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THE MULTI-CRITERIA ANALYSIS METHOD AND ITS IMPORTANCE IN INVESTMENT PROJECTS

Sayfiyeva Parizoda Otabek qizi

1st year master's student at Tashkent State University of Economics

Raimjanova Madina Asrarovna

Professor of the Department Valuation and Investments at Tashkent State University of Economics

A R T I C L E I N F O.

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Abstract

When faced with multiple investment options, investors must select the one that aligns best with the project's objectives. To facilitate this decision, investors typically create a detailed plan outlining the investment project. Various evaluation methods are then employed to assess the project's effectiveness. However, these methods often yield conflicting results, posing challenges for investors in making informed decisions.

This article introduces a framework aimed at enhancing the investment decision-making process. It emphasizes the importance of using approaches like multi-criteria analysis to evaluate investment effectiveness. Given the potential discrepancies in evaluation outcomes, it underscores the significance of considering various criteria to make optimal investment choices. Multi-criteria analysis serves as a valuable tool for ranking potential investment ventures and improving decision-making processes essential for achieving investment objectives.

Introduction. It is known that today, investment projects are evaluated using techniques that assess their economic effectiveness. These techniques are categorized into two groups: static methods and dynamic methods. Static methods are commonly employed in initial investment assessments due to their simplicity in computation. However, these methods have a drawback as they only reflect the investment's performance within a single year, known as a base year. On the other hand, dynamic methods offer a comprehensive evaluation of the entire investment period, extending beyond just one year. But sometimes these methods are not highly helpful in making final investment decisions.

That's why to optimize investment decisions and achieve investment goals effectively, it is essential to evaluate outcomes against diverse investment options. Hence, this study delves into a model for decision-making in investments that enhances efficiency through the application of multi-criteria techniques.

From this point of view, it is possible to distinguish between two families of methods, although, as highlighted further below, their boundaries are frequently blurred:[1]

- Mono-criterion methods, which assess a given plan against a single and specific objective. This family includes, for instance, cost-benefit analysis (CBA), which assesses a plan primarily against the objective of economic efficiency (as shown by the benefit-cost ratio or the net present value of the plan), by translating all impacts into discounted monetary terms.
- Multi-criteria methods, which appraise or evaluate a plan by taking into account (more explicitly than mono-criterion methods) the various dimensions of interest, and the interplay between multiple, often contrasting, objectives, and different decision criteria and metrics.

So let's first get acquainted with what the multi-criteria method is and its origin, classification. Multi-criteria analysis (MCA), known by various names such as multiple-criteria decision-making (MCDM), multiple-criteria decision analysis (MCDA), multi-objective decision analysis (MODA), multiple-attribute decision-making (MADM), or multi-dimensional decision-making (MDDM), encompasses a range of methods, techniques, and tools of varying complexity that specifically take into account multiple objectives and criteria in decision-making scenarios. The multi-criteria decision-making (MCDM) method is a mathematical approach used to evaluate and select the best alternative among a set of options based on multiple criteria or objectives. It helps decision-makers consider various factors simultaneously, taking into account both quantitative and qualitative aspects. The origins of MCDM can be traced back to the early 20th century, with significant developments occurring in the fields of operations research, management science, and decision analysis. One of the pioneers in this area was Ronald A. Howard, who introduced the concept of decision analysis in the 1960s. Since then, various MCDM methods have been developed, such as the Analytic Hierarchy Process (AHP), TOPSIS (Technique for Order Preference by Similarity to Ideal Solution), and ELECTRE (Elimination and Choice Expressing Reality).

For example, Mohanty (1992) applied the TOPSIS method to address project selection challenges by comparing three construction projects based on 15 criteria in India. Triantaphyllou and Mann (1995) used the analytic hierarchy process (AHP) to select an information system project. Mohanty et al. (2005) applied the analytic network process (ANP) for project selection. Amiri (2010) combined AHP and fuzzy TOPSIS for project selection in oil development. Aragonés-Beltrán et al. (2014) used AHP and ANP to create a model aiding investors in selecting suitable projects for investment. Pangsri (2015) applied multiple criteria decision-making (MCDM) techniques, including AHP and TOPSIS, for project selection.

