Evaluating Computational Methodologies for Grading Buildings on Energy Performance Using Machine Learning Techniques

Abolfazl Seyrfar, S.M.ASCE,[1] and Hossein Ataei, Ph.D., P.E., F. ASCE[2]

[1]Ph.D. Candidate, Department of Civil, Materials, and Environmental Engineering, University of Illinois at Chicago, 842 W. Taylor St., Chicago, IL 60607; e-mail: aseyrf2@uic.edu
[2]Clinical Associate Professor, Department of Civil, Materials, and Environmental Engineering, University of Illinois at Chicago, 842 W. Taylor St., Chicago, IL 60607; e-mail: hataei@uic.edu

ABSTRACT

Buildings are the largest user of energy in the United States and account for more than 50% of carbon emissions in large cities. Adopting effective tools for encouraging more energy-efficient buildings is therefore paramount. Cities in the U.S. widely use the EnergyStar score for grading the energy efficiency of the buildings. The EnergyStar score uses multiple linear regression (MLR) model to assign a 1-100 score to each building, and its accuracy has been questioned recently by experts. This study evaluates the EnergyStar grading methodology and compares it with more complex machine learning based methods. The work focuses on two major aspects of the grading: (1) model accuracy, and (2) building attributes used in modeling. The results show that the two developed machine learning models, Random Forest and Extreme Gradient Boosting, outperform the Linear EnergyStar model. Therefore, considering the significant impact of grading labels on energy improvement actions, implementing more accurate grading methods is suggested.