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TOPSIS and its Extensions: A Distance-Based MCDM Approach

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Preface

In the real world, there are many problems that need to be dealt with and solved with a satisfactory solution. This book makes an extensive investigation of the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), a prominent distance-based Multi-Criteria Decision-Making (MCDM) method, and its variations and possible extensions.

MCDM is important as it provides tools for decision-makers to assess tradeoffs in alternative performance. TOPSIS is widely used, probably due to its reliance on the data rather than exhaustive analysis of decision-makers' preference. A number of methods are thoroughly reviewed in the book. Also presented are many real-world examples taken from the published literature. The book intends to give a thorough and rigorous analysis of methods along with a demonstration of practical examples.

Objective of the Study

The objective herein aims to provide sufficient materials to demonstrate the development of TOPSIS up to date and to be used as a handbook on it. It contains the basic process of TOPSIS, numerous variant processes, property explanations, theoretical developments, and illustrative examples with real-world cases. Possible readers would be graduate students, researchers, analysts, and professionals, who are interested in TOPSIS, a distance-based algorithm, or who would like to compare TOPSIS with other MCDM methods when dealing with decision-making on finite numbers of alternatives. Aside from deliberation for research reference, its arrangement could be employed as a self-learning book with step-by-step illustrations for the MCDM community. Due to space constraints and personal concentration, coverage is limited to the crisp domain with traditional preference structure, in which fuzzy and other domains are mentioned only in simple forms. Even so, we believe the materials cover the essential issues in this area.

Book Organization

TOPSIS has proven highly popular, with a strong research stream that continues to grow each year. This research stream has seen many variants of TOPSIS. This book gives a theoretical review of the basic TOPSIS method, explaining each step of the TOPSIS process supported by the presentation of computations for real examples taken from the published literature. Chapter 1 discusses the process of multiple criteria modeling. Chapter 2 describes how TOPSIS fits into that process and presents the TOPSIS algorithm and its relationship to decision-maker choice behavior. Chapter 3 presents basic variants of the TOPSIS method. TOPSIS support for group decision-making is discussed in Chap. 4. Chapter 5 discusses decision support system aspects of TOPSIS. TOPSIS can be used for multiple tasks. Chapter 6 focuses on the use of TOPSIS for sorting problems, as opposed to identification of one preferred alternative. Chapter 7 deals with the potential for rank reversal in TOPSIS. We noted that the stream of TOPSIS research has led to the presentation of many variants. Chapter 8 discusses methods closely related to the TOPSIS idea of getting close to the ideal and far away from the nadir. Fuzzy TOPSIS methods model decisions from the perspective of imprecise measures. VIKOR applied the TOPSIS idea using Minkowski metrics. The Best-Worst Method (BMW) focuses on using the best and worst to generate stable criteria weights. The book concludes with Chap. 9, which reviews TOPSIS applications published in the literature.

Hwang CL, Yoon K (1981). *Multiple Attribute Decision Making: A State-of-the-Art Survey*. Springer-Verlag, Berlin. ISBN: 9783540105589.

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The first author has known TOPSIS ever since he studied at Kansas State University, U.S.A., but found many ambiguous works and associated extensions after teaching MCDM courses in Taiwan, R.O.C. He thus has attempted to bridge the gap between existing works and the essence of TOPSIS. Over the past two decades, many colleagues and students have inspired him to investigate the insights of TOPSIS. He is thankful to Prof. Huan-Jyh Shyur at Tamkang University, Taiwan, for his enduring cooperation and support. He is also grateful to Prof. David L. Olson of the University of Nebraska-Lincoln, the second author, for his long-term support and for acting as a mentor to clarify his thoughts. With the help of Profs. Ignacy Kaliszewski and Dmitry Podkopaev at the Polish Academy of Sciences, he has been able to involve the properties of TOPSIS. He also appreciates those pioneers in shaping TOPSIS, including Prof. Ching-Lai Hwang at Kansas State University, the founder of the method, Prof. Po Lung Yu at National Chiao Tung University and the University of Kansas, and Prof. Milan Zeleny at Fordham University, U.S.A.

During his own development spanning two decades, numerous professors and friends have supported him in preparing the contents, including Profs. E. Stanley Lee, Shing I. Chang, and David Ben-Arieh at Kansas State University, Dr. Young-Jou Lai at Halliburton, Texas, Prof. Minghe Sun at the University of Texas at San Antonio, Prof. Jennifer S. Shang at the University of Pittsburgh, U.S.A., Prof. Luiz Flavio Autran Monteiro Gomes at Ibmec, Brazil, Prof. Przemysław Juszczak at the University of Economics in Katowice, Poland, Prof. Bertrand Mareschal at Université Libre de Bruxelles, Belgium, Prof. Gwo-Hshiung Tzeng at National Taipei University, Profs. Hsiao-Fan Wang and Ue-Pyng Wen at National Tsing Hua University, Prof. Chiang Kao at National Cheng Kung University, Prof. Liang-Chih Huang at National Chung Cheng University, Prof. Ping-Teng Chang at Tunghai University, Prof. Ping-Feng Pai at National Chi Nan University, Prof. Jei-Zheng Wu at Soochow University, Prof. Chih-Hung Wang at National Chiayi University, and Profs. Hai-Ming Chen, I-Fei Chen, Chi-Bin Cheng, Wen-Shuenn Deng, Chao-Che Hsu, Chichang Jou, Tong-liang Kao, Jyh-Jiuan Lin, Hui-Chiung Lo, Jerry C.Y. Miao, Liang-Yuh Ouyang, Tzong-Ru Tsai, Ruey-Chyn Tsaur, Wei-Tzen Yang, and Dr. Yuan-Sheng Lee at Tamkang University, Taiwan. Various students have also contributed to this book,

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Distinguished Chair

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