JUSIKOM PRIMA (Jurnal Sistem Informasi dan Ilmu Komputer Prima)
Vol. 7 No. 2, February 2024 E-ISSN:2580-2879

IMPLEMENTATION OF DATA MINING ROUGHT SET IN ANALYZING LECTURER PERFORMANCE

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ABSTRACT

Lecturers are professional educators or scientists with the main task of transforming, developing, and disseminating science, technology, and art through education, research, and community service by the Tridharma of Higher Education. The main task of lecturers is to implement the tri dharma of higher education with the scope of activities in the form of teaching, research, and community service. Based on this, the Payakumbuh College of Technology assesses lecturers' performance to maintain the educational institution's quality. A method is needed to identify the quality of lecturers' performance. Lecturer performance can be determined using a rough set approach with several stages. Rough set is a data mining technique applied in several fields, including selecting study programs and predicting mobile phone sales income. Based on the results of using the rough set method, lecturer performance information is produced in a certain period, which aims to help leaders understand the possible performance of lecturers in a certain period. The benefit that can be obtained is that the knowledge obtained through the rough set method can determine the possibility of achieving lecturer performance.

Keywords*: Lecturer, Performance, Data Mining, Rough Set*

INTRODUCTION

Lecturers are an important tool for supporting teaching and learning. According to Law 14 of 2005, article 1 point 2, lecturers are professional educators or scientists who are responsible for changing, developing, and disseminating science, technology, and art through education, research, and community service [1]. Performance is a person's ability to do certain work, and achieving goals shows their performance [2].

Previous research by Hartama et al. (2016), Analysis of STMIK IBBI Lecturer Performance using the Rough Set Method, found that Rough Set is a reasonably simple data mining algorithm that can be used to measure lecturer performance and assess the aspects or attributes being evaluated [3]. Further research by Hengki (2019), Data Mining Rough Set in STMIK IBBI Lecturer Performance Analysis, found that this algorithm can measure lecturer performance [3]. The study results are lecturer performance data reports produced by the rules of the Rough Set method, which measures lecturer performance from various aspects, such as learning, research, and community service. Lecturer performance is measured by the rough set method in the form of lecturer achievements, which can help management make decisions regarding the assignment of lecturer workload [4].

Data mining is a field of several scientific fields that combines techniques from machine learning, pattern recognition, statistics, databases, and visualization to retrieve information from large databases [5]. A rough set is a data mining technique that handles Uncertainty, Imprecision, and Vagueness problems in Artificial Intelligence (AI) applications. A rough set is an efficient technique for Knowledge Discovery in a Database (KDD) in the process and data mining stages [6].

METHOD

The research approach uses the rough set method to complete the algorithm, which is considered very effective for Knowledge Discovery (KDD) database processes and data mining.

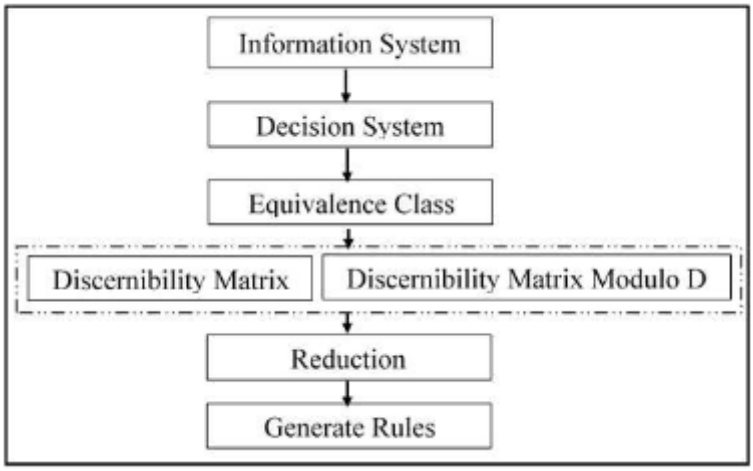


Figure 1. Rough Set Method Algorithm

1. *Information Systems*

   Information System is a table consisting of rows representing data and columns representing data attributes or variables. Information systems in data mining are called data sets. Information systems can be presented as functions:

$$S = \{U,A\} \quad (1)$$

   Information:

