

SELEKSI FITUR CHI-SQUARE PADA ALGORITMA *UNSUPERVISED LEARNING* UNTUK PENGUKURAN INDIKATOR KINERJA UTAMA DI PROVINSI RIAU

TUGAS AKHIR

Diajukan Sebagai Salah Satu Syarat
untuk Memperoleh Gelar Sarjana Komputer pada
Program Studi Sistem Informasi

Oleh:

UMAIRAH RIZKYA GURNING

11950320687



RIAU

UIN SUSKA RIAU

FAKULTAS SAINS DAN TEKNOLOGI
UNIVERSITAS ISLAM NEGERI SULTAN SYARIF KASIM RIAU
PEKANBARU

2023

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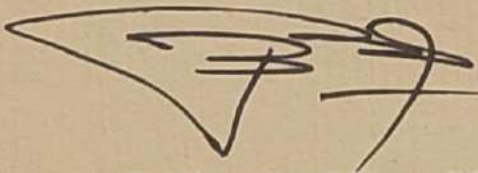
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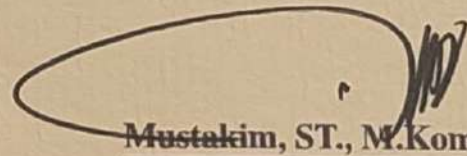
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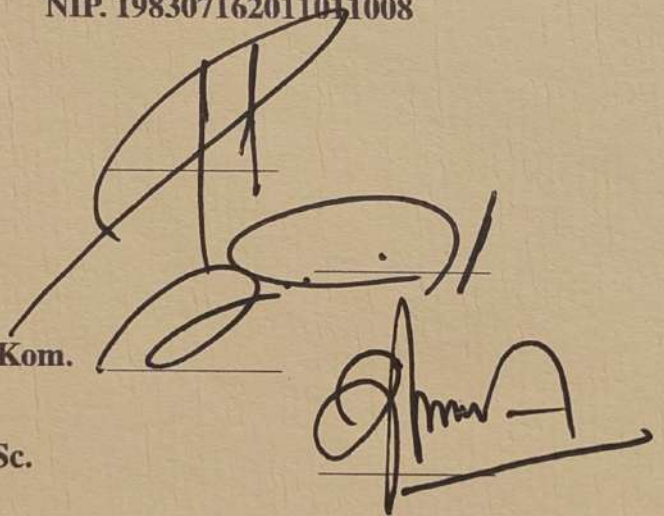
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Sekretaris : Mustakim, ST., M.Kom.

Anggota 1 : Inggih Permana, ST., M.Kom.

Anggota 2 : Idria Maita, S.Kom., M.Sc.



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NIM : 11950320687
Program Studi : Sistem Informasi
Seleksi Fitur Chi-Square pada Algoritma
Judul Tugas Akhir : Unsupervised Learning Untuk Pengukuran
Indikator Kinerja Utama di Provinsi Riau

Menyatakan bahwa akan melengkapi seluruh kelengkapan administrasi Tugas Akhir Program Studi Sistem Informasi Fakultas Sains dan Teknologi Universitas Islam Negeri Sultan Syarif Kasim Riau berupa bukti pelaksanaan conference secara lengkap. Demikian yang dapat Saya sampaikan dengan sesungguhnya. Saya ucapkan Terimakasih.

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Yang membuat pernyataan,

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LEMBAR PERSEMBAHAN

Bismillahirrahmanirrahim

Subhanallah walhamdulillah wa laailahailallah wallahuakbar, allahumma sholli ala sayyidina muhammad wa ala ali sayyidina muhammad. Dengan segenap terimakasih dan puji beserta syukur saya haturkan kepada Allah SWT, tuhan seluruh semesta dan pemilik segenap perkara yang menciptakan manusia dengan roh beserta akal. Tidak terhitung segala limpahan nikmat dan rahmat-Mu, sampai akhirnya saya dapat menyajikan laporan Tugas Akhir ini. Segala bentuk kekurangan sekiranya menjadi koreksi untuk pengembangan saya agar menjadi lebih baik dan terdapat manfaat pada Tugas Akhir ini, *Aamiin ya Rabbala'lamiin.*

Penuh dengan segala rasa sujud syukurku dengan mengharapkan ridho-Mu ya Allah SWT yang telah menjadikan saya hamba yang senantiasa bertafakur, beriman, berpendidikan, dan permisif ketika melewati segala lika-liku aktivitas ini. Kupersembahkan hadiah istimewa ini karya kecilku sebagai salah satu bentuk bakti, rasa terimakasih, dan hormatku kepadamu orang tuaku tercinta, ayah dan mama.

