BAB V

SIMPULAN DAN SARAN

5.1 Simpulan

Berdasarkan hasil penelitian yang telah dilakukan, dapat disimpulkan beberapa hal sebagai berikut:

1. Penggunaan Algoritma Klastering yang dioptimasi dapat meningkatkan kualitas klastering. Dibuktikan dengan nilai evaluasi seperti *Sillhoutte Score*, *Davies Bouldin Index*, dan *Calinski Harabasz Index* yang ditunjukkan dengan nilai SCA-KM 0,7393272 dan KM-ALPSO 0,7393269 yang lebih tinggi dibandingkan algoritma *K-Means* 0,7390778.
2. Penerapan Algoritma Optimasi seperti ALPSO, IHHO, SCA, dan GA terbukti efektif dalam menghindari solusi lokal minimum dan dapat meningkatkan akurasi segmentasi dibandingkan dengan algoritma klastering dasar.
3. Preprocessing data berperan penting dalam meningkatkan hasil klastering, dengan mengurangi *noise* dan kesenjangan antar data yang cukup jauh, yang berdampak pada peningkatan hasil klastering dan akurasi dalam pengelompokkan pelanggan.

5.2 Saran

Berdasarkan hasil penelitian ini, terdapat beberapa saran yang dapat diberikan untuk penelitian dan pengembangan selanjutnya adalah:

1. Penggunaan data yang lebih besar dan lebih kompleks untuk menguji generalisasi dan skalabilitas algoritma-algoritma yang dikembangkan, terutama pada *e-commerce* skala besar.

2. Pengembangan algoritma klastering lebih lanjut dengan menambahkan algoritma optimasi yang lainnya atau menambahkan optimasi yang dilakukan untuk menambah efektivitas algoritma klastering.
3. Dapat menambahkan algoritma evaluasi eksternal untuk validasi lebih lanjut, terutama jika tersedia *label ground-truth* dari data klaster.
4. Dapat dilakukan pencarian nilai parameter secara otomatis berdasarkan dataset yang digunakan serta dapat mencari kombinasi parameter yang sesuai berdasarkan dataset yang digunakan.

DAFTAR PUSTAKA

Afzal, A., Khan, L., Hussain, M. Z., Zulkifl Hasan, M., Mustafa, M., Khalid, A., Awan, R., Ashraf, F., Khan, Z. A., & Javaid, A. (2024). *Customer Segmentation Using avg Clustering*. *2024 IEEE 9th International Conference for Convergence in Technology, I2CT 2024*. https://doi.org/10.1109/I2CT61223.2024.10543349

Armaya'u, Z. U., Gumel, M. M., & Tuge, H. S. (2022). *Comparing Flowchart and Swim Lane Activity Diagram for Aiding Transitioning to Object-Oriented Implementation*. *American Journal of Education and Technology*, *1*(2), 88–106. https://doi.org/10.54536/ajet.v1i2.612

Breitinger, F., & Jotterand, A. (2023). *Sharing datasets for digital forensic: A novel taxonomy and legal concerns*. *Forensic Science International: Digital Investigation*, *45*. https://doi.org/10.1016/j.fsidi.2023.301562

Chaudhuri, A. B. (2020). *Flowchart and Algorithm Basics: The Art of Programming*. *Mercury Learning and Information*.

Cullu, K., Guzel, S., Zontul, M., & Karateke, S. (2023). *Customer segmentation-based basket analysis with association rule mining combined with SVD and K-Means algorithms*. *2023 Innovations in Intelligent Systems and Applications Conference, ASYU 2023*. https://doi.org/10.1109/ASYU58738.2023.10296718

Elgamal, Z. M., Yasin, N. B. M., Tubishat, M., Alswaitti, M., & Mirjalili, S. (2020). *An improved harris hawks optimization algorithm with simulated annealing for feature selection in the medical field*. *IEEE Access*, *8*, 186638–186652. https://doi.org/10.1109/ACCESS.2020.3029728