   U = {x1, x2, ..., xm} which is a set of examples

A = {a1, a2, ..., an} which is a set of condition attributes in sequence

2. *Decision Systems*

   A decision system is an information system with additional attributes called decision attributes, called classes or targets in data mining. This attribute represents the result of a known classification. Decision System is a function that describes an information system, so the information system (IS) becomes:

$$S = \{U, A\} \quad (2)$$

   Information:

   U = {x1, x2, ..., xm} which is a set of examples

   A = {a1, a2, ..., an}, a set of sequence condition attributes.

   C = decision attributes (Decision)

3. *Equivalence Class*

   *Equivalence Class*is to group the same objects for attribute A (U, A). Class EC5 is an indeterminacy that gives 2 different decisions. Data cleaning techniques can overcome this situation. The right-hand column represents the number of objects in the same type of decision system.

4. *Discernibility Matrix*

   Discernibility Matrix means: given an IS A=(U, A) and B combined A, the Discernibility Matrix of A is MB, where each entry MB(I,j) consists of attributes that differ between objects Xi and Xj.

5. *Discernibility Matrix Modulo D*

   Discernibility Matrix Modulo D is Interpreted as follows: Modulo (i,j) is a set of different attributes between objects Xi and Xj and also different decision attributes.

6. *Reduction*

   For data with a very small number of variables, it is impossible to find all combinations of existing variables because the number of indiscernibilities to be searched = (2n-1-1). Therefore, a technique for searching combinations of attributes that may be known is created.

7. *Generate Rules*

   The primary process of finding knowledge in a database is extracting rules from a decision-making system—a rough set method for generating decision rules from decision tables.

RESULTS

1. Criteria for Lecturer Performance Evaluation

In the lecturer performance assessment carried out by researchers, the specified performance must be met to assess whether the lecturer's performance is good or not. These performances are shown in the following table:

Table 1 Range Criteria values

No	Teaching and learning process	%
1	Absence	15%
2	Teaching Credits	10%
3	UAS questions	10%
4	Performance	25%
5	PA Lecturer	3%
6	Mentor	4%
7	Examiner	3%
No	Study	%
1	Conduct research	15%
No	Devotion	%
1	Doing Devotion	15%

To determine the performance of lecturers who are "Very Good," "Good," "Fair," "Poor," and "Not Good," the author determines the evaluation range that must be met by each lecturer, as in the table below:

Table 2 Decision Value Range

No	Mark	Decision

1	<=100	Very good
2	<=85	Good
3	<=70	Enough
4	<=50	Not enough
5	<=30	Not good

To carry out analysis using the rough set method, data transformation is required for each criterion. Data transformation can be seen in the following table:

Table 3PBM Transformation Results (P1)

No	Teaching and learning process	Mark
1	29 % - 36 %	1
2	37 % - 44 %	2
3	45 % - 52 %	3
4	53 % - 60 %	4
5	61 % - 68%	5

Table 4. Research Transformation Results (P2)

No	Study	Mark
1	0 % - 3 %	1
2	4 % - 7 %	2
3	8 % - 11 %	3
4	12 % - 15 %	4
5	16 % - 19%	5

Table 5. Results of Devotion Transformation (P3)

No	Devotion	Mark
1	0 % - 3 %	1

2	4 % - 7 %	2
3	8 % - 11 %	3
4	12 % - 15 %	4
5	16 % - 19%	5

2. Settlement Analysis Using Rough Set

1. *Information Systems*

The data used is data obtained directly from the Payakumbuh College of Technology, which was analyzed using the rough set method. The results of the assessment of lecturer performance data can be seen in the following table:

Table 6. Lecturer Performance Assessment Data Information

No.	Dosen	Absensi	SKS Ngajar	Soal UAS	Performance	Dosen PA	Pembimbing	Penguji	Pengajaran	Penelitian	Pengabdian
1	A	32	55	100	100	0	100	100	52	100	50
2	B	13	30	100	75	0	0	100	37	50	50
3	C	13	25	100	100	0	50	100	44	75	0
4	D	38	35	100	75	100	100	100	48	50	0
5	E	13	25	100	50	0	50	50	30	25	0
6	F	75	75	100	100	100	100	100	64	75	50
7	G	13	25	100	75	100	100	100	43	50	0
8	H	70	55	100	100	100	100	50	60	50	50
9	I	70	55	100	100	100	100	100	61	75	0
10	J	75	100	100	50	100	50	50	50	25	0
11	K	87	100	100	100	100	50	0	63	25	0
12	L	13	25	100	100	100	50	0	44	50	0
13	M	13	25	100	50	0	50	0	29	25	0
14	N	75	100	100	75	100	100	0	57	100	0
15	O	80	100	100	75	100	50	0	56	100	0
16	P	100	100	100	100	100	100	0	67	50	0

2. *Decision Systems*

A decision system is an information system with additional attributes called decision attributes, called classes or targets in data mining. The following is the decision system table:

Table 7. Decision System

No.	Dosen	P1	P2	P3	Decision
1	A	52	15	8	Baik
2	B	37	8	8	Cukup
3	C	44	11	0	Cukup
4	D	48	8	0	Cukup
5	E	30	4	0	Kurang
6	F	64	11	8	Baik
7	G	43	8	0	Cukup
8	H	60	8	8	Baik
9	I	61	11	0	Baik
10	J	50	4	0	Cukup
11	K	63	4	0	Cukup
12	L	44	8	0	Cukup
13	M	29	4	0	Kurang
14	N	57	15	0	Baik
15	O	56	15	0	Baik
16	P	67	8	0	Baik

Note: P1=PBM, P2=Research, P3=Service

3. *Equivalence Class*

*Equivalence Class*is to group the same objects for attribute A (U, A). Table 7 shows that the data has been transformed according to the respective criteria, and 11 objects have different attributes. Following are the results from the table*Equivalence Class*:

Table 8. Equivalence Class

No.	Dosen	P1 [a]	P2 [b]	P3 [c]	Decision
1	A	3	4	3	Baik
2	B	2	3	3	Cukup
3	C,G,L	2	3	1	Cukup
4	D	3	3	1	Cukup
5	E,M	1	2	1	Kurang
6	F	5	3	3	Baik
7	H	4	3	3	Baik
8	I, P	5	3	1	Baik
9	J	3	2	1	Cukup
10	K	5	2	1	Cukup
11	N, O	4	4	1	Baik

4. *Discernibility Matrix*

To calculate the Discernibility Matrix, the author refers to Table 8, which produces the Discernibility Matrix as in the following table:

Table 9. Discernibility Matrix

	A	B	C,G,L	D	E,M	F	H	I,P	J	K	N,O
A	x	ab	abc	bc	abc	ab	ab	abc	bc	abc	ac
B	ab	x	c	ac	abc	a	a	ac	abc	abc	abc
C,G,L	abc	c	x	a	ab	ac	ac	a	ab	ab	ab
D	bc	ac	a	x	ab	ac	ac	a	b	ab	ab
E,M	abc	abc	ab	ab	x	abc	abc	ab	a	a	ab
F	ab	a	ac	ac	abc	x	a	c	abc	bc	abc
H	ab	a	ac	ac	abc	a	x	ac	abc	abc	x
I, P	abc	ac	a	a	ab	c	ac	x	ab	b	ab
J	bc	abc	ab	b	a	abc	abc	ab	x	a	ab
K	abc	abc	ab	ab	a	bc	abc	b	a	x	ab
N, O	ac	abc	ab	ab	ab	abc	x	ab	ab	ab	x

5. *Discernibility Matrix Modulo D*

*Discernibility Matrix Modulo D*is is defined as a set of different attributes between objects Xi and Xj and different decision attributes. Referring to Table 9, the resulting Discernibility Matrix Modulo D can be seen in the following table:

