A novel deep learning model to estimate and predict residential construction cost

Amir Hossein Pakizeh [a], Hamed Kashani [b]

[a] *M.Sc. student, Department of Civil Engineering, Sharif University of Technology, Tehran , Iran*
[b] *Assistant Professor, Department of Civil Engineering, Sharif University of Technology, Tehran, Iran*

Abstract

The accurate prediction of nonstationary construction costs can contribute to the enhancement of the understanding about sources and patterns of construction costs fluctuations. This understanding can facilitate informed decision making about investment in construction projects. It can help investors better manage the risks associated with construction cost fluctuations and achieve maximum profit. This paper puts forward a novel prediction model for the construction costs of residential buildings. The proposed model comprises two sub-models. A set of variables that determine the building characteristics and the market conditions are the inputs to the first sub-model. This sub-model uses unsupervised deep Boltzmann machine (DBM) learning approach to learn the complex relationships among the explained and explanatory variables. The results are then used in order to build a regression model using support vector regression (SVR) and multi-layer Perceptron (MLP). The first sub-model estimates the current construction cost of a given residential building. The second sub-model, which is based on the adaptive multiscale ensemble-learning paradigm, incorporates ensemble empirical mode decomposition (EEMD) and autoregressive integrated moving average (ARIMA). This sub-model generates a construction cost time series based on estimated costs of the first sub-model and predicts the construction cost of the residential building under study in the following time steps. In order to evaluate the prediction performance of the proposed model, it is applied to a dataset on the construction costs of 360 residential buildings. The results show that the model is successfully able to predict construction costs of residential buildings to the accuracy performance of 98%.

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Keywords: nonstationary construction costs; unsupervised deep Boltzmann machine (DBM); support vector regression (SVR); ensemble empirical mode decomposition (EEMD); autoregressive integrated moving average (ARIMA);

1. Introduction

Completion within predefined budget is success criteria for construction projects as project cost overrun can lead to a variety of problems that eventually lead project failure. Hence, construction cost estimates are often utilized as the basis for budgeting as well as cost control during the construction period. The accurate prediction of nonstationary construction costs can contribute to the enhancement of the understanding about sources and patterns of construction costs fluctuations. This understanding can facilitate informed decision making about investment in construction projects. It can help investors better manage the risks associated with construction cost fluctuations and achieve maximum profit. Over the past few decades, research have proposed the application of a variety of methods such as stochastic techniques [1], regression, artificial neural network (ANN) [2–6], case based reasoning (CBR) [7, 8], and support vector machine (SVM) [9] in order to estimate construction costs. This paper puts forward a novel one-step-ahead construction cost prediction model for the construction costs of residential buildings based on the characteristics of the building under study and the market condition. The proposed deep learning model comprises two sub-models. The first sub-model, estimates the current construction cost of a given residential building based on it characteristics, uses unsupervised deep Boltzmann machine (DBM) learning approach to learn the complex relationships among the

*Corresponding author: Hamed Kashani, email: hamed.kashani@sharif.edu