

Chapter 11

A Comparison of Pairs, Triads and Quads in Multi- Attribute Decision Making

Charalambos L. Iacovou
Wake Forest University, USA

Larry Shirland
University of Vermont, USA

Ronald L. Thompson
Wake Forest University, USA

ABSTRACT

The pair-wise comparison technique is a common approach for completing multi-attribute evaluations. However, this approach has limitations, especially for larger attribute sets, where the use of the technique is time-consuming because it requires a relatively large number of comparisons. The authors conducted an experiment to test the efficacy of three alternative approaches for eliciting preferences, specifically pairs, triads and quads. Ninety-three subjects used one of the three approaches to rank the importance of fifteen items. The results indicate that those employing the pair-wise approach took significantly longer than those using the triad or quad approach. In addition, the triad technique yielded more accurate results (compared to the pair and quad methods). Finally, the quad approach generated fewer intransitivities than the pair-wise or triad approaches. No differences were observed across the three techniques with respect to reliability or perceived ease of use. Implications are provided for both practitioners and researchers.

DOI: 10.4018/978-1-4666-1589-2.ch011

INTRODUCTION

Individual decision-makers and organisational groups are often asked to evaluate large sets of items as part of their routine managerial responsibilities. Such multi-attribute evaluations span various contexts: administrators evaluating diverse budget requests (Shen, Lo & Wang, 1998), steering committees prioritising multiple competing project proposals (Jessop, 2002), individual product designers deciding on which product qualities to focus (Horowitz & Zappe, 1995), policy makers considering options for urban waste management (Bollinger & Pictet, 2008) or paper recycling (Pati, Vrat, & Kumar, 2008), and many others. Although evaluating a large set of attributes is a common managerial task, it's not easy to execute effectively (Zeleny, 2008). Regardless of the approach used, decision makers must implicitly or explicitly consider their strength of preference for one attribute over another (Lai, 2001). Various innovative techniques have been developed to elicit the weights of attributes as judged by decision makers, using subjective, objective and integrated approaches (Wang & Luo, 2010; Wang & Parkan, 2006).

One prevalent multi-attribute evaluation method that is used to carry out such evaluations is based on pair-wise comparisons (Lahdelma, Salminen, & Kuula, 2003). This method decomposes the evaluation task into a series of judgment-based choices that consider a pair of attributes at a time and then utilizes statistical techniques to infer the implicit importance weights from the decision-maker's choices (Schoemaker & Waid, 1982). Research suggests that pair-wise comparisons and other methods that decompose the evaluation task into a series of choices may be preferred over holistic methods (such as point allocations and simple rankings). This may be because comparison-based evaluations of large sets have lower cognitive load requirements (in comparison to holistic techniques that require the *simultaneous* consideration of *all* attributes)

and thus avoid some of the reliability problems associated with cognitive overload (Srivastava, Connolly & Beach, 1995).

While the pair-wise technique has become the *defacto* standard in comparison-based evaluations and is quite useful in reducing task complexity, it suffers from two major limitations when used to assess a large number of attributes (Lahdelma et al., 2003). First, the time that is required to complete the evaluation of the pairs can be quite lengthy. When employing the pair-wise comparison approach, each pair of attributes must be evaluated to assess the relative importance of one attribute to the other. For n attributes, this results

in $\binom{n}{2}$ comparisons. For example, an evaluation

of 25 attributes would require at least 300 pair-wise comparisons, a highly time-consuming task for most decision-makers. Second, the large number of independent comparisons in pair-wise judgments may result in conflicting choices and lack of transitivity (Flynn, Sakakibara, Schroeder, Bates & Flynn, 1990). To illustrate, assume that a respondent is asked to evaluate three attributes (A, B and C) using pair-wise comparisons. If the respondent were to rank $A > B$, $B > C$, and $C > A$, an intransitivity occurs (since the first two comparisons would imply $A > C$).

To address the above two issues that are associated with pair-wise methods, a triad-based comparison technique was formulated by Shirland, Jesse, Thompson and Iacovou (2003). This technique utilizes triad-based judgments instead of pair-wise ones. To generate the importance weights, this technique employs a two-stage process. First, an integer programming model is used to generate the set of triads that participants will use. The integer programming model minimizes the number of triads to be evaluated while ensuring that each possible pair of attributes is compared at least once. Next, the respondent completes the ranking of each attribute within each triad set. Finally, the within-triad rankings are used

21 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

www.igi-global.com/chapter/comparison-pairs-triads-quads-multi/65963

Related Content

Real Options Reasoning as a Tool for Managerial Decision Making

Bernadette Power (2008). *Encyclopedia of Decision Making and Decision Support Technologies* (pp. 766-775).

www.irma-international.org/chapter/real-options-reasoning-tool-managerial/11319

The Impact of Balance Score Card Implementation on Supply Chain Firms

Josiah Edmond and Fawzy Soliman (2017). *Decision Management: Concepts, Methodologies, Tools, and Applications* (pp. 557-575).

www.irma-international.org/chapter/the-impact-of-balance-score-card-implementation-on-supply-chain-firms/176772

A Decision Support System for Sustainable Waste Collection

Mattias Strand, Anna Syberfeldt and André Geertsen (2017). *International Journal of Decision Support System Technology* (pp. 49-65).

www.irma-international.org/article/a-decision-support-system-for-sustainable-waste-collection/186803

Research on Manufacturing Upgrading and Its Influencing Factors Based on Var Modeling: Evidence From Jiangsu Province in China

Ni Zhong, Ming Yu Cheng, Sheik Kyin Tey and Kuk Fai Fok (2025). *International Journal of Decision Support System Technology* (pp. 1-22).

www.irma-international.org/article/research-on-manufacturing-upgrading-and-its-influencing-factors-based-on-var-modeling/371756

Application of Cloud-Based Remote Sensing With Google Earth Engine in Land Cover Change Analysis

Liem Duy Nguyen and Ngan Thi Thu Pham (2025). *Applying Remote Sensing and GIS for Spatial Analysis and Decision-Making* (pp. 197-240).

www.irma-international.org/chapter/application-of-cloud-based-remote-sensing-with-google-earth-engine-in-land-cover-change-analysis/361387