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Decision Making for the Best Hospital Evaluation Using the AHP-COPRAS Method

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Abstract: The assessment of the Hospital is very important in providing a rating as a measure of accreditation. Hospitals should provide the best service to visiting patients. The purpose of this study is to provide a ranking of hospitals that should be a measure of the appropriateness of a hospital as seen from a number of criteria as a true assessment. The criteria used as a barometer for the assessment consist of ten criteria, namely Administrative Services, Doctor Services, Pharmaceutical Installation Services, Cleanliness, Convenience, Security, Number of Administrative Personnel, Number of Pharmaceutical Personnel, Administrative Complaints, and Pharmacy Installation Complaints. The scoring system that will be applied uses the Analytical Hierarchy Process (AHP) method as a determinant of the weight of each criterion and the Fuzzy assessment uses the Complex Proportional Assessment (COPRAS) method. The two methods will be collaborated as a determinant in the process of giving a rating system to the ten hospitals that are included in the priority assessment. The results obtained from the ranking process of the two AHP and COPRAS methods are seen from the acquisition of the utility value produced, the largest value obtained from the utility gives the best rating. The utility value is obtained from the total assessment of a number of criteria for each hospital and the largest utility rating does not exceed one. The highest value of the utility generated by the RS10 alternative with a utility scale of 0.098 as the best value.

Keywords: AHP, COPRAS, Hospital, Multi-criteria,Utility.

INTRODUCTION

The community really hopes that with the quality of service in each hospital, the assessment of hospitals has been regulated in government regulations and the minister of health through an accreditation assessment. Every hospital always improves services to the community on an ongoing basis and this is the accreditation assessment for each hospital which is always a priority for public safety (Algunmeeyn et al., 2020). Hospital is a health service institution that organizes complete individual health services that provide inpatient, outpatient and emergency services. Accreditation Standards are guidelines that contain the level of achievement that must be met by hospitals in improving the quality of service and patient safety (Sutoto & Utarini, 2019). The KARS logo is used for hospitals that have been accredited by KARS, with valid accreditation certificates. Hospitals that have been accredited by KARS can use the KARS logo as hospital graduation with examples such as initial accreditation with 1 star, basic accreditation with 2 stars, intermediate accreditation with 3 stars, main accreditation with 4 stars, plenary accreditation is the highest accreditation with 5 stars.

This assessment was carried out by the hospital accreditation assessment team, while what will be discussed in the hospital assessment in this study is the form of implementation owned by the

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hospital . This assessment uses 10 criteria desired by the patient. The criteria used as a reference for the assessment were obtained from the development of a questionnaire on a number of respondents who wanted these criteria to work well and always improve and provide satisfaction to patients (Sutoto & Utarini, 2019).

Currently, many hospitals provide Health Insurance services such as BPJS or the like, which are also regulated in government regulations and regulations of the Minister of Health in implementing services for patients who are included with BPJS services. Through the assessment expected by patients who have a number of certain criteria. As for the number of criteria expected in the assessment of services quality perception to BPJS patients (Kondasani & Panda, 2016), there are ten criteria which is included in the patient perception quality which is most highlighted by the patients, namely Administrative Services (ADS), Doctor Services (DOS), Pharmaceutical Installation Services (PIS), Cleanliness (CLN), Convenience (KVN), Security (SCR). , Number of Administrative Personnel (NAP), Number of Pharmaceutical Personnel (NPI), Administrative Complaints (ADC), and Pharmacy Installation Complaints (PIC). All of this is an important highlight for BPJS patients, especially for patients who make payments as BPJS members. Indeed, they do not make payments directly to hospitals that have been determined by the government as hospitals that are ready to serve patients, but through certain media that are programmed by the government in mutual cooperation to help people (Fatima et al., 2018) who do not have great ability in financing very expensive hospitals on the health of a patient (Abidin, 2016). This government program has been widely recognized by the community with such good evaluations in supporting health for the wider community who have a middle to lower economy .

With this program, the community wants to be given adequate services in the healing process that they feel well and smoothly. Thus an assessment was made for twelve hospitals with ten assessment criteria included. The calculation process carried out is to provide a fuzzy assessment of the size of the criteria as a scoring based on the assessment of a number of patients who know more about the hospital and the weight ranking of each criterion using the Analityc Hierarchy Process (AHP) method (Akmaludin et al., 2020). Assessments from twelve hospitals must first go through the normalization stage before being processed using the Complex Proportional Assessment (COPRAS) method . The COPRAS method is a method that can be used for a rating system based on utility quantities (Cholil & Setyawan, 2021). Each utility value generated cannot exceed one, the value of one is the result obtained based on the overall value of the COPRAS method. The highest utility value is the value given as the highest priority (Ginting et al., 2020). Previous studies evaluating the quality of hospital services were carried out using the linear programming method with multidimensional analysis and the reliability of the results was supported by sensitivity analysis as a decision-making tool (Jiang & Liao, 2019). Other studies say that the measurement of academic value is carried out using the multi-criteria Fzzt AHP-COPRAS method to select new student admissions which is very supportive in decision making. (Kustiyahningsih & Aini, 2020). Another collaborative method COPRAS and WAPRAS which is used as an integration of strategic green supplier selection which helps in decision making (Masoomi et al., 2022).

