The ordered weighted geometric averaging (OWGA) operators on fuzzy numbers based in admissible orders

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Abstract. The ordered weighted geometric averaging, abbreviated as OWGA, is an aggregation operator that has been explored and applied to many problems since its introduction in [1], mainly as an important tool in fuzzy methods for decision-making problems, e.g. in [2, 3]. The main difficulty with this operator and other averaging operators of its type arises when the attribute values are provided in linguistic form. One of the approaches proposed to solve this was recently done by [4], who adapts OWAs to fuzzy number considering admissible orders for fuzzy numbers. These fuzzy numbers are recognized to model linguistic variables, while these admissible orders were introduced by [5]. In this work, we will present the OWGA operator on fuzzy numbers based on admissible orders and study the properties of such an operator following the ideas of [6, 7]. Finally, we will present an example with data obtained from measurements in the kelp forest subantarctic of the Magellan subantarctic region.

Keywords: Fuzzy number · Admissible order · Ordered weighted geometric averaging · Sub-Antactic kelp forest.

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References

1. Xu, Z., Da, Q. The ordered weighted geometric averaging operators. International Journal of Intelligent Systems, vol. **17**(7), 709-716 (2002).
2. Hu, Z., Zhou, L., Zhang, K., Wang, Y. Continuous triangular fuzzy generalized OWA operator and its application to combined prediction. Soft Computing, **27**23, 17551-17571 (2023).
3. Zheng, T., Chen, H., Yang, X. Entropy and probability based Fuzzy Induced Ordered Weighted Averaging operator. Journal of Intelligent & Fuzzy Systems, **44**3, 4949-4962 (2023).
4. García-Zamora, D., Cruz,A., Neres, F., Santiago, R., Roldán, A., Paiva, R., Dimuro, G., Martínez, L., Bedregal, B., Bustince, H.. Admissible OWA operators for fuzzy numbers. Fuzzy Sets and Systems, **480**, 108863 (2024).
5. Zumelzu, N., Bedregal, B., Mansilla, E., Bustince, H., Díaz, R. Admissible orders on fuzzy numbers. IEEE Transactions on Fuzzy Systems, **30**11, 4788-4799 (2022).
6. Liu, X. Some properties of the weighted OWA operator. IEEE Transactions on Systems, Man, and Cybernetics, Part B (Cybernetics), **36**(1), 118-127 (2006).
7. Liu, X. The solution equivalence of minimax disparity and minimum variance problems for OWA operators. International Journal of Approximate Reasoning, **45**12, 68-81 (2007).