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Project Synopsis

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Connecting Life with Learning

on

DriveSense

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Abstract:
The selection of appropriate decision criteria and their relative importance plays a crucial role in solving real-world decision-making problems, especially in domains involving multiple conflicting factors. Traditional selection processes often rely heavily on expert judgment, which may be subjective, inconsistent, and difficult to scale across different datasets and applications. To address this challenge, Multi-Criteria Decision-Making (MCDM) methods have gained significant attention, among which the Step-Wise Weight Assessment Ratio Analysis (SWARA) method offers a simple and effective approach for criteria weighting based on expert preference ranking.
This project aims to study and analyze the behavior of the SWARA method by applying it to multiple real-world datasets across different application domains. The project initially focuses on implementing the SWARA method independently on various datasets to understand its sensitivity, reliability, and adaptability. Based on the observations obtained from these experiments, the project further compares the decision outcomes generated by human experts and those produced using the SWARA method.
To enhance practical usability, a web-based application is proposed in which users can upload datasets and provide expert preference rankings. The system then computes SWARA-based weights and compares expert-driven selections with algorithmic decisions. The proposed solution highlights the potential of SWARA as a transparent and systematic decision-support tool that bridges the gap between expert knowledge and automated decision-making systems.

Introduction

In modern decision-making environments, problems are rarely dependent on a single criterion. Instead, they involve multiple criteria that may conflict with one another, such as accuracy versus cost, performance versus time, or quality versus resource utilization. Selecting optimal solutions under such conditions becomes challenging, particularly when decisions rely solely on human judgment. Experts often differ in opinions, and their decisions may be influenced by experience, bias, or incomplete information.

Multi-Criteria Decision-Making (MCDM) techniques provide a structured framework to address such problems by evaluating alternatives based on multiple criteria simultaneously. These methods help in assigning relative importance to criteria and ranking available alternatives in a transparent and systematic manner. Among various MCDM approaches, theStep-Wise Weight Assessment Ratio Analysis (SWARA) method has emerged as a simple yet

effective technique for criteria weighting. SWARA allows experts to rank criteria according to their importance and then computes weights through a step-wise mathematical process.

The motivation behind this project arises from the need to understand how algorithm-based decision-making methods like SWARA perform when applied to real-world datasets and how closely their outcomes align with expert decisions. While SWARA has been used in various application areas such as engineering design, healthcare, supply chain management, and information systems, there exists a gap in analyzing its practical behavior across multiple datasets and comparing its results with expert-driven selections in a unified system.

The primary contribution of this project is twofold. First, it implements the SWARA method on different datasets to study its behavior, stability, and effectiveness in real-life decision scenarios. Second, it proposes a web-based application that enables users to upload datasets, define criteria rankings, and compare expert-based selections with SWARA-based decisions. This comparative analysis helps in evaluating the reliability of SWARA as a decision-support mechanism.

The technologies used in this project include Python for algorithm development, data processing libraries for dataset handling, and web technologies for building the user interface. The project lies at the intersection of decision science, data analytics, and intelligent decision-support systems, making it suitable for practical and research-oriented applications.

Literature Survey

- Several researchers have explored Multi-Criteria Decision-Making methods to address complex decision problems involving multiple conflicting criteria. Traditional MCDM techniques such as the Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP) have been widely used; however, they require extensive pairwise comparisons, which may become cumbersome as the number of criteria increases.

The SWARA method was introduced as a simplified alternative to traditional weighting techniques, focusing on expert-driven ranking rather than exhaustive comparisons. Researchers have demonstrated that SWARA reduces computational complexity while maintaining decision accuracy. Studies have applied SWARA in areas such as supplier selection, risk assessment, sustainable development evaluation, and project prioritization, showing that it effectively captures expert preferences in a structured form.Recent works have also combined SWARA with other MCDM methods such as TOPSIS, VIKOR, and COPRAS to improve ranking accuracy and decision robustness. These hybrid approaches use SWARA for criteria weighting and other methods for alternative ranking, resulting in improved decision quality. However, most existing studies focus on single-domain applications and do not extensively analyze the behavior of SWARA across multiple datasets.

Furthermore, limited research exists on comparing expert decision outcomes directly with SWARA-based algorithmic results using a unified computational platform. Existing implementations are often theoretical or domain-specific, lacking user-friendly tools for practical adoption. This project addresses this gap by providing a comparative framework and a web-based application that enables real-time evaluation of SWARA against expert decision-making across diverse datasets.

Methodology/ Planning of work

Step 1: Dataset Selection

Multiple real-world datasets are selected from different application domains to ensure diversity in decision scenarios. These datasets represent problems involving multiple conflicting criteria.

Step 2: Identification of Decision Criteria

For each dataset, relevant decision criteria are identified based on domain knowledge and problem requirements. The selected criteria are validated to ensure their relevance and impact on the decision outcome.

Step 3: Expert Preference Collection

Domain experts are consulted to rank the identified criteria from the most important to the least important. Experts also provide relative importance values to express how much less important each criterion is compared to the previous one.

Step 4: Application of SWARA Method

The SWARA method is applied in a step-wise manner. Criteria are ordered based on expert rankings, comparative importance coefficients are calculated, and initial weights are adjusted iteratively. The final weights are normalized so that their total equals one.

Step 5: Sensitivity and Reliability Analysis

To evaluate the robustness of the SWARA method, slight variations in expert rankings and importance values are introduced. The resulting changes in criteria weights are analyzed to study sensitivity and reliability.

Step 6: Comparison with Expert Decisions

Decision outcomes generated using SWARA-based weights are compared with decisions made directly by human experts. This comparison helps assess the effectiveness of SWARA in capturing expert reasoning in a structured form.

Step 7: Web-Based System Development

A web-based application is developed that allows users to upload datasets, input expert preferences, compute SWARA weights, and visualize results. The system also enables comparison between expert-driven and algorithmic decisions.

Step 8: Result Evaluation:The results obtained from all datasets are analyzed collectively to evaluate the applicability, transparency, and practicality of the SWARA method as a decision-support tool.

Facilities required for proposed work

Software Requirements

- Operating System:
  - Windows 10 / Windows 11 / Linux
- Programming Language:
  - Python 3.x
- Development Tools and IDE:
  - Visual Studio Code / PyCharm / Jupyter Notebook
- Libraries and Frameworks:
  - NumPy – for numerical computations
  - Pandas – for dataset handling and preprocessing
  - Matplotlib / Seaborn – for data visualisation and analysis
  - Flask / Django – for web application development
- Web Technologies:
  - HTML, CSS, JavaScript – for front-end interface
  - Bootstrap (optional) – for responsive UI design
- Database (Optional):
  - MySQL / SQLite – for storing datasets and user inputs

Data Requirements

- Real-world datasets from various domains such as:
  - Healthcare
  - Shopping items (online purchasing data)
  - Supply Chain Management
  - Information Systems
- Expert preference rankings for criteria evaluation

Other Requirements

- Web browser (Google Chrome / Mozilla Firefox)
- Documentation tools (MS Word / LaTeX) for report preparation

References

https://dergipark.org.tr/en/pub/politeknik/article/907712

This paper reviews variations in the SWARA method's implementation and evaluates how these changes affect criterion weights and decision outcomes, including an application combined with SMAA-2.

Keshavarz-Ghorabaee, M., Amiri, M., Zavadskas, E. K., Turskis, Z., & Antucheviciene, J. (2018).
An Extended Step-Wise Weight Assessment Ratio Analysis with Symmetric Interval Type-2 Fuzzy Sets for Determining the Subjective Weights of Criteria in Multi-Criteria Decision-Making Problems. Symmetry, 10(4), 91.
Link: https://www.mdpi.com/2073-8994/10/4/91

Application of SWARA Technique to Find Criteria Weights for Selecting Landfill Site in Baghdad Governorate.
This study applies the SWARA technique for solid waste site selection criteria, demonstrating SWARA in an environmental decision problem.
Link: https://www.researchgate.net/publication/350369178_Application_of_SWARA_Technique_to_Find_Criteria_Weights_for_Selecting_Landfill_Site_in_Baghdad_Governorate

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