

A Generalized PROMETHEE III with Risk Preferences on Losses and Gains

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Abstract

This study aims to generalize the Preference Ranking Organization METHod for Enrichment Evaluations (PROMETHEE) III model by introducing risk preferences of decision makers. The risk preferences are expressed by an S-shaped value function with gain and loss parts. This study then illustrates an environmental evaluation of waste treatment plants for waste electrical and electronic equipment (WEEE) in Taiwan. Sensitivity analysis and the rank test demonstrate that the proposed model is rather stable.

The PROMETHEE methods have been involved in various applications, especially in environmental management. One core process of PROMETHEE is to establish a preference difference function with two types of thresholds. The range of the slope lines of the linear preference is within the interval of $[0, 1]$. Working from the concept of the prospect theory, we extend its S-shaped function to the interval range of $[-1, 1]$ so as to express risk preferences that occur in two quadrants.

This research assesses a project on 15 local WEEE treatment plants to promote their recycling capability and technology competitiveness. According to the five aspects, the performance measures of the plants are obtained from a field study. The proposed model has an advantage on rank invariance by changing the thresholds in our case with sensitivity analysis demonstrating the robustness of the model. The generalized PROMETHEE III with risk preferences indeed provides an extension for making a decision in an uncertain environment.

Keywords: PROMETHEE, Risk preference, S-shaped value function, Environmental evaluation, Sensitivity analysis.

1. Introduction

Preference Ranking Organization METHod for Enrichment Evaluations (PROMETHEE) is one type of popular outranking methods in the area of multiple-criteria decision aid (MCDA) for evaluation of actions. It helps decision makers (DMs) to structure, qualify, and analyze real world problems, in order to make a better decision [6]. However, many traditional MCDA methods concentrate on the selection process without considering the risk preferences of DMs. The final choice could thus be distorted