[1] Mouter, N. (Ed.) (2020). Standard Transport Appraisal Methods. (Advances in Transport Policy andPlanning; Vol. 6). Academic Press. https://www.elsevier.com/books/standard-transport-appraisal-methods/mouter/978-0-12-820821-2.

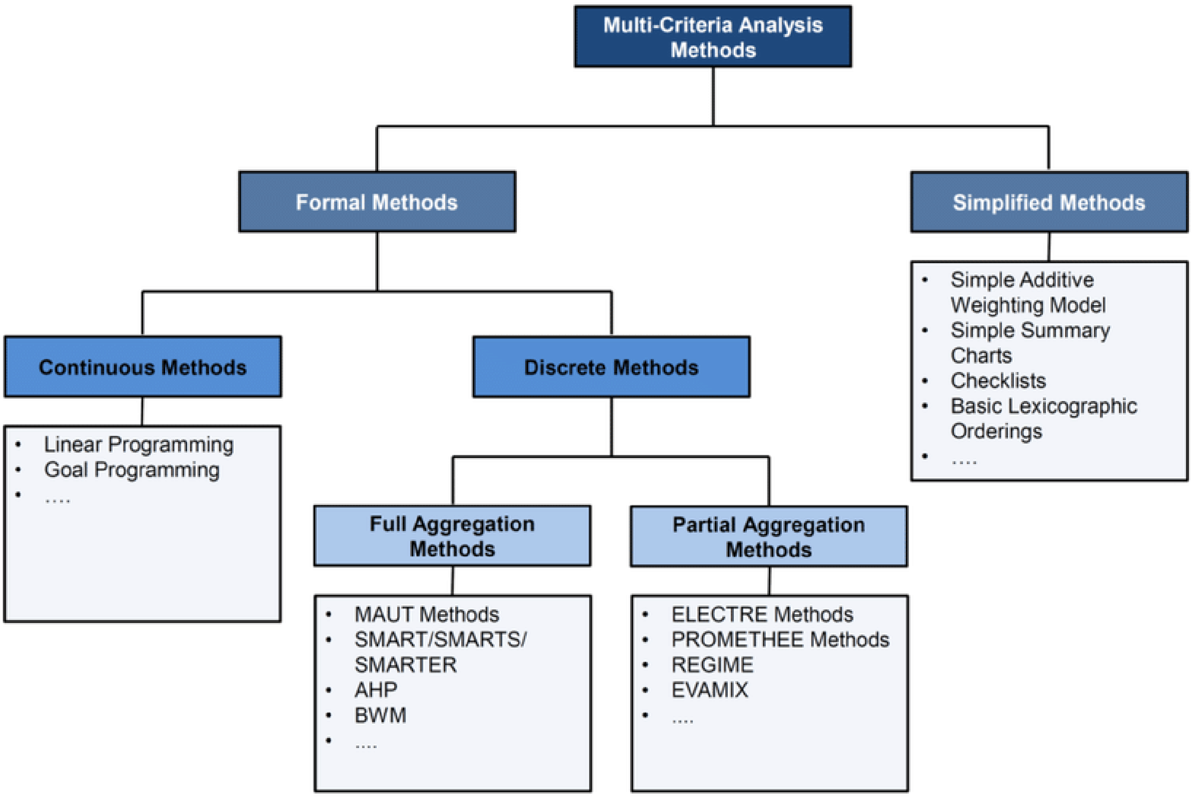

Figure 1. Classification of MCA methods[2].

The comprehensive categorization of multiple criteria analysis (MCA) methods has proven to be a challenging task due to the wide range of techniques available. Various partial taxonomies have been proposed over time by different researchers, such as Roy (1996), Munda (1995), Janssen and Munda (1999), Rogers et al. (2000), Belton and Stewart (2002), Kodikara (2008), Rogers and Duffy (2012), Ishizaka and Nemery (2013), and Zardari et al. (2015).