Gumasing, M. J. J., Prasetyo, Y. T., Ong, A. K. S., Persada, S. F., & Nadlifatin, R. (2023). *Factors influencing the perceived usability of wearable chair exoskeleton with market*

segmentation: A structural equation modeling and K-Means Clustering approach. *International Journal of Industrial Ergonomics*, *93*. https://doi.org/10.1016/j.ergon.2022.103401

Henderi , Wahyuningsih , T., & Rahwanto, E. (2021). *Comparison of Min-Max normalization and Z-Score Normalization in the K-nearest neighbor (kNN) Algorithm to Test the Accuracy of Types of Breast Cancer*. http://archive.ics.uci.edu/ml.

Hosen, M. A., Moz, S. H., Kabir, S. S., Galib, S. M., & Adnan, M. N. (2023). *Enhancing Thyroid Patient Dietary Management with an Optimized Recommender System based on PSO and K-means*. *Procedia Computer Science*, *230*, 688–697. https://doi.org/10.1016/j.procs.2023.12.124

Kuo, R. J., Alfareza, M. N., & Nguyen, T. P. Q. (2023). *Genetic based density peak possibilistic fuzzy c-means algorithms to cluster analysis- a case study on customer segmentation*. *Engineering Science and Technology, an International Journal*, *47*. https://doi.org/10.1016/j.jestch.2023.101525

Kuo, R. J., Amornnikun, P., & Nguyen, T. P. Q. (2020). *Metaheuristic-based possibilistic multivariate fuzzy weighted c-means algorithms for market segmentation*. *Applied Soft Computing Journal*, *96*. https://doi.org/10.1016/j.asoc.2020.106639

Kuo, R. J., Zheng, Y. R., & Nguyen, T. P. Q. (2021). *Metaheuristic-based possibilistic fuzzy k-modes algorithms for categorical data clustering*. *Information Sciences*, *557*, 1–15. https://doi.org/10.1016/j.ins.2020.12.051

Lasisi, M., & Kolade, K. (2025). *Data Mining*. In *Encyclopedia of Libraries, Librarianship, and Information Science* (pp. 82–88). Elsevier. https://doi.org/10.1016/B978-0-323-95689-5.00190-5

Li, Y., Chu, X., Tian, D., Feng, J., & Mu, W. (2021). *Customer segmentation using K-means clustering and the adaptive particle swarm optimization algorithm*. *Applied Soft Computing*, *113*. https://doi.org/10.1016/j.asoc.2021.107924

Matthes, E. (2023). *Python Crash Course, 3rd Edition: A Hands-On, Project-Based Introduction to Programming* (Third Edition). No Starch Press.

Noviantoro, A., Silviana, A. B., Fitriani, R. R., & Permatasari, H. P. (2022). *RANCANGAN DAN IMPLEMENTASI APLIKASI SEWA LAPANGAN BADMINTON WILAYAH DEPOK BERBASIS WEB*. *Jurnal Teknik Dan Science*, *1*(2).

Nowak-Brzezinska, A., & Horyn, C. (2020). Outliers in rules - *The comparision of LOF, COF and KMEANS algorithms*. *Procedia Computer Science*, *176*, 1420–1429. https://doi.org/10.1016/j.procs.2020.09.152

Papadogiannis, I., Wallace, M., & Karountzou, G. (2024). *Educational Data Mining: A Foundational Overview*. *Encyclopedia*, *4*(4), 1644–1664. https://doi.org/10.3390/encyclopedia4040108

Porter, L., & Zingaro, D. (2024). *Learn AI-Assisted Python Programming, Second Edition: With GitHub Copilot and ChatGPT* (Second Edition). Simon and Schuster.

