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Decision Support System Design for Determining Exemplary Lecturer using Simple Additive Weighting (SAW)

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Abstract

STMIK AKAKOM has 67 lecturers. In each semester, an evaluation is held to determine lecturers' performance to maintain good institutional quality. The evaluation process is based on students' and Department Quality-Assurance Team (DQAT) assessments. Up until now, the results of these evaluations were left unprocessed. This study aimed to determine well-performed and less-performed lecturers by combining evaluation results from students and DQAT using the simple additive weighting (SAW) method. There are 17 criteria used in this study with different weight values. The results showed that the technique determined the lecturers' ranking significantly based on their respective performance. The most well-performed lecturer is L40 with Vi (order for lecturer) value of 0.95, the second is L41 with Vi value of 0.92, and the third one is L25 with Vi of 0.91, while the most under-performed lecturer is L67 with a Vi value of 0.72.
Keywords: Lecturer, Performance, Ranking, SAW

Abstrak

STMIK AKAKOM memiliki 67 dosen. Setiap semester diadakan evaluasi untuk mengetahui kinerja dosen dalam menjaga kualitas kelembagaan yang baik. Proses evaluasi didasarkan pada penilaian mahasiswa dan Tim Quality Assurance (DQAT) Departemen. Hingga saat ini, hasil evaluasi tersebut dibiarkan begitu saja. Penelitian ini bertujuan untuk mengetahui dosen berprestasi dan kurang berprestasi dengan menggabungkan hasil evaluasi mahasiswa dan DQAT menggunakan metode simple additive weighting (SAW). Terdapat 17 kriteria yang digunakan dalam penelitian ini dengan nilai bobot yang berbeda. Hasil penelitian menunjukkan bahwa teknik menentukan peringkat dosen secara signifikan berdasarkan kinerjanya masing-masing. Dosen yang berprestasi paling baik adalah L40 dengan nilai Vi (urutan untuk dosen) sebesar 0,95, yang kedua L41 dengan nilai Vi 0,92, dan yang ketiga L25 dengan Vi sebesar 0,91, sedangkan dosen yang paling rendah kinerjanya adalah L67 dengan nilai Vi 0,72.
***Kata-kata kunci**: Dosen, Kinerja, Peringkat, SAW*

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1. Introduction

Lecturers of STMIK AKAKOM perform the *tri dharma* of higher education. One of the tri dharma components is to deliver education through the teaching and learning process to maintain the lecturers' teaching quality and match the quality standards, this activity needs to be evaluated. The evaluation process is performed in 2 ways. First, it is performed by students during the final semester exams by filling out questionnaires and second, it is performed by the Department Quality-Assurance Team (DQAT) at the end of the semester by filling out the evaluation form. Currently, the results of the evaluation have been left unprocessed. The chairman of STMIK AKAKOM would like to see the results to be used by stakeholders in making decisions regarding several existing academic policies. First, lecturers' ratings need to be established to make it easier to determine who is the exemplary lecturer. Second, it is necessary to make it easier to give rewards and punishments to lecturers. Based on the problems above, this research tried to establish a ranking system of lecturers using the SAW method. The SAW method has been used before to determine the lecturer's performance. The results of the study were able to show the best lecturer [1]. SAW can be used in determining the outstanding lecturers [2]. SAW method was previously combined with the AHP method to evaluate lecturers at Budi Dharma University, Tangerang. The results showed that the criteria weight has high accuracy, i.e. 90.39% of the 28 lecturers teaching 47 subjects [3]. AHP and SAW methods were also used to determine the best lecturer recommendations at UNTIRTA, according to the Ministry of Research, Technology, and Higher Education [4]. SAW is also used to determine which lecturers get promotions and awards. The criteria used are performance and SKP.

Performance value is determined from the importance of commitment, integrity, orientation, service, discipline, cooperation and leadership. The highest value obtained from the SAW calculation is 0.94 so that the lecturer deserves a promotion and award at the University of Sriwijaya [5]. Another research conducted by developing a lecturer assessment information system based on the results of student assessments was able to assist in assessing lecturers' performance [6]. Evaluation of lecturer performance has also been performed using fuzzy SAW method, in which the variables used include mastery and ability to explain, answer questions, motivate students, create a pleasant classroom atmosphere, and a higher students' attendance. The results show the best lecturer with the most excellent value ranking (V2) = 40, the second-best of V2 = 32.5 and the third of V2 = 20.75 [7]. SAW has also been used in the recruitment process for lecturers at the University of Tanri Abeng Jakarta and the criteria used include tests of general

knowledge, English, psychology, teaching proficiency. SAW results are also used to select the best lecturer from several candidates in a lecturer's recruitment process [8]. SAW method is suitable in assisting decision making when used for testing employee performance appraisals with 75 respondents and produced an accuracy of up to 100% [9]. This research focuses on designing a decision support system in detail to be more relevant to user needs. The data used is different from other research, which only comes from students but already includes data on the results of internal quality assurance.

