

# 31. Online Fuzzy C-Means Clustering for Lecturer Performance Assessment Based on National and International Journal Publication

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## Online Fuzzy C-Means Clustering for Lecturer Performance Assessment Based on National and International Journal Publication

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### ABSTRACT

One way that can be done to determine the quality of lecturer performance is to conduct an assessment of the number of scientific publications have been conducted by the lecturers. The data of Mathematic and Natural Science Lecturer, Unnes, totaled 160 lecturers will be assessed based on national and international journal publications. By using these data sources, will be applied data mining using Fuzzy C-Means algorithms and clustering method. Clustering method is one of the main methods of data analysis to help identify a grouping of data objects (cluster) of the dataset. The data of lecturer journal publications will be processed by a variable that is used as the assessment benchmark are index Scopus, journal accreditation, and the index DOAJ. So it will be found knowledge, information, and performance assessment of lecturers into four clusters which consisting of various lecturers. From the results of clustering using C-Means Clustering then obtained the FMIPA lecturer performance assessment on national and international journal publication.

**Keywords :** *online fuzzy, C-Means, Clustering, Lecturer Performance Assessment*

### INTRODUCTION

In any organization, the activities regarding the performance assessment or performance quality of each worker or employee is a common activity undertaken by an organization or institution. It also applies to institutions in higher education, whether it be university, college, or high school. Universities which has qualified lecturers will be much in demand by the public. Because of that, a program to improve the quality of lecturers becomes an obligation that is not negotiable in the present and the future. [1]

The performance assessment is the determination of periodic operational effectiveness based on strategic objectives, standards and criteria established previously. One of the main factors that determine the quality of education in universities is the quality of lecturer that is in it. Lecturer is one important component of the education system in college. A lecturer should also have high discipline, also must have a sense of responsibility towards the education they provide to students. In executing the Tri Dharma Perguruan Tinggi, professors implement three types of activities, namely education and teaching, research, and community service. Thus, lecturer performance can also be seen from the number of publications of research that has been done. A lecturer is obliged to conduct a study. [2]

One way that can be done to determine the quality of lecturer performance is to conduct an assessment of the number of scientific publications that have been conducted by a lecturer using Fuzzy C-Means. This method is quite effective in simplifying and accelerating the process of making a decision to solve the problem into its parts.

Fuzzy c-means is the development of non hierarchical method c-means cluster allocating data to each group by using fuzzy set theory. In the fuzzy c-means used variables of membership function which refers to how likely the data could become a member in a group.

By using fuzzy c-means algorithms, to conduct the necessary assessment clustering of datasets. Clustering method is one of the main methods of data analysis to help identify grouping of data objects from the dataset. Clustering is an an unattended classification and is the process of partitioning a set of objects from a set of data into several classes. Cluster analysis is a multivariate technique that has the main purpose to classify objects based on characteristics. Cluster analysis to classify objects so that each object is the closest similarity to other objects are in the same cluster. The

groups formed has a high internal homogeneity and external heterogeneity is high. [3]

According to its case, the research problem of the studies is how to implement of Fuzzy C-Means Clustering in determination of lecturer performance based on national and international journal publication which this research is devoted for lecturer in each departement of Mathematic and Natural Science in Semarang State University. The data show that from 2001 to 2016, as many publications indexed journals lecturer internationally, in this case indexed in Scopus were 110 journals from 1579 journals. So there needs an enhancement in the activity of journal publications to International scale.

Data publication of the journal will do weighting based on a predetermined value of Dikti in the number of credits of each journal that has been published. There are several kinds of journals that earn the number of credits in scoring, among which journals have been indexed Scopus indexed journals DOAJ, journals have been accredited by Dikti.

In this study, data from the weighting are divided into two weight values of national and international weight values of the respective lecturers. Then the results were processed using the application software RapidMiner to get the result of data clustering.

The purpose of this research is to get the result of Fuzzy C-Means Clustering implementation and the result of lecturer performance assessment into deficient\_cluster, and active\_cluster. The study was conducted with the testing of the system has been built. System testing is done by calculating the level of accuracy in applying the system C-Means Clustering method to lecturers by the publication of national and international journals.

## METHODS

Clustering method is one of the main methods of data analysis to help identify grouping of data objects from the dataset. Clustering is an unsupervised classification and is the process of partitioning a set of objects from a set of data into several classes. This can be done by applying various equations and measures regarding the distance algorithm, namely the Euclidean Distance [4]

Cluster analysis is a multivariate technique that has the main purpose to classify objects based on characteristics. Cluster analysis to classify objects so that each object is the closest similarity to other objects are in the same cluster. The groups formed has a high internal homogeneity and external heterogeneity is high. The focus of the cluster analysis is comparing objects based

on a set of variables, it is this which led experts to define the set of variables as a critical stage in the cluster analysis. Set variable cluster is a set of variables that represent characteristics of the used objects. There are differences between the methods and algorithms Clustering Clustering. [5]

Clustering solves the problem. While Clustering algorithm is just an example of the method. All Clustering algorithm can basically be categorized into two main categories. Namely the partition and hierarchy. One algorithm which belong to the partition is a K-Means.

In general, the technique of fuzzy cluster is to minimize the objective function which is the main parameters in the fuzzy membership functions (MF), which is also called the fuzzier (awonn and Hoppner, 2001). Klawonn was specifically concerned with fuzzy clustering as a good method to use in grouping the spatial data and image analysis (Laboratory of Data Analysis and Pattern Recognition). Therefore, most of the references of this article was obtained from the research journal Klawonn along with other researchers. [6]

The main principle of grouping with fuzzy c-means cluster is to minimize the objective function

$$J_{FCM} (P, U, X, c, m) = \sum_{i=1}^c \sum_{k=1}^N (u_{ik})^m d_{ik}^2(x_k, p_i)$$

assuming the constraint

$$\sum_{i=1}^c u_{ik} = 1, u_{ik} \in \{0, 1\}, k \in \{1, K, N\}$$

P and U are variables optimum condition which expected for the matrix U optimum conditions mean convergence of the group's membership in the FCM. X, c, m are input parameter from JFCM, where:

- c is the number of clusters that meet X (number of clusters desired,  $2 \leq c < N$ )
- $m \geq 1$  is the level of all the late-fuzzy grouping results. This parameter is called the fuzzier, the value of m that is often used and is considered the most delicate is  $m=2$  (Klawonn dan Höppner, 2001)
- $u_{ik}$  is a membership level that an element of the matrix U.
- N is number of observations
- $d_{ik}^2$  is the distance observation can be formulated as follows:

$$d_{ik}^2(x_k, p_i) = \|x_k - p_i\|^2 = (x_k - p_i)^T A (x_k - p_i)$$

Clustering algorithm Fuzzy C-means cluster is given as follows:

1. Determine C, a lot of clusters or groups who want to be made.
2. Determining the level of all fuzzy-and grouped (m).
3. Calculating fuzzy cluster center (P) by the equation (2)

$$P_i = \frac{\sum_{k=1}^N u_{ij}^m x_k}{\sum_{k=1}^N u_{ij}^m}$$

4. Update members of the matrix U by the equation

$$u_{ij} = \frac{1}{\sum_{j=1}^c \left( \frac{d_{ij}^2}{d_{ij}^2} \right)}$$

5. Compare the value of membership in the matrix U, if not much changed then the meaning is convergent and has a maximum membership. The iteration is stopped and the results obtained grouping

Before processing the data, the data is collected in the form of excel from every department in the Faculty of Mathematics and Natural Sciences Pengentahuan. Table 1 is a breakdown of the number of journals and the number of lecturers who successfully obtained, starting from the year 2013 until the month of April 2016 of all lecturers in the Faculty of Mathematics and Natural Sciences, State University of Semarang.

**Table 1.** Details Number Journal and Lecturer

NO.	DEPARTEMENT	LECTURER NUMBER	JOURNALS NUMBER
1.	Biology	39	380
2.	Physics	24	164
3.	Computer Science	10	85
4.	Natural Sciences	21	283
5.	Chemistry	29	323
6.	Mathematics	39	344

In applying this C-Means Clustering method of data that has to be tested it is necessary to calculate the weighting of the journal based on the journals of national and international journals. The following weighting value equation:

**Table 2.** Calculation of Weight Journal

NO.	LECTURER NAME	TITLE	JOURNAL	WEIGHT	AUTHOR	AUTHOR NUMBER	AUTHOR ROLE	PERFORMANCE WEIGHT
1.	Margareta R.	Bird Community in Taman Kebati Universitas Negeri Semarang	International Journal of Ecology & Development	40	M. Rahayuningsih, B. Priyono	2	1	24

$$x = \frac{W \quad P \quad e \quad x W}{a \quad p}$$

For the percentage of the author are based on the percentage of authors in the journal publication, the percentage of 60% to 40% and the first author to author other than the first. While the weighting is determined by a predetermined value of Higher Education in the number of credits of each journal that has been published. There are several kinds of journals that earn the number of credits in scoring, among which journals have been indexed weighted Scopus 40, journals have been indexed DOAJ 20 journals have been accredited Higher Education 15, and non-accredited journals weighted 10.

As the sample to calculate the weights on each journal on behalf Margareta Rahayuningsih (Table 2) of the Department of Biology, the calculations to get the weights are as follows:

$$x = \frac{W \quad P \quad x W}{a \quad p c}$$

$$x = \frac{6 / 1 \quad x 4}{1}$$

$$x = 2$$

Weighting results in the form of a journal entry excel containing the data associated with the name of the lecturer, a national journal publications weight, the weight of international journal publications, with the aim that in testing the system by utilizing the application RapidMiner can easily import the data.

Thus, the value of the weight of each journal that has been published can be seen from the calculation of the weighting. From the calculation of the weighting is based on the publication of national and international journals, so that the results obtained weighted sum of grades of lecturers

The collected data is then calculated based on the weighted attributes obtained. Table 3 is information related to the calculation of the weighting of the results of national and international journal publications.

**Table 3.** Description Variable Weight Calculation

NO.	ATTRIBUTE	INFORMATION
1.	Title	The title is the result of research in the form of a journal published by the lecturers.
2.	Journal	Source lecturer journal publications.
3.	Weight	A number of credits obtained by statutes that have been determined by the government consisting of accredited national journal publications by DIKTI, national journals indexed DOAJ berbahas British national journals indexed DOAJ Indonesian language, and non-accredited national journals. Then for international journals among other reputable international journals indexed SCOPUS and non reputed international journals.
4.	Author	List of names of authors listed in the research journal.
5.	Author Number	Number of author names listed in the research journal.
6.	Performance Weight	Calculated based on the percentage of writers, weight, and the number of authors.



**Figure 2.** Fuzzy Cluster Center

**RESULTS AND DISCUSSION**

Weighting results entered in the application RadiMinner by applying the C-Means clustering method so that the data from each cluster known lecturers from six departments in the Faculty of Mathematics and Natural Sciences, State University of Semarang. There are 160 lecturers that will be implemented into the system of counting based on the weight of national and international.

In this study, the data obtained is processed under the condition that the desired clusterisasi is 2, then many clusters there are two points. So fuzzy cluster center for weight A (national weight) and the weight B (the international weights) can be seen in Figure 2.

Based on fuzzy cluster center is obtained, it can be seen that the criteria for weighting A where cluster\_1 is a high weight, then cluster\_0, is a low weight. Then to the weight B, where it can be seen that for cluster\_1 is high weight of B, and cluster\_0 is low weight of B.

Based on the results of the application of methods Clustering Fuzzy C-Means logic that has been done, it

can be seen the performance level of the lecturers in the Faculty of Mathematics and Natural Sciences, State University of Semarang in the publication of national and international journals. From the results obtained, there are four groups, each group consisting of various lecturers from six departments in the Faculty of Mathematics and Natural Sciences, State University of Semarang as shown in Table 4.

**Table 4.** Details of Cluster Data

NO.	CLUSTER	NUMBER
1.	The High NationalWeight, High International Weight	0
2.	The High NationalWeight, Low International Weight	5
3.	The Low National Weight, High International Weight	9
4.	The Low NationalWeight, Low International Weight	146

From the results of the implementation of the system it can be seen that the lecturer has a weight of national height and weight of high international as much as 0, then for a

lecturer with the weight of national height and weight of international low as 7 lecturers, and professors with the weight of national low and the weight of international higher by 9 lecturers then national lecturers with lower weight and international low weight as much as 146 lecturers.

#### **CONCLUSION**

In applying the fuzzy logic with C-Means clustering method in the evaluation of faculty performance can be done using applications Rapid Miner. Data processing is carried out in several stages, halted from data collection to calculate the weights of each journal publications of national and international journals. Then the results of weight recapitulated by distinguishing between national and international publications. Yield data recapitulated in the form of excel so that data can be imported into applications Rapid Miner. Data processing with the application of fuzzy logic with C-Means clustering method can be cluster\_0 and cluster\_1 diclusterisasikan who then showed clusters of all lecturers in the Faculty of Mathematics and Natural Sciences, State University of Semarang. Based on the results of pengolhan these data, it can be related to the results of clusterisasi obtained 4 cluster: the lecturer who has high national weight and high international weight as much as 0, then for a lecturer with high national weight and low international weight as 5 lecturers, and professors with a low national weight and high international weight as much as 9 lecturer and lecturers with low national weights and low international weight of 146 lecturers.

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