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An adaptive water demand forecasting model for different types of district metered area in urban water distribution system

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ABSTRACT

Due to increased population and urbanization, the demand for water resources has similarly risen. However, the water resources collected from nature are limited in amount, so an organized distribution system is required for stable and continuous supply. The Water Distribution System (WDS) in urban networks operates various control devices such as pumps, valves, and others. It can prevent water shortage and ensure usability. For optimal operation of the system, predicting water demand patterns for each District Metered Area (DMA) is necessary. Because the water demand pattern is influenced by various factors such as characteristics of the DMAs (e.g., type of DMA and number of users), weather, and socioeconomic factors, an appropriate methodology that reflects various factors must be established (Pacchin et al., 2019; Salloom et al., 2021).

The dataset for this research was provided by the Battle of Water Demand Forecasting (BWDF) at the WDSA-CCWI 2024 conference, which aimed to objectively compare methods for short-term demand forecasting across various real urban DMAs.

This study aims to develop an adaptive demand forecasting model applicable to various DMAs. Firstly, 10 DMAs located in the northeast of Italy are classified into four types: Residential, Commercial, Industrial, and Public (e.g., Hospital and Sports facility). Then, a statistical analysis was conducted for each case about the overall trend of demand data, peak time, and annual change trend. Additionally, impact factors such as days of the week, climate, and other socioeconomic factors were examined. For example, during the data periods, DMAs underwent lockdown to minimize the spread of COVID-19, with a halt to activities and movements. Since the lockdown policy altered people's lifestyle patterns and impacted the overall trend of water demand patterns, additional analysis was conducted during this lockdown period.

Various demand forecasting models are applied to different cases, and the best

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model is identified. Three time series forecasting models applied are statistical, heuristic model, and machine learning. By using the results of simulation, develop the best model that not only use demand data but also consider additional effective factors such as climate data and socioeconomic factors. Based on adaptive demand forecasting models with high performance, this allows future research to suggest effective plans for WDS operation.

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