In Figure 1, we can see the classification proposed by Dean (2018). In this classification system, a primary differentiation is between formal and simplified methods. Formal MCA techniques rely on detailed processes, a set of fairly strict (though occasionally arbitrary) guidelines, and occasionally advanced mathematical principles. On the other hand, simplified methods involve straightforward and often basic applications of MCA.

The next scheme of classification proposed by also gives a rough overview of MCA (Figure2). Note that in the article many different classifications are used.

[2] Source: Adapted from Dean (2018).

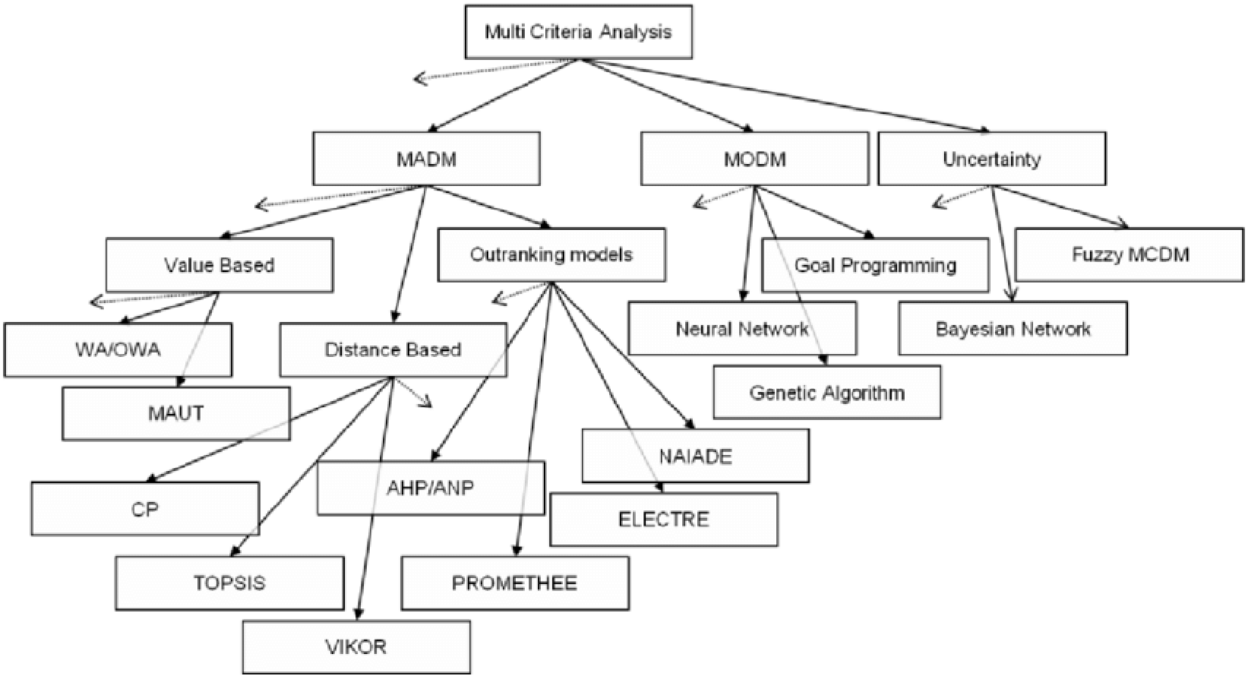

Figure 2. Concise classification of MCDM or MCA[3]. The dotted arrows indicate existence of other MCA methods.

Research methods and results. As we mentioned above efficient assessments of investments are categorized into static and dynamic methods for evaluating investment effectiveness.

Static rating evaluates the financial viability of an investment project by utilizing a set budget of several basic static criteria. But this approach to evaluating investments may present an incomplete view by considering only a limited timeframe rather than the full economic lifespan of the investment, potentially leading to a distorted assessment. One drawback of this assessment method is the lack of insight into mitigating the impacts of investment at the start and end of the exploitation period, thus hindering the ability to plan for timely interventions and enhancements.

To address the issue of static indicators, the process of discounting is used. Accelerating static indicators entails adjusting the yearly costs and benefits of investments (revenue, expenses, and total investments) to their present value, or determining the average annual value over the entire economic lifespan of the project.

