produce a goal that is achieved, and this data mining application is equipped with a display that aims to make it easier for its users. The function of this interface is to provide input and display the output of the application. In this application, it has an interface consisting of a login menu, Community, and a process menu.
The Main Menu displays the login and main menus at the start of the system. The Main Menu is as follows.
1. Login Menu
   The login menu is used to secure the system from unauthorized users before accessing the main menu. The login menu displays as follows:

Fig 1. Login Menu

2. Main Menu

The Main Menu serves as a hub for community data, processes, and reports. The main menu displays as follows:
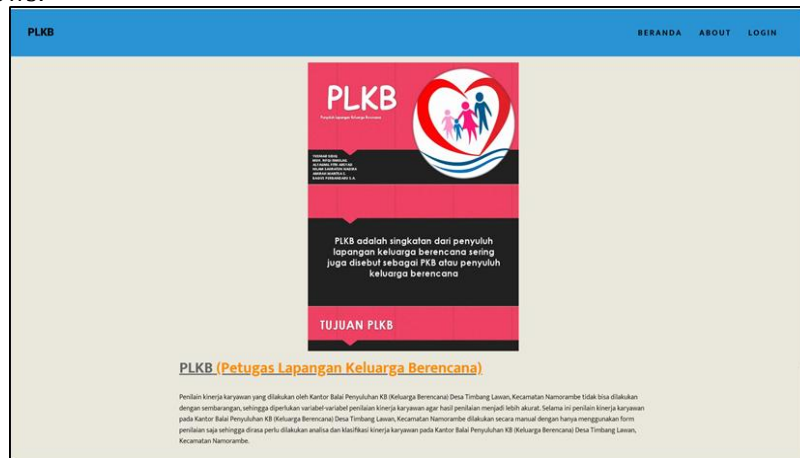

Fig 2. Main Menu

3. Community Data Menu

The Community Data Menu is used to process community data in Timbang Lawan Village, Namorambe District. The Community Data Menu is as follows:

Fig 3. Community Data Menu

4. Process Menu C4.5

The C4.5 process menu is used to process data to determine the performance of the PKLB in Timbang Lawan Village, Namorambe District, using the Decision Tree method. The C4.5 process menu is as follows.

Fig 4. Process Menu C4.5

A. Testing

In this section, you will be asked to conduct testing using new data samples. In this section, you will be asked to verify the accuracy of the system you designed using previously tested and calibrated tools. The results of the program process in determining PKLB performance are as follows.

Fig 5. C4.5 Associating Results

B. Implementation of C4.5

The algorithmic process carried out using the C4.5 method is as follows:

1. Calculating Gain and Entropy

A decision tree is created after calculating the total entropy, using the entropy of each attribute, and calculating the gain and determining the highest gain. This can be calculated using the following equation:

$$Entropy\ (Total) = \left(-\frac{24}{40}\ x\ Log2(\frac{24}{40}) \right) + \left(-\frac{16}{40}\ x\ Log2(\frac{16}{40}) \right)$$

$$= 0.97095$$

The entropy calculation for each attribute is the same as the calculation for finding the total entropy. The gain value of the Gain attribute is calculated using the following equation:

$$Gain = 0.97075 \left(\left(\frac{17}{0.97075} * 0.97742 \right) \right) + \left(\frac{23}{0.97095} * 0.965664 \right)$$

$$= 0.0003$$

4.   CONCLUSION

Based on the analysis of the problems encountered in the case discussed, which focused on determining the level of public satisfaction in determining the performance of the PLKB, the following conclusions can be drawn: Based on the research results, the C4.5 method was applied by implementing the method steps and determining the level of public satisfaction in determining the performance of the PLKB. Based on the research results, the data mining system application was designed by modeling the system and building a web-based system to determine the level of public satisfaction in determining the performance of the PLKB using the C4.5 method. Based on the research results, system testing was conducted by logging into the system and processing variable and process data to determine the level of public satisfaction in determining the performance of the PLKB, by displaying a report on the results of the level of public satisfaction in determining the performance of the PLKB.

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