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Assessing Quality of Life Indicators in Contemporary Buildings in Kruja, Albania: A Regression Model Approach

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Purpose: This article aims to highlight key indicators of residents' quality of life in a specific contemporary building in Kruja, Albania.

Design/Method/Approach: A questionnaire with 30 questions was prepared for the inhabitance, and the Binary or Tobit probabilistic models were taken into consideration as part of the methodology, to conclude. The study will further analyze the implications of the inhabitants and their behavior in a specific contemporary building in the city of Kruja. It was examined the statistical significance of each variable (questions) in the models elaborated with EViews 8 software. The stable models that are associated with the "Log-likelihood" statistics were statistically significant at a significance level of p < 5%, or with 95% confidence, based on the model tests.

Findings: The study concluded that the most statistically significant quality of life indicators part of the questionnaire is related to the typology of the apartments, methods of cooling during summer, present living conditions, apartment improvement, apartment orientation, and time spent in the living room. Furthermore, the study reveals that most of the quality-of-life indicators (part of the questionnaire) are not statistically important, so they will not be considered part of the models created in the article. The study reveals that increasing the living space and improving orientation is crucial to enhance the satisfaction of apartment inhabitants. When apartment sizes increase and orientation is improved, residents are more likely to opt for fans over air conditioners to reduce electricity costs and avoid installing additional cooling facilities during summer. They believe that better living conditions require larger apartments, additional water supply, increased electrical costs, and more time spent in the living room. The inhabitants also emphasize the importance of reducing moisture levels, decreasing window opening frequency, and increasing time spent with family. Interestingly, a one-degree improvement in summer cooling methods (e.g., switching from air blowers to air conditioning) corresponds to a one-degree improvement in winter heating methods (e.g., switching from gas to electricity), leading to a heightened need for clean electric heating. Overall, the study emphasizes the importance of meeting the physical and spatial needs of the residents to enhance their overall satisfaction and quality of life. Urban policies significantly impact housing affordability, quality, transport systems, environmental sustainability, and social equity, affecting overall living standards and economic growth. Cities must create well-designed policies that consider residents' needs and study findings to ensure sustainable development and citizen welfare.

Theoretical Implications: Gujarati's (Basic Economics) theory was developed in the article.

Practical Implications: This study will serve as an indicator to analyze the further improvements that might occur in the specific building (not just in the city of Kruja), considering the main quality of life indicators.

Originality/Value: The article will serve as a base for further analysis of resident's behavior and their social impact in the community in order to be aware of their needs for further developments in the construction field.

Research Limitations/Future Research: The findings depend profoundly on the type of building the residents are living in. The research stream that can be inspired by the research is strongly related to mathematical regression models, statistics, and probability.

Paper Type: Empirical

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Оцінка показників якості життя у сучасних будівлях міста Круя, Албанія: підхід на основі регресійних моделей

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Мета роботи: Ця стаття має на меті висвітлити ключові показники якості життя мешканців у конкретному сучасному будинку в Круї, Албанія.

Дизайн / Метод / Підхід дослідження: Для мешканців було підготовлено анкету з 30 запитаннями, а в рамках методології було враховано імовірнісні моделі Binary або Tobit, щоб зробити висновки. У подальшому дослідженні буде проаналізовано наслідки для мешканців та їхню поведінку в конкретній сучасній будівлі в місті Круя. Було перевірено статистичну значущість кожної змінної (питань) у моделях, розроблених за допомогою програмного забезпечення EViews 8. Стабільні моделі, пов'язані зі статистикою «Log-likelihood», були статистично значущими на рівні значущості р < 5%, або з 95% довірчою ймовірністю, на основі модельних тестів

