Latvia University of Life Sciences and Technologies

27th Annual International Scientific Conference

RESEARCH FOR RURAL DEVELOPMENT 2021

12-14 May 2021, Jelgava, Latvia

PROPERTY EVALUATION BASED ON AMBIGUOUS LOGIC THROUGH BUILDING INSPECTION IN SÃO PAULO CITY, BRAZIL

Vladimir Surgelas[1], Vivita Pukite[2], Irina Arhipova[3]
Latvia University of Life Sciences and Technologies

Introduction

The civil engineering branch is strongly related to the development of the countries and there is still a lot of information available in the buildings constructed. However, these data are dispersed without proper treatment. On the other hand, if these real estate data are reorganized to discover behavior parameters, these properties' values can be predicted and still work as data and causal relationships between explanatory variables.

Resarch Aim

The purpose of the research is to use construction inspection strategies associated with artificial intelligence and heuristics to predict the market value of a residential apartment in São Paulo city, Brazil. Those samples are located in the Lithuania Republic square at Vila Zelina neighborhood.

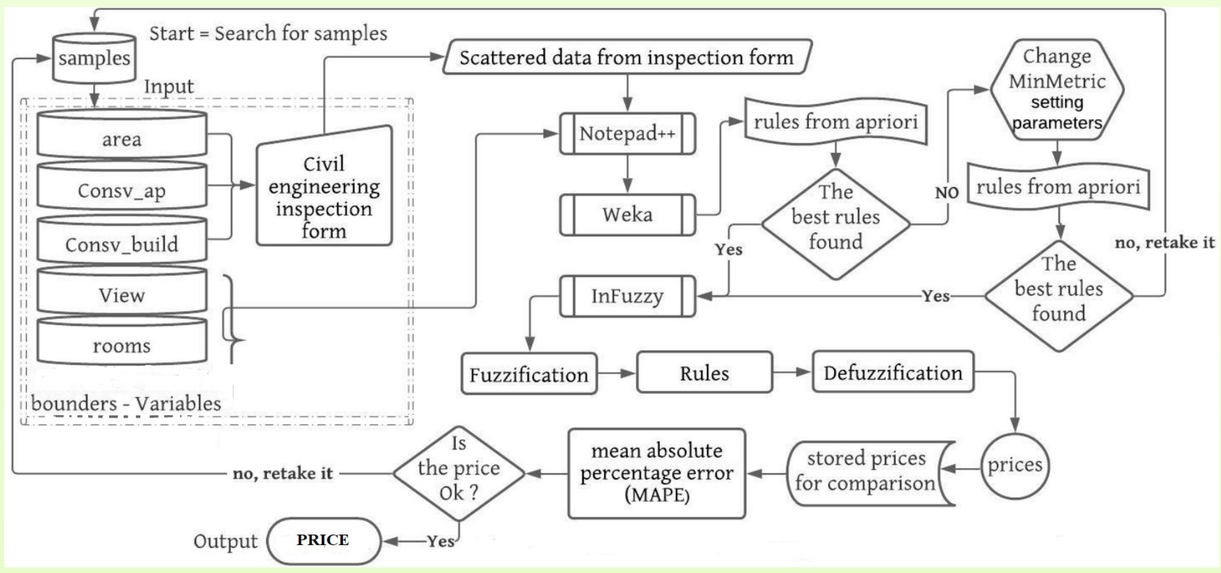
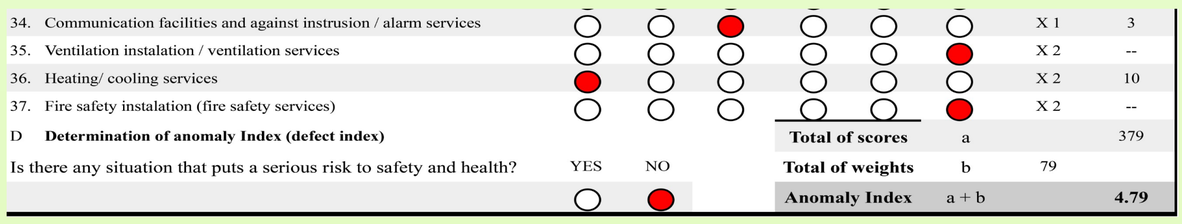


Figure 1. The methodology used for forecasting the price of the residential apartment. Source: author.



34.	Communication facilities and against instrusion / alarm services	○	○	●	○	○	○	X 1	3
35.	Ventilation instalation / ventilation services	○	○	○	○	○	●	X 2	--
36.	Heating/ cooling services	●	○	○	○	○	○	X 2	10
37.	Fire safety instalation (fire safety services)	○	○	○	○	○	●	X 2	--
D	**Determination of anomaly Index (defect index)**				**Total of scores**	a			379
Is there any situation that puts a serious risk to safety and health?		YES	NO		**Total of weights**	b	79		
		○	●		**Anomaly Index**	a + b			**4.79**

Figure 2. Conservation status partial form view: sample 1. Source: Adapted from (Pedro, Paiva & Vilhena, 2008).

Materials and Methods

The methodology was divided into 5 phases described as follow (Figure 1).

Phase 1 - Investigation for the data source accessible on the World Wide Web. Residential apartment offers are available on real estate sites in the region under study. During the visit to the surveyed properties, the standard engineering inspection form was applied. 37 items are analyzed (Figure 2).

Phase 2 - The data were organized by the author to aggregate the attributes of each apartment. The author created the attribute-Relation File Format (ARFF) file on the Notepad++ with the content of the price/square meter ratio.

Phase 3 - The rule system was developed on the basis of the combinations of inputs (total of 5), which were assigned a weight of 1 to establish relevant equality for each rule and reach associations able to optimized the parameters.

Phase 4 - In this phase the InFuzzy software was used, which is a tool for the development of diffuse system applications. In this task, the author inserted the association rules of interest chosen for this research, as selected in Step 3.

Phase 5 - The intention of this phase was to understand the precision of the experimental model. It is about reporting the results of step 4 and checking for compatibility.

Results

1. Thirty seven (37) construction items were analyzed visually, involving various specialties within the field of engineering science. Abnormalities observed in the civil engineering inspection were described linguistic terms.
2. An ARFF file was created in Notepad ++ and the association rules were generated by the Weka software.
3. By Weka software, with minimum support: 0.25 and minimum confidence level set at 0.95. So 1,215 rules were generated by the data mining / learning algorithm. In this situation the 67 best rules following in the same confidence level were chosen with “price” as a conclusion and the system used the InFuzzy rule block.
4. The defuzzification result by the center of mass shows the end process variable (Predicted price at 1,396.94 Euro m^{-2}).
5. The good results derived a Main Percentage Absolute Error (MAPE) of 5%, the mean absolute error (MAE), root-mean-square error (RMSE), and determination coefficient (R^2) of 0.99. Moreover, the average value of the listed prices of 1,243.67 Euro m^{-2} is compared with the average price of the fuzzy model of 1,396.94 Euro m^{-2}, it is clear that the system generated differences ranging from 10% to 12%. In the case of real estate values, this percentage of 10% to 12% can be seen as a normal negotiable variation of the price.

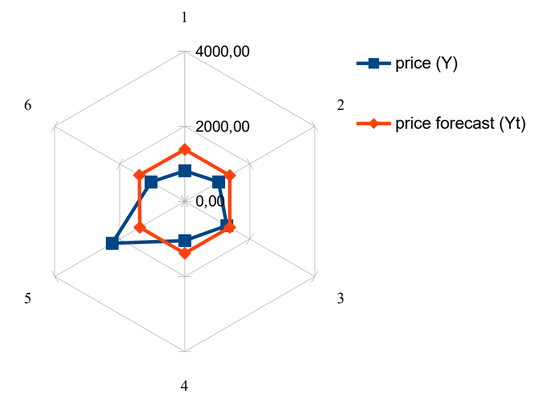


Figure 3. Overview of residential apartment value forecasting. Source: author.

Table 1

Simulation in metric error

price (Y)	price forecast (Yt)	Y-Yt (Euro/m^{-2})	(Y-Yt)/Yt	$(Y-Yt)^2$	abs(Y-Yt)	$[(Y-Yt)/Yt]^2$
815,73	1383,33	-567,60	-0,70	322169,76	567,6	0,48
1040,06	1383,33	-343,27	-0,33	117834,29	343,27	0,11
1292,31	1383,33	-91,02	-0,07	8284,64	91,02	0,00
1045,56	1383,33	-337,77	-0,32	114088,57	337,77	0,10
2231,25	1383,30	847,95	0,38	719019,20	847,95	0,14
1037,10	1396,94	-359,84	-0,35	129484,83	359,84	0,12
				1410881,29	2547,45	97%
				272,50	134,08	**5%**
				RSME	MAE	MAPE

Conclusions

1. This research demonstrates that the heuristic knowledge of a civil engineering experiment can be translated into a system to estimate, with the aid of artificial intelligence tools, the price of an apartment in the real estate market. In this sense, the prices obtained by the model using six properties in Vila Zelina, São Paulo, Brazil were very close to those followed by the sellers.
2. The linguistic terms obtained in a civil engineering inspection were transformed in indexes and included in inference equations to obtain a conclusion. Consequently, with regard to the linguistic rules of human behavior. Thus, this research concludes that the use of fuzzy logic in the evaluation of property prices is a relevant method and generates significant results close to the market reality.

Contacts

e-pasts: [1]dr.engenho@gmail.com / [2]vivita.pukite@llu.lv / [3]zinpror@llu.lv