Table 10. Discernibility Matrix Modulo D

	A	B	C,G,L	D	E,M	F	H	I,P	J	K	N,O
A	x	ab	abc	bc	abc	x	x	x	bc	abc	x
B	ab	x	x	x	abc	a	a	ac	x	x	abc
C,G,L	abc	x	x	x	ab	ac	ac	a	x	x	ab
D	bc	x	x	x	ab	ac	ac	a	x	x	ab
E,M	abc	abc	ab	ab	x	abc	abc	ab	a	a	ab
F	x	a	ac	ac	abc	x	x	x	abc	bc	x
H	x	a	ac	ac	abc	x	x	x	abc	abc	x
I, P	x	ac	a	a	ab	x	x	x	ab	b	x
J	bc	x	x	x	a	abc	abc	ab	x	x	ab
K	abc	x	x	x	a	bc	abc	b	x	x	ab
N, O	x	abc	ab	ab	ab	x	x	x	ab	ab	x

6. *Reduction*

After the Discernibility Matrix Modulo D process sees the same decision in each Equivalence Class in the Decision column, the resulting reduct can be seen in the following table:

Table 11. Reduction

	Aljabar Boolean	Prime Implicant	Reduct
A	(avb)^(avbvc)^(bvc)^(avbvc)^(bvc)^(avbvc)	ac	{ac}
B	(avb)^(avbvc)^a^a^(avc)^(avbvc)	a	{a}
C,G,L	(avbvc)^(avb)^(avc)^(avc)^a^(avb)	a	{a}
D	(bvc)^(avb)^(avc)^(avc)^a^(avb)	a	{a}
E,M	(avbvc)^(avbvc)^(avb)^(avb)^(avbvc)^(avbvc)^(avb)^a^a^(avb)	a	{a}
F	a^(avc)^(avc)^(avbvc)^(avbvc)^(bvc)	ab + ac	{ab}, {ac}
H	a^(avc)^(avc)^(avbvc)^(avbvc)^(avbvc)	a	{a}
I, P	(avc)^a^a^(avb)^(avb)^b	a	{a}
J	(bvc)^a^(avbvc)^(avbvc)^(avb)^(avb)	ab + ac	{ab}, {ac}
K	(avbvc)^a^(bvc)^(avbvc)^b^(avb)	a	{a}
N, O	(avbvc)^(avb)^(avb)^(avb)^(avb)^(avb)	a	{a}

7. *Generate Rules*

The main process of finding knowledge in a database is extracting rules from a decision-making system. The rough set stage results on lecturer performance data produce 23 rules or rule patterns

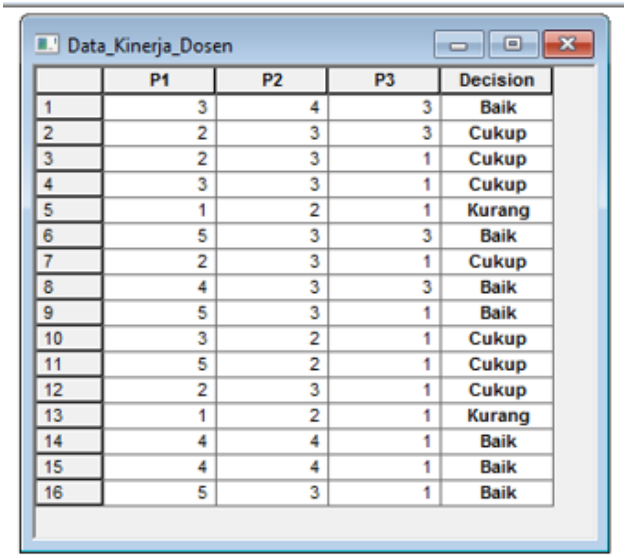
with various conditions to determine decisions on lecturer performance. These 23 Rules can be explained as follows:

1. IF P1 = "3" AND P2 = "4" THEN DECISION = "GOOD"
2. IF P1 = "5" AND P2 = "3" THEN DECISION = "GOOD"
3. IF P1 = "4" AND P2 = "3" THEN DECISION = "GOOD"
4. IF P1 = "4" AND P2 = "4" THEN DECISION = "GOOD"
5. IF P1 = "2" AND P2 = "3" THEN DECISION = "ENOUGH"
6. IF P1 = "3" AND P2 = "3" THEN DECISION = "ENOUGH"
7. IF P1 = "3" AND P2 = "2" THEN DECISION = "ENOUGH"
8. IF P1 = "5" AND P2 = "2" THEN DECISION = "ENOUGH"
9. IF P1 = "1" AND P2 = "2" THEN DECISION = "LESS"
10. IF P1 = "3" AND P3 = "3" THEN DECISION = "GOOD"
11. IF P1 = "5" AND P3 = "3" THEN DECISION = "GOOD"
12. IF P1 = "4" AND P3 = "3" THEN DECISION = "GOOD"
13. IF P1 = "4" AND P3 = "1" THEN DECISION = "GOOD"
14. IF P1 = "5" AND P3 = "1" THEN DECISION = "GOOD" OR DECISION = "ENOUGH"
15. IF P1 = "2" AND P3 = "3" THEN DECISION = "ENOUGH"
16. IF P1 = "2" AND P3 = "1" THEN DECISION = "ENOUGH"
17. IF P1 = "3" AND P3 = "1" THEN DECISION = "ENOUGH"
18. IF P1 = "1" AND P3 = "1" THEN DECISION = "LESS"
19. IF P1 = "1" THEN DECISION = "LESS"
20. IF P1 = "2" THEN DECISION = "ENOUGH"
21. IF P1 = "3" THEN DECISION = "GOOD" OR DECISION = "ENOUGH"
22. IF P1 = "4" THEN DECISION = "GOOD"
23. IF P1 = "5" THEN DECISION = "GOOD" OR DECISION = "ENOUGH"

3. Test Analysis Using Rosetta Software

1. Lecturer Performance Information Data

The following is a display of the results of the lecturer performance assessment database that has been imported into the Rosetta software:


Data_Kinerja_Dosen

	P1	P2	P3	Decision
1	3	4	3	Baik
2	2	3	3	Cukup
3	2	3	1	Cukup
4	3	3	1	Cukup
5	1	2	1	Kurang
6	5	3	3	Baik
7	2	3	1	Cukup
8	4	3	3	Baik
9	5	3	1	Baik
10	3	2	1	Cukup
11	5	2	1	Cukup
12	2	3	1	Cukup
13	1	2	1	Kurang
14	4	4	1	Baik
15	4	4	1	Baik
16	5	3	1	Baik

Figure 2. Lecturer performance data

2. Reduct

The following is a display of the reduct results produced by the Rosetta tool from lecturer performance data:

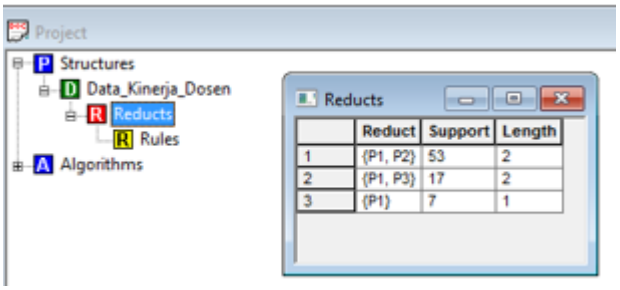
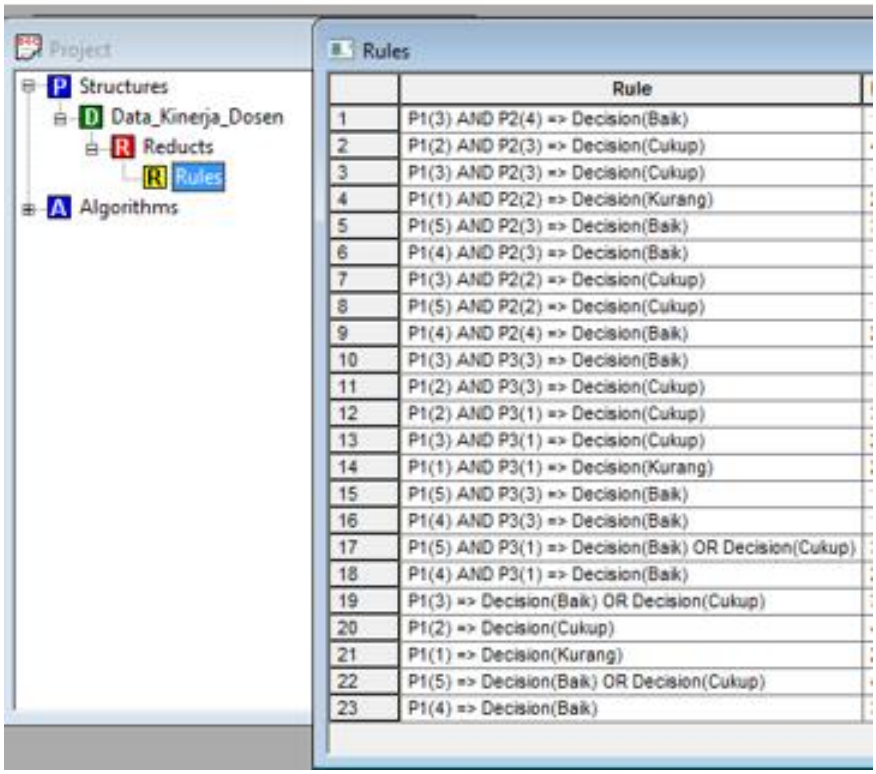


Figure 3. Reduce Results

3. Generate Rules

The following is a display of the rules produced by the Rosetta tool, wherein the display there are 23 rules according to the results of the analysis using the rough set method:



	Rule
1	P1(3) AND P2(4) => Decision(Baik)
2	P1(2) AND P2(3) => Decision(Cukup)
3	P1(3) AND P2(3) => Decision(Cukup)
4	P1(1) AND P2(2) => Decision(Kurang)
5	P1(5) AND P2(3) => Decision(Baik)
6	P1(4) AND P2(3) => Decision(Baik)
7	P1(3) AND P2(2) => Decision(Cukup)
8	P1(5) AND P2(2) => Decision(Cukup)
9	P1(4) AND P2(4) => Decision(Baik)
10	P1(3) AND P3(3) => Decision(Baik)
11	P1(2) AND P3(3) => Decision(Cukup)
12	P1(2) AND P3(1) => Decision(Cukup)
13	P1(3) AND P3(1) => Decision(Cukup)
14	P1(1) AND P3(1) => Decision(Kurang)
15	P1(5) AND P3(3) => Decision(Baik)
16	P1(4) AND P3(3) => Decision(Baik)
17	P1(5) AND P3(1) => Decision(Baik) OR Decision(Cukup)
18	P1(4) AND P3(1) => Decision(Baik)
19	P1(3) => Decision(Baik) OR Decision(Cukup)
20	P1(2) => Decision(Cukup)
21	P1(1) => Decision(Kurang)
22	P1(5) => Decision(Baik) OR Decision(Cukup)
23	P1(4) => Decision(Baik)

Figure 4. Results Rules

CONCLUSION

After conducting research, several conclusions can be drawn based on the results of the research that has been carried out, namely as follows:

1. Applying the rough set method can determine the performance assessment of lecturers at STT Payakumbuh.
2. Data Mining with the rough set method can be used to determine the level of lecturer performance assessment.
3. From the results of the lecturer performance assessment using the rough set algorithm, the following results were found:
   a. According to the assessment, seven lecturers performed "GOOD", namely Lecturers A, F, H, I, N, O, and P.
   b. According to the assessment, seven lecturers have "SUFFICIENT" performance: Lecturers B, C, D, G, J, K, and L.

c. According to the assessment, two lecturers had "LESS" performance, namely Lecturers E and M.

This research can be continued by adding input attributes such as the results of student lecturer performance assessment questionnaires and the results of assessing lecturer activity in each student's participation in team activities at the university.

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