Результати дослідження: Дослідження показало, що найбільш статистично значущі показники якості життя в частині опитувальника пов'язані з типом квартири, способами охолодження влітку, поточними житловими умовами, благоустроєм квартири, орієнтацією квартири та часом, проведеним у вітальні. Крім того, дослідження виявило, що більшість показників якості життя (частина анкети) не є статистично значущими, тому вони не будуть розглядатися як частина моделей, створених у статті. Дослідження показало, що збільшення житлової площі та покращення орієнтації є вирішальними для підвищення задоволеності мешканців квартир. Коли розміри квартир збільшуються, а орієнтація покращується, мешканці з більшою ймовірністю віддають перевагу вентиляторам, а не кондиціонерам, щоб зменшити витрати на електроенергію та уникнути встановлення додаткових охолоджувальних пристроїв влітку. Вони вважають, що кращі умови проживання вимагають більших квартир, додаткового водопостачання, збільшення витрат на електроенергію та більше часу, проведеного у вітальні. Мешканці також підкреслюють важливість зниження рівня вологості, зменшення частоти відчинення вікон та збільшення часу, проведеного з родиною. Цікаво, що покращення на один градус методів охолодження влітку (наприклад, перехід від вентиляторів до кондиціонерів) відповідає покращенню на один градус методів опалення взимку (наприклад, перехід від газу до електроенергії), що призводить до зростання потреби в екологічно чистому електричному опаленні. Загалом, дослідження підкреслює важливість задоволення фізичних та просторових потреб мешканців для підвищення їхньої загальної задоволеності та якості життя. Міська політика суттєво впливає на доступність житла, його якість, транспортні системи, екологічну стійкість та соціальну справедливість, впливаючи на загальний рівень життя та економічне зростання. Міста повинні розробляти добре продуману політику, яка враховує потреби мешканців та результати досліджень для забезпечення сталого розвитку та добробуту громадян.

Теоретична цінність дослідження: У статті розвинуто теорію Гуджараті (базової економіки).

Практична цінність дослідження: Це дослідження слугуватиме індикатором для аналізу подальших покращень, які можуть відбутися в конкретній будівлі (а не лише в місті Круя), враховуючи основні показники якості життя.

Оригінальність / Цінність дослідження: Стаття слугуватиме основою для подальшого аналізу поведінки мешканців та їхнього соціального впливу в громаді з метою усвідомлення їхніх потреб для подальших розробок у сфері будівництва.

Обмеження дослідження / Майбутні дослідження: Результати дослідження значною мірою залежать від типу будинку, в якому проживають мешканці. Напрямок досліджень, який може бути натхненним дослідженням, тісно пов'язаний з математичними регресійними моделями, статистикою та ймовірністю.

Тип статті: Емпіричний

Ключові слова: показники якості життя, поведінка мешканців, імовірнісні моделі, сучасна забудова, задоволеність житлом, міська політика, енергоефективність.

1. Introduction

The city of Kruja is a medieval city founded in the V-VI century. From the 7-th to the 9th centuries AD, the city of Kruja was expanded to include a fortification. Kruja served as the first Arbër independent state's capital in 1190 (*Xhexhi et al., 2019*).

Immediately after the fall of the socialist regime in 1990, the city of Kruja began its expansion with new structures especially for residential purposes. The new technologies applied in the construction industry were following the market's demands. New structures began to arise equipped with innovative building materials and innovative technology. The role of the inhabitants' behavior is also important considering the newly built structures (*Lotfabadi, 2013*).

The degree of the impact that occupant behavior has on the variance in energy use between homes is yet unclear, although it is a significant factor (*Branco et al., 2004; Jeeninga et al., 2001*). Additionally, there is not much research that addresses the influence of occupancy behavior (*Haas et al., 1998*). The relationship between the residents' behavior and building and household factors is poorly understood. As building designs become more energy-efficient, the impact of occupants on overall energy use is becoming increasingly significant (*Papakostas & Sotiropoulos, 1997; de Groot et al., 2008*). Households play a significant role in determining energy use for heating in residential buildings. Several studies indicate that age is a key factor; older households generally use more energy than younger ones, particularly for space heating (*Liao & Chang, 2002; Lindén et al., 2006*).

