Sensitivity Analysis of The AHP and TOPSIS Methods for The Selection of The Best Lecturer Base on The Academic Achievement

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Abstract

In order to resolve cases related to an alternative selection problems (MADM problems), various methods have been applied. Many methods are used to solve the MADM problems, which sometimes give different results. To resolve MADM problem, we can use AHP and TOPSIS methods. The advantages of AHP method are it can provide solutions through the analysis of quantitative and qualitative decision. In addition, it presented simple solution using hierarchical model. On the other hand, TOPSIS method gives a simple concept and is easy to implement, computationally efficient, and easy to be understood.

In this research, we aim to comparing the AHP and TOPSIS methods to solve problem best lecturer selection base on academic achievement. The best lecturer selection is analyses with Chung-Hsing algorithm and using AHP and TOPSIS method. From the experiment result, it can be seen that many changes occur to alternative grade base on those methods. The grade changes show which methods that the most appropriate to be used. Then, based on the chosen method we can determine the best alternative.

The research result shows that TOPSIS has many changes rather than AHP. TOPSIS results have variance from 17.39% to 72.05%. On the other hand AHP have showed 0% to 44.72% for experiment weight among 1.1 to 2. We conclude that TOPSIS method is more appropriate than AHP method so it can be used for select the best lecture base on the academic achievement.

Keywords : AHP; TOPSIS; Sensitivity analysis.

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1. Introduction

Decision making is a selection among several alternative solutions to problems. When decision makers are faced with simple decisions, it is easy for them decide. But when the decision to be made very complex, then the decision makers need a tool or a method that is scientifically and consistently. Decision makers sometimes use their experience and not infrequently use intuition in making decisions, and sometimes the results is improper decision. For those reasons, the decision-making model is very important in helping decision makers in making decisions.

Multi Attribute Decision Making (MADM) is a method that can be used for an alternative selection using certain criteria. Basically, MADM problem is to evaluate the m alternatives against a set of n attributes or criteria, with each attribute are not interdependent on each other. Then determine the value of the weight of each attribute, and ranking process to get the best alternative based on the values obtained given preference (Kusumadewi, et al., 2006).

The methods used to solve the MADM problem sometimes give different results. This makes problems for decision makers to choose which method works best on the selection for alternative. Many researchs has been done using AHP and TOPSIS method for determining an alternative. AHP method is widely used because it can provide solutions through decision analysis quantitatively and qualitatively, and presented in a simple solution through the model hierarchy. With the hierarchy of a complex and unstructured problems solved into more detailed groups. The TOPSIS method is used because the concept is simple and easy to implement, computationally efficient, making it easy to understand.

Selection of several alternatives with AHP and TOPSIS method has been done, such as Azizi, M. et al. in his article discusses the determination of the criteria in site selection for plywood and veneer industry in the country of Iran. The method used is the AHP. (Azizi,et al., 2003). Bayazit and Karpak doing research in selecting the best lime supplier for AKG Construction Inc. company, which manufactures building materials. The method used is the AHP, because AHP can accommodate group decision and can be used to solve complex problems in the selection of suppliers (Bayazit and Karpak, 2005). Dan Xue, Qilan Zhao, and Xinyi Guo evaluate customer satisfaction in Fast Food restaurants in China and USA by using TOPSIS method. Research goal is to find out the views, trends and attitudes of customers towards the product, and service companies. (Dan Xue, et al., 2008). Monjezi, et al using TOPSIS method to choose the design blasting limestone most suitable in the province of Lorestan, Iran. According Monjezi, TOPSIS method effectively used in limestone blasting design selection. (Monjezi, et al, 2010). Kusumadewi and Hartati perform

sensitivity analysis on MADM methods in the Clinical Group Decision Support System (CGDSS). That system make diagnosis to select the type of mental disorder based on symptoms is given. The method used is the method of SAW and TOPSIS. (Kusumadewi and Hartati, 2008)

The achievement of the learning process in a university is inseparable from the role of lecturer. Lecturer is major element in higher education organization. Lecturer has responsibility to carrying out the process of learning, doing research, and community service. By giving awards for lecturer that have good reputation is important element in developing and growing academic atmosphere. In the selection of the best lecturer often appears subjectivity of the decision makers, so to avoid the problem, the selection was done using MADM model. In this model the method used is selected among which the most appropriate method of AHP and TOPSIS.

2. Methodology

In this research we analyze the sensitivity of AHP and Topsis methods to determine which method is most suitable for used in the selection of the best lecturer base on academic achievement.