Prastyabudi, W. A., Alifah, A. N., & Nurdin, A. (2024). *Segmenting the Higher Education Market: An Analysis of Admissions Data Using K-Means Clustering*. *Procedia Computer Science*, *234*, 96–105. https://doi.org/10.1016/j.procs.2024.02.156

Rahadi, N. W., & Vikasari, C. (2020). *Pengujian Software Aplikasi Perawatan Barang Milik Negara Menggunakan Metode Black Box Testing Equivalence Partitions*. *Infotekmesin*, *11*(1), 57–61. https://doi.org/10.35970/infotekmesin.v11i1.124

Rajput, L., & Singh, S. N. (2023). *Customer Segmentation of E-commerce data using K-means Clustering Algorithm*. *Proceedings of the 13th International Conference on*

Cloud Computing, Data Science and Engineering, Confluence 2023, 658–664. https://doi.org/10.1109/Confluence56041.2023.10048834

Setiawan, K. E., Kurniawan, A., Chowanda, A., & Suhartono, D. (2022). *Clustering models for hospitals in Jakarta using fuzzy c-means and k-means. Procedia Computer Science*, *216*, 356–363. https://doi.org/10.1016/j.procs.2022.12.146

Singh, A. K., Mittal, S., Malhotra, P., & Srivastava, Y. V. (2020). *Clustering Evaluation by Davies-Bouldin Index(DBI) in Cereal data using K-Means*. *Proceedings of the 4th International Conference on Computing Methodologies and Communication, ICCMC 2020*, 306–310. https://doi.org/10.1109/ICCMC48092.2020.ICCMC-00057

Tabianan, K., Velu, S., & Ravi, V. (2022). *K-Means Clustering Approach for Intelligent Customer Segmentation Using Customer Purchase Behavior Data*. *Sustainability (Switzerland)*, *14*(12). https://doi.org/10.3390/su14127243

Uddin, M. A., Talukder, M. A., Ahmed, M. R., Khraisat, A., Alazab, A., Islam, M. M., Aryal, S., & Jibon, F. A. (2024). *Data-driven strategies for digital native market segmentation using clustering*. *International Journal of Cognitive Computing in Engineering*, *5*, 178–191. https://doi.org/10.1016/j.ijcce.2024.04.002

Umar Hussain. (2023). *What is Data, Its Type and Summary Statisitcs*. *Journal of Saidu Medical College, Swat*, *13*(3), 132–133. https://doi.org/10.52206/jsmc.2023.13.3.815

Wang, F., Zhang, H., Li, K., Lin, Z., Yang, J., & Shen, X. L. (2018). *A hybrid particle swarm optimization algorithm using adaptive learning strategy*. *Information Sciences*, *436–437*, 162–177. https://doi.org/10.1016/j.ins.2018.01.027

Widia, D. M., & Asriningtias, S. R. (2021). *Website*. In *Cara Cepat dan Praktis Membangun Web Dinamis dengan PHP dan MySQ* (pp. 3–3).

Wu, R. (2024). *Behavioral analysis of electricity consumption characteristics for customer groups using the k-means algorithm. Systems and Soft Computing*, *6*. https://doi.org/10.1016/j.sasc.2024.200143

Yulistyanti, D., Akhirina, T. Y., Afrizal, T., Paramita, A., & Farkhatin, N. (2022). *Testing Learning Media for English Learning Applications Using BlackBox Testing Based on Equivalence Partitions*. *Scope : Journal of English Language Teaching*, *6*(2), 73. https://doi.org/10.30998/scope.v6i2.12845

Zhang, W., & Wu, Z. (2024). *E-commerce recommender system based on improved K-means commodity information management model. Heliyon*, *10*(9). https://doi.org/10.1016/j.heliyon.2024.e29045

Zhang, W., Yue, Z., Ye, J., Xu, H., Wang, Y., Zhang, X., & Xi, L. (2022). *Modulation format identification using the Calinski–Harabasz index. Applied Optics*, *61*(3), 851. https://doi.org/10.1364/ao.448043

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