Numerous worldwide research has revealed a link between the role of users, home dimensions, and energy usage. The monthly income and energy consumption might also have a significant role (*Biesiot & Noorman, 1999*). Some variations in energy use cannot be attributed to features of the occupants, such as age distribution, size of the family, or degree of education. The household's socioeconomic variations are considered in the study (*Vringer et al., 2007*). Energy consumption fluctuations can be caused by mechanical elements, such as appliances and equipment, which can similarly impact energy usage as the way human activity affects energy use (*Haas et al., 1998*). According to another study, the interior temperature differs for various types of homes depending on the occupancy habits and preferences (*Leth-Petersen & Togeby, 2001*).

Xhexhi et al. (2019) conducted another similar study in the city of Kruja related to the historical medieval dwellings located in Kruja's inner citadel. It was found 5 statistically stable models that interact with each other. Numerous variables, including the number of occupants, the standard of living, the size of the homes, the heating system and the amount of time spent inside, the current situation, the monthly expenses, the degree of satisfaction, building improvement, and restoration, interact with each other with probabilities that can be either positive or negative percentages. A questionnaire of 30 questions was applied and the number of responses was 10 (*Xhexhi et al., 2019; Xhexhi, 2021*).

Another research was carried out by *Xhexhi et al. (2020c)*, in the city of Kruja, related to a group of buildings constructed during the socialist regime, it was found that the standards of life indicators that interact with each other are: living area, standard of living quality, amount of time spent at home, social contact among residents, moisture level in the house, orientation of the residence, amount of resident happiness, apartment improvements, and monthly electricity expenses. A questionnaire of 30 questions was applied and the number of responses was 14 (*Xhexhi, 2021; Xhexhi et al., 2020c*).

In another comparative study conducted by *Xhexhi et al. (2020a)*, where considered three stocks of dwellings in the city of Kruja: the heritage buildings, buildings constructed during the socialist regime, and the contemporary ones. Employing the probabilistic models, an indexed model was constructed with the involvement of the three building categories. It was observed that the buildings constructed during the socialist period category are almost excluded from the debate between heritage buildings, and contemporary buildings considering quality-of-life indicators. They are statistically distinct from the other two categories (*Xhexhi et al., 2020a; Xhexhi, 2021*).

Another research was undertaken in the city of Kruja employing two categories of buildings, the heritage buildings and the socialist ones. The study examines the link between two parameters, the temperature and moisture content of the interior walls and flooring of the heritage and socialist structures in Kruja's city, employing linear regression models. It was discovered that the relationship between temperature and moisture content in historical structures, as determined by linear regression models, is stronger than in socialist buildings. For historical structures, a one-degree rise in temperature will result in a 2.2% decrease in moisture content, meanwhile, for socialist buildings, the result is 1.02% (*Xhexhi et al., 2020b; Xhexhi, 2021*).

Xhexhi (2023a) conducted another study in the city of Tirana, Albania employing a questionnaire to a specific neighborhood constructed during the socialist regime. The findings revealed that despite the building's poor physical qualities, residents have a high level of loyalty to the structures and an above-average level of contentment with their neighborhood. Their happiness level is primarily focused on the location of the local area rather than the physical materials of the buildings (*Xhexhi, 2023a*).

Idraganti (*2011*) employed a model of linear regression based on survey data. He defined sustainable thermal comfort requirements by including environmental, behavioral, and psychological modifications. The importance of occupant adaptive behavior in achieving thermal comfort is underlined (*Indraganti, 2011*).

Famuyibo's statistical analytic methods for archetype (buildings sharing similar characteristics) developments provide a more comprehensive overview of the building stock than previous qualitative methods. The author employs multi-linear regression and descriptive statistics to identify archetypes. This project represented 65% of the Irish population's housing stock (*Famuyibo et al., 2012*). On the other hand, *Arambula Lara et al.* (*2014*), employed clustering and regression techniques to select the best parameters for classifying a huge number of existing buildings.