Sensitivity analysis performed by changing the parameter values in the model to determine the impact of such changes. Changes in parameter values will lead to changes in the results shown by an alternate. This modification allows the decision to change from one alternative to another alternative

The process of sensitivity analysis performed by calculating the degree of sensitivity of each attribute on the result ranking on the AHP and TOPSIS methods. To determine the degree of sensitivity of each attribute, it used an algorithm developed by Chung-Hsing (Kusumadewi, et al. 2008) as follows:

a. Determine for all attributes, the value of the initial weight = 1. (j = 1,2, … , n).
b. Change the weight of an attribute in a range between 1 to 2, with the addition of 0.1 while all other attributes have the value of weights = 1
c. Normalization the weights of attributes are such that Σ w = 1.
d. Use the weights in step c for both methods
e. Calculate the percentage change in the ranking by comparing the results of ranking when the value of its weight equal 1

The number of percentage change in ranking over the two methods showed method of the most appropriate to use.

For this research is using data that used in the Department of Mathematics, Faculty of Mathematic and Natural Sciences Diponegoro University. Lecturers data used are 23 lecturers, in 2008-2010 which active in the Department of Mathematics not included in the learning task.

The criteria and sub criteria used for this study is work's criteria base on univeristy'sTri Dharma which includes education, research, community service, and support activities, as well as the criteria of personality, which includes discipline, cooperation, and responsibility.

3. Results and Discussion

3.1 AHP Data Processing

Processing data with AHP method involves the preparation of a hierarchical structure, AHP weighting and ranking alternative.

3.1.1 Preparation of Hierarchical Structure

The preparation of hierarchical structures on this issue consists of four levels of objectives, criteria, sub criteria and alternatives.

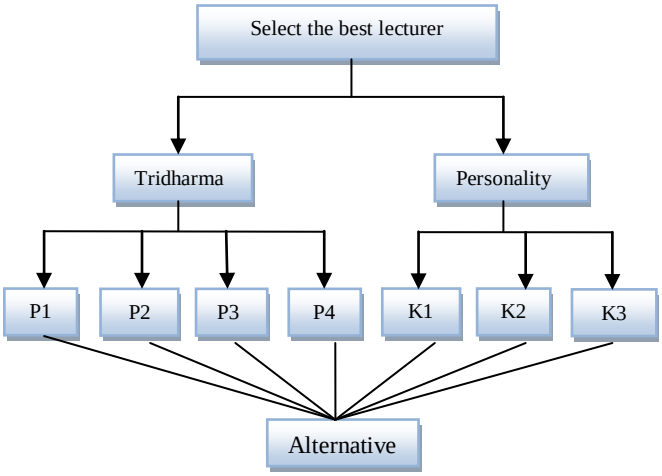

Figure 1. Outstanding Lecturer Selection Hierarchy Structure

In the selection of faculty achievement, targets to be achieved where the priority is the faculty to be elected was the most outstanding lecturers. As an alternative to the lecturers in Mathematics majors are active in the year 2008 to 2010, who are not learning task. The criteria used are grouped into two groups of criteria: Tridharma colleges and personality. Criteria Tridharma college consists of sub-criteria of education and teaching (P1), research (P2), community service (P3) and supporting (P4). While the criteria for personality consists of sub-criteria of the discipline (K1), cooperation (K2) and responsibility (K3). Hierarchical structure of the selection of outstanding lecturers is given in Figure 1.

3.1.2 Weighting of AHP

AHP method of processing is done by determining the weights for each of the criteria, sub criteria and alternatives are done using the paired comparison matrix. The process of weighting and consistency of paired comparison matrix is processed by using an application program, which can be seen in Figure 2.

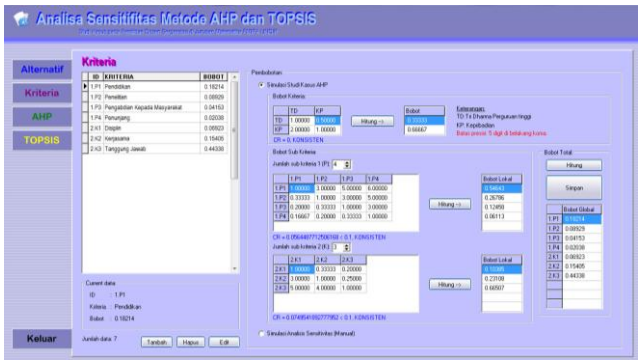

Figure 2. Weighting Process AHP

Based on the weighting process and test the consistency in the application program obtained by the weight of each

criteria and sub criteria and the value of CR (Consistency Ratio), whose results showed that each of the criteria have different interests and CR ≤ 0.
The results of the priority weighting of each criteria and sub criteria in a row can be seen in Table 1 and Table 2.