2. Method

The stages carried out in the research is shown in **Figure 1**.

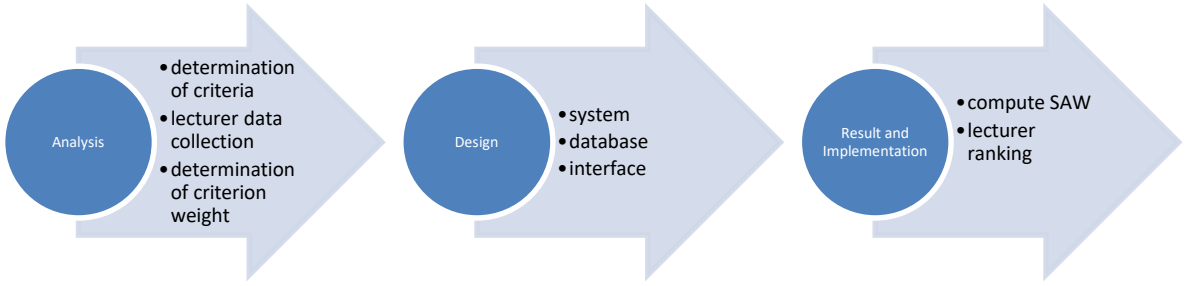

Figure 1. Research Stages

From Figure 1, the first stage in this study is an analysis to determine the criteria to be used to assess lecturers' performance. The requirements were from lecturers' questionnaires and evaluation forms used in STMIK AKAKOM, and there are 17 criteria. The next stage is determining the lecturer data. The number of lecturers evaluated was 67 consisting of permanent and non-permanent lecturers at STMIK AKAKOM. All lecturers are from five study programs, namely informatics, information systems, computer technology, accounting information systems, and software engineering. Therefore, it has determined the criteria and lecturers' data. The next step defines the weight of each measure. Finally, academic decision-making officials carry out the process of determining the weight.

The next stage is creating designs, i.e., system design, database design, and interface design. Implementation is done by applying the SAW method to the data collected. Each lecturer has a score for each criterion. The data used in this study are from the odd semester of the 2020/2021 academic year. The result of applying the SAW method is the lecturer ranking.

SAW is implemented by finding the weighted sum of the performance ratings for each alternative on all attributes. The SAW method requires a decision matrix normalization process (X) to a scale compared with all alternative ratings **[7]**. In the SAW method, there are two attributes, i.e. the attribute for the benefit criteria (if the most considerable value is the best) and the cost criterion attribute (if the smallest value is the best) **[10]**. The formula to calculate normalized performance rating value is given in (1), while the formula to calculate the ranking for each alternative/lecturer is shown in (2).

$$R_{ij} = \frac{X_{ij}}{\text{Max } X_{ij}} \text{ atau } R_{ij} = \frac{\text{Min } X_{ij}}{X_{ij}} \quad (1)$$

Where :

Rij : Normalized performance rating value

Xij : The attribute value for each criterion

Max Xij : The most significant value of each criterion

Min Xij: The smallest value of each criterion

$$V_i = \sum_{j=1}^{n} W_j R_{ij} \quad (2)$$

Where:

Vi : Ranking for each alternative / lecturer

Wj : The grade from each criterion

Rij : The quality of normalized performance rank

The completion steps in this research are as follows:

a. Determining the criteria that will be used as a reference in making decisions, namely:

K1 : Material plans and objective is given at the start of the lectures

K2 : Lecturer arrives on time and teaches according to the allotted time

K3 : Deliver the course according to the syllabus.

K4 : Gives practices/discussion/QNA

K5 : Give quizzes/assignment/homework adequately

K6 : Exam items are consistent with materials given

K7 : Discussion of exam items

K8 : The use of media and teaching technology

K9 : Transparency (openness) of the evaluation

K10 : Lecturer's ability in explaining the materials

K11 : Mastery of materials, insights and implementations in the subject taught.