LITERATURE REVIEW

Analytic Hierarchy Process (AHP)

Analytic Hierarchy Process (AHP) as a method that has determination of ranking criteria and alternatives by using acceptable consistency logic in any decision-making support (dos Santos et al., 2021). In this study AHP can be included in determining the criteria for hospital assessment. AHP is widely used in rankings that can stand alone and can be collaborated with other methods (de Castro-Pardo et al., 2019). This is one of the advantages of AHP which is a multi-criteria assessment in the Multi-criteria Decision Making (MCDM) group. The MCDM method was proposed by Saaty with the development of repetition techniques to get the optimal value resulting from an eigenvector, of course MCDM is very different from other methods, even though it has similarities in its usage function. Determination of the eigenvector value through a repetition process provides a real picture in the application of the assessment of a number of criteria being compared. Therefore the AHP method is

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better known as a comparison system that is applied to a comparison scale in the calculation process. The arrangement of data elements used uses the concept of two-dimensional matrices, pay attention to equation 1, where the data elements are arranged using special rules in making decisions both temporary and final decisions which are known as the synthesis process. Proof of the optimal eigenvector is known by reducing the final eigenvector value with the previous eigenvector value giving a value without any difference, so to obtain conditions like this it is necessary to do repeated calculations called repetition. The matrices multiplication process is the same as matrices calculations in general, where the connecting matrices must have the same order as the other matrices.

$$X_{(i,j)} = \begin{matrix} A_1 \\ A_2 \\ A_3 \\ \vdots \\ A_i \end{matrix} \begin{bmatrix} a_{(1,1)} & a_{(1,2)} & a_{(1,3)} & \cdots & a_{(1,j)} \\ a_{(2,1)} & a_{(2,2)} & a_{(2,3)} & \cdots & a_{(2,j)} \\ a_{(3.1)} & a_{(3,2)} & a_{(2,4)} & \cdots & a_{(3,j)} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ a_{(i,1)} & a_{(i,2)} & a_{(i,3)} & \cdots & a_{(i,j)} \end{bmatrix} \quad (1)$$

Obtaining the result of multiplying the matrices with the acquisition of the eigenvector value provides an illustration of determining whether the results are acceptable or not. The number of comparisons that must be made must comply with the established rules using equation 2, while the determination of consistency includes two stages, namely the search for the Consistency Index (CI) which is used to measure the length of the matrices by reducing the order of the matrices by dividing the two parts as a divider from the acquisition of the CI magnitude. , to find the CI value, you can use equation 2. The length of the matrices is determined by the symbol λ max which must be obtained first to find out how much the matrices have. Thus the value of the Consistent Ratio (CR) can be found using equation 3. The value of the CR value is used to determine a decision either temporary or as a final decision. Equation 3 must be supported by a Random Index (RI), each value of which is determined by the number of orders processed on a matrices, pay attention to Table 1 Random Index as a decision to be accepted or not. Whether or not a decision measure is accepted is determined by the amount of the CR value which must be equal to or less than 10 percent.

$$CN = \frac{n*(n-1)}{2} \quad (2)$$

$$CI = \frac{(\lambda \text{ max}-\text{n})}{(n-1)} \quad (3)$$

$$CR = \frac{CI}{RI} \quad (4)$$

CR calculations are indeed very influential on the Radom Index, Table 1 is the result of the determination from Saaty who found the calculations strictly, so that many researchers can only apply and use values that have become a reference in using the obtained CR values.

Table 1. Random Index (Alonso & Lamata, 2006)

Ordo	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0	0	0.6	0.9	1.12	1.24	1.32	1.41	1.45	1.48	1.51	1.48	1.56	1.57	1.58

Complex Proportional Assessment (COPRAS)

Complex Proportional Assessment (COPRAS) is a method used in multi-attribute decision making using stepwise ranking and evaluating alternative procedures regarding significance and level of utility (Goswami & Mitra, 2020). The COPRAS method is very efficient for use as an evaluation of

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the ranking of hospitals that are focused on this study. The COPRAS method is applied by setting a fuzzy value for each assessment criterion that will be normalized first before calculations are carried out with the application of COPRAS. The fuzzy method is used to carry out the conversion process for the dataset so that it can be carefully calculated to determine the amount of utility for each alternative. Some equations that can be used in the COPRAS method are determining the highest index and lowest index of a number of alternatives from each criterion. Next, determine the relative weight for each relative priority and finally determine the performance index which is called utility as a ranking determination of a number of alternatives.

The stages of completing the COPRAS method have several steps that must be carried out, the continuation process obtained through the AHP method in the COPRAS method must go through a stage called normalization which is shown through equation 5 and weighted normalization matrices from the conversion of datasets that can be used according to equation 6, p. so that it can be processed into COPRAS calculations. Entering the COPRAS method for the first time that will be carried out is the calculation of the highest index value using equation 7 and the calculation of the lowest index value that can be used in equation 8 as a derivative (Organ & Yalçın, 2016). By knowing the two largest and smallest index values, then you can proceed by knowing the relative weight in advance which can be done using equation 9. To determine the priority position of the alternative as the key to determining the ranking then use equation 10 followed by the ranking utility value of a number of alternatives through the equation 11.

$$X_{ij} = \frac{X_{ij}}{\sum_{i=1}^{m} X_{ij}} \quad (5)$$

$$D = D_{ij} = W_{ij} * W_j \quad (6)$$

$$S_{i+} = \sum_{j=1}^{k} D_{+ij} \; ; j = 1,2,3, \dots, k \quad (7)$$

$$S_{i-} = \sum_{j=1}^{k} D_{-ij} \; ; j = k+1, k+2, \dots ., n \quad (8)$$

$$Q_i = S_{+1} + \frac{S_{-imin} \sum_{i=1}^{m} S_{-i}}{S_{-i} \sum_{i=1}^{m} (\frac{S_{-imin}}{S_{-i}})} = S_{+i} + \frac{\sum_{i=1}^{m} S_{-1}}{S_{-1} \sum_{i=1}^{m} (\frac{1}{S_{-1}})} \; ; \; i = 1,2, \dots, \mathrm{m} \quad (9)$$

$$A^* = \{A_i | Max \; Q_i\} \quad (10)$$

$$P_i = \frac{Q_i}{Q_{max}} x \; 100\% \quad (11)$$

The process stages which are a collaboration of the two AHP (Ganguly & Kumar, 2019) and COPRAS methods can be realized as a method described in an algorithm which can be seen in Fig. 1. The working process of this algorithm is a method for completing hospital selection from the collaboration of the two multi-criteria methods with AHP and COPRAS as a solution to solving problems.

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METHOD

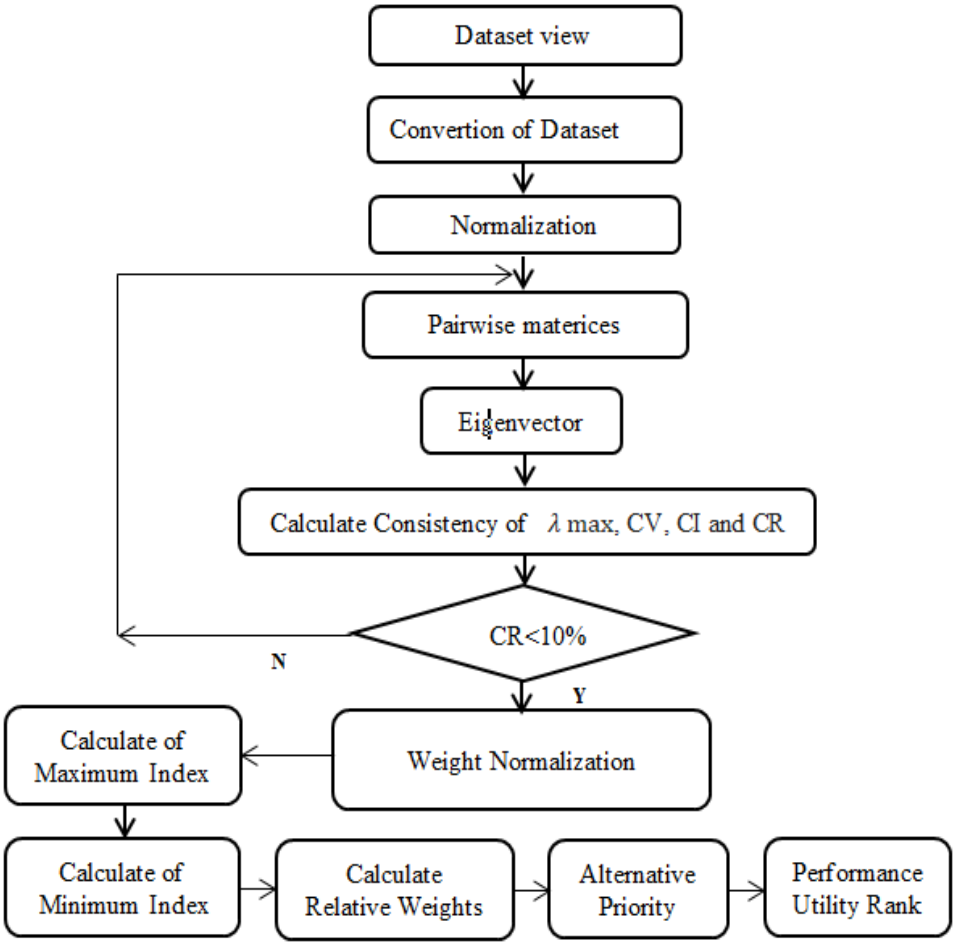

Fig. 1. AHP-COPRAS Algoritm

Explanation of the Fig. 1:

1) Dataset View: The dataset view is the input from a number of patients who go to the hospital as input to provide a fuzzy value based on a predetermined range which will be converted based on the largest and smallest range values according to the type of criteria.
2) Convertion of dataset: This process is to give a fixed value at the position of the range and by paying attention to the type of criteria where it can be seen that the largest data is the best or the smallest data is the best, because the data conditions are the opposite of the measurement of the criteria used.
3) Normalization: The normalization stage is carried out to determine the position of the existence of the converted data based on a predetermined range of values.
4) Pairwise matrices: Compile the criteria that have been compared based on their importance values in the form of a two-dimensional matrices.
5) Eigenvector: Calculations are performed in iterations until there is no visible difference between the previous eigenvector value and the last eigenvector value, until it stops at a zero value without any difference in the resulting eigenvector value. This indicates that the eigenvect value is said to be optimal.
6) Calculate consistency: The process that must be carried out to find a consistency value with respect to the magnitude of the value of each criterion being compared, whether it gives a value that is feasible for further processing or not which is measured based on the CR value must be less than or equal to 10 percent.

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7) Condition CR<10%: Paying attention to the results of the consistency calculation whether the decision process can be continued or must check the entry errors against pairwise matrices. According to the Saaty stipulation, the value of the consistency ratio (CR) must be less than ten percent, otherwise the feasibility of the process must be stopped.
8) Weight normalization: Determination of the optimal eigenvector value, will be a measure of the weight of each criterion that will be ready to be used as a calculation of each weight feasibility for use with a combination of other methods, in this study the method used is COPRAS method.
9) Calculate of maximum index: At this stage, the largest index value is determined based on the type of benefit criteria that are summed up.
10) Calculate of minimum Index: This stage determines the smallest index value based on the total type of cost criteria.
11) Calculate relative weight: Determine the relative weight based on the maximum index value and minimum index value of each criterion by taking into account the inverse value of the minimum value and the number of minimum inversion values being compared.
12) Alternative priority: Describes the position of the alternative priority position from the maximum index value added to the minimum number of priority indexes and the ratio of the maximum index value to the total minimum index value.
13) Performance utility rank: Comparison between priority alternatives with the number of priority alternatives.

RESULT

The criteria used to provide an assessment of a number of respondents to hospital services, of course, will be grouped into a number of tables of fuzzy assessment criteria. Tables related to service criteria that provide an overview of fuzzy assessments and those related to service criteria consist of three tables, namely administrative services, doctor's services, and pharmaceutical services. These three tables have similarities in terms of fuzzy assessment, see Table 1. For fuzzy assessments related to complaints as fuzzy assessments carried out with due regard to Table 2, the range of usage of complaints is calculated (Suryandartiwi, 2020) in the accumulated time for each month of service activities. Activities related to cleanliness, comfort, and safety in hospitals are defined by the size of the fuzzy numbers shown in Table 3.

Table 1. Services

Range	Description	Fuzzy Number
81-100	Very Good	4
61-80	Good	3
41-60	Good Enough	2
21-40	Good Less	1
0-20	Not Good	0

Table 3 is a reference for determining fuzzy numbers from the three criteria used, namely administrative service activities, doctor service activities, and pharmaceutical installation service activities. These activities pay great attention to and have a strong influence on the capacity mechanism for hospitals which currently have an increase in the number of patients, so that the equivalent number of patients must be directly proportional to the quantitative number of personnel.

Table 2. Complaints

Range	Description	Fuzzy Number
0-5	Very Good	4
6-10	Good	3
11-15	Good Enough	2
16-20	Good Less	1
>20	Not Good	0

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Note that shown in Table 2 which provides a fuzzy assessment of activities related to aspects of complaints at the hospital. This table is a thing that has a negative effect on hospital activities, especially in terms of serving patients.

Table 3. Cleanliness, Convinence, and Security

Range	Description	Fuzzy Number
81-100	Very Good	4
61-80	Good	3
41-60	Good Enough	2
21-40	Good Less	1
0-20	Not Good	0

By paying attention to table 3, it is a very important part that is highly maintained by every hospital, where criteria relating to cleanliness, convenience and security are criteria that are the mainstay of the hospital as the biggest concern that is ready to serve patients, this is part of the assessment smallest and still be taken into account in the assessment.

A number of fuzzy numbers that have been described above as assessment criteria for hospitals, will be shown in detail in Table 4, which will explain the use of the ten criteria which are used as hospital assessment criteria which are included in full with the type of criteria. These ten criteria will be calculated for the assessment of the amount of weight that each criterion has, see Table 4.

Table 4. Criteria

Kode	Criteria	Type (Benefit/Cost)
C1	Administrative Services (ADS)	(B)
C2	Doctor Service (DOS)	(B)
C3	Pharmaceutical Installation Services (PIS)	(B)
C4	Cleanliness (CLN)	(B)
C5	Convenience (KVN)	(B)
C6	Security (SCR)	(B)
C7	Number of Administrative Personnel (NAP)	(B)
C8	Number of Pharmaceutical Personnel (NPI)	(B)
C9	Administrative Complaints ADC)	(C)
C10	Pharmacy Installation Complaints (PIC)	(C)

With many assessment criteria, the assessment of the hospital becomes very complicated, so a method is needed that can solve the problems experienced by patients, especially in patient care. The recommended method in determining the ranking of hospitals is a collaboration of the two methods, namely the analytic hierarchy process (AHP) method and the Complex Proportional Assessment (COPRAS) method. Both of these methods have identification to handle all matters related to multi-criteria. Starting from the description of the dataset view that has passed the assessment results of a number of patients through an assessment questionnaire with a convenient sampling technique, shown in Table 5.

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Table 5. Dataset view

Type	(B)	(B)	(B)	(B)	(B)	(B)	(B)	(B)	(C)	(C)
Alt. \ Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
RS01	78	79	75	1	6	12	12	85	85	86
RS02	75	75	60	3	6	16	12	75	85	85
RS03	84	76	78	3	8	21	24	90	82	85
RS04	70	77	75	2	7	18	21	78	82	90
RS05	76	73	75	6	5	18	18	88	90	90
RS06	60	75	75	11	3	9	14	75	97	85
RS07	77	75	70	6	12	15	12	90	96	85
RS08	74	75	70	2	8	21	20	90	90	88
RS09	70	60	70	6	8	18	18	75	88	76
RS10	85	80	82	2	1	24	25	85	95	90
RS11	58	75	75	4	6	7	7	88	78	88
RS12	73	75	78	9	7	15	12	75	76	75

Observe Table 5 which provides an overview of the accumulative ratings from a number of respondents as a dataset view which is the basic assessment of the twelve hospitals. This view dataset will be converted into fuzzy numbers which have been explained in the assessment tables above, as an initial assessment using the COPRAS method. The process of conversion results will be shown in Table 6.

Table 6. Fuzzy number convertion of dataset

Type	(B)	(B)	(B)	(B)	(B)	(B)	(B)	(B)	(C)	(C)
Alt \ Criteria	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
RS01	3	3	3	4	3	12	12	4	4	4
RS02	3	3	4	4	3	16	12	3	4	4
RS03	4	3	3	4	3	21	24	4	4	4
RS04	3	3	3	4	3	18	21	3	4	4
RS05	3	3	3	3	4	18	18	4	4	4
RS06	4	3	3	2	4	9	14	3	4	4
RS07	3	3	3	3	2	15	12	4	4	4
RS08	3	3	3	4	3	21	20	4	4	4
RS09	3	4	3	3	3	18	18	3	4	3
RS10	4	4	4	4	4	24	25	4	4	4
RS11	2	3	3	4	3	7	7	4	3	4
RS12	3	3	3	3	3	15	12	3	3	3

The results of the conversion of the fuzzy numbers listed in Table 6 will be used as the basic data for collaborative calculations of the AHP method and the COPRAS method. The AHP method will be used to determine the amount of each weight for each criterion and the COPRAS method is used to determine which process and rating system must go through one more process, namely normalization, see Table 7.

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Table 7. Normalization

Type Alt \Criteria	(B) C1	(B) C2	(B) C3	(B) C4	(B) C5	(B) C6	(B) C7	(B) C8	(C) C9	(C) C10
RS01	0.079	0.079	0.079	0.095	0.079	0.062	0.062	0.093	0.087	0.087
RS02	0.079	0.079	0.105	0.095	0.079	0.082	0.062	0.070	0.087	0.087
RS03	0.105	0.079	0.079	0.095	0.079	0.108	0.123	0.093	0.087	0.087
RS04	0.079	0.079	0.079	0.095	0.079	0.093	0.108	0.070	0.087	0.087
RS05	0.079	0.079	0.079	0.071	0.105	0.093	0.092	0.093	0.087	0.087
RS06	0.105	0.079	0.079	0.048	0.105	0.046	0.072	0.070	0.087	0.087
RS07	0.079	0.079	0.079	0.071	0.053	0.077	0.062	0.093	0.087	0.087
RS08	0.079	0.079	0.079	0.095	0.079	0.108	0.103	0.093	0.087	0.087
RS09	0.079	0.105	0.079	0.071	0.079	0.093	0.092	0.070	0.087	0.065
RS10	0.105	0.105	0.105	0.095	0.105	0.124	0.128	0.093	0.087	0.087
RS11	0.053	0.079	0.079	0.095	0.079	0.036	0.036	0.093	0.065	0.087
RS12	0.079	0.079	0.079	0.071	0.079	0.077	0.062	0.070	0.065	0.065

Observe Table 7 which is the beginning of the process of determining the weight of each criterion using the AHP method with an assessment of the importance of each criterion. The preparation of criteria using the two-dimensional concept matrices in determining the element matrices is in accordance with equation 1. The number of comparison criteria to be compared can be applied to equation 2, as a basis for determining the weight of each criterion.

The process of multiplication matrices can be done using the mathematic algebra matrices method with the iteration concept to find the optimal eigenvector value. The MCDM-AHP method is the best method in determining the weight of the criteria (Ali et al., 2019) in this study. The iteration process is carried out through five stages, to obtain optimal eigenvector values, note Table 8 which is the result of obtaining optimal eigenvector values using mathematical algebra matrices and Fig.2 which is the result of obtaining optimal eigenvector value using expert choice apps (Ahmad et al., 2020) whith the overall inconsistency 0,06; you can see on Fig. 2.

Table 8. Optimum eigenvector using mathematic algebra matrices

Criteria	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**Eigenvector**
C1	1.000	2.023	2.101	2.052	2.140	2.145	2.026	2.341	2.634	2.422	0.179
C2	0.494	1.000	2.021	2.164	2.234	2.347	3.034	3.142	3.268	2.046	0.169
C3	0.476	0.495	1.000	2.042	2.302	2.435	2.554	2.563	2.945	3.032	0.144
C4	0.487	0.462	0.490	1.000	2.034	2.153	2.236	2.225	3.035	3.023	0.117
C5	0.467	0.448	0.434	0.492	1.000	2.342	2.326	2.043	3.055	3.026	0.102
C6	0.466	0.426	0.411	0.464	0.427	1.000	2.045	2.138	3.042	2.162	0.081
C7	0.494	0.330	0.392	0.447	0.430	0.489	1.000	3.033	2.136	2.034	0.069
C8	0.427	0.318	0.390	0.449	0.489	0.468	0.330	1.000	2.302	2.022	0.054
C9	0.380	0.306	0.340	0.329	0.327	0.329	0.468	0.434	1.000	3.163	0.046
C10	0.413	0.489	0.330	0.331	0.330	0.463	0.492	0.495	0.316	1.000	0.040
The Result of □ Max=	**10.823**	***CI=***	**0.091**	***CR=***	**0.062**						

The optimum eigenvector value using the mathematical algebra matrices in Table 8, there is an until five iteration process to produce an optimal decision on the eigenvector value, this is done as evidenced by the acquisition of a consistency ratio value of 0.062 which states that the determination of the ten criteria can proceed to the next process using the difrerent method collaboration.

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Fig. 2. Optimum Eigenvector using Expert Choice Apps (Al-Harbi, 2001)

Observe Table 8 as the determination of the optimum eigenvector value which will be a reference in the process of calculating weight normalization which has an important role in the application of the COPRAS method as a whole up to the ranking stage. With the acquisition of the eigenvector, each criterion weight can be processed from each of the alternatives listed through the conversion process, see Table 9.

Table 9.Weight Normalization

Type \Criteria	(B) C1	(B) C2	(B) C3	(B) C4	(B) C5	(B) C6	(B) C7	(B) C8	(C) C9	(C) C10
Alternative\Weight	0.179	0.169	0.144	0.117	0.102	0.081	0.069	0.054	0.046	0.040
RS01	0.014	0.013	0.011	0.011	0.008	0.005	0.004	0.005	0.004	0.003
RS02	0.014	0.013	0.015	0.011	0.008	0.007	0.004	0.004	0.004	0.003
RS03	0.019	0.013	0.011	0.011	0.008	0.009	0.009	0.005	0.004	0.003
RS04	0.014	0.013	0.011	0.011	0.008	0.008	0.007	0.004	0.004	0.003
RS05	0.014	0.013	0.011	0.008	0.011	0.008	0.006	0.005	0.004	0.003
RS06	0.019	0.013	0.011	0.006	0.011	0.004	0.005	0.004	0.004	0.003
RS07	0.014	0.013	0.011	0.008	0.005	0.006	0.004	0.005	0.004	0.003
RS08	0.014	0.013	0.011	0.011	0.008	0.009	0.007	0.005	0.004	0.003
RS09	0.014	0.018	0.011	0.008	0.008	0.008	0.006	0.004	0.004	0.003
RS10	0.019	0.018	0.015	0.011	0.011	0.010	0.009	0.005	0.004	0.003
RS11	0.009	0.013	0.011	0.011	0.008	0.003	0.002	0.005	0.003	0.003
RS12	0.014	0.013	0.011	0.008	0.008	0.006	0.004	0.004	0.003	0.003

The results listed in Table 9 can be applied in determining the ranking system in the COPRAS method, the steps are carried out according to those listed in equation 5 to equation 11, which will complete the ranking system for the twelve alternatives that are used as hospital assessments. The stages of the normalization process and weight normalization are the key basis for calculating the COPRAS method (Bagga et al., 2019), the results of this method can be seen in Table 10.

Table 10. Utility results of COPRAS

Alt	S+i	S-i	1/S-i	S-i * Total 1/S-i	Q	U	Ranking
RS10	0.083	0.022	45.729	14.586	0.098	0.098	1
RS03	0.073	0.019	52.112	12.800	0.090	0.090	2
RS09	0.067	0.016	60.972	10.940	0.087	0.087	3
RS07	0.062	0.014	72.872	9.153	0.086	0.086	4
RS06	0.063	0.016	61.385	10.866	0.084	0.084	5
RS08	0.067	0.019	52.112	12.800	0.084	0.084	6
RS05	0.065	0.019	52.413	12.726	0.082	0.082	7
RS04	0.065	0.019	52.112	12.800	0.082	0.082	8
RS02	0.065	0.019	52.112	12.800	0.082	0.082	9
RS12	0.059	0.016	60.972	10.940	0.079	0.079	10
RS01	0.061	0.019	52.112	12.800	0.078	0.078	11
RS11	0.051	0.019	52.112	12.800	0.068	0.068	12

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DISCUSSIONS

Paying attention to the calculation process using the COPRAS method as a multi-criteria decision making, of course, in determining the weight of the criteria it is not based on the wishes of the researcher. The use of many criteria as a barometer of assessment attributes, preferably using the mathematical algebra matrix method and expert choice apps, so that the criteria weighting technique is in accordance with research ethics, so setting the criteria weights becomes more valuable for research and the results obtained in determining the rating system become more consistent. This treatment can be a consideration for researchers in developing aspects of knowledge in the world of research. The collaboration of the AHP and COPRAS methods can be optimally applied as seen in the determination of the weights obtained from calculating the optimal values of the normalized eigenvectors. Likewise, the data in the COPRAS method also undergoes a normalization process for the dataset, so that the stages of the normalization process are carried out twice, this proves that the results of the collaboration of the AHP and COPRAS methods provide very optimal values and are very influential in decision making as has been obtained in performance utility to simplify the ranking system, which of course takes into account the type of each criterion used. There are two types of criteria used, namely benefits and costs, determine with processed data that is contradictory, you have to understand more deeply in determining data normalization, so that the processed data will be easy to process with other methods. In previous studies it was seen that there were differences in determining the value of the criteria based on the wishes of the researcher, so that it did not consider the interests of others in determining the assessment of the weight of each criterion, this would of course be subjective. This is a real difference to the results generated based on the many responses from many people who processed it based on research with the help of the matrix algebraic method compared to expert choice apps.

CONCLUSION

The collaboration of the AHP and COPRAS methods can provide a rating system that provides results that are able to apply service selection assessments to twelve hospitals through very long stages. The AHP method is the core of the normalization process, where the normalization process is the basic principle in determining the locations of the twelve alternatives, so that they can be processed into the calculations of the COPRAS method. The process applied to the COPRAS method also includes a process of normalizing the processed dataset, so that the collaboration of the AHP and COPRAS methods gives very optimal results. The scoring system using the COPRAS method provides the best solution in determining the ranking of twelve hospitals in terms of utility acquisition as a rating benchmark. The largest utility value will occupy the best position in the assessment and become the top priority in the rating system. The results obtained from the assessment of the twelve hospitals with the highest rating were RS10, followed by RS03 in second place. By implementing the collaboration of the AHP and COPRAS methods, we can provide an optimal hospital ranking solution based on the optimal eigenvector value measure through the iterative stages of the normalization process. Further research allows it to be carried out even deeper, especially in determining the optimal decision results that can be compared again.

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REFERENCES

Abidin. (2016). Pengaruh Kualitas Pelayanan BPJS Kesehatan terhadap Kepuasan Pasien di Puskesmas Cempaka Kota Parepare Effect of BPJS Health Service Quality on Patient Satisfaction in Cempae Community Health Center , Parepare City. *Jurnal Mkm*, *12*(2), 70–75.

Ahmad, I., Kim, S. K., Lee, J., & Rho, J. J. (2020). Analytic hierarchy process model for the selection of optimal internet access technologies in rural Pakistan. *International Journal of the Analytic Hierarchy Process*, *12*(2), 254–271. https://doi.org/10.13033/ijahp.v12i2.712

Akmaludin, A., Hartati, T., Purwanto, H., & Sukendar, T. (2020). The Best Selection of Programmers in Generation 4 . 0 Using AHP and ELECTRE Elimination Methods The Best Selection of Programmers in Generation 4 . 0 Using AHP and ELECTRE Elimination Methods. *Journal Conference Series*, 0–7. https://doi.org/10.1088/1742-6596/1477/3/032001

Al-Harbi, K. M. A. S. (2001). Application of the AHP in project management. *International Journal of Project Management*, *19*(1), 19–27. https://doi.org/10.1016/S0263-7863(99)00038-1

Algunmeeyn, A., Alrawashdeh, M., & Alhabashneh, H. (2020). Benefits of applying for hospital accreditation: The perspective of staff. *Journal of Nursing Management*, *28*(6), 1233–1240. https://doi.org/10.1111/jonm.13066

Ali, Y., Haroon, M., Abdullah, M., & Khan, A. U. (2019). The best manufacturing procedure for the commercial production of urea: Using AHP based topsis. *International Journal of the Analytic Hierarchy Process*, *11*(3), 313–330. https://doi.org/10.13033/ijahp.v11i3.636

