Segmentation analysis of hourly water and electricity use in Southern California to support demand-side management programs

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Intelligent water and electricity meters are increasingly being used by water and energy utilities to record residential demands with sub-daily, usually hourly, sampling resolution. The availability of time series of water-electricity use recorded with hourly resolution enables finding repeating structures and routines in consumers' habits. These are key to characterize heterogeneous types of consumers and inform customized demand-side management programs. Yet, extracting relevant and concise information for decision makers from fine-resolution water-electricity use databases calls for proper data mining techniques.

In this research, we contribute a three-phase data-driven customer segmentation analysis of hourly residential water and electricity data metered for each household to (i) identify recurrent water and electricity use routines for each household, (ii) segment water and electricity consumers based on routine similarities, and (iii) infer potential determinants of targeted demand routines from survey psychographic data. We apply our analysis to segment over 1000 residential accounts located in the Los Angeles County (Southern California) and propose recommendations for designing water-electricity demand-side management programs targeting water/electricity conservation or demand peak shifting. The outcomes of our analysis for the specific case study in Southern California reveal that there is a correlation between the amount of water and electricity used daily, yet water and electricity routines are often asynchronous. Moreover, we found a variety of potential determinants of water/electricity demand for different consumer groups. Based on the above findings we identify segments of high consumers and suggest that they can be targeted with demand management programs differentiated between water and electricity, as well as among different segments of users. Overall, our customer segmentation analysis is demonstrated to be a promising tool to support customized demand-side management.