Inconsistency Reduction in Pairwise Comparison Matrices and a Novel Algorithm for Generating Random Pairwise Comparison Matrices within a Specified Inconsistency Coefficient Range: FAST-PCM

Abstract

In this doctoral dissertation, the focus is placed on the issue of inconsistency reduction in pairwise comparison matrices, which serve as a pivotal component in multi-criteria decision-making methods. The research's central point is the introduction and analysis of a novel algorithm, FAST-PCM. This algorithm, grounded on existing inconsistency reduction methods, aims to significantly optimize the process of generating random pairwise comparison matrices within a specified inconsistency coefficient range.

Beginning with a comprehensive literature review, the author delves into the concept of pairwise comparison matrices, their applications, and the challenges associated with inconsistency. This theoretical foundation sets the stage for the empirical investigations presented in subsequent chapters. The second chapter offers a detailed analysis of various iterative inconsistency reduction algorithms, utilizing the Monte Carlo simulation methodology. The third chapter introduces the REDUCE.py library - a Python-based software tool designed to minimize inconsistency in pairwise comparisons. The fourth chapter centers on the REDUCE web application, facilitating the automatic reduction of inconsistency in pairwise comparison matrices. In the fifth chapter, the author explores the potential of machine learning techniques in the context of inconsistency reduction, merging traditional approaches with modern data analysis technologies. The work's pivotal element is the sixth chapter, discussing the FAST-PCM algorithm and the online tool PC MATRICES GENERATOR. These innovations not only validate the dissertation's thesis but also indicate new horizons in the field of multi-criteria decision-making.

In conclusion, this doctoral dissertation represents a scholarly contribution to the domain of multi-criteria decision-making. Through the synthesis of theory and practice and the introduction of innovative tools and methods, the work advances a deeper understanding and optimization of the inconsistency reduction process in pairwise comparison matrices.

Keywords:
Inconsistency reduction algorithms, pairwise comparison matrices, multi-criteria decision-making, Monte Carlo simulations, software tools, machine learning, web applications, inconsistency, REDUCE.py library, Industry 4.0, decision-making technologies, numerical methods, Saaty's fundamental scale, priority vector, FAST-PCM algorithm, matrix generation, inconsistency coefficient, AHP.