These methods are also divided into

- Methods that do not use discounted cash flows (NDCF techniques);
- Methods that use discounted cash flows (DCF techniques).

Decision makers cannot achieve maximum shareholder value by using NCDF techniques because these methods do not integrate or satisfy all three fundamental criteria necessary for doing so. The drawback is that they do not take into account the discount factor in the computation, thus failing to evaluate any risks associated with future cash flows.

The methods that do not use the discount cash flows include the following indicators:

- Payback period;
- Accounting rate of return;

[3] Source: Adapted from David Nijssen (2013). Improving spatiality in decision making for river basin management.

- Cumulative cash flows;
- The rate of return.

Apart from the four methods categorized as non-discounted cash flow techniques, scientific literature also discusses additional methods that incorporate discounted time of return, using discounted cash flows. These methods, while not classified as dynamic indicators or indicators within discounted cash flows, offer alternative approaches.

The methods used in the discount cash flows include the following methods:

- The net present value;
- Internal rate of return;
- The modified internal rate of return;
- Profitability index.

Dynamic indicators, such as those related to investments and their impacts, offer a more sophisticated analysis of investment projects, providing a realistic assessment of various aspects and the rationale behind undertaking the project.

When making decisions, it is essential to start by defining an investment objective and the specific criteria for assessing how well this objective is met. Subsequently, one must choose the most appropriate project from the available investment options to achieve the desired investment goal effectively. Decision-making typically involves assessing different solutions or choices. When this evaluation focuses on a single criterion, a solution that optimally meets the target function is identified, a process known as single-criteria optimization or simply optimization.

In practical scenarios, decision-making often involves evaluating investment options based on multiple criteria, adding complexity to the process compared to single-criteria optimization.

During the decision-making process, different alternatives and criteria are analyzed and processed, either directly or indirectly, using an alternate matrix form to ultimately derive a final outcome. In multi-criteria analysis, various alternatives and criteria are considered, with some requiring maximization and others minimization.

Each method of multi-criteria analysis is distinguished by a unique selection criterion, leading to varied outcomes when applied to the same issue. Due to these variations, different methods of multi-criteria analysis produce diverse outcomes. However, only the method demonstrating the most favorable results in investment decision-making will be applied in practice.

So, the investor must evaluate numerous investment options and develop a comprehensive investment proposal based on thorough analysis. If all evaluation methods yield identical rankings for the alternatives, a unanimous decision can be easily reached, concluding the decision-making process. Conversely, if there are discrepancies in the rankings provided by different methods, achieving a unanimous decision becomes challenging. In such instances, it is essential to make a compromise decision that best aligns with the decision-making objectives.

In such situations a proposed decision-making model consists of the following steps:

1. Identify initial investment options.
2. Evaluate project effectiveness.
3. Streamline evaluation parameters using correlation analysis.
4. Rank investment alternatives using multi-criteria methods.
5. Make the final decision.

Through the implementation of these four steps, we derive rankings for different options, aiding us in selecting projects that most effectively meet the investment decision objectives. Utilizing multi-criteria analysis helps establish the preferred order of these options. Subsequently, a compromise decision is made by selecting the option with the highest ranking.

Discussion. Through the above mentioned investment decision-making model, we can use it to evaluate investment projects, in particular, to choose the most optimal investment project. And the use of multi-criteria methods allows us to rank investment projects by efficiency. Another advantage of this model is that it can be modified to suit different investment projects.

Conclusion. When making investment decisions, it is advisable to employ multiple evaluation methods to assess investment effectiveness. If reaching a single solution becomes challenging, a compromise should be sought. A compromise solution does not demand that a project excels in all aspects, as that may not be feasible. Instead, the focus is on ensuring that the project performs best overall compared to others while still accommodating compromises. In conclusion, it can be noted that the model demonstrated a strategic approach to making investment decisions by efficiently evaluating investment projects using various multi-criteria analysis methods. This innovative model introduces a fresh perspective on investment decision-making by integrating multiple methodologies, emphasizing the challenge of selecting the most favorable investment project among several alternatives.

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