

ALGORITHMS FOR SUPPORTING EVIDENCE-BASED DECISION-MAKING

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Abstract

Decision-making is a fundamental process in public administration, business management, education, and other professional fields. The increasing volume and complexity of available information have created a need for analytical algorithms capable of organizing data, identifying patterns, comparing alternatives, and supporting informed judgments. This article explores the role of decision-support algorithms, including rule-based systems, multicriteria decision analysis, statistical models, and machine learning techniques. It explains how these approaches can improve consistency, efficiency, and the systematic evaluation of alternatives. Particular attention is given to data quality, algorithmic transparency, human responsibility, and ethical safeguards. The article argues that algorithms should complement human expertise rather than replace it, especially when decisions have significant consequences for individuals or society.

Keywords: decision-making, algorithms, decision-support systems, artificial intelligence, multicriteria analysis, machine learning, data-driven management.

Introduction

Decision-making involves identifying a problem, examining available information, evaluating possible alternatives, and selecting an appropriate course of action. In complex environments, decision-makers may face incomplete information, competing objectives, limited resources, and time constraints. Under these circumstances, analytical algorithms can provide structured support by processing information and comparing possible solutions.

A decision-support algorithm does not necessarily make the final decision independently. Instead, it can help users understand the available evidence, recognize relevant patterns, estimate potential risks, and evaluate alternatives

according to defined criteria. Its effectiveness depends on the suitability of the method, the quality of the data, and the context in which the results are used.

Main Discussion

Several categories of algorithms can support decision-making. Rule-based algorithms use predefined conditions and logical instructions. For example, an administrative system may direct an application to the appropriate department according to its subject, urgency, and legal requirements. Such systems are relatively easy to interpret when their rules are clearly documented, but they may struggle with unfamiliar situations or complex exceptions.

Multicriteria decision analysis is useful when several objectives must be considered simultaneously. A decision-maker selecting a project, evaluating candidates, or allocating resources may need to consider cost, expected benefit, feasibility, risk, and social impact. The Analytic Hierarchy Process (AHP) helps establish the relative importance of criteria through pairwise comparisons. Other approaches, such as ELECTRE, support the comparison or classification of alternatives when criteria conflict. These methods make the evaluation process more systematic, although their results depend on the criteria and assumptions selected.

Statistical models provide another source of decision support. Regression analysis, for instance, can estimate relationships between variables and help predict outcomes when appropriate data are available. Classification algorithms can group cases into predefined categories, while clustering methods identify similarities among observations without requiring predefined labels.

Machine learning expands these capabilities by allowing systems to identify patterns from historical data. Such algorithms can be applied to demand forecasting, risk assessment, resource planning, and the prioritization of administrative tasks. However, historical patterns do not automatically establish causation, and a model that performs well on past data may fail when conditions change.

A general decision-support process can be organized into five stages. First, the problem and intended outcome must be clearly defined. Second, relevant and lawfully obtained data are collected and checked. Third, an appropriate model is selected according to the nature of the problem. Fourth, the model evaluates alternatives and produces recommendations. Finally, a responsible decision-maker examines the results, considers contextual factors, and determines the appropriate action.

Model evaluation is essential throughout this process. Raschka (2018) discusses the importance of appropriate model selection and evaluation procedures in machine learning research. Techniques such as cross-validation can help estimate how well a model generalizes to unseen data. Additional evaluation should consider accuracy, reliability, interpretability, and the consequences of incorrect predictions.

Transparency and accountability are especially important when algorithms influence decisions concerning employment, education, public services, or access to resources. Biased training data can produce unequal outcomes, while inaccurate information can lead to inappropriate recommendations. Organizations should therefore document model limitations, monitor performance, protect personal data, and establish procedures for reviewing disputed decisions.

Human oversight remains indispensable. An algorithm may identify statistical patterns, but it cannot independently determine every relevant legal, social, or ethical consideration. Decision-makers should understand the basis of recommendations and retain responsibility for decisions within their authority. In high-impact situations, individuals should have appropriate opportunities to request explanations and challenge errors.

Conclusion

Decision-support algorithms can improve the organization and analysis of information, making complex decisions more systematic and evidence-based. Rule-based systems, multicriteria methods, statistical techniques, and machine

learning offer different advantages depending on the problem being addressed. However, no algorithm is universally suitable, and computational recommendations should not be confused with objective or infallible judgments. Effective implementation requires reliable data, appropriate validation, transparent procedures, continuous monitoring, and meaningful human oversight. By combining analytical technology with professional expertise and ethical responsibility, organizations can use algorithms to improve decision quality while preserving accountability and public trust.

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