Alonso, J. A., & Lamata, M. T. (2006). Consistency in the analytic hierarchy process: a new approach. *International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems*, *14*(4), 445–459. https://doi.org/10.1142/S0218488506004114

Bagga, P., Joshi, A., & Hans, R. (2019). QoS based Web Service Selection and Multi-Criteria Decision Making Methods. *International Journal of Interactive Multimedia and Artificial Intelligence*, *5*(4), 113. https://doi.org/10.9781/ijimai.2017.12.001

Cholil, S. R., & Setyawan, M. A. (2021). Metode COPRAS untuk Menentukan Kain Terbaik dalam Pembuatan Pakaian pada Butik Batik Hatta Semarang. *Jurnal Teknologi Informasi Dan Ilmu Komputer*, *8*(6), 1169. https://doi.org/10.25126/jtiik.2021863584

de Castro-Pardo, M., de la Fuente-Cabrero, C., Laguna-Sánchez, P., & Pérez-Rodríguez, F. (2019). Combining AHP and goal programming in the context of the assessment of e-learning. *International Journal of the Analytic Hierarchy Process*, *11*(3), 301–312. https://doi.org/10.13033/ijahp.v11i3.630

dos Santos, M., de Araújo Costa, I. P., & Gomes, C. F. S. (2021). Multicriteria Decision-Making In The Selection Of Warships: A New Approach To The Ahp Method. *International Journal of the Analytic Hierarchy Process*, *13*(1), 147–169. https://doi.org/10.13033/ijahp.v13i1.833

Fatima, T., Malik, S. A., & Shabbir, A. (2018). Hospital healthcare service quality, patient satisfaction and loyalty: An investigation in context of private healthcare systems. *International Journal of Quality and Reliability Management*, *35*(6), 1195–1214. https://doi.org/10.1108/IJQRM-02-2017-0031

Ganguly, A., & Kumar, C. (2019). Evaluating supply chain resiliency strategies in the Indian pharmaceutical sector: A Fuzzy Analytic Hierarchy Process (F-AHP) approach. *International Journal of the Analytic Hierarchy Process*, *11*(2), 153–180. https://doi.org/10.13033/ijahp.v11i2.620

Ginting, G., Alvita, S., Karim, A., Syahrizal, M., & Khairani Daulay, N. (2020). Penerapan Complex Proportional Assessment (COPRAS) Dalam Penentuan Kepolisian Sektor Terbaik. *Jurnal Sains Komputer & Informatika (J-SAKTI*, *4*(2), 616–631.

Goswami, S. S., & Mitra, S. (2020). Selecting the best mobile model by applying AHP-COPRAS and AHP-ARAS decision making methodology. *International Journal of Data and Network Science*, *4*(1), 27–42. https://doi.org/10.5267/j.ijdns.2019.8.004

Jiang, L., & Liao, H. (2019). A Linear Programming Method Based on Probabilistic Linguistic Kolmogorov-Smirnov Distance for Hospital Service Quality Evaluation. *2019 IEEE Symposium Series on Computational Intelligence, SSCI 2019*, 3195–3200. https://doi.org/10.1109/SSCI44817.2019.9003104

*name of corresponding author

Kondasani, R. K. R., & Panda, R. K. (2016). Service Quality Perception and Behavioural Intention: A Study of Indian Private Hospitals. *Journal of Health Management*, *18*(1), 188–203. https://doi.org/10.1177/0972063416639168

Kustiyahningsih, Y., & Aini, I. Q. H. (2020). Integration of FAHP and COPRAS Method for New Student Admission Decision Making. *Proceeding - 2020 3rd International Conference on Vocational Education and Electrical Engineering: Strengthening the Framework of Society 5.0 through Innovations in Education, Electrical, Engineering and Informatics Engineering, ICVEE 2020*, *November*. https://doi.org/10.1109/ICVEE50212.2020.9243260

Masoomi, B., Sahebi, I. G., Fathi, M., Yıldırım, F., & Ghorbani, S. (2022). Strategic supplier selection for renewable energy supply chain under green capabilities (fuzzy BWM-WASPAS-COPRAS approach). *Energy Strategy Reviews*, *40*(January). https://doi.org/10.1016/j.esr.2022.100815

Organ, A., & Yalçın, E. (2016). Performance Evaluation Of Research Assistants By Copras Method. *European Scientific Journal*, *7881*(August), 1857–7881.

Suryandartiwi, W. (2020). Pengaruh Complaint Handling terhadap Patient Loyalty Melalui Satisfaction Complaint Handling di RS Penyelenggara BPJS Yogyakarta. *Jurnal Administrasi Rumah Sakit*, *1*(1), 34–46.

Sutoto, S., & Utarini, A. (2019). Mendorong riset dan berbagi pengalaman untuk peningkatan mutu dan keselamatan pasien di rumah sakit. *The Journal of Hospital Accreditation*, *1*(1), 1–2. https://doi.org/10.35727/jha.v1i1.18

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