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Evaluation of Mathematical Regression Models for Historic Buildings Typology Case of Kruja (Albania)

Klodjan Xhexhi[1], Andrea Maliqari[2], Paul Louis Meunier[3]

[1]Polytechnic University of Tirana, Faculty of Architecture and Urban Design, L.9, Rr.Panorama, Tirana, Albania

[2]Polytechnic University of Tirana, Albania

[3]Estp, Paris, France

Abstract: ***The city of Kruja (Albania)contains three types of dwellings that date back to different periods of time: the historic ones, the socialist ones, the modern ones. This paper has to deal only with the historic buildings typology. The questionnaire that is applied will be considered for the development of mathematical regression based on specific data for this category.Variation between the relevant variables of the questionnaire is fairly or inverse linked with a certain percentage of influence. The aim of this study is to have better insights of the important role of the building occupancy, people lifestyle, economiclevel and the quality of life of the residents in the inner medieval citadel, the physics characteristics and energy efficiency of the historical dwellings. The variables such as: number of residents, quality of life, surface of the dwellings, heating instruments and time spent in the dwelling, current living conditions, monthly bills, level of satisfaction, restoration, building improvements, interact with each other with probabilities with different positive or negative percentages.***

Keywords: people lifestyle, physics characteristics of the historic buildings, energy efficiency, quality of life, economic level of the residents, mathematical models

1. Introduction

1.1 Historical aspect

The name of the city is closely related to the word "kroi" (which in Albanian means fountain). Kruja started its activity after being flattened by barbarians ("Zgerdheshi" at the end of late antiquity (V-VI century). This is based upon the discovery of the cemetery in Kruja in the years 1959-1960. The fortress of Kruja was built during these centuries which was extended in a city during the 7th to the 9th century AD. In 1190, Kruja was the capital of the first Arbër autonomous state. The earthquake of 1618 turned down a considerable part of the buildings inside the castle. This is the main reason why within the fortification there are other constructions that belong to the XIII, XIV, XV and XVIII and XIX century [18].

Figure 1: A [15]; B [16]; C [17]

1.2 Background

Globalizationand people lifestyle is in a continuous change. This aspect is fairly linked with energy use and quality of life. In the northern part of European Union, 41% of total final energy consumption comes from buildings, with 30% being used in residential buildings [1].

The governments have enacted a series of policies and regulations in order to increase energy efficiency of dwellings and insuring a good indoor environment. An example of such initiatives is the EPBD, which obliged all European members to implement performance-based energy regulations aimed at decreasing energy consumption in buildings in relation to heating, cooling, ventilation, lighting and domestic hot water. Energy savings due to energy conservation measures are suspected to be lower in reality than predicted [2, 3].

The importance of building characteristics has been determinedin diverse studies. Leth-Petersen and Togeby [4] studied theinfluence of building regulations on energy use, finding that theyhave been important in reducing energy consumption in newbuildings. As a consequence, overall energy use associated with building characteristics is decreasing, making the role of theoccupant even more important [5,6,7]. In the Netherlands, Beerepoot and Beerepoot[8] found that energy performanceregulations have been successful in conserving energy. Nevertheless, the variation in energy consumption is still large fordwellings with the same characteristics.

Occupant behavior play an important role in the variation of the energy consumption in different household [2, 9], but the extent of such influence is still unknown. There is also little work that includes the impact of occupancy behavior [5]. There is little information related to the effect of occupant behavior according to building and household characteristics.

Households can influence energy use for heating in residential buildings. According to several authors, age is an important characteristic determining energy use. Older households tend to consume more energy than younger households, especially for space heating [10, 11]. The correlation between the role of occupancy, size of the dwelling and energy use can be found in several international studies. Also the monthly income and monthly consume for energy use can be an important factor. Biesiot and Noorman [12], using data from household budgetsurveys, energy prices and the primary energy requirements ofgoods in the Netherlands, found an almost linear relationshipbetween expenditure and energy use, confirming that the higherthe disposable yearly income, the higher the energy requirements.

The aim of this study is to have better insights of the important role of the building occupancy, people lifestyle, economic level and the quality of life of the inhabitants in the inner medieval citadel, the physics characteristics and energy efficiency of the historical dwellings. It aims to determine the respective effects between the variables (questions) of the questionnaire, of the building and occupant attributes in energy use, in social environment and in physic characteristics of the dwellings.

There are differences in energy use that are not explained by occupant characteristics such as household size, level of education and age distribution [13]. Vringer et al. [13] investigated the effect of value patterns, problem perception, and motivation in relation to climate change on energy use in Netherlands. The study consider the socioeconomic differences of the household. There were no significant differences between the different value patterns and the energy requirements of groups. The families that are least motivated to save energy uses 4% more energy.

Mechanical parameters such as equipment and appliances effect energy use to the same extend as occupant behaviour [5], causing variation in energy use. Some authors have found no fairy relationship between thermal characteristics of a building and energy use. Meanwhile the relation between indoor temperature and energy demand is a linear and fairy relation [5]. The indoor temperature varies for different types of dwelling due to the occupancy behaviour and preferences [4].

The different heating systems has been found to be an important issue in determining the use of energy in residential buildings. The presence of people in the building influence energy use for space heating [7].

1.3 Literature Review

In 2000 was included data on housing quality in a sample of 15000 houses across the Netherlands. It was an interview based survey which included, data on household characteristics, the use of the dwelling, the presence at home, heating and ventilation behaviour, building characteristics of the dwelling, such as percentage of insulation per surface, type of materials, type of heating system. The data for 3 years of use was obtained from energy providers.

The survey includes data on building characteristics, household characteristics, and occupant behaviour.

The analyses methods used in the study was ANOVA and regression analysis with SPSS. The two-way ANOVA was first used to determine the variation in energy use for heating in different type of dwelling with different insulation levels and to determine the energy use not accounted for these main building characteristics.

For the regression analyses three types of variables were used: building characteristics, household characteristics, and occupant behaviour. Building characteristic variables are those related to the type of dwelling, size of dwelling, type of insulation and the presence of various kinds of rooms. Household characteristics define the users of the dwelling such as age, number of people in the house hold and income. Occupant behaviour is based on lifestyle and the preferences of the occupants in relation to the use of heating and ventilation system [21].

There are many regression analysis used in order to determine the influence of building characteristics and occupant behaviour on energy use. Regression equations allow an analysis of factor influencing energy related aspect of dwelling use and choice that stimulation tools do not [22].

The regression equations are a faster and easy way to predict energy use in a large sample of dwellings than are building simulation tools [23].

These regression models usually include energy demand, energy prices, disposable yearly income, geographic, socioeconomic, demographic and dwelling characteristics [24], but not occupant behaviour or preferences. These models were used also to understand behaviour in different climate conditions and for energy demand forecasting, and were used to model the energy consumption in dwelling in relation to occupant behaviour and building characteristics.

2. Methodology for the probability model (Binary or Tobit)

To evaluate the variables (quality variables for the quality of the explanatory descriptors) according to correlative and causal relationships in the econometric models, are applied binary models Log and Prob, and models for scaled variables Tobit. Such phenomena are generally modeled using the binary link:

$$Yi = \beta Xi + \mu i$$

Where Yi is equal to one (1) when the choice is approved and zero (0) in other cases; this means that:

- -Yi = 1 if Xi is greater than or equal to a critical value X *
- -Y = 0 if Xi is less than a critical value, X *

Mathematically, this model is expressed as:

$$Prob\ (Yi = 1) = F\ (\beta\ 'Xi)$$
$$Prob\ (Yi = 0) = 1\text{-}F\ (\beta\ 'Xi)$$

Where Yi is the answer to the observation of variable responses, Y. This means that Yi = 1 for a positive decision and Yi = 0 for a negative decision.

The function, F can take the form of a normal function, a logistic function, or a probability function. The log model uses a logical function with the distribution of cumulative estimation, P (questions), as follows:

$$P(Y = 1) = \frac{e^{\beta' X}}{1 + e^{\beta' X}}$$

$$P(Y = 0) = 1 - \frac{e^{\beta' X}}{1 + e^{\beta' X}} = \frac{1}{1 + e^{\beta' X}}$$

The probability model is a conditional return regression of the Y values for the given X value, this mathematical expectation will be:

$$E(Y/X) = 1*[F(\beta' X)] + 0*[1 - F(\beta' X)] = F(\beta' X)$$

Evaluation of the parameters of the model will be done by means of maximum ranges, with partial derivatives. Since all variables taken into consideration as dependent and independent ones are binary (ieonly category 0 and 1), and scaled (categorized according to study object levels) multiple regression patterns in this case will be most usable, such as:

$$Ln\ [Pi / (1\text{-}Pi)] = Logit = \beta 0 + \beta 1X1 + \beta 2X2 + ... + \beta nXn + \varepsilon i$$

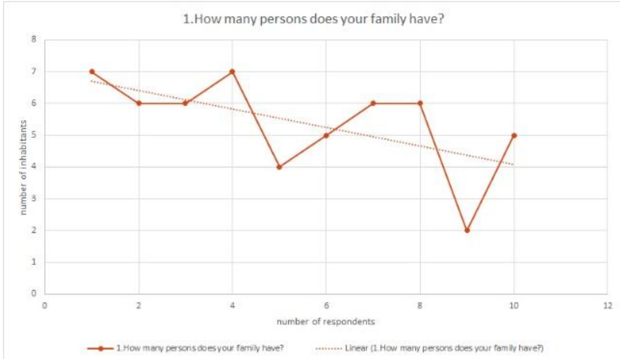
From where with Pi is the probability of the dependent variables that occur or not, when a phenomenon encoded in one of the independent variables. To find the probabilities we will do the antilogarithmic action [anti-ln (logit) = Pi / (1-Pi)]. So Pi will be:

$$P_i = \frac{e^{\beta_0 + \beta_1 X_1 + \cdots + \beta_n X_n}}{1 + e^{\beta_0 + \beta_1 X_1 + \cdots + \beta_n X_n}}$$

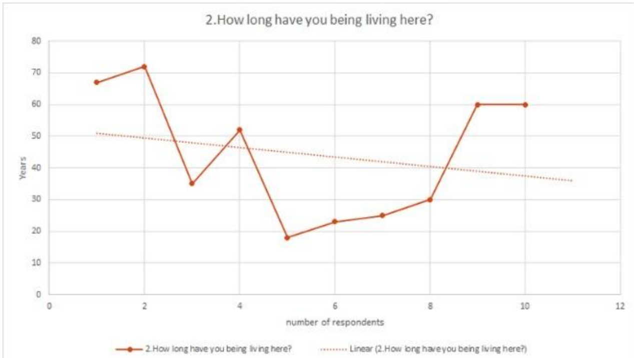
These models were analyzed to explain the correlation of the variables taken in the study, not only from the point of view of correlative links such as bonding strength, but also to analyze the elasticity of scalable causative correlations of dependent variable from independent variables [14].

3. Questionnaire and interpretation (Medieval buildings, dating from XVIII century)

It is undermine a questionnaire of 30 questions. 10 residents with different ages and gender were asked.



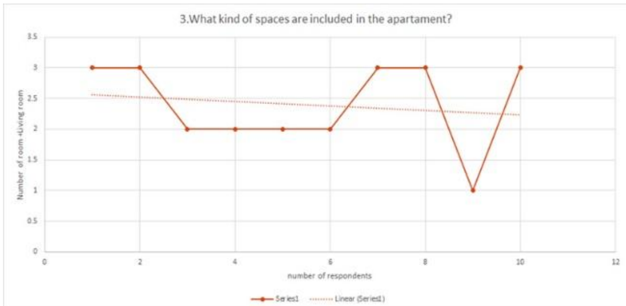
(A)



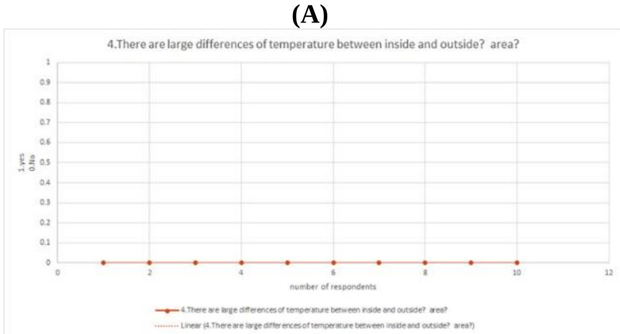
(B)

Figure 2: A; B

Figure 2A reveals the downward trend related to the number of inhabitants per dwelling. Meanwhile figure 2B reveals a sustainability of the inhabitants over time.



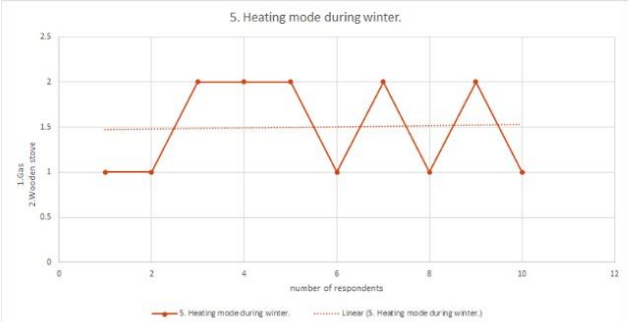
(A)



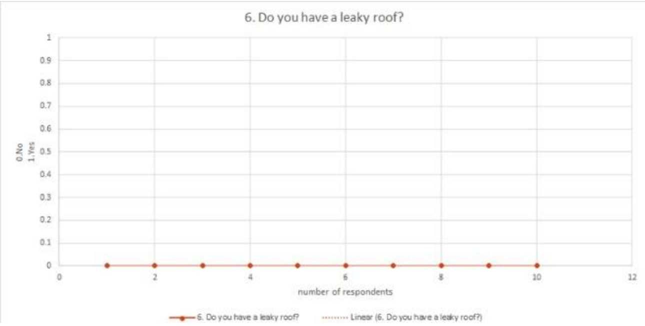
(B)

Figure 3: A; B

Since we are dealing with historical buildings which are preserved by Albanian law [19] for historic buildings and in the existinginner castle no major constructions or modifications are allowed, the trend for this point remains almost neutral (Figure 3A). The residence do not figure out or don't understand the concept of the differences between the temperature of the inside and outside environment (Figure 3B).



(A)

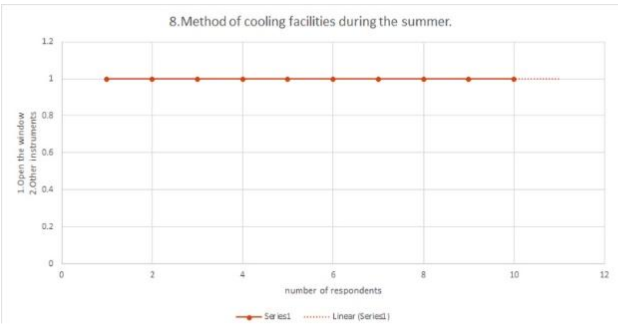


(B)

Figure 4: A; B

The ratio between the two different manners of heating the dwelling during winter between gas and wooden stove is relatively equal (Figure 4A). Despite the living conditions are poor the inhabitants try to keep their dwelling relatively in a good condition. According to the questionnaire there is no leaky roof in the inner citadel (Figure 4B).

(A)

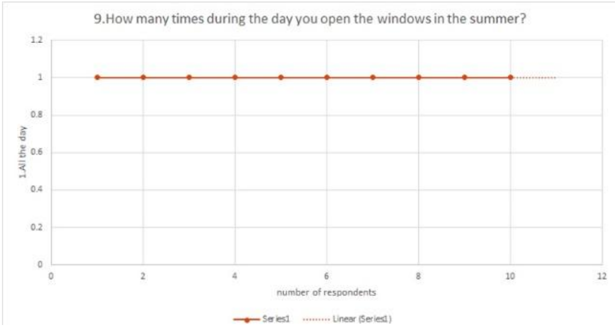


(B)

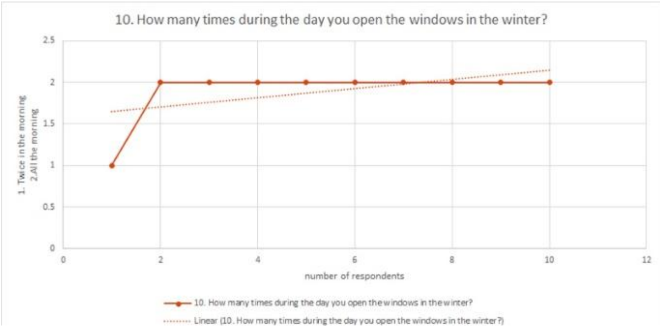
Figure 5: A; B

Historical dwellings have relatively high moisture indices. This is attributed to their very weak isolation and of course to the physic characteristics of building materials (Figure 5A). The buildings have to deal with the sloppy terrain too.

Opening the window is considered by the residents an instrument of ventilation and refreshment in the summer time. Meanwhile in the winter time the residents prefer to ventilate their home once in the day, mostly in the morning. They cannot afford to ventilate their dwellings more than once in the day in the winter time (Figure 5B; 6A; 6B).



(A)



(B)

Figure 6: A; B

(A)

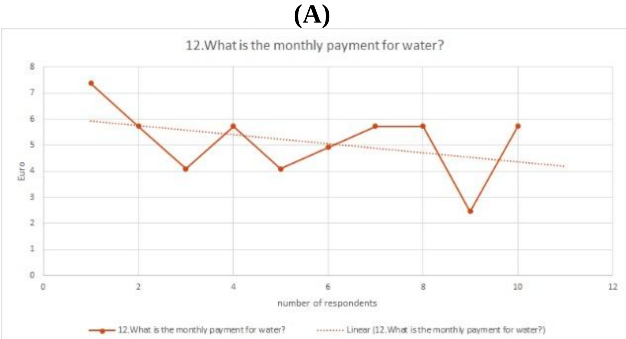


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Figure 7: A; B

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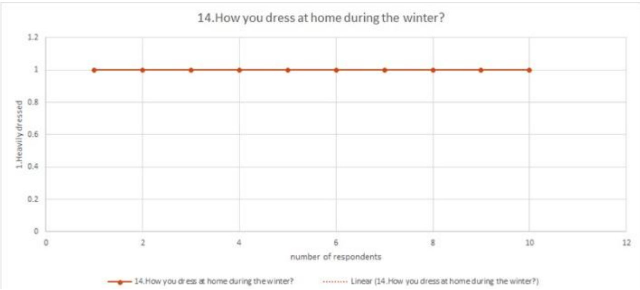
The resident's trend of spending quality time is focused mostly toward living room and kitchen (Figure 7A). The trend for the monthly payment for water is decreasing. Residents also have other benefits as natural water sources (Figure 7B). Meanwhile the trend of electrical energy is increasing with a very small factor (Figure 8A).

(A)

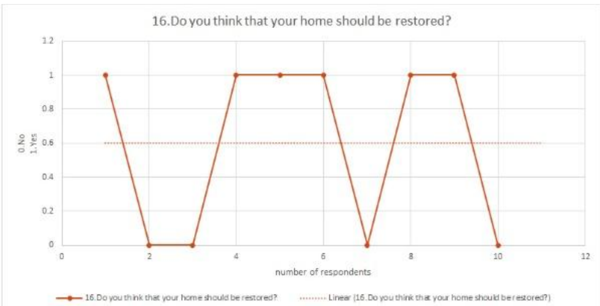


(B)

Figure 8: A; B

The inhabitants get heavily dressed in the winter time and normal dressed in the summer time this is due to the current living condition and to the dwelling physic characteristics (Figure 8B; 9A).

(A)

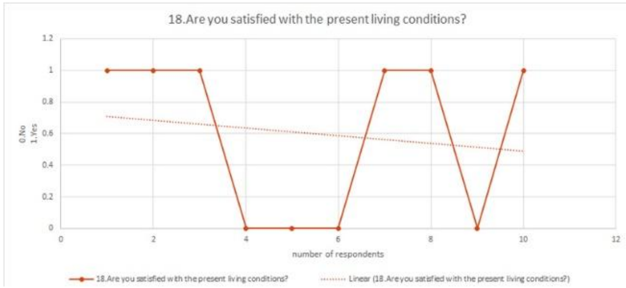


(B)

Figure 9: A; B

Residents despite the difficult conditions think contradictory about the restoration or not of their dwelling. Despite this, trend in this case is neutral. Residents are aware of the historical values of the buildings and prefer careful restoration in most of the cases (Figure 9B).

(A)

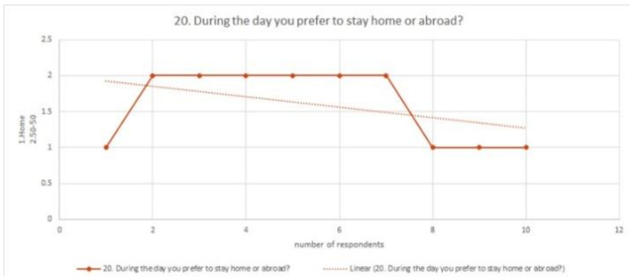


(B)

Figure 10: A; B

Resident's trend of painting their home is increasing due to the poor physic condition of the dwellings and moisture (Figure 10A). Meanwhile the trend of satisfaction of the inhabitants is decreasing due to these poor living conditions (Figure 10B).

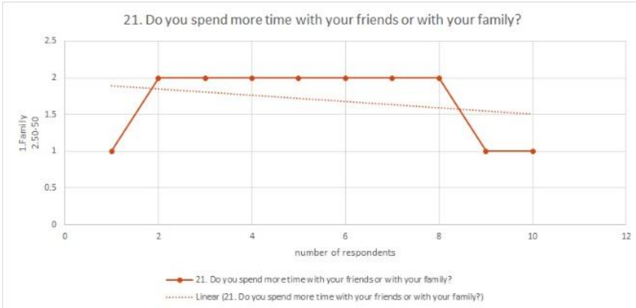
(A)



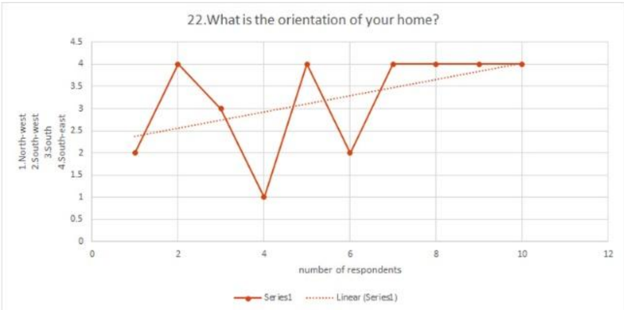
(B)

Figure 11: A; B

There is much to be done for the improvement of the dwelling. The inhabitants prefer mostly to renovate their roof (Figure 11A). The social level and occupancy behaviour is another important factor to consider. The residents prefer mostly to spend their time home and abroad in an equal manner. However the trend is decreasing (Figure 11B).



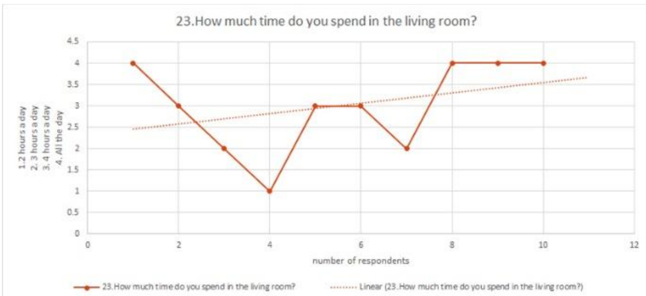
(A)



(B)

Figure 12: A; B

The majority of the residents prefer to spend their time in equal manner with the friends and with the family (Figure 12A). Winning orientation for the historic dwellings (kitchen-living room) is south-east. This is due to the Skanderbeg mounting in the north-east, the Kruja's climate [20], and the sea in the south-west (Figure 12B).



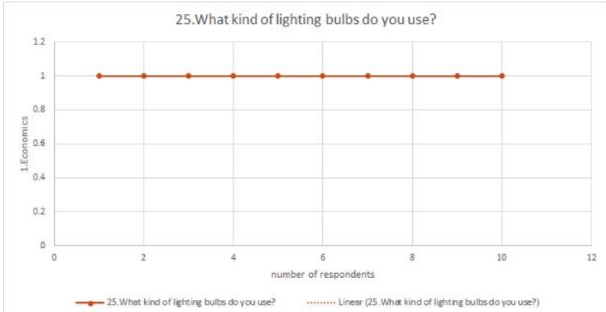
(A)

(B)

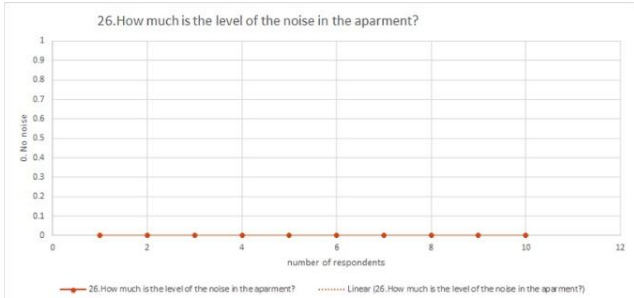
Figure 13: A; B

The trend of the spending time in the living room is increasing. Residents prefer to spend most of their time in the living room (Figure 13A).

The inhabitants refuse to change their living place with a better one despite the poor living conditioning. Being within the historic area they claim to win as much as possible from their property. This is one of the reasons why they sell their property with great difficulty (Figure 13B).



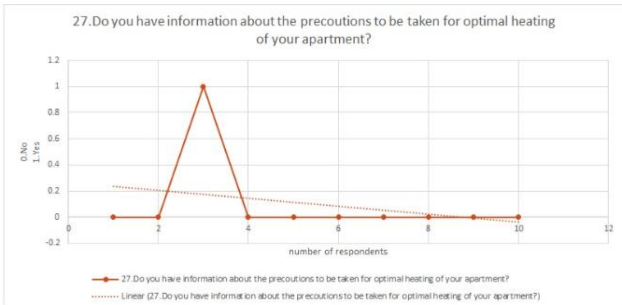
(A)



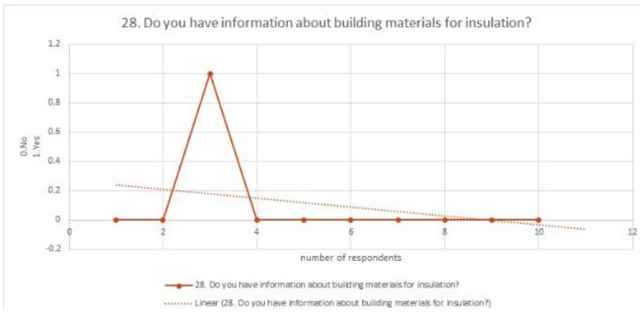
(B)

Figure 14: A; B

The use of the lighting bulbs is economics ones. The other categories (led) are relatively expensive for the inhabitants (Figure 14A). This is another indicator of the economic level of the inhabitants. The level of the noise in the inner citadel is very good.This is due to the pedestrian zone and lack of a car road (Figure 14B)



(A)

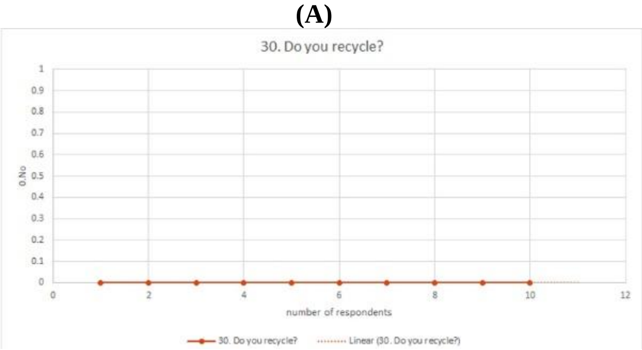


(B)

Figure 15: A; B

Unfortunately the inhabitants have no information or very little information about the precautions to be taken for optimal heating and building insulation materials (Figure 15A; B).

(A)



(B)

Figure 16: A; B

The inhabitants do not have much information about recycling and the impact of it in the community. They do not recycle at all (Figure 16A; B).

4. Evaluation models for historic buildings

Model NR.1

Dependent Variable: P3				
Method: ML - Censored Normal (TOBIT) (Quadratic hill climbing)				
Sample: 1 10				
Included observations: 10				
Left censoring (value) at zero				
Convergence achieved after 6 iterations				
Covariance matrix computed using second derivatives				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.780374	0.423149	6.570676	0.0000
P1	-0.719626	0.292570	-2.459675	0.0139
P22	0.163551	0.121854	1.342189	0.1795
P18	0.827103	0.243708	3.393820	0.0007
Error Distribution				
SCALE:C(5)	0.305709	0.068359	4.472136	0.0000
Mean dependent var	2.400000	S.D. dependent var		0.699206
S.E. of regression	0.432338	Akaike info criterion		1.467633
Sum squared resid	0.934580	Schwarz criterion		1.618926
Log likelihood	-2.338167	Hannan-Quinn criter.		1.301666
Avg. log likelihood	-0.233817			
Left censored obs	0	Right censored obs		0
Uncensored obs	10	Total obs		10

Source: Working on Eviews 8 by the author

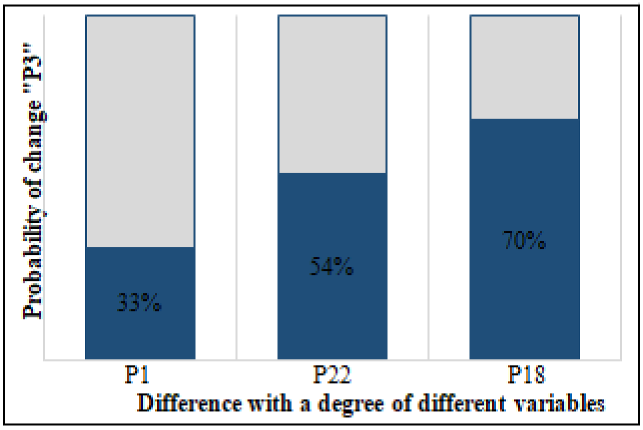
The equation of the probabilistic model is:

$$\textbf{Probability}\ \{P_3\} = \frac{e^{\{Y\}}}{1 + e^{\{Y\}}}$$

Where Y parameter varies according to linear logic equation:

$$Y = 2.780374 - 0.719626*P1 + 0.163551*P22 + 0.827103*P18 + \varepsilon_i$$

According to model tests, it is observed that the model referring to statistic "Log likelihood" is statistically significant with significance level p <5% (i.e. with reliability 95%). This means that such a model stands in its overall approach to the logical and probability of variables. But if we analyze the statistical significance of each variable in the model, student statistics (t-test) tell us that with the importance level p <5% (ie with reliability of 95%), the variable "P22" is statistically insignificant, while the other variables are important in explaining the variation of the quality of life indicator given by the question "P3" of the questionnaire. The probabilistic effect is graphically shown as follows:



Source: by the author

According to this model (Tobit probability regression with many variables), from the results presented in the graph above we identify the following connections:

- The quality of life indicator "P3" (question) correlates negatively (obliquely) and statistically significant with the variable "P1". A one step increaseof the "P1" variable will bring the change to a degree of "P3" with a probability of 33% (under conditions where other variables are kept constant). The reason why this elasticity / probability exists (according to questions P3 and P1 and corresponding responses of the questionnaire) is explained by the fact that:

If the number of residents increases, the indicator square meter/ inhabitant will decreases. In the same way the quality of life will decrease.

- The quality of life indicator "P3" correlates positively and statistically with the variable "P18". When variable "P18" takes value 1, it changes "P3" with a degree with a probability of 70% (under conditions where other variables are kept constant). The reason why this elasticity / probability exists(according to questions P3 and P18 and corresponding responses of the questionnaire) is explained by the fact that:

The connection between the current conditions of the dwelling is proportional to the optimal space in the dwelling. As one increases, the other one increases too.

Model NR.2

Dependent Variable: P5				
Method: ML - Censored Normal (TOBIT) (Quadratic hill climbing)				
Sample: 1 10				
Included observations: 10				
Left censoring (value) at zero				
Convergence achieved after 5 iterations				
Covariance matrix computed using second derivatives				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.956704	0.409670	7.217286	0.0000
P23	-0.187151	0.079209	-2.362761	0.0181
P3	-0.412011	0.153387	-2.686095	0.0072
Error Distribution				
SCALE:C(4)	0.319523	0.071448	4.472136	0.0000
Mean dependent var	1.500000	S.D. dependent var		0.527046
S.E. of regression	0.412499	Akaike info criterion		1.356025
Sum squared resid	1.020933	Schwarz criterion		1.477059
Log likelihood	-2.780126	Hannan-Quinn criter.		1.223251
Avg. log likelihood	-0.278013			
Left censored obs	0	Right censored obs		0
Uncensored obs	10	Total obs		10

Source: Working on Eviews 8 by the author

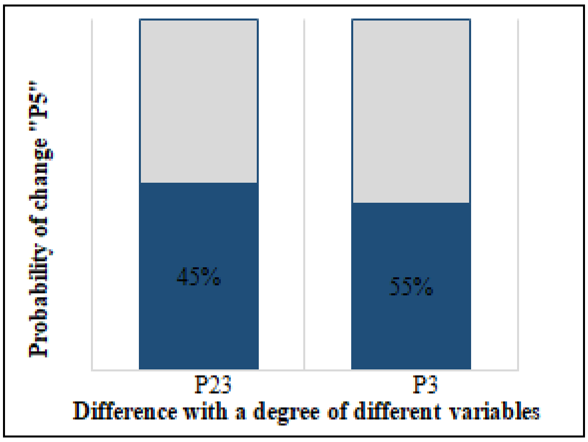
The equation of the probabilistic model is:

$$\textbf{Probability}\ \{P_3\} = \frac{e^{\{Y\}}}{1 + e^{\{Y\}}}$$

Where Y parameter varies according to linear logic equation:

$$\mathbf{Y = 2.956704 - 0.187151*P23 - 0.412011*P3 + \varepsilon_i}$$

According to model tests, it is observed that the model referring to statistic "Log likelihood" is statistically significant with significance level p <5% (i.e. with reliability of 95%).This means that such a model stands in its overall approach to the logical and probability of variables.But if we analyze the statistical significance of each variable in the model, student statistics (t-test) tell us that with the importance level p <5% (ie with reliability of 95%), where all variables are important in explaining the variation of the indicator of the quality of life provided by the question "P5" of the questionnaire. The probabilistic effect is graphically shown as follows:



Source: by the author

According to this model (Tobit probability regression with many variables), from the results presented in the graph above we identify the following:

- The "P5" quality of life indicator is negatively linked (statistically significant) to the variable "P3". A one step increase of the variable "P3" will bring the change to a degree of "P5" with a probability of 55% (under conditions where other variables are kept constant). The reason why this elasticity / probability exists (according to questions P5 and P3 and corresponding responses of the questionnaire)is explained by the fact that:

If the surface increases, this affects negatively the heating instruments in the dwelling. In this case is necessary to change or modify the heating instruments in the dwelling from wooden stove to gas.

- The quality of life indicator "P5" correlates negatively (obliquely) and statistically significant with the variable "P23". A one step increaseof the variable"P23" will bring the change to a degree of “P5” with a probability of 45% (in case other variables are kept constant). The reason why this elasticity / probability exists(according to questions P5 and P23and corresponding responses of the questionnaire)is explained by the fact that:

If the time spent in the dwelling increases, this affects negatively the heating instruments in the dwelling. In this case is necessary to change or modify the heating instruments in the dwelling from wooden stove to gas.

Model NR.3

Dependent Variable: P18				
Method: ML - Censored Normal (TOBIT) (Quadratic hill climbing)				
Sample: 1 10				
Included observations: 10				
Left censoring (value) at zero				
Convergence achieved after 9 iterations				
QML (Huber/White) standard errors & covariance				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-1.202121	0.689364	-1.743811	0.0812
P3	0.544344	0.124395	4.375921	0.0000
P11	-0.494859	0.124234	-3.983270	0.0001
P12	0.000742	0.000643	1.153996	0.2485
P13	0.000198	0.000115	1.716479	0.0861
P16	-0.544344	0.142725	-3.813932	0.0001
Error Distribution				
SCALE:C(7)	0.090817	0.020611	4.406286	0.0000
Mean dependent var	0.600000	S.D. dependent var		0.516398
S.E. of regression	0.131433	Akaike info criterion		0.328541
Sum squared resid	0.051824	Schwarz criterion		0.540351
Log likelihood	5.357293	Hannan-Quinn criter.		0.096187
Avg. log likelihood	0.535729			
Left censored obs	4	Right censored obs		0
Uncensored obs	6	Total obs		10

Source: Working on Eviews 8 by the author

The equation of the probabilistic model is:

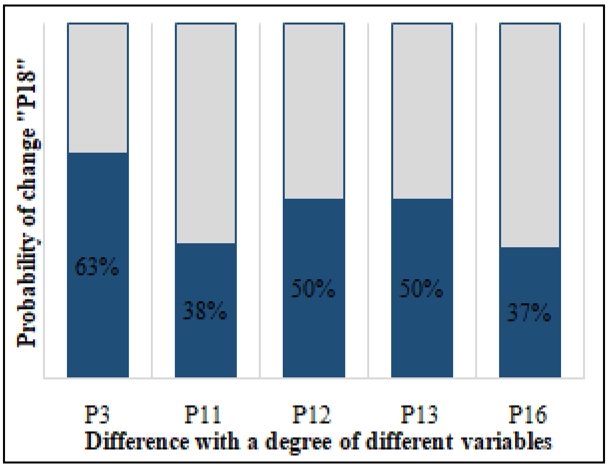
$$\textbf{Probability}\ \{P_3\} = \frac{e^{\{Y\}}}{1 + e^{\{Y\}}}$$

Where Y parameter varies according to linear logic equation:

$$\mathbf{Y = -1.202121 + 0.544344*P3 - 0.494859*P11 + 0.000742*P12 + 0.000198*P13 - 0.544344*P16 + \varepsilon_i}$$

According to model tests, it is observed that the model referring to statistic "Log likelihood" is statistically significant with significance level p <5% (iewith reliability of 95%). This means that such a model stands in its overall approach to the logical and probability of variables.But if we analyze the statistical significance of each variable in the model, student statistics (t-test) tell us that with a p <5% significance level (ie with reliability of 95%), the variable

"P12" is not statistically significant, Other variables are important in explaining the variation of the quality of life indicator given by the question "P18" of the questionnaire (variable "P13" is a statistically significant p <10%). The probabilistic effect is graphically shown as follows:



According to this model (Tobit probability regression with many variables), from the results presented in the graph above we identify the following connections:

- The quality of life indicator "P18" is positively correlated (fairly) and statistically significant with the "P3" variable. A one step increaseof the variable "P3" will bring the change to a "P18" with the probability of 63% (under conditions where other variables are kept constant). The reason why this elasticity/probability exists (according to questions P18 and P3 and corresponding responses of the questionnaire) is explained by the fact that:

The connection between the current conditions of the dwelling is proportional to the optimal space in the dwelling. As one increases, the other one increases too.

- The quality of life indicator "P18" correlates negatively (obliquely) and statistically significant with the variable "P11". A one step increase of the variable "P11" will bring the change to a "P18" with a probability of 38% (under conditions where other variables are kept constant). The reason why this elasticity/probability exists (according to questions P18 and P11 and corresponding responses of the questionnaire) is explained by the fact that:

The reason for the adverse impact of these two variables is interpreted in direct relation to the way of life of Krutan's families (many families under one roof). Solid families in the inner dwelling prefer to spend more time mostly in their respective sleeping rooms, (greater degree of intimacy) which increase the level of pleasure.

- The quality of life indicator "P18" relates positively (fairly) and statistically important to the variable "P13". A one step increase of thevariable "P13" will bring the change to a degree of "P18" with a probability of 50% (under conditions when other variables are kept constant). The reason why this elasticity/probability exists (according to questions P18 and P13 and corresponding responses of the questionnaire)is explained by the fact that:

The connection between the current conditions of the dwelling is proportional to the monthly bill of electricity. As one increases, the other one increases too. If the monthly bill is higher this affects positively the level of satisfaction for conditions of the dwelling.

- The quality of life indicator "P18" correlates negatively (obliquely) and statistically significant with the variable "P16". A one step increase of the variable "P16" will bring the change to a degree of "P18" with a probability of 37% (under conditions where other variables are kept constant). The reason why this elasticity/probability exists (according to questions P18 and P16 and corresponding responses of the questionnaire)is explained by the fact that:

The residents of the historical buildings may agree with the restoration of their dwellings but this affects negativelywith the level of satisfaction of the current condition of the dwelling. If the need for restoration gets up, the level of satisfaction of the conditions of the dwelling will fall down.

Model NR.4

Dependent Variable: P16				
Method: ML - Censored Normal (TOBIT) (Quadratic hill climbing)				
Sample: 1 10				
Included observations: 10				
Left censoring (value) at zero				
Convergence achieved after 5 iterations				
Covariance matrix computed using second derivatives				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	1.778794	0.742330	2.396231	0.0166
P18	-1.388670	0.453978	-3.058892	0.0022
P19	-0.846674	0.302537	-2.798578	0.0051
P3	0.643555	0.335115	1.920402	0.0548
Error Distribution				
SCALE:C(5)	0.352400	0.111572	3.158501	0.0016
Mean dependent var	0.600000	S.D. dependent var		0.516398
S.E. of regression	0.415182	Akaike info criterion		1.856133
Sum squared resid	0.861878	Schwarz criterion		2.007425
Log likelihood	-4.280663	Hannan-Quinn criter.		1.690165
Avg. log likelihood	-0.428066			
Left censored obs	4	Right censored obs		0
Uncensored obs	6	Total obs		10

Source: Working on Eviews 8 by the author

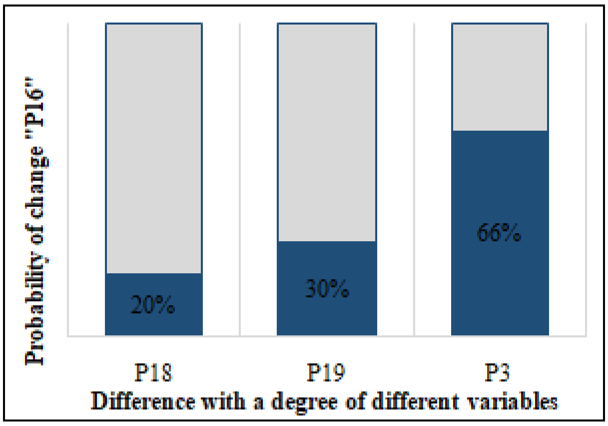
The equation of the probabilistic model is:

$$\textbf{Probability}\ \{P_3\} = \frac{e^{\{Y\}}}{1 + e^{\{Y\}}}$$

Where Y parameter varies according to linear logic equation:

$$\mathbf{Y = -\ 1.778794 - 1.388670*P18 - 0.846674*P19 + 0.643555*P3 + \varepsilon_i}$$

According to model tests, it is observed that the model referring to statistic "Log likelihood" is statistically significant with significance level p <5% (ie with reliability of 95%). This means that such a model stands in its overall approach to the logical and probability of variables. But if we analyze the statistical significance of each variable in the model, student statistics (t-test) tell us that with the importance level p <5% (ie with reliability of 95%) all other variables are important in explaining the variation of the indicator of the quality of life given through the question "P16" of the questionnaire (variable "P3" is an important statistic with p <10%). The probabilistic effect is graphically shown as follows:



According to this model (Tobit probability regression with many variables), from the results presented in the graph above we identify the following connections:

- The quality of life indicator "P16" relates positively (fairly) and statistically important to the variable "P3". A one step increase of the variable "P3" will bring the change to a degree of "P16" with a probability of 66% (under conditions where other variables are kept constant). The reason why this elasticity/probability exists (according to questions P16 and P3 and corresponding responses of the questionnaire)is explained by the fact that:

The connection between the restorations of the dwelling is proportional to the optimal space in the dwelling. As one increases, the other one increases too. The need for restoration is bigger when the surface of the dwelling increases.

- The quality of life indicator "P16" correlates negatively (obliquely) and statistically significant with the variable "P18". A one step increase of the variable "P18" will bring the change to a degree of "P16" with a probability of 20% (under conditions where other variables are kept constant). The reason why this elasticity/probability exists (according to questions P16 and P18 and corresponding responses of the questionnaire)is explained by the fact that:

The residents of the historical buildings may agree with the restoration of their dwellings but this affects negatively with the level of satisfaction of the current condition of the dwelling. If the need for restoration gets up, the level of satisfaction of the conditions of the dwelling will fall down.

- The quality of life indicator "P16" correlates negatively (obliquely) and statistically significant with the variable "P19". A one step increase of the variable "P19" will bring the change to a degree of "P16" with probability of 30% (under conditions when other variables are kept constant). The reason why this elasticity/probability exists (according to questions P16 and P19 and corresponding responses of the questionnaire) is explained by the fact that:

If the need for potential improvement in the dwelling gets up, the need for restoration will fall down.

Model NR.5

Dependent Variable: P19				
Method: ML-Censored Normal (TOBIT) (Quadratic hill climbing)				
Sample: 1 10				
Included observations: 10				
Left censoring (value) at zero				
Convergence achieved after 5 iterations				
Covariance matrix computed using second derivatives				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.915738	0.507028	1.806091	0.0709
P11	0.457174	0.175771	2.600960	0.0093
P2	0.009791	0.005896	1.660555	0.0968
Error Distribution				
SCALE:C(4)	0.355221	0.079430	4.472136	0.0000
Mean dependent var	2.400000	S.D. dependent var		0.516398
S.E. of regression	0.458588	Akaike info criterion		1.567845
Sum squared resid	1.261817	Schwarz criterion		1.688879
Log likelihood	-3.839224	Hannan-Quinn criter.		1.435071
Avg. log likelihood	-0.383922			
Left censored obs	0	Right censored obs		0
Uncensored obs	10	Total obs		10

Source: Working on Eviews 8 by the author

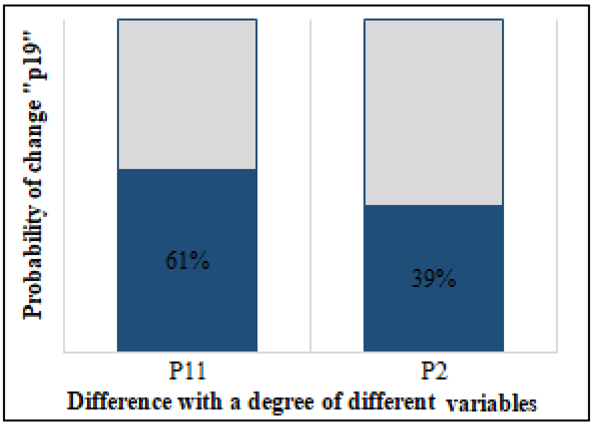
The equation of the probabilistic model is:

$$\textbf{Probability } \{P_3\} = \frac{e^{\{Y\}}}{1 + e^{\{Y\}}}$$

Where Y parameter varies according to linear logic equation:

$$\mathbf{Y = 0.915738 + 0.457174*P11 + 0.009791*P2 + \varepsilon_i}$$

According to model tests, it is observed that the model referring to statistic "Log likelihood" is statistically significant with significance level p <5% (iewith reliability 95%).This means that such a model stands in its overall approach to the logical and probability of variables. But if we analyze the statistical significance of each variable in the model, the student's statistic (t-test) shows that with the importance level p <5% (ie with reliability of 95%) the variable "P11" and the importance level p <10% the variable "P2"In the explanation of the variation of the quality of life indicator given by the question " P19 "of the questionnaire. The probabilistic effect is graphically shown as follows:



According to this model (Tobit probability regression with many variables), from the results presented in the graph above we identify the following connections:

- The quality of life indicator "P19" correlates positively (fairly) and statistically importantly with the variable "P11". A one step increaseof the variable "P11" will bring the change to"P19" with a probability of61% (in case other variables are kept constant). The reason why this elasticity/ probability exist (according to questions P19 and P11 and corresponding responses of the questionnaire) is explained by the fact that:

If the need for potential improvement in the dwelling increase, the need for spending quality time in the right place of the dwelling increases too.

- The quality of life indicator "P19" correlates positively (fairly) and statistically important to the variable "P2". A one step increase with a variable of the "P2" will bring the change to a "P19" with a probability of 39% (under conditions where other variables are kept constant). The reason why this elasticity / probability exist(according to questions P19 and P2 and corresponding responses of the questionnaire) is explained by the fact that:

If the time that is consumed in the dwelling increases, the potential for improvements in the dwelling increases too.

5. Conclusions

5.1 Model nr.1

If the number of residents increases with a degree, the indicator square meter/ inhabitant will decreases with a probability of 33%. In the same way the quality of life will decrease. The connection between the current conditions of the dwelling is proportional to the optimal space in the dwelling. As one increases with a degree, the other one increases too with a probability of 70%.

5.2 Model nr.2

If the surface increases with a degree, this affects negatively the heating instruments in the dwelling with a probability of 55%. In this case is necessary to change or modify the heating instruments in the dwelling from wooden stove to gas. If the time spent in the dwelling increases with a degree, this affects negatively the heating instruments in the dwelling with a probability of 45%. In this case is necessary to change or modify the heating instruments in the dwelling from wooden stove to gas.

5.3 Model nr.3

The connection between the current conditions of the dwelling is proportional to the optimal space in the dwelling. As one increases with one degree, the other one increases too with a probability of 63%.

Solid families(many families under one roof) in the inner dwelling prefer to spend more quality time mostly in their respective sleeping rooms, (greater degree of intimacy) which increase the level of pleasure. If the first variable increases the second one will decrease with a probability of 38%.

The connection between the current conditions of the dwelling is proportional to the monthly bill of electricity. As one increases with a degree, the other one increases too with a probability of 50%. If the monthly bill is higher this affects positively the level of satisfaction for conditions of the dwelling.

The residents of the historical buildings may agree with the restoration of their dwellings but this affects negatively with the level of satisfaction of the current condition of the dwelling. If the need for restoration increases with a degree, the level of satisfaction of the conditions of the dwelling will decrease with a probability of 37%.

5.4 Model nr.4

The connection between the restorations of the dwelling is proportional to the optimal space in the dwelling. As one increases with a degree, the other one increases too with a probability of 66%. The need for restoration is bigger when the surface of the dwelling increases.

The residents of the historical buildings may agree with the restoration of their dwellings but this affects negatively with the level of satisfaction of the current condition of the dwelling. If the need for restoration increases with a degree, the level of satisfaction of the conditions of the dwelling will decrease with a probability of 20%.

5.5 Model nr.5

If the need for potential improvement in the dwelling increases with a degree, the need for spending quality time in the right place of the dwelling increases too with a probability of 61%.

If the time that is consumed in the dwelling increases with a degree, the potential for improvements in the dwelling increases too with a probability of 39%.

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