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Elisabeth Bourgeois
Research Institute in Management and Economics (IREGE)
Savoie Mont-Blanc University

Toward Understanding Constrained Heating Choices: An Exploratory and Structural Analysis

Abstract

How do households navigate the trade-off between comfort and cost when heating their homes? This question is critical for addressing energy inequities and designing effective policies to promote sustainable consumption. While existing research has explored economic and structural factors, the role of hedonistic tendencies, such as pleasure-seeking and sociability, in shaping heating behaviors remains underexplored. This study adopts a hybrid approach to bridge this gap, combining exploratory profiling and confirmatory structural modeling, using survey data from 4169 households.

Latent Class Analysis (LCA) identifies behavioral profiles, revealing distinct patterns of energy-saving behaviors driven by hedonistic and structural factors. Supervised classification models, such as Random Forest and Gradient Boosting, predict heating limitation behaviors with moderate accuracy but struggle to capture minority patterns, underscoring the limitations of predictive-only approaches. These insights inform the development of a Structural Equation Model (SEM) to test hypotheses about the mediation and moderation effects derived from exploratory analysis.

Initial SEM results suggest that economic constraints and building inefficiencies mediate the influence of hedonistic tendencies on heating behaviors, while also moderating their intensity. These findings highlight the need for targeted structural renovations and segmented communication strategies tailored to behavioral profiles. Additionally, the results pave the way for practical tools, such as a profiling system to classify households by heating behaviors and a cost-benefit simulation tool to quantify the economic and environmental impacts of constrained heating choices. Future research could further refine these tools, laying the groundwork for policies that reduce energy inequities and foster sustainable consumption.