

Predicting Product Development Time and Cost Using Production Data

Problem Statement

There are several factors that affect the business decision making. Some factors are crucial as those have the potential to divert the decision in wrong way. Cost and time estimation are two main factors among those. As their over prediction might lead to resigning of a contract or an objective that could be achieved and underprediction resulting in having a loss. An accurate prediction model is required for prediction of cost and time of production at the initial stage.

Background

Whenever there is a requirement of developing a new product (software/equipment/process/house) or producing a new batch (of vehicle/cloth/eatable item) the first stage before actual implementation is the estimation of cost and time.

There are two techniques for cost estimation. The qualitative technique of cost estimation includes intuitive or analogical techniques. Adequate expert knowledge and experience are needed in the intuitive method. However, it still needs some tool to assess the expert's decision. It includes cost-based analysis, decision support system like fuzzy logic approach, rule-based approach. In analogical method, cost is estimated based on historical data of previously executed process for ex. Regression analysis, Neural Network Method. This regression analysis is used in trend analysis, financial forecasting, time series prediction. The quantitative technique of cost estimation considers the detailed design and product's features and includes parametric and analytical techniques. Parametric method uses statistical methods for cost estimation. Analytical method estimates the cost as the summation of the cost of elementary units, activities and operations.

There are too many parameters that cannot be quantified at the early stage of forecasting. However, the development cost is a combination of fixed and variable cost. No cost is completely variable or completely fixed. Estimating the cost based on the experience of the same product require detailed knowledge of product structure. The software industries make an estimation of cost based on the efforts require for development using COCOMO model versions. The COCOMO model also provides the measurement of estimation of development time.

Methodology

We will apply multiple regression techniques using the deep neural network. The regression equation between variables can be written as

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + \dots + b_{tX_t} + u$$

where y is the cost or time and X_i are the variables on which cost or time factors depend and a , b_i and u are the intercept, slope and regression residuals respectively.

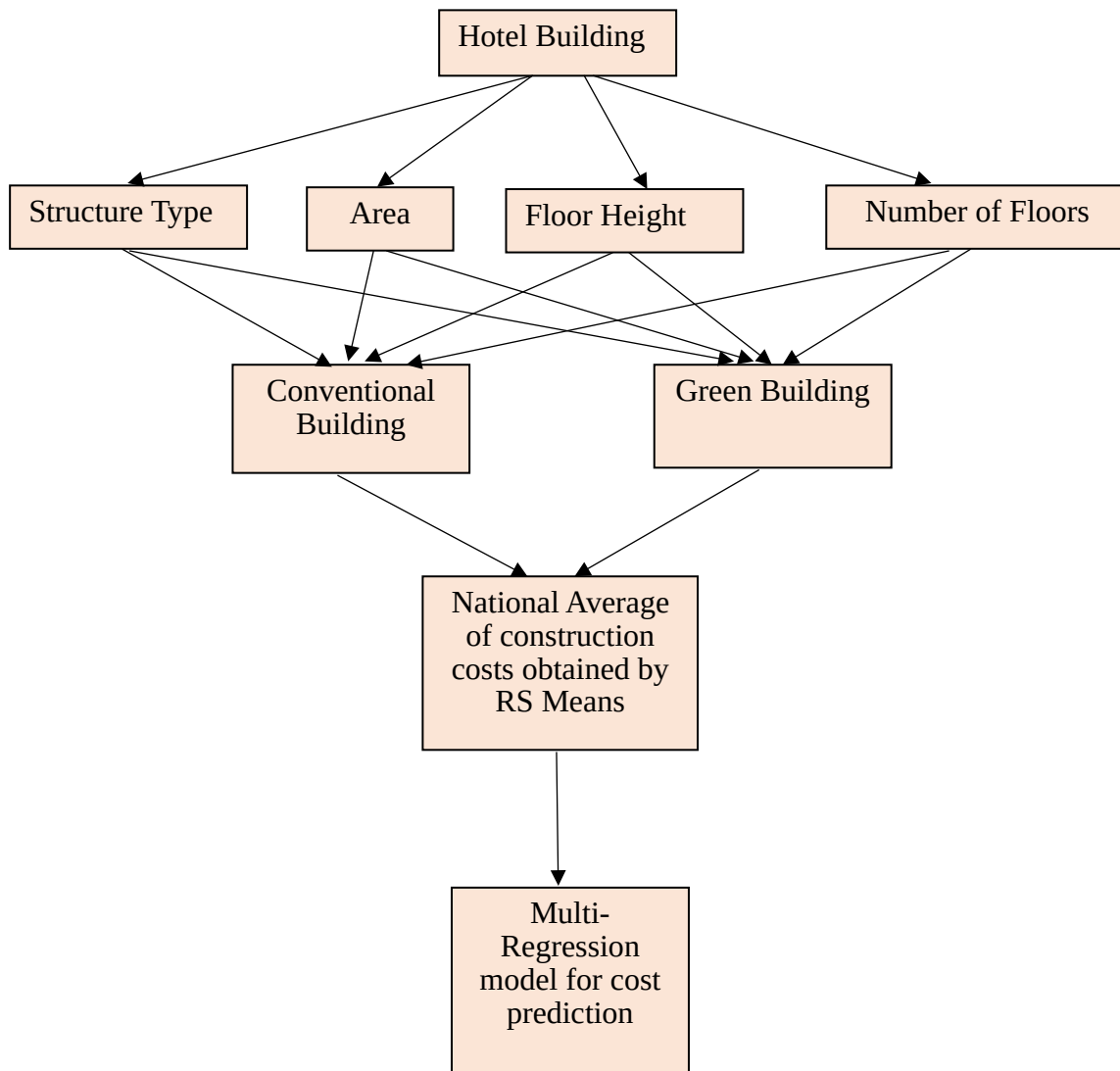


Fig 1: Predicting cost of constructing new hotel building [1]

Step 1 Data collection

In this step data production will be collected from industries and then normalize the data and filter the required features.

Step 2 Data pre-processing and Analysis

In this step time series analysis of data will done to determine the how parameters are fluctuating their values.

Step 3 Training Model

In this step, neural network will be trained on normalized data values for prediction.

Step 4 Testing Model

In this step, the model will be tested for evaluation of the new product.

Evaluation Measure

Mean Squared Error, Mean Absolute Error, accuracy can be used for measuring the performance of prediction.

Software and Hardware

The regression-based deep prediction model will be developed using anaconda python libraries using NVIDIA GPU.

Dataset

- <http://promise.site.uottawa.ca/SERepository/datasets-page.html>
- <http://www.cesldata.com/>

References

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2. Jian S Dai, Stavroula Balabani, Product Cost Estimation: Technique Classification and Methodology Review, Journal of Manufacturing Science and Engineering · May 2006, DOI: 10.1115/1.2137750
3. **Jan Erik Heller, Manuel Löwer, Jörg Feldhusen. Future Product Development Cost Prediction Model for Integrated Lifecycle Assessment. Shuichi Fukuda; Alain Bernard; Balan Gurumoorthy; Abdelaziz Bouras. 11th IFIP International Conference on Product Lifecycle Management (PLM), Jul 2014, Yokohama, Japan. Springer, IFIP Advances in Information and Communication Technology, AICT442, pp.377-386, 2014, Product Lifecycle Management for a Global Market.**