K12 : The ability to communicate with students

K13 : The ability to motivate and stimulate interest within the students to learn

K14 : Materials are available

K15 : Reference books are available

K16 : Signing lecture official document in class

K17 : Signing lecture official document in laboratorium

b. Determine the alternatives (the lecturers who will be assessed). Maintain confidentiality; the lecturer's name was kept secret and coded as L1 to L67.

c. Giving value of each alternative (Li) for each predetermined criterion (Kj), with values of i = 1,2, .. 67 and j = 1,2, .. 17

d. Determine the weight value (W) for each criterion. Academic decision-makers did the weight valuation. W = [W1, W2, W3… Wj]

e. Normalize the decision matrix by calculating the normalized rating value (Rij) based on (1) adjusted for the attribute type. The attribute used is the benefit attribute (MAXIMUM)

f. Ranking each lecturer (Vi) by multiplying the normalized performance rating value (Rij) by the weight value (W), such as (2)

3. Results and Discussion

The design and implementation are carried out by the steps described previously. In addition, before determining the criteria, the authors conducted interviews with resource persons, the vice-chairman of the academic affairs, to get information related to the requirements, including the weight of each criterion.

a. System Design

The system design is implemented using Data Flow Diagram (DFD). DFD level 0 is shown in Figure 2. There will be three users of the system, namely, administrator, chairman and vice-chairman 1. The administrator responsible for managing data used for calculations and determining the exemplary lecturer, while the chairman and vice-chairman only receive reports on the ideal lecturer. DFD level 0 presented in the **Figure 2**.

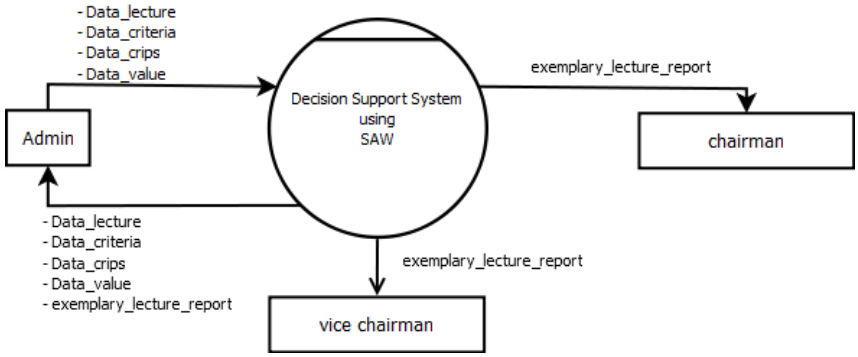

Figure 2. DFD level 0

In addition to DFD level 0, a detailed description of the processes performed by the system can be seen at DAD level 1, as shown in Figure 3. In Figure 3, the Administrator inserts admin data, criteria data, alternative data with *crisp* data or criterion values, and alternative data will store in a table record according to its type. Next, the alternative data record will be calculated using the SAW method. Then the ranking process will be performed to find data with the most significant value, followed by making a report of the ranking results. The chairman and vice-chairman only need to log in to access the information. DFD level 1 presented in the **Figure 3.**