Table 1. Priority Criteria Weights

No.	Criteria	Weight
1.	Tridharma	0.33333
2.	Personality	0.66667

CR = 0

Table 2. Priority Sub Criteria Weights

Criteria	Sub Criteria	Local Weights	Global Weights
Tridharma	Education	0.54643	0.18214
	Research	0.26786	0.08929
	Community service	0.12458	0.04153
	Support activities	0.06113	0.02038

CR = 0.06

Personality	Discipline	0.10385	0.06923
	Cooperation	0.23108	0.15405
	Responsibility	0.66507	0.44338

CR = 0.07

Table 1 shows that personality is the important criteria than the Univeristy Tridharma (0.66667). For matrices of order 1 and 2, the CR value is always zero so that the matrix is always consistent (Chunlan and Yonglin, 2008).

3.1.3 Alternative ranking

Alternative ranking process is done by determining the matrix of pairwise comparisons of all alternatives for each criterion. After determining the matrix of pairwise comparisons for each alternative, then the weight vector is determined for each alternative. The results of the weight vector for each alternative can be seen in Table 3, with the global weighting for each criterion, respectively, for P1 = 0.18214, P2 = 0.08929, P3 = 0.04153, P4 = 0.02038, K1 = 0.06923, K2 = 0.15405, K3 = 0.44338. And consistency of CR values for each alternative on each criteria assessment respectively. For P1 = 0.051, P2 = 0.068, P3 = 0.046, P4 = 0.038, K1 = 0.052, K2 = 0.043, K3 = 0.045.

Table 3. Alternative Weight value on each criteria

	P1 0,18214	P2 0,08929	P3 0,04153	P4 0,02038	K1 0,06923	K2 0,15405	K3 0,44338
A001	0.01605	0.01118	0.01946	0.01958	0.01586	0.01878	0.01702
A002	0.08953	0.05991	0.05332	0.09189	0.08025	0.05273	0.09057
A003	0.02374	0.11098	0.02106	0.01662	0.01757	0.02014	0.01825
A004	0.08419	0.08049	0.05978	0.07794	0.06787	0.03941	0.03639
A005	0.06738	0.07354	0.03579	0.05796	0.03477	0.03957	0.03131
A006	0.03086	0.05364	0.04256	0.06464	0.06886	0.04490	0.06420
A007	0.05063	0.02874	0.02832	0.03770	0.04318	0.05914	0.05440
A008	0.03334	0.03499	0.03569	0.02383	0.05346	0.07601	0.05743
A009	0.02806	0.04668	0.06782	0.02531	0.02514	0.02666	0.02141
A010	0.03630	0.04184	0.07122	0.04909	0.04487	0.08239	0.07875
A011	0.02548	0.02278	0.03290	0.02447	0.02203	0.02892	0.02572
A012	0.03215	0.06046	0.05501	0.04627	0.05988	0.07338	0.07221
A013	0.06480	0.05761	0.07856	0.03722	0.09247	0.04974	0.07686
A014	0.06860	0.03271	0.05033	0.02533	0.05890	0.07042	0.06802
A015	0.05391	0.03063	0.04841	0.03507	0.03793	0.03365	0.02761
A016	0.05168	0.05835	0.08560	0.06659	0.04178	0.03082	0.02766
A017	0.02278	0.02108	0.02883	0.02092	0.01886	0.02422	0.02010
A018	0.02008	0.01239	0.02476	0.03353	0.05261	0.04258	0.06068
A019	0.02141	0.01340	0.02639	0.03543	0.04174	0.06870	0.05158
A020	0.01738	0.01616	0.01683	0.01475	0.01148	0.01434	0.01193
A021	0.06829	0.04765	0.04169	0.08278	0.03083	0.03072	0.02936
A022	0.07246	0.05746	0.04416	0.07399	0.05849	0.04214	0.03519
A023	0.02091	0.02735	0.03152	0.03909	0.02117	0.03064	0.02336

From the weights of each alternative and the global weights of each sub criteria, calculate the total score for each candidate faculty achievement. Overall ranking of candidates can be seen in Figure 3. From the total score for each alternative was found that the prioritization of alternative generating a lecturer with the code A002 which ranked first for prioritized as an outstanding lecturer.

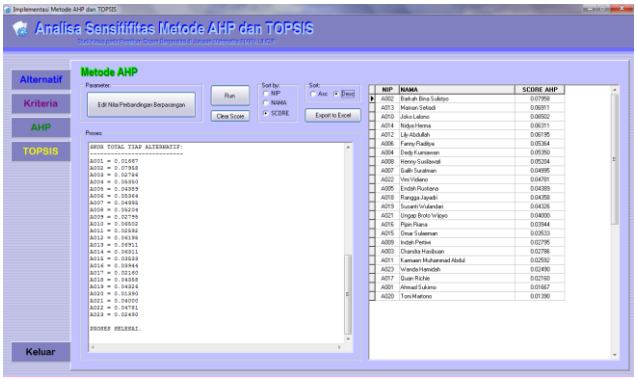

Figure 3. Alternative ranking using AHP Method

3.2 TOPSIS Process

Data processing with TOPSIS method begins with a decision matrix input of each alternative on each criteria (Figure 4). Then decision makers give weight to each criteria w_i with $\Sigma w_j = 1$ (Table 4).

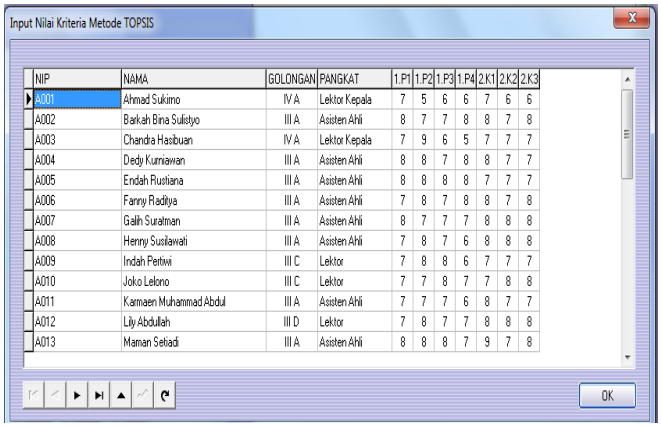

Figure 4. Decision Matrix Input of TOPSIS Method

Table 4. Weight of Criteria

Criteria	P1	P2	P3	P4	K1	K2	K3
Weight	0.160	0.140	0.120	0.100	0.140	0.160	0.180

3.2.1 Normalize the Decision Matrix

Value of pairwise comparisons between alternatives and criterias in the decision matrix is normalized into a comparable scale, using equation:

$$r_{ij} = \frac{X_{ij}}{\sqrt{\sum_{i=1}^{m} X_{ij}^2}}$$

$$i = 1, 2, 3, \ldots, m \text{ and } j = 1, 2, \ldots, n.$$

The normalized decision matrix can be seen in Table 5.

Table 5. Normalized Decision Matrix (R)

0.19589	0.14091	0.17594	0.18257	0.19115	0.17386	0.16863
0.22387	0.19728	0.20526	0.24343	0.21846	0.20283	0.22484
0.19589	0.25365	0.17594	0.15215	0.19115	0.20283	0.19673
0.22387	0.22546	0.20526	0.24343	0.21846	0.20283	0.19673
0.22387	0.22546	0.23458	0.24343	0.19115	0.20283	0.19673
0.19589	0.22546	0.20526	0.24343	0.21846	0.20283	0.22484
0.22387	0.19728	0.20526	0.21300	0.21846	0.23181	0.22484
0.19589	0.22546	0.20526	0.18257	0.21846	0.23181	0.22484
0.19589	0.22546	0.23458	0.18257	0.19115	0.20283	0.19673
0.19589	0.19728	0.23458	0.21300	0.19115	0.23181	0.22484
0.19589	0.19728	0.20526	0.18257	0.21846	0.20283	0.19673
0.19589	0.22546	0.20526	0.21300	0.21846	0.23181	0.22484
0.22387	0.22546	0.23458	0.21300	0.24577	0.20283	0.22484
0.22387	0.19728	0.20526	0.18257	0.21846	0.23181	0.22484
0.22387	0.19728	0.20526	0.21300	0.21846	0.20283	0.19673
0.22387	0.22546	0.23458	0.24343	0.21846	0.20283	0.19673
0.19589	0.19728	0.20526	0.18257	0.19115	0.20283	0.19673
0.19589	0.16910	0.20526	0.18257	0.21846	0.20283	0.22484
0.19589	0.16910	0.20526	0.18257	0.21846	0.23181	0.22484
0.19589	0.19728	0.17594	0.15215	0.16385	0.17386	0.16863
0.22387	0.22546	0.20526	0.24343	0.19115	0.20283	0.19673
0.22387	0.22546	0.20526	0.24343	0.21846	0.20283	0.22484
0.19589	0.19728	0.20526	0.21300	0.19115	0.20283	0.19673

3.2.2 Normalize the Weighting matrix

The process is continued with normalize the weighting matrix. Elements of the weighted normalized matrix are the result of multiplication weighting criteria to the matrix element normalized. Table normalized weighting matrix can be seen in Table 6.

Table 6.Weighted Normalized Matrix (Y)

0.03134	0.01973	0.02111	0.01826	0.02676	0.02782	0.03035
0.03582	0.02762	0.02463	0.02434	0.03058	0.03245	0.04047
0.03134	0.03551	0.02111	0.01521	0.02676	0.03245	0.03541
0.03582	0.03156	0.02463	0.02434	0.03058	0.03245	0.03541
0.03582	0.03156	0.02815	0.02434	0.02676	0.03245	0.03541
0.03134	0.03156	0.02463	0.02434	0.03058	0.03245	0.04047
0.03582	0.02762	0.02463	0.02130	0.03058	0.03709	0.04047
0.03134	0.03156	0.02463	0.01826	0.03058	0.03709	0.04047
0.03134	0.03156	0.02815	0.01826	0.02676	0.03245	0.03541
0.03134	0.02762	0.02815	0.02130	0.02676	0.03709	0.04047
0.03134	0.02762	0.02463	0.01826	0.03058	0.03245	0.03541
0.03134	0.03156	0.02463	0.02130	0.03058	0.03709	0.04047
0.03582	0.03156	0.02815	0.02130	0.03441	0.03245	0.04047
0.03582	0.02762	0.02463	0.01826	0.03058	0.03709	0.04047
0.03582	0.02762	0.02463	0.02130	0.03058	0.03245	0.03541
0.03582	0.03156	0.02815	0.02434	0.03058	0.03245	0.03541
0.03134	0.02762	0.02463	0.01826	0.02676	0.03245	0.03541
0.03134	0.02367	0.02463	0.01826	0.03058	0.03245	0.04047
0.03134	0.02367	0.02463	0.01826	0.03058	0.03709	0.04047
0.03134	0.02762	0.02111	0.01521	0.02294	0.02782	0.03035
0.03582	0.03156	0.02463	0.02434	0.02676	0.03245	0.03541
0.03582	0.03156	0.02463	0.02434	0.03058	0.03245	0.04047
0.03134	0.02762	0.02463	0.02130	0.02676	0.03245	0.03541

3.2.3 Determine the matrix of positive ideal solution and negative ideal solution.

Positive ideal solution and negative ideal solution can be determined based on the weighted normalization matrix. Elements of the matrix A+ in Table 7 is the maximum value of each column in Table 6, while the elements of the matrix in Table A- is the minimum value of each column in Table 6.

Table 7. Matrix of Positive and Negative Ideal Solution

Kriteria	P1	P2	P3	P4	K1	K2	K3
A+	0.03582	0.03551	0.02815	0.02434	0.03441	0.03709	0.04047
A-	0.03134	0.01973	0.02111	0.01521	0.02294	0.02782	0.03035

3.2.4 Determine distance between the value of each alternative with the positive and negative ideal solution matrix

The next step is to determine the distance of each alternative to the positive ideal solution (S +) and the distance of each alternative to the negative ideal solution (S-). Calculation of S + and S- by using the equation:

$$S_i^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^+)^2}, \; i = 1, 2, \ldots, m$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2}, \; i = 1, 2, \ldots, m$$

with V_{ij} are elements of the weighted normalized matrix

V_j^+ is an element of A^+

V_j^- is element of A^-

The results of calculation S_i^+ and S_i^- can be seen in Table 8.

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Table 8. Value of S + and S-

Alternatif	S^+	S^-
A001	0.02455	0.00489
A002	0.01052	0.01898

Alternatif	S^+	S^-
A003	0.01608	0.01763
A004	0.00947	0.01901
A005	0.01101	0.01883
A006	0.00917	0.02045
A007	0.00993	0.01946
A008	0.00998	0.02021
A009	0.01335	0.01614
A010	0.01225	0.01876
A011	0.01391	0.01376
A012	0.00848	0.02089
A013	0.00681	0.02241
A014	0.01124	0.01873
A015	0.01207	0.01540
A016	0.00879	0.01996
A017	0.01540	0.01207
A018	0.01567	0.01482
A019	0.01497	0.01685
A020	0.02313	0.00789
A021	0.01155	0.01782
A022	0.00800	0.02093
A023	0.01447	0.01317

3.2.5 Determine the value of preferences for each alternative

Preference value for each alternative is the relative closeness of each alternative is calculated by the equation:

$$A_i = \frac{S_i^-}{S_i^- + S_i^+}$$

3.2.6 Alternative ranking

From the calculation of priority values indicate an alternative preference, so the ranking of alternatives can be determined based on preference values obtained. Preference value for each alternative is shown in the figure 5, therefore a lecturer with the code A013 in the first rank to be given priority as achievement lecturer

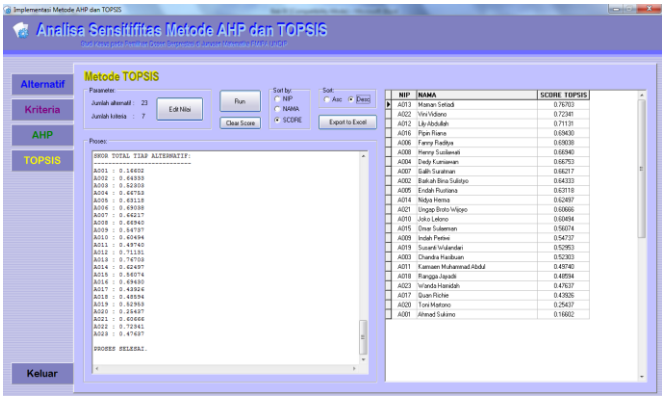

Figure 5. Alternative ranking using TOPSIS Method

3.3 Sensitivity Analysis of AHP and TOPSIS Methods

Sensitivity analysis will be done to AHP and TOPSIS methods to determine what method is most appropriately used in the selection of achievement lecturer. The process is carried out is by finding many alternative ranking changes that occur for each method if the value of the weight of each sub criteria is changed. At first, the weights for each sub criteria were given an initial value = 1, then the value of a sub-criteria weights are changed in the range 1-2 by increasing the weighting of 0.1, while the other sub-criteria have weights equal to 1. After the weights are normalized, then apply the AHP and TOPSIS methods.

3.3.1 Sensitivity Analysis of AHP Method

Sensitivity analysis is done with an initial weight value = 1 for each sub-criteria (P1 = 1, P2 = 1, P3 = 1, P4 = 1, K1 = 1, K2 = 1, K3 = 1). Then do the changes in the weights of a sub-criteria by increasing the weight in the range 1-2, ie the value of 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, and 2.0, while the other sub-criteria = 1, for see the trend of the results of alternative ranking will change or not. A sub-criteria weight is said to sensitive if a change is changing the ranking order of alternatives.

From the matrix of the weight of each alternative in Table 3, then calculate the total score for each candidate achievement lecturer. For all the weight of the sub criteria P1, P2, P3, P4, K1, K2, K3 is1, the ranking results can be seen in Table 9.

Table 9. The initial alternatif ranking using AHP

No.	NIP	Skor AHP
1	A002	0.07403
2	A013	0.06532
3	A004	0.06372
4	A010	0.05778
5	A012	0.05705
6	A022	0.05484
7	A014	0.05347
8	A006	0.05281
9	A016	0.05178
10	A005	0.04862
11	A021	0.04733
12	A008	0.04496
13	A007	0.04316
14	A015	0.03817
15	A019	0.03695
16	A018	0.03523
17	A009	0.03444
18	A003	0.03262
19	A023	0.02772
20	A011	0.02604
21	A017	0.02240
22	A001	0.01685
23	A020	0.01470

Changes in weight of the sub criteria successively is done from sub criteria P1, P2, P3, P4, K1, K2 and K3. Table 10 is the result of changes in ranking alternative when weight is changed to 1.1 while the other weights are fixed = 1. The result can be seen that when the weights are changed to 1.1, while the weighted sub criteria others = 1, there is no change in ranking. Column 2 shows when the weight of the sub criteria P1 was changed to 1.1, while the weights of sub criteria from P2 to K3 fixed value 1, no change in ranking

alternatives. This happens either to change the weight of P1, P2, P3, P4, K1, K2 and K3. Value 0 indicates no change in ranking alternatives.

Table 10. Ranking Changes using AHP for weight = 1.1

No	P1	NIP	P2	NIP	P3	NIP	P4	NIP	K1	NIP	K2	NIP	K3	NIP
1	0	A002	0	A002	0	A002	0	A002	0	A002	0	A002	0	A002
2	0	A013	0	A013	0	A013	0	A013	0	A013	0	A013	0	A013
3	0	A004	0	A004	0	A004	0	A004	0	A004	0	A004	0	A004
4	0	A010	0	A010	0	A010	0	A010	0	A010	0	A010	0	A010
5	0	A012	0	A012	0	A012	0	A012	0	A012	0	A012	0	A012
6	0	A022	0	A022	0	A022	0	A022	0	A022	0	A022	0	A022
7	0	A014	0	A014	0	A014	0	A014	0	A014	0	A014	0	A014
8	0	A006	0	A006	0	A006	0	A006	0	A006	0	A006	0	A006
9	0	A016	0	A016	0	A016	0	A016	0	A016	0	A016	0	A016
10	0	A005	0	A005	0	A005	0	A005	0	A005	0	A005	0	A005
11	0	A021	0	A021	0	A021	0	A021	0	A021	0	A021	0	A021
12	0	A008	0	A008	0	A008	0	A008	0	A008	0	A008	0	A008
13	0	A007	0	A007	0	A007	0	A007	0	A007	0	A007	0	A007
14	0	A015	0	A015	0	A015	0	A015	0	A015	0	A015	0	A015
15	0	A019	0	A019	0	A019	0	A019	0	A019	0	A019	0	A019
16	0	A018	0	A018	0	A018	0	A018	0	A018	0	A018	0	A018
17	0	A009	0	A009	0	A009	0	A009	0	A009	0	A009	0	A009
18	0	A003	0	A003	0	A003	0	A003	0	A003	0	A003	0	A003
19	0	A023	0	A023	0	A023	0	A023	0	A023	0	A023	0	A023
20	0	A011	0	A011	0	A011	0	A011	0	A011	0	A011	0	A011
21	0	A017	0	A017	0	A017	0	A017	0	A017	0	A017	0	A017
22	0	A001	0	A001	0	A001	0	A001	0	A001	0	A001	0	A001
23	0	A020	0	A020	0	A020	0	A020	0	A020	0	A020	0	A020

3.3.2 Sensitivity Analysis of TOPSIS Method

As in the method of AHP, sensitivity analysis of TOPSIS Method be done by giving the initial weights of all sub-criteria = 1. Then the results of the ranking changes that occur can be known if the weight is changed to 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, and 2.0. Table 11 is a alternative ranking tables using TOPSIS with initial weights of all = 1.

Table 11.The initial alternatif ranking using TOPSIS

N0.	NIP	SKOR TOPSIS
1	A013	0.76041
2	A016	0.73474
3	A022	0.73175
4	A006	0.70657
5	A004	0.69904
6	A012	0.69439
7	A005	0.66897
8	A002	0.65427
9	A007	0.63989
10	A021	0.63821
11	A008	0.62066
12	A010	0.59918
13	A014	0.57272
14	A015	0.57228
15	A009	0.54230
16	A023	0.49704
17	A019	0.48854
18	A003	0.48383
19	A011	0.48382
20	A018	0.45178
21	A017	0.42772
22	A020	0.24880
23	A001	0.19063

Table 12. Ranking Changes using TOPSIS for weight=1.1

N0	P1	NIP	P2	NIP	P3	NIP	P4	NIP	K1	NIP	K2	NIP	K3	NIP
1	0	A013	0	A013	0	A013	0	A013	0	A013	0	A013	0	A013
2	0	A016	0	A016	0	A016	0	A016	0	A016	0	A016	1	A022
3	0	A022	0	A022	0	A022	0	A022	0	A022	0	A022	1	A016
4	0	A006	0	A006	0	A006	0	A006	0	A006	0	A006	0	A006
5	0	A004	0	A004	0	A004	0	A004	0	A004	1	A012	1	A012
6	0	A012	0	A012	0	A012	0	A012	0	A012	1	A004	1	A004
7	0	A005	0	A005	0	A005	0	A005	0	A005	0	A005	0	A005
8	0	A002	0	A002	0	A002	0	A002	0	A002	0	A002	0	A002
9	0	A007	1	A021	0	A007	1	A021	0	A007	0	A007	0	A007
10	0	A021	1	A007	0	A021	1	A007	0	A021	0	A021	0	A021
11	0	A008	0	A008	0	A008	0	A008	0	A008	0	A008	0	A008
12	0	A010	0	A010	0	A010	0	A010	0	A010	0	A010	0	A010
13	0	A014	0	A014	0	A014	1	A015	0	A014	0	A014	0	A014
14	0	A015	0	A015	0	A015	1	A014	0	A015	0	A015	0	A015
15	0	A009	0	A009	0	A009	0	A009	0	A009	0	A009	0	A009
16	0	A023	1	A003	0	A023	0	A023	1	A019	0	A023	0	A023
17	0	A019	1	A023	0	A019	0	A019	1	A023	0	A019	0	A019
18	0	A003	1	A011	1	A011	1	A011	1	A011	1	A011	1	A011
19	0	A011	1	A019	1	A003	1	A003	1	A003	1	A003	1	A003
20	0	A018	0	A018	0	A018	0	A018	0	A018	0	A018	0	A018
21	0	A017	0	A017	0	A017	0	A017	0	A017	0	A017	0	A017
22	0	A020	0	A020	0	A020	0	A020	0	A020	0	A020	0	A020
23	0	A001	0	A001	0	A001	0	A001	0	A001	0	A001	0	A001

The results of ranking changes with change in weight of the sub criteria = 1.1 can be seen in Table 12.
The results show when the weight is changed to 1.1 for:
- P1, there is no change in ranking
- P2, there are six changes in rankings
- P3, there are two changes in rankings
- P4, there are six changes in rankings
- K1, there are four changes in Rankin
- K2, there are four changes in rankings
- K3, there are six changes in rankings

Ranking changes that occur are indicated by a value of 1., For example in P2 there are 6 alternative with a value of 1, which means that alternative rankings have changed compared with the ranking when all weights = 1 . For example, when the weighting of criteria for all = 1, the A021 is at number - 10. Meanwhile, after weighting the criteria P2 changed to 1.1 then the position of A021 is at number 9. Similarly to the position of A007, at first in order to - 9 turned into a ranked 10.

3.3.3 Comparison of Changes in the ranking of AHP and TOPSIS methods

The results of sensitivity analysis of both methods is shown by the many changes in the ranking of the AHP and TOPSIS methods of ranking results when the value of its weight = 1.

Table 13. Comparison of Changes in Ranking using TOPSIS and AHP methods

Weight	P1		P2		P3		P4		K1		K2		K3		Percent	
	T	A	T	A	T	A	T	A	T	A	T	A	T	A	T	A
1.1	0	0	6	0	2	0	6	0	4	0	4	0	6	0	17.39	0
1.2	2	0	10	2	2	4	8	2	10	0	7	0	8	0	29.19	4.97
1.3	4	0	13	6	2	4	13	5	11	0	11	2	12	2	40.99	11.80
1.4	4	4	14	7	10	5	16	7	11	2	12	6	13	4	49.69	21.74

Weight	P1		P2		P3		P4		K1		K2		K3		Percent	
	T	A	T	A	T	A	T	A	T	A	T	A	T	A	T	A
1.5	6	4	14	11	2	6	20	7	13	4	14	6	14	5	51.55	26.71
1.6	6	7	14	12	14	7	21	9	16	4	15	6	15	7	62.73	32.30
1.7	7	8	14	12	15	7	21	9	16	4	17	6	16	8	65.84	33.54
1.8	7	12	14	12	16	7	22	9	16	6	18	7	16	8	67.70	37.89
1.9	9	13	14	14	16	7	22	10	16	6	18	7	17	8	69.57	40.37
2.0	11	13	14	14	16	7	22	12	16	6	19	9	18	11	72.05	44.72

Table 13 shows number of changes in the ranking table that occurs between the AHP and TOPSIS method. It can be seen that the comparison table ranking changes between AHP and TOPSIS method give results that the greater the change in weight for a more sub-criteria ranking changes occur both on the method of AHP and the TOPSIS method. Total change in the ranking of TOPSIS method more than the total change in the ranking of the AHP method. This happens on all the weight changes from 1.1 to 2. At 1.1 weight changes a lot of changes TOPSIS method for ranking of 17:39% while for the AHP method does not change. In the weight change of 1.2, many changes TOPSIS method for ranking in 29.19% and 4.97% for the AHP. TOPSIS method for ranking the total change ranged from 17.39% to 72.05%, while for the method of AHP from 0% to 44.72% in weight change criteria of 1.1 to 2. Since the total change in ranking that occurred on TOPSIS method is greater than the total change in ranking on the method of AHP, the TOPSIS method is more suitable for the selection of achievement lecturer.

6. Conclusion

1. The results of sensitivity analysis showed that the alternative order of priority by using TOPSIS method is more sensitive than AHP method.
2. For w_i = 1.1 to 2, percentage change in ranking by using Topsis method is greater than using AHP method, therefore the TOPSIS method is more suitable for the selection of achievement lecturer.
   The special case in the weight change = 1.1, the total change in ranking on TOPSIS method is 17.39% while in the AHP method does not.
3. TOPSIS results have variance from 17.39% to 72.05%. On the other hand AHP have showed 0% to 44.72% for experiment weight among 1.1 to 2.

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