Ayahanda dan ibundaku tersayang, terimakasih untuk setiap perjuangan yang engkau usahakan, ungkapan doa yang selalu engkau hanturkan disetiap sujud panjangmu, membimbing, dan mendorong saya dalam kebaikan dan selalu ada saat keadaan tersulit sekalipun. Terimakasih untuk segala pengorbanan yang engkau lakukan sampai kapanpun tiada rasa, tiada cara yang dapat membalas semua yang engkau lakukan. Untuk itu ananda selalu mendoakan yang terbaik untuk ayah dan mama agar bahagia dunia dan akhirat kelak serta diberikan bagian istimewa di sisi-Nya serta sehingga kita bisa berkumpul kembali bersama-sama di *Jannah-Nya.*

Untuk kakak dan adik yang sangat saya cintai. Terimakasih untuk segala waktu berharga yang telah dilalui bersama, doa, dan dukungan yang tiada hentinya. Terimakasih juga saya ucapkan untuk bapak dan ibu dosen Sistem Informasi yang sudah mewariskan ilmu, motivasi, dan panduan untuk menyelesaikan Tugas Akhir ini dengan baik. Kemudian untuk teman seperjuangan terimakasih telah memberikan dukungan dan motivasi, semoga terus diberikan rahmat serta karuniannya, dan dilimpahkan kemudahan dengan berlipat ganda. *Aamiin.*

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KATA PENGANTAR

Alhamdulillah Robbil 'Alamin, bersyukur kehadiran Allah *Subhanahu Wa Ta'ala* atas segala rahmat dan karunianya sehingga saya dapat menyelesaikan Tugas Akhir ini dengan judul “Seleksi Fitur Chi-Square pada Algoritma Unsupervised Learning untuk Pengukuran Indikator Kinerja Utama di Provinsi Riau”. Shalawat serta salam kita ucapkan kepada *Sayyidina Wa Habibina* Nabi Muhammad *Shallallahu Alaihi Wassalam* dengan mengucapkan *Allahumma Sholli'Ala Sayyidina Muhammad Wa'Ala Alihi Sayyid- ina Muhammad*. Tugas Akhir ini dibuat sebagai salah satu syarat untuk mendapatkan gelar Sarjana Komputer di Program Studi Sistem Informasi Universitas Islam Negeri Sultan Syarif Kasim Riau.

Pada penulisan Tugas Akhir ini, ada beberapa pihak yang sudah berkontribusi dan mendukung Peneliti baik berupa materi, moril, dan motivasi. Ucapan terimakasih dan doa kepada:

1. Bapak Prof. Dr. Hairunas, M.Ag sebagai Rektor Universitas Islam Negeri Sultan Syarif Kasim Riau.
2. Bapak Dr. Hartono, M.Pd sebagai Dekan Fakultas Sains dan Teknologi.
3. Bapak Eki Saputra, S.Kom., M.Kom sebagai Ketua Program Studi Sistem Informasi.
4. Bapak Mustakim, ST., M.Kom sebagai dosen pembimbing Tugas Akhir ini.
5. Ibu Siti Monalisa, ST., M.Kom sebagai Sekretaris Program Studi Sistem Informasi, Fakultas Sains dan Teknologi, Universitas Islam Negeri Sultan Syarif Kasim Riau.
6. Bapak Tengku Khairil Ahsyar, S.Kom., M.Kom sebagai Kepala Laboratorium Program Studi Fakultas Sains dan Teknologi, Sistem Informasi, Universitas Islam Negeri Sultan Syarif Kasim Riau.
7. Bapak Inggih Permana, ST., M.Kom sebagai Penguji I sekaligus Pembimbing Akademik Peneliti yang telah banyak memberikan arahan, masukan dan motivasi dalam perkuliahan hingga penyelesaian Tugas Akhir ini.
8. Ibu Idria Maita, S.Kom., M.Sc sebagai Penguji II Peneliti yang telah banyak memberikan arahan dan masukan dalam penyelesaian Tugas Akhir ini.
9. Ibu dan Bapak dosen Sistem Informasi yang telah memberikan ilmunya kepada Peneliti. Mudah-mudahan semua ilmu yang diberikan dapat Peneliti amalkan dan semoga menjadi amal jariyah.
10. Kedua orangtua Peneliti, Chandra Gurning, SE dan Syarifah Susilawaty, S.KM yang tanpa lelah untuk terus memberikan semangat, motivasi, dukungan, bantuan serta doa terbaiknya dan selalu menjadi motivasi peneliti

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dalam menyelesaikan Tugas Akhir ini.

11. Kakak dan adik tercinta. Terima kasih selalu memberikan perhatian, memberikan semangat, doa, dan dorongan kepada peneliti.
12. Teman-teman seperjuangan Sistem Informasi angkatan 2019 Kelas A yang tidak bisa peneliti sebutkan satu persatu.
13. Tim Riset yang membanggakan *Puzzle Research Data Technology* (PREDATECH) terdiri dari Dosen Pembimbing terbaik (Pak Mustakim, Pak Inggih, Pak Afdal, Buk Rice Novita, dan Dosen lainnya), para alumni (Bang Assad, Bang Said, Kak Rahmi, Kak Jeni, Kak Rahmatul dan lainnya), Teman-teman seperjuangan seperangkatan (Sania, Sarah, Ratna, Adyah, Weni, Hilda, Bobby, Rizky, Akhas, dan lainnya), Adik-adik (Hamdi, Wiwit, Anisa, Suryani, Na-ufal, dan lainnya) serta Teman-teman PREDATECH lainnya yang tidak bisa peneliti sebutkan satu persatu yang selalu menyemangati, memberikan masukan, memberikan ilmu terbaiknya dan menjadi inspirasi Peneliti.
14. Semua pihak yang namanya tidak dapat disebutkan satu persatu yang telah banyak membantu dalam pelaksanaan Tugas Akhir dan menyelesaikan laporan Tugas Akhir ini.

Semoga dengan segala jerih payah dan dorongan yang telah diberikan selama ini akan menjadi amal kebajikan dan mendapatkan balasan yang layak dari Allah *Subhanahu Wa Ta'ala*. Tentunya pada Laporan Tugas Akhir ini masih jauh dari kesempurnaan dan masih banyak kekurangan. Penulis berharap ada masukan, kritikan, maupun saran yang dapat disampaikan melalui e-mail 11950320687@students.uin-suska.ac.id atau umairahrizkyagurning@gmail.com dan semoga laporan ini bermanfaat bagi kita semua. Akhir kata penulis ucapkan terimakasih.

UIN SUSKA RIAU

Pekanbaru, 16 Januari 2023

Penulis,

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[2023 ICCoSITE] Your paper #1570871914 ('Chi-Square Features Selection in Unsupervised Learning Algorithm for Measuring Key Performance Indicators in Riau Province')

1 pesan

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26 Desember 2022 pukul 14.25

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Kepada: Umairah Rizky Gurning <11950320687@students.uin-suska.ac.id>, Mustakim Mustakim <mustakim@uin-suska.ac.id>, Inggih Permana <ingghipermana@uin-suska.ac.id>, Idria Maita <idria@uin-suska.ac.id>

Dear Mrs. Umairah Gurning:

Congratulations - your paper #1570871914 ('Chi-Square Features Selection in Unsupervised Learning Algorithm for Measuring Key Performance Indicators in Riau Province') for 2023 ICCoSITE has been **accepted** to be presented and published in The The 2023 International Conference on Computer Science, Information Technology and Engineering - 2023 ICCoSITE which will be held in Virtual (Jakarta, Indonesia) during 29th January 2022.

The double-blind review process has already been taken from three reviewers and the results are attached to this email. You have to revise your paper aligned with the review results.

The reviews are below or can be found at [1570871914](#).

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LETTER OF ACCEPTANCE

2023 International Conference on Computer Science, Information Technology, & Engineering
Virtual Conference (Online) 16-17 February 2023

Paper : 1570871914
Chi-Square Features Selection in Unsupervised Learning Algorithm for Measuring Key Performance Indicators in Riau Province

Authors : Umairah Rizky Gurning (Universitas Islam Negeri Sultan Syarif Kasim Riau & Puzzle Research Data Technology, Indonesia); Mustakim Mustakim (Universitas Islam Negeri Sultan Syarif Kasim Riau, Indonesia & Puzzle Research Data Technology, Indonesia); Inggh Permana (Lec, Indonesia); Idria Maita (UIN SUSKA RIAU, Indonesia)

Dear Author(s),

We are pleased to inform you that your paper has been **accepted to be presented** in the 2023 International Conference on Computer Science, Information Technology, & Engineering (ICCoSITE) which organized by **Bina Insani University** with our partner **APTİKOM, Universitas Indraprasta PGRI, Universitas Nasional, Institut Teknologi Garut, and STMIK ROSMA.**

The ICCoSITE will be conducted as a virtual conference on 16-17 February 2023. The accepted and presented paper has been strictly undergone the peer-reviewed process and will be submitted for uploading to the IEEE Xplore Digital Library and it will be normally indexed in SCOPUS database.


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Congratulations on the acceptance of your paper and thank you for your interest. We look forward to seeing you at the conference soon.

General Chair,



Ahmad Chusyairi, S.Kom., M.Kom.

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Chi-Square Features Selection in Unsupervised Learning Algorithm for Measuring Key Performance Indicators in Riau Province

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Abstract— *The process of obtaining population documents which still takes time, causes the population service need to find a pattern of community satisfaction as an improvement. Key Performance Indicator has been regulated by the Ministry of Administrative Reform has 14 service elements that must be considered, with many of these elements making it difficult to find data patterns and can reduce the value of the accuracy and performance of an algorithm. In this study, feature selection was applied using Chi-Square and applying the K-Means, K-Medoid, FCM, SOM, and DBSCAN algorithms to find elemental patterns that must be prioritized in increasing community satisfaction. After processing the algorithm, the best cluster validity was obtained in the DBSCAN algorithm which used the Chi-Square feature selection with a value of 0.47 and obtained 5 features that were very influential in measuring community satisfaction, especially in the implementation of Sistem Informasi Administrasi Kependudukan (SIAK) in Dumai City population agency.*

Keywords— *Chi-Square, Clustering, Feature Selection, Key Performance Indicator, Sistem Informasi Administrasi Kependudukan (SIAK), Unsupervised Learning*

I. INTRODUCTION

Indonesian population data management Since 2013 has been stored in the National Database by implementing a Sistem Informasi Administrasi Kependudukan (SIAK) as stipulated in Law No.24 of 2013 explains the population and use of SIAK in managing various population data [1][2][3]. This system has been applied in all regions of Indonesia including Riau Province [4]. Based on data from the Central Statistics Agency, Dumai is one of the cities in Riau Province that has a population of 323,452 people [5] SIAK Dumai City manages data a hundreds thousands of people, but its application still involves physical documents so as to hamper the service process. To improve public services, the government makes the Key Performance Indicator (KPI) which is used as a benchmark to increase the effectiveness of services with 14 elements of service listed in Kep. Men. PAN 25, 2004. The number of elements causes some elements to often be neglected and cannot determine its main priority.

Many data dimensions are considered inefficient in problems related to modeling and data processing due to the

discovery of the "Curse Of Dimensionality" problem, where data size can significantly increase the spatial and temporal complexity of data processing [6][7][8]. In this sense, data with many features can hamper the process of recognizing data patterns [9]. In this sense, data with many features can hamper the process of recognizing data patterns [10], or randomly removing features from the data can cause data loss [11], while irrelevant or redundant features can also make the method less efficient [12]

To get a model that is easy to interpret, achieve more efficient performance, avoid overfitting, and achieve high accuracy, this can be achieved by reducing data dimensions, but suitable methods must be used to reduce dimensions so as not to cause data loss [13][14]. Methods that can be used for feature reduction are feature extraction and feature selection [6][12][15]. Feature extraction is the process of extracting new features from the original features using feature mapping [16], feature information is converted into a lower dimensional space [17], while feature selection is the process of selecting a subset of features from original features [18], features are a subset of features [19]. The selected function is processed as characteristic data [20]. The advantage of feature selection over feature extraction is that feature selection allows better understanding of data, whereas feature extraction does not [6][18].

There are various methods that can be used for feature selection, as was done by Tanti, Sirait, and Andri, in 2021, researching solutions to overcome class inequality, so that classifier performance is optimized using chi-square and adaboost. Regarding the results obtained, the two methods have the ability to increase the achievement value of minority group rankings [19]. Another study by Anisa in 2022 optimized the Naïve Bayes algorithm with chi-square to produce an increase in accuracy, which initially obtained an accuracy of 82%, but has increased to 83%. It can be said that the application of chi-square has succeeded in increasing the accuracy value of the naïve Bayes classifier [20].

As a renewal of previous research, this research compares several Unsupervised Learning algorithms using the Chi-Square feature selection. In clustering data is divided into

several clusters that have the same meaning in the cluster [12]. The unsupervised learning algorithm used in this study is K-Means, the simplest and easiest algorithm to implement [21], Self-Organizing Map (SOM) which has the advantage of being able to explore grouping and relationships in high dimensional data [22], K-Medoid is an algorithm that can overcome the problem of Noise and Outlier [23], Fuzzy C-Means (FCM) has an advantage in understanding unclear data [24] and density-based spatial clustering of applications with noise (DBSCAN) based on density so Excellent in grouping large data [25]. This research uses data questioners distributed to the people of Dumai City. By implementing the algorithm, this research is expected to obtain the attributes or features that most influence the community satisfaction assessment index in government agencies, especially in the application of SIAK in Dumai City and obtain a good validity cluster to the application of Chi-Square as a feature selection.

II. RESEARCH METODOLOGY

In this research applied five stages with the steps listed in Figure 1. The method used in this study was the data mining feature selection method and the clustering algorithm by applying the Chi-Square model to the K-Means Clustering algorithm, K-Medoids, FCM, SOM and DBSCAN.

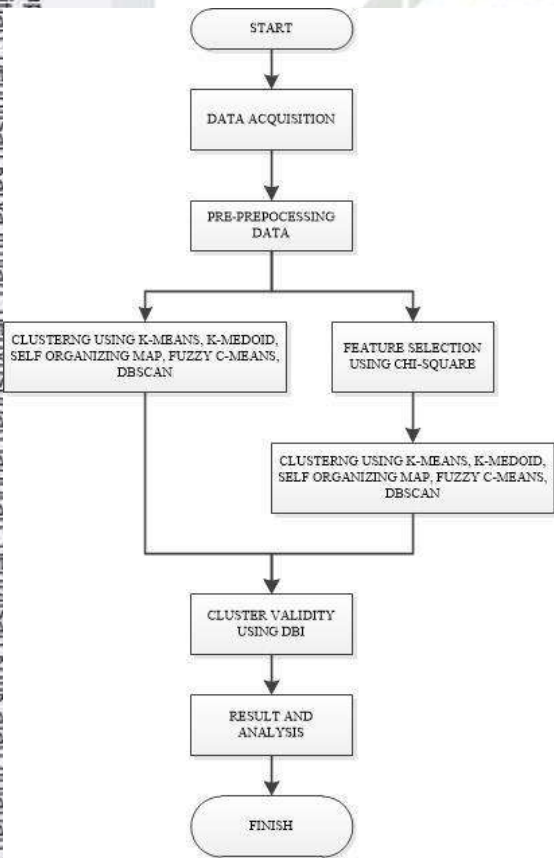


Fig. 1. Research Methodology

A. Feature Selection

Feature Selection is a subset of significant features for use in the data processing [21]. The main advantage of FS is to facilitate understanding of information, reduce training and overcome dimensional curse problems. In addition, the complexity and processing requirements of classification are also reduced [22][23].

B. Chi-Square

Chi-square is used to select features or determine better features by testing the freedom of a term with its category [24]. This method considers the emergence of categories and characteristics [25]. This method is a feature selection that can eliminate features without lowering the accuracy value obtained [26][27].

C. K-Means

This algorithm is an algorithm for fast grouping large data and abnormal data based on the degree of similarity and dissimilarity of objects [28]. The use of this algorithm in the clustering depends on the data owned and the conclusions you want to draw by testing each attribute in the existing data set and grouping these attributes into a cluster with the closest distance. Calculation of the distance of the cluster is done by equation 1 [29].

$$m \sum_k d_{ik} \sqrt{\sum_{j=1}^m (c_{ij} - x_{ik})^2} \quad (1)$$

D. K-Medoids

K-Medoid algorithm is an algorithm based on the use of Medoids, which aims to reduce the sensitivity of partitions related to extreme values of data. K-Medoids uses objects as representatives of the cluster center (medoids) of each cluster so that it is also called Partitioning Around Medoids (PAM) [30]. In processing with K-Medoid each data is allocated to the cluster that is closest to equation 3 which is called the Euclidian Distance equation [31].

$$d_{ik} \sqrt{\sum_{j=1}^m (c_{ij} - x_{ik})^2} \quad (2)$$

E. Fuzzy C-Means

FCM is a data mining grouping method [32][33]. FCM uses the Fuzzy group model, so that data can be included in any category or cluster formed by membership, or membership varies between 0 and the existence of data in a cluster is represented by the specified membership level [34][35]. To calculate the center of the cluster in this algorithm can use equation 3.

$$V_{kj} = \frac{\sum_{i=1}^n ((\mu_{ik})^w * x_{ij})}{\sum_{i=1}^n (\mu_{ik})^w} \quad (3)$$

F. Self-Organizing Map (SOM)

In 1982, Professor Teuvo Kohonen launched a neural network method called Self Organizing Map (SOM) [36][37][38]. This algorithm is a topology of the Unsupervised Artificial Neural Network (ANN) algorithm, which does not require supervision [39]. When SOM classifying data, the characteristics of the data are used as a reference for grouping [36][40]. This algorithm consists of layers that are interconnected, namely the output that describes the cluster and the input that is given [41]. The distance between vectors in SOM can be calculated by equation 4.

$$D_i = \sum_{j=1}^n (W_{ij} - X_j)^2 \quad (4)$$



where in this trial feature selection had no effect on reducing the DBI value but the value obtained was quite good compared to the experiments in the previous algorithm.

Self-Organizing Map (SOM)

Experiments with the SOM algorithm produce DBI values which can be seen in Figure 5.

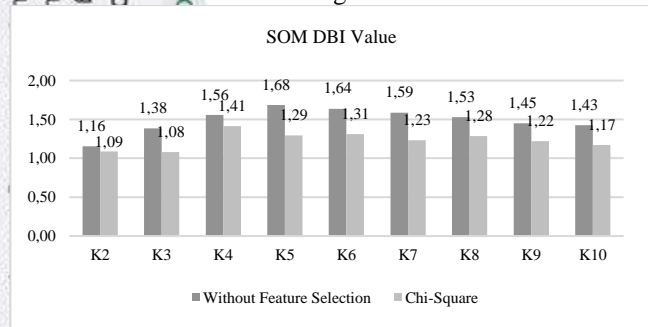


Fig. 5. The results of SOM cluster validity

Experiments with the SOM algorithm produced unfavorable DBI values, namely with an average DBI value of all 1.36. Data with selection features can reduce the DBI value by 9% in this algorithm.

Density-Based Spatial Clustering Of Applications With Noise (DBSCAN)

The last experiment in this study was carried out with the DBSCAN algorithm. In this algorithm, data inflection points are obtained at values 1 and 0.33, so this algorithm experiment uses an epsilon value of 1 for data without feature selection and 0.33 for data with feature selection. The results of the cluster validity of the SOM algorithm can be seen in Figure 6.

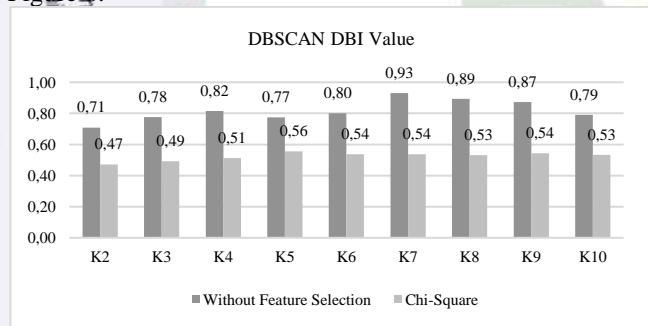


Fig. 6. The results of DBSCAN cluster validity

Based on experiments conducted with the DBSCAN algorithm, the best algorithm performance increases compared to other algorithms as evidenced by a decrease in the DBI value of 22% and an average DBI value of 0.29.

Comparison of DBI Values

Comparison of the results of the DBI unsupervised learning algorithm without feature selection in this study can be seen in Figure 6.

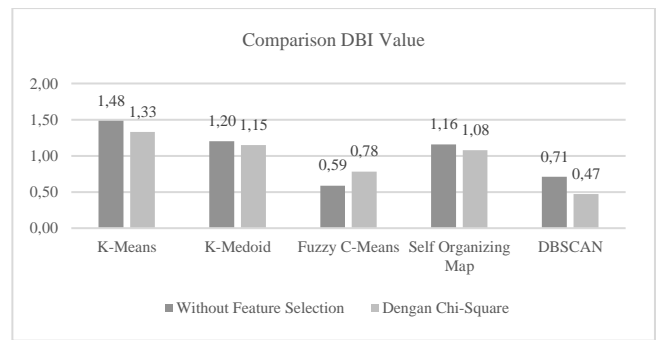


Fig. 7. Comparison DBI Value

Based on a comparison of the DBI values, we can see that the average obtained after using feature selection has decreased by 3%, from 1.02 without feature selection to 0.96 after using feature selection. And the algorithm with the best average DBI value is DBSCAN with an average value of 0.58.

IV. CONCLUSION

Based on the experimental results in this study, the best DBI value was 0.47 in the DBSCAN algorithm experiment with Chi-Square feature selection. So it can be concluded that the best algorithm for finding patterns of community satisfaction is DBSCAN, from its application it can also be seen that feature selection has an effect on improving algorithm performance and increasing accuracy values but different from the FCM algorithm the application of feature selection is considered less influential for decreasing accuracy. Based on this research that applies Chi-Square feature selection, it selects 14 attributes into 5 attributes, namely A7, A8, A10, A11 and A13. The attributes are (A7) Service speed, (A8) Fairness in getting service, (A10) Fairness of service fees, (A11) Fixed service schedule and (A13) Environmental comfort. So that agencies are expected to emphasize and improve services, especially on the five attributes.

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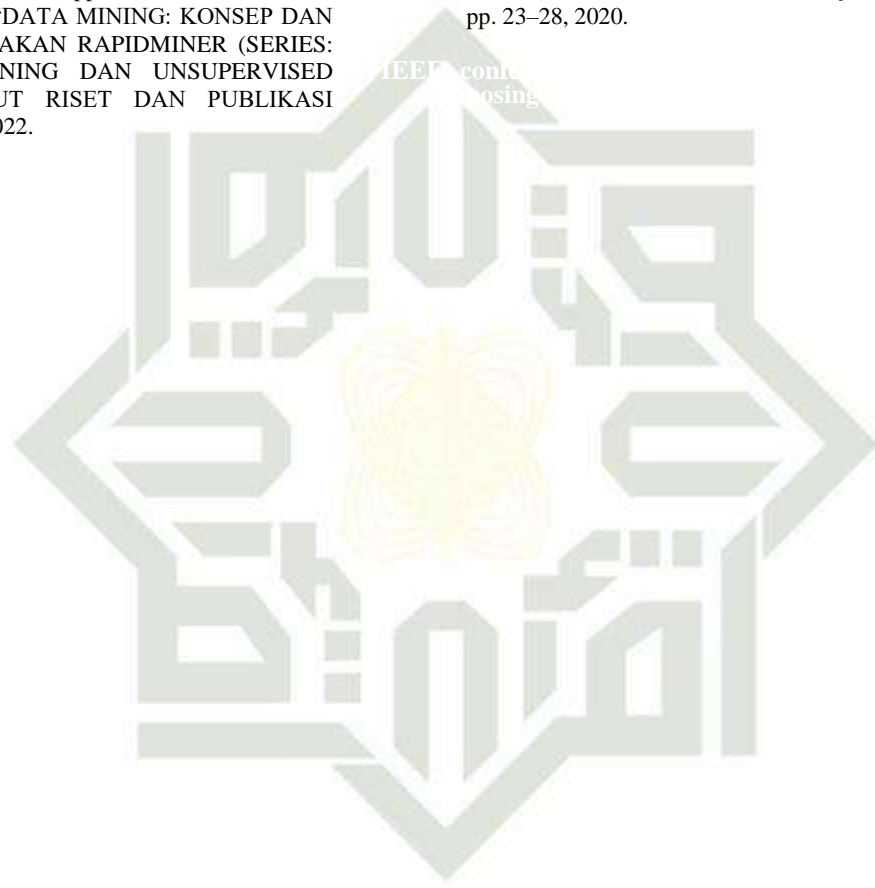
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Jakarta - Indonesia

CONFERENCE DATES
16 - 17
FEB 2023

Topics of interest include:

Communication, Networking, and Broadcasting

1. Communication Systems and Communication Standards
2. Sensor Networks
3. Acoustic and Under Water Communication
4. Security and Authentication
5. Ad-hoc Networks and Wireless Networks
6. RFID and Applications
7. Vehicular Technology and Networks
8. Information Security and Network Security
9. Parallel and Distributed Systems
10. Remote Sensing and Geographic Information System
11. Multimedia Information Processing and Retrieval
12. Telecommunication and Mobile Communication

Computing and Processing

1. Soft Computing, Fuzzy Logic and Artificial Neural Networks
2. Mathematical Modeling and Simulation
3. Data Mining, Web Technology and Ontology
4. Cloud Computing
5. Green Computing
6. Mobile Computing
7. Nanoelectronics and Quantum Computing
8. Big Data
9. Internet of Things

Signal Processing & Analysis

1. Image, Speech, and Signal Processing
2. Computer Vision
3. Artificial Intelligence
4. Pattern Recognition

Information System

1. Business Intelligence
2. E-Business
3. Big Data Analytics
4. Graph Analytics
5. Real-time Big Data Analysis
6. Data Models for Big and Smart Data
7. Business Models for Big Data and Smart Data
8. Semantic Web Applications
9. Data and Information Quality
10. Information Extraction
11. Data Integration
12. Conceptualization, Notation, and Ontologies
13. Enterprise Modelling on Data and Information
14. Data Management for Analytics
15. Web Analytics
16. Statistics Exploratory Data Analysis
17. Data Modelling and Visualization
18. Data Structures and Data Management
19. City Data Management
20. Deep Learning and Big Data
21. Social Web Search and Mining
22. Big Data as a Service

Robotics & Internet of Things

1. Sensors
2. Embedded Systems Design
3. Hardware Implementation
4. Vehicular Technology
5. Simulation and Hardware Implementation Techniques
6. Robotics and Mechatronics
7. Control Systems

Important Date:

Deadline
Full Papers Submission: 5th December 2022
Papers Acceptance Notification: 27th December 2022
Payment Registration: 31th December 2022
Upload Final Manuscript: 10th January 2023
Conference Day: 16th - 17th February 2023

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	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	Tingkat Kepuasan
4	4	4	4	5	4	5	5	4	5	4	4	4	4	Puas
4	4	4	3	4	4	4	3	4	3	3	4	4	4	Puas
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DAFTAR RIWAYAT HIDUP



Umairah Rizky Gurning lahir di kota Medan, pada tanggal 10 Juni 2001. Peneliti merupakan anak dari Bapak Chandra Gurning dan Ibu Syarifah Susilawaty, merupakan anak kedua dari tiga bersaudara yakni Syacha Memai Gurning sebagai kakak kandung dan Muhammad Akhyar Gurning sebagai adik kandung. Pada tahun 2006 peneliti memulai pendidikan dengan masuk TK Nurul Muslimin Kota Medan dan lulus pada tahun 2007. Selanjutnya peneliti melanjutkan ke jenjang sekolah dasar di SD Islam Terpadu Al-Ulum Medan pada tahun 2007 kemudian menamatkan sekolah dasar pada tahun 2013 di SD Negeri 004 Kota Dumai, setelah menempuh pendidikan sekolah dasar selama 6 tahun, pada tahun 2013 peneliti melanjutkan pendidikan sekolah menengah pertama di SMP Negeri 3 Kota Dumai. Kemudian, setelah 3 tahun menyelesaikan pendidikan di bangku sekolah menengah pertama, pada tahun 2016 peneliti melanjutkan pendidikan sekolah menengah atas di SMA Negeri 1 Kota Dumai dengan jurusan IPA. Setelah menyelesaikan pendidikan di SMAN 1 Kota Dumai pada tahun 2019 peneliti diterima menjadi mahasiswa Program Studi Sistem Informasi Fakultas Sains dan Teknologi Universitas Islam Negeri Sultan Syarif Kasim Riau (UIN Suska Riau) melalui jalur SNMPTN. Peneliti juga menjadi penerima Beasiswa Prestasi Pemerintah Provinsi Riau pada tahun 2020. Selain itu juga peneliti tergabung didalam komunitas grup research Study Club Puzzle Reasearch Data Technology UIN Sultan Syarif Kasim Riau pada tahun 2019. Akhir kata peneliti mengucapkan rasa syukur yang tak terhingga serta ribuan terimakasih atas bantuan seluruh pihak terkait sehingga selesainya Tugas Akhir ini yang berjudul "Seleksi Fitur Chi-Square pada Algoritma Unsupervised Learning untuk Pengukuran Indikator Kinerja Utama di Provinsi Riau".