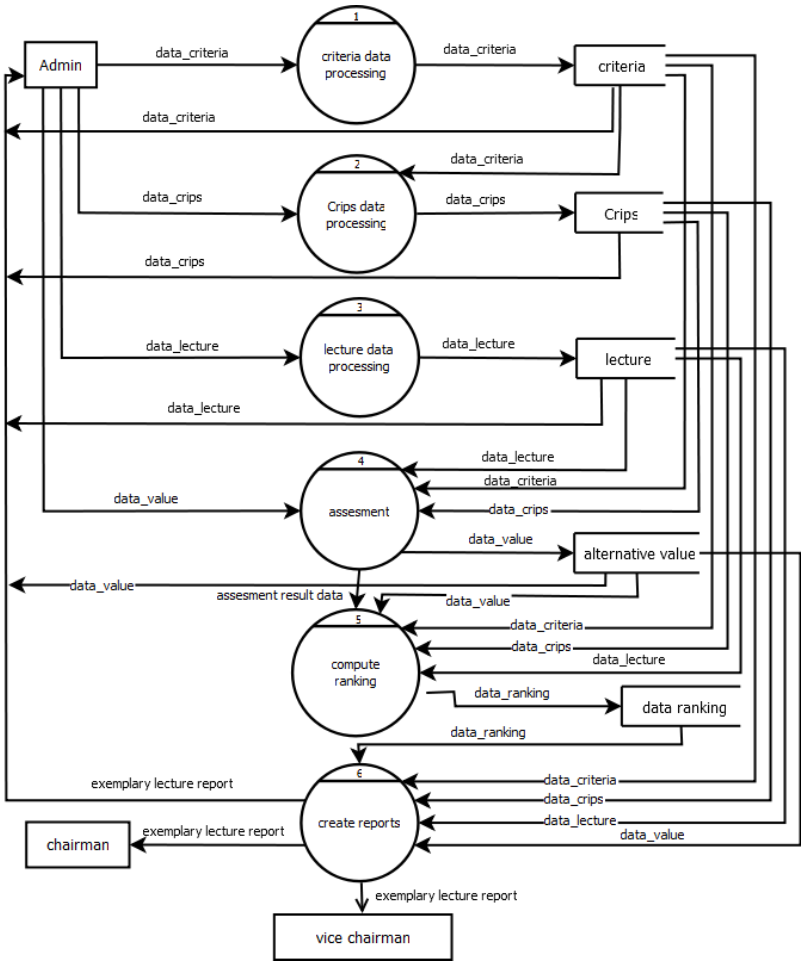

Figure 3. DFD Level 1

a. Database Design

The database system has six tables, namely users, lecturers, results, criteria, classification and crisp tables. The user table is used to store user data; the lecturer table is used to store lecturer's data; the criteria table is used for storing criteria. The classification table is used for storing data grouping criteria and criteria values. Results from the table are used for storing exemplary lecturer results. Finally, the Crips table is used for storing criteria values. The database design for this system is shown in **Figure 4**.

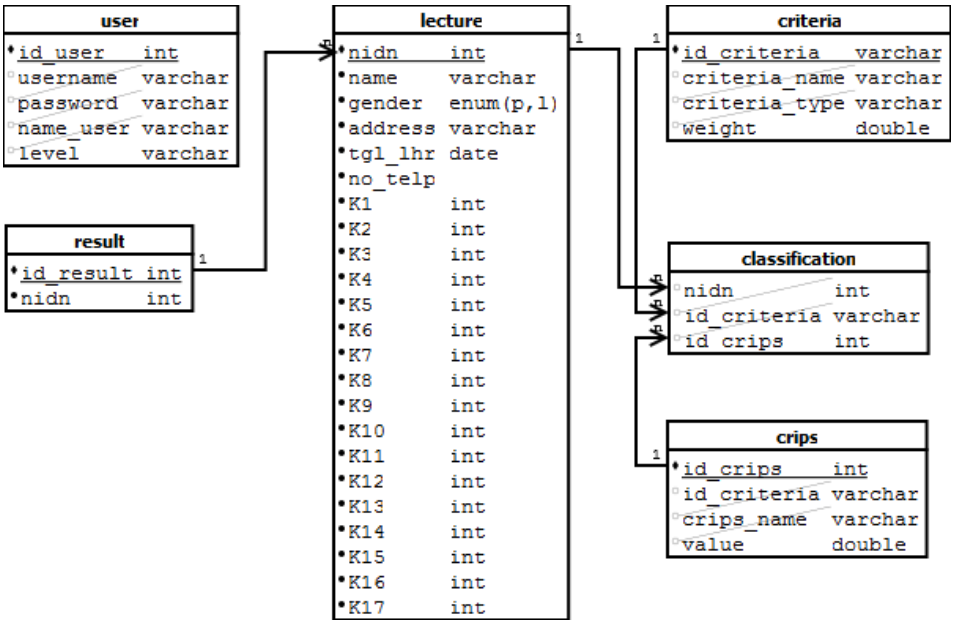

Figure 4. Table Relationship

b. Interface Design

The system interface design on the main page is shown in Figure 5, with five menus, homepage, lecture, criteria, report, and logout. System interface design presented in the **Figure 5**.

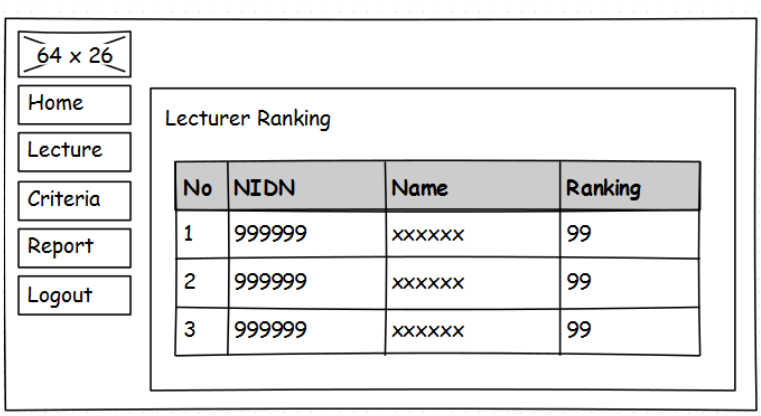

Figure 5. System Interface Design

1) Lecturer Assessment Data

The data used in this study are from the evaluation conducted by students and Department Quality-Assurance Team. Lecturer performance appraisal data at STMIK AKAKOM is shown in **Table 1.**

Table 1. Lecturer Assessment Data

Lecturer	Criteria																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
L1	3	4	3	4	4	4	4	3	4	4	3	4	4	3	4	4	4
L2	4	5	4	4	4	4	4	4	4	4	5	5	4	5	4	3	4
L3	4	4	4	5	4	4	4	4	4	4	5	4	4	4	4	3	4
L4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
L5	4	4	3	4	4	4	4	4	4	3	4	4	4	4	3	3	5
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
L67	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5

Note:5– excellent, 4 – good, 3 – average, 2 - bad, 1- Terrible

2) Criteria Weight

They are determining criterion, alternatives and filling in data or each alternative/lecturer with measure. The next step defines the weight of each standard, which, in this study, is decided by the academic decision-maker. The consequences of each criterion used are shown in **Table 2**.

Table 2. Criteria Weight

	Criteria																
Weight	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
(%)	3	7	8	5	5	6	5	6	7	8	9	8	6	6	3	4	4

From **Table 2**, it is clear that the criteria with the highest weight are the criteria with the code K11 (mastery of material, insight and implementation of the courses taught) and the requirements with the lowest weight. i.e. K1 (material plan and course objectives are given at the beginning of the lecture) and K15 (the availability of reference book). After determining the weight, the next step is to normalize the decision matrix by calculating the Rij value. Since the benefit attribute is used to calculate the Rij value, it is necessary to determine the maximum value of each criterion. The results of calculating the total value of each measure are shown in **Table 3**.

Table 3. Maximum Value

Lecturer	Criteria																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
L1	3	4	3	4	4	4	4	3	4	4	3	4	4	3	4	4	4
L2	4	5	4	4	4	4	4	4	4	4	5	5	4	5	4	3	4
L3	4	4	4	5	4	4	4	4	4	4	5	4	4	4	4	3	4
L4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
L5	4	4	3	4	4	4	4	4	4	3	4	4	4	4	3	3	5
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
L67	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	5	5
max	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Sample calculation of Rij using Equation (2) is as follows:

$$R_{11} = \frac{X_{ij}}{Max_{ij}} = \frac{3}{\max(3,4,4,4,4,\ldots,4)} = \frac{3}{5} = 0.6$$

$$R_{12} = \frac{X_{ij}}{Max_{ij}} = \frac{4}{\max(4,5,4,4,4,\ldots,3)} = \frac{4}{5} = 0.8$$

$$R_{13} = \frac{X_{ij}}{Max_{ij}} = \frac{3}{\max(3,4,4,4,4,\ldots,3)} = \frac{3}{5} = 0.6$$

$$R_{14} = \frac{X_{ij}}{Max_{ij}} = \frac{4}{\max(4,4,5,4,4,\ldots,4)} = \frac{4}{5} = 0.8$$

While the results of the overall calculation of the normalized rating (Rij) is shown in **Table 4.**

Table 4. Normalized Rating Values

Lecturer	Criteria																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
L1	0.6	0.8	0.6	0.8	0.8	0.8	0.8	0.6	0.8	0.8	0.6	0.8	0.8	0.6	0.8	0.8	0.8
L2	0.8	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.6	0.8
L3	0.8	0.8	0.8	1.0	0.8	0.8	0.8	0.8	0.8	1.0	1.0	1.0	1.0	1.0	1.0	0.8	0.8
L4	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.6	0.6	0.8	0.8	0.8	0.8	0.6	1.0
L5	0.8	0.8	0.6	0.8	0.8	0.8	0.8	0.8	0.8	1.0	1.0	1.0	1.0	1.0	1.0	0.8	0.8
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
L67	0.8	0.6	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.6	0.6	0.6	0.6	0.6	0.6	1.0	1.0

Having determined Rij value, the next process is calculating the lecturers' ranking by multiplying the weight of each criterion with the normalized rating value. Example of how such calculation is as follows:

V1=(0.6*3/100)+(0.8*7/100)+(0.6*8/100)+(0.8*5/100)+(0.8*5/100)+(0.8*6/100)+(0.8*5/100)+(0.6*6/100)
+(0.8*7/100)+(0.8*8/100)+(0.6*9/100)+(0.8*8/100)+(0.8*6/100)+(0.6*6/100)+(0.8*3/100)+(0.8*4/100)
+(0.8*4/100)
=0.02+0.06+0.05+0.04+0.04+0.05+0.04+0.04+0.06+0.06+0.05+0.06+0.05+0.04+0.02+0.03+0.03=0.74

V2=(0.8*3/100)+(1.0*7/100)+(0.8*8/100)+(0.8*5/100)+(0.8*5/100)+(0.8*6/100)+(0.8*5/100)+(0.8*6/100)
+(0.8*7/100)+(0.8*8/100)+(0.8*9/100)+(0.8*8/100)+(0.8*6/100)+(0.8*6/100)+(0.8*3/100)+(0.6*4/100)
+(0.8*4/100)
=0.02+0.07+0.06+0.04+0.04+0.05+0.04+0.05+0.06+0.06+0.07+0.06+0.05+0.05+0.02+0.02+0.03=0.81

V3=(0.8*3/100)+(0.8*7/100)+(0.8*8/100)+(1.0*5/100)+(0.8*5/100)+(0.8*6/100)+(0.8*5/100)+(0.8*6/100)
+(0.8*7/100)+(1.0*8/100)+(1.0*9/100)+(1.0*8/100)+(1.0*6/100)+(1.0*6/100)+(1.0*3/100)+(0.8*4/100)
+(0.8*4/100)
=0.02+0.06+0.06+0.05+0.04+0.05+0.04+0.05+0.06+0.08+0.09+0.08+0.06+0.06+0.03+0.03+0.03=0.89

V4=(0.8*3/100)+(0.8*7/100)+(0.8*8/100)+(0.8*5/100)+(0.8*5/100)+(0.8*6/100)+(0.8*5/100)+(0.8*6/100)
+(0.8*7/100)+(0.6*8/100)+(0.6*9/100)+(0.8*8/100)+(0.8*6/100)+(0.8*6/100)+(0.8*3/100)+(0.6*4/100)
+(1.0*4/100)
=0.02+0.06+0.06+0.04+0.04+0.05+0.04+0.05+0.06+0.05+0.05+0.06+0.05+0.05+0.02+0.02+0.04=0.77

V5=(0.8*3/100)+(0.8*7/100)+(0.6*8/100)+(0.8*5/100)+(0.8*5/100)+(0.8*6/100)+(0.8*5/100)+(0.8*6/100)
+(0.8*7/100)+(1.0*8/100)+(1.0*9/100)+(1.0*8/100)+(1.0*6/100)+(1.0*6/100)+(1.0*3/100)+(0.8*4/100)
+(0.8*4/100)
=0.02+0.06+0.05+0.04+0.04+0.05+0.04+0.05+0.06+0.08+0.09+0.08+0.06+0.06+0.03+0.03+0.03=0.86

V67=(0.8*3/100)+(0.6*7/100)+(0.8*8/100)+(0.8*5/100)+(0.8*5/100)+(0.8*6/100)+(0.8*5/100)+(0.8*6/10
0)+(0.8*7/100)+(0.6*8/100)+(0.6*9/100)+(0.6*8/100)+(0.6*6/100)+(0.6*6/100)+(0.6*3/100)+(1.0*4/10
0)+(1.0*4/100)
=0.02+0.04+0.06+0.04+0.04+0.05+0.04+0.05+0.06+0.05+0.05+0.05+0.04+0.04+0.02+0.04+0.04=0.72

Ranking Results is shown in **Table 5.**

Table 5. Lecturers' Ranking

Lecturer	Vij	Ranking
L1	0.74	63
L2	0.81	47
L3	0.89	8
L4	0.77	60
L5	0.86	30
…	…	…
L67	0.72	67

4. Conclusion

Having examined the calculation of SAW, this research produces a ranking of lecturers that can be used to support decisions from management in giving rewards and punishments for lecturers at STMIK AKAKOM. The first ranking lecturer is lecturer with the initials L40 (Vi = 0.95), the second place is lecturer with the initials L41 (Vi = 0.92) and the third is a lecturer with the initials L25 (Vi = 0.91), while the lowest ranking lecturer is lecturer with the initials L67 (Vi = 0.72).

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