Gaitani et al. (2010) examined data from 1100 Greek schools to choose typical buildings based on heated area, building lifespan, heating infrastructure, external insulation, classroom and student number, and user profile. To limit the number of independent variables studied, individual contributions to energy performance were computed (*Gaitani et al., 2010*).

Wang et al. (2024) developed a safety system to monitor and protect elderly individuals living alone, addressing the rising safety concerns associated with increased life expectancy. Using low-cost sensors and Raspberry Pi technology, the system integrates facial recognition and PIR motion detection to monitor activities and send alerts to family members if anomalies are detected. Consulting with a speed-up module, the proposed method that incorporates YuNet and SFace made great improvements in both accuracy and speed. This was an affordable yet effective way of securing old people's life and easing their families' concerns (*Wang et al., 2024*).

In the Chilean city of Temuco, 11 houses were subject to investigation regarding indoor air quality and hygrothermal comfort. These houses were divided according to the implementation of the Atmospheric Decontamination Plan (PDA) aimed at reducing PM2.5 concentrations in polluted cities. Only one group met temperature requirements, with an average temperature of 20.6°C and ±3.52°C fluctuation across them. Humidity levels ranged between 55.6% and 64.82% respectively. In moderately implemented PDA homes, CO_2 level was slightly below the maximum allowed amount for concentration (1000 ppm). In all dwellings, PM2.5 content peaked above this WHO threshold value (15 µg/m³), from a low of 44.4 µg/m³ up to a high of 130 µg/m³ in one of the homes. PM2.5 concentrations always exceeded limits showing the importance of thermal insulation measures as part of improving indoor air quality and lowering PM2.5 levels (*Martinez-Soto et al., 2024*).

The role of intrinsic and extrinsic incentives in public organizations is studied by *Mario (2019)*. For public organizations, intrinsic incentives such as autonomy and reputation are more significant as they relate to job satisfaction and commitment. Extrinsic incentives such as rewards or punishments can push out intrinsic motivation leading to lower job satisfaction. Motivation, performance, and goal theory should be related to a better understanding of motivation. Both intrinsic and extrinsic motivations can reduce corruption, but the former is better. The paper stresses also the importance of recognizing both types of incentives while designing incentive systems for public organizations (*Coccia, 2019*).

A recent research paper delves into the struggles and possibilities of promoting consciousness in an area, in Indonesia. The study utilized research techniques with a focus on phenomenology to explore how the local community perceives, reacts to, and deals with issues within the watershed. It revealed that the community encounters obstacles such as knowledge about the watershed environment restricted access to information and educational materials, financial challenges, and ineffective local governance. To tackle these hurdles the authors recommend implementing initiatives and campaigns for awareness encouraging community involvement and embracing technological advancements. They underscore the significance of collaboration between governmental organizations (NGOs) and local residents to ensure effective conservation endeavors (*Wibowo et al., 2024*).

Coccia (2019) delves into the reward systems utilized in administration to inspire individuals and organizations towards specific objectives. The author contrasts the form of rewards encompassing both non-monetary incentives and assesses their efficacy in encouraging desired behaviors. The research emphasizes the significance of considering the social milieu within which incentives are put into practice well as advocating for a balanced approach that incorporates both rewards and penalties. The paper concludes by offering insights on crafting and executing incentive structures that can be adapted to public administration settings (*Coccia, 2019*).

Another study highlights the critical need to assess urban environmental quality and advocates for a comprehensive multi-criteria approach. It recommends updating the existing urban environment quality index by incorporating additional criteria through a multi-criteria evaluation methodology, which includes expert opinions and weighting coefficients. The study underscores the importance of the operational phase of real estate objects, which can span several decades, emphasizing the necessity of maintaining environmental sustainability throughout this period. It also notes the impact of environmental factors on public health and emphasizes the importance of ensuring environmental safety. The authors stress the need for a comