Analytical network process method for badminton athlete’s scholarship recommendations

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Abstract. Pathways admissions line independent achievement sports especially badminton was held in UIN Sunan Gunung Djati Bandung aimed to help athletes who want to proceed to a higher level and change the paradigm of athletes on the importance of continuing education to a higher level in accordance with the specified criteria. The process of input in determining the acceptance still uses old system by Microsoft Excel that sometimes causes confusion. To help determine an independent candidate of badminton accomplishment line, it is then required a decision support system. The Method that can be used for deciding support system by using Analytical Network Process (ANP). Using this method, the calculation was done by doing a comparison between the criteria and alternatives then produce supermatrics, then do the weighting process will determine the athletes who deserve to UIN Sunan Gunung Djati in Bandung. This research used 9 prospective registrants (alternate) as a sample after doing comparison calculation manually and the application of the method itself then acquired relative error of 0%. So the system has been made is said to be worth used relative error less than 50%.

1. Introduction
In 2018 UIN Bandung opened 5 entry paths, including the National Selection of State Universities (SNMPTN), Joint Selection of State Universities (SBMPTN), National Islamic Religious Higher Education Academic Achievement Selection (SPAN-PTKIN), College Entrance Exams State Islamic Religion (UM-PTKIN), and Independent Examination (UM). On the independent track managed by the campus, UIN Bandung opens a quota of 589 students. The quota is a normative quota, meaning that the amount can increase if it has not met the total or overall quota. This Mandiri track includes the CBT track test, tahfidz track and achievements, and special routes for foreign students [1].

One of the new student admission paths is the achievement acceptance path or scholarship for all sports, especially badminton held at UIN Sunan Gunung Dati Bandung. In this independent path of achievement there are three stages of selection that have been determined by the campus, namely administration of 20%, religious knowledge of 20%, and practice of 60% [1].

Decision support systems (DSS) are areas of information systems (IS) that are focused on supporting and improving managerial decision-making. Essentially, DSS is about developing and deploying IT-based systems to support decision processes [2]. DSS has been an important area of IS scholarship since it emerged in the 1970s. It has also been a major area of IT practice and decisions made using IT-based decision support can have a significant effect on the nature and performance of an organization [3,4].
Decision support in several previous studies that have been carried out to solve a problem using a method and provide an assessment that is implemented in a system. Ngurah Agus Sanjaya the implementation of the ANP method for executive support systems in information technology consulting companies was built to assist the executive level in assessing the development of the projects it was working on [5]. From the weighting of SEO, the highest results of the two criteria weights are the ranking average (0.6346) and ranking (0.2280) with the condition criteria reaching the target (good) and the condition reaching the target (bad).

One of the most advanced and complex multi-criteria decision-making methods is the analytic network process (ANP). This method supports modelling dependencies and feedback between elements in the network. For this reason, the ANP is one of the most appropriate methods for making decisions in fields that are characterised by existing dependencies of higher-level elements on lower level elements [6,7].

Based on the background and previous research studies above, in this study will use the ANP method in decision making using several criteria, namely the level of certificate of athletes covering (international, national, provincial, district / city), PBSI-certified clubs, total test scores, number of matches labeled PBSI, and badminton experience (year) and give weighting values of 0.5 and 2.

2. Methodology
The Analytic Network Process or ANP method is a new approach to qualitative methods. Introduced by Professor Thomas Saaty, a research expert from Pittsburgh University, was intended to “replace” the Analytic Hierarchy Process (AHP) method. ANP's strengths from other methodologies are its ability to measure and synthesize a number of factors in a hierarchy or network. There are 2 linkages in the ANP method, namely the interrelationships in a set of elements (inner dependence) and the interrelationships between different elements (outer dependence). With the relationship between these elements, the ANP method is more complex than the AHP method [8].

As the aim of the study is to construct a decision model for selecting students with outstanding achievements in the field of badminton, an extensive literature review has been performed to identify decision parameters. The ANP decision model can be constructed by using four main steps, which are problem structuring and model construction, preparation of pair-wise comparison matrices of interdependent component levels, supermatrix formation, and determination of the relative importance weight of each factor [9].

The decision-making problems in the ANP are modelled as networks, not as hierarchies as with the AHP. The ANP is a generalisation of the AHP. Figure 1 presents the structural differences between a linear hierarchy and a nonlinear network. The basic elements in the hierarchy and network are clusters (components; rectangles and ellipses in Figure 1), nodes (elements in clusters, not specified in Figure 1) and dependencies (arcs). The meaning of ‘depend on’ is the opposite of ‘have an influence on’ [6].

![Figure 1. Structural difference between a linear and a nonlinear network [10].](image-url)
3. Results and discussion

3.1. Data analysis and determination of Analytical Network Process (ANP) methods
In this study, the existing attribute data will be used from the data of prospective student applicants to Sunan Gunung Djati UIN Bandung on independent track of badminton achievement. The data used for prospective applicants is the prospective applicants in 2018 with prospective applicants joining as many as 9 people. In the ANP method to determine the best prospective students who register the independent badminton achievement track, complete data from prospective students can be adjusted to the criteria and from the overall value obtained.

3.2. Initialize initial weight with ANP
Before going on to the data testing phase, the thing to do is to initialize the value of each weight that is in the weight of the specified criteria, namely from the level of certificate needed (international, national, provincial, district), PB data listed in the shade PBSI, total test scores, comparison with PBSI labels, years of experience. With the criteria for alternatives already determined, then the next is to give weight to these criteria, for the criteria yes given a weight of 2 and the criteria not given a weight of 0.5 for the first and second criteria. Weighting for the next criteria is by calculating the value obtained by the number 50 then divided by 3000.

3.3. Prediction / testing test
Test results of predictions are done by inputting testing data in the form of participant data and the criteria possessed by the participant and the results of the practice. These data are data that are used to get the final results of the participant sequence and the assessment obtained. In this test 9 test data were used.

3.4. Comparison of criteria for each alternative node
The pairwise comparison matrix of this criterion functions to get the eigen vector value and see the ratio of Consistency Ratio (CR), where the terms CR ≤ 0.1. The value of this comparison is obtained from the decision maker [5,8].

So it can be seen that the value is consistent because of CR <0.1. If the CR > 0.1 value is inconsistent or does not meet the requirements, the decision matrix must be repeated until the CR value is consistent or meets consistent requirements.
3.5. Alternative comparison (Participants) of each criteria node
After obtaining a value that is consistent with the above criteria, then it is then to determine the value of the comparison between alternatives for each criterion. Alternative resolution steps are the same as the completion steps in the criteria.

| Table 1. Eigenvalue vector for alternative paired comparison matrices. |
|-------------------------------------------------------------|
|                  A01  | A02  | A03  | A04  | A05  | A06  | A07  | A08  | A09  | eVector |
|-------------------|------|------|------|------|------|------|------|------|---------|
| A01               | 0.080| 0.045| 0.142| 0.053| 0.063| 0.128| 0.118| 0.077| 0.010   | 0.090   |
| A02               | 0.160| 0.090| 0.142| 0.053| 0.063| 0.128| 0.118| 0.077| 0.010   | 0.077   |
| A03               | 0.040| 0.045| 0.071| 0.053| 0.063| 0.128| 0.118| 0.077| 0.010   | 0.077   |
| A04               | 0.160| 0.180| 0.142| 0.105| 0.063| 0.128| 0.118| 0.077| 0.010   | 0.120   |
| A05               | 0.160| 0.180| 0.142| 0.210| 0.125| 0.128| 0.118| 0.077| 0.010   | 0.138   |
| A06               | 0.040| 0.045| 0.036| 0.053| 0.063| 0.064| 0.118| 0.077| 0.010   | 0.066   |
| A07               | 0.040| 0.045| 0.036| 0.053| 0.063| 0.032| 0.059| 0.077| 0.010   | 0.065   |
| A08               | 0.160| 0.180| 0.142| 0.210| 0.250| 0.128| 0.118| 0.154| 0.010   | 0.160   |
| A09               | 0.160| 0.180| 0.142| 0.210| 0.250| 0.128| 0.118| 0.308| 0.200   | 0.189   |

3.6. The final result of the calculation of the ANP method
This process aims to get the value of the final results and calculations from the ANP method. After getting the priority value from the alternative candidate participants using the ANP method, it is used again to calculate the overall priority value using the following formula [11]:

\[ \text{Priority} = \frac{\text{ANP}_1 + (\text{Total Value} + (\text{Match Value} \times 50) + (\text{Experience} \times 50))}{3000} \]

Priority prediction test results are carried out so that the priority values of all prospective new students are obtained and the order of candidates who follow them. The results of comparison of priority predictions from prospective new students are presented in the table below.

| Table 2. Final priority value results. |
|---------------------------------------|
| Code | K01 | K02 | K03 | K04 | K05 | K06 | K07 | K08 | Priority Value |
|------|-----|-----|-----|-----|-----|-----|-----|-----|----------------|
| A03  | v   | V   | v   | v   | v   | 80  | 25  | 10  | 0.649683       |
| A06  | v   | V   | v   | v   | v   | 75  | 15  | 7   | 0.431349       |
| A07  | -   | -   | v   | v   | v   | 70  | 6   | 6   | 0.245159       |
| A08  | -   | -   | -   | -   | -   | 70  | 5   | 6   | 0.216587       |
| A05  | -   | -   | -   | v   | -   | 55  | 4   | 5   | 0.184206       |
| A04  | -   | -   | -   | -   | v   | 60  | 3   | 4   | 0.152540       |
| A01  | -   | -   | -   | v   | -   | 60  | 0   | 5   | 0.119206       |
| A09  | -   | -   | -   | -   | -   | 75  | 2   | 2   | 0.101587       |

3.7. Relative mistake level

| Table 3. Calculation of relative errors. |
|----------------------------------------|
| Manual calculation | System Calculation |
| No | Alternative Code | Total Value | No | Alternative Code | Total Value |
|------|------------------|-------------|------|------------------|-------------|
| 1    | Alternative Code | 0.649683    | 1    | Alternative Code | 0.649683    |
| 2    | A06              | 0.431349    | 2    | A06              | 0.431349    |
| 3    | A07              | 0.245159    | 3    | A07              | 0.245159    |
Table 3. Cont.

|   |   |   |   |   |
|---|---|---|---|---|
| 4 | A01 | 0.119206 | 4 | A01 | 0.216587 |
| 5 | A04 | 0.152540 | 5 | A04 | 0.184206 |
| 6 | A05 | 0.184206 | 6 | A05 | 0.165873 |
| 7 | A02 | 0.165873 | 7 | A02 | 0.152540 |
| 8 | A08 | 0.216587 | 8 | A08 | 0.119206 |
| 9 | A09 | 0.101587 | 9 | A09 | 0.101587 |
| Total | 2.26619 | Total | 2.26619 |

In the table above to find out how big the error rate is relative to the system calculation, it is necessary to know the difference in comparison of the calculations done manually and after applying the Analytical Network Process method using the equation

\[
Kr_m = \frac{L_m - L_p}{L_m} \times 100\%
\]

\(L_m\) = Actual measurement values

\(L_p\) = Value of Measurement of Research Results

\(Kr_m\) = Error relative to measurement results

\[
Kr_m = \frac{2.26619 - 2.26619}{2.26619} \times 100\%
\]

\(= 0\%\)

4. Conclusion

The Analytical Network Process method that is applied to the system built follows the steps of the method, namely making a paired matrix, determining vector eigenvalues, checking consistency ratios, and making supermarkets by comparing participant data and criteria data with a weighting of 2 for criteria data owned by participants and a value of 0.5 for criteria data that are not owned by prospective new students. In addition, the results of the final priority values generated are calculated further with additional criteria, namely the total test scores, the number of matches, and the number of years of experience. Then from that result, there is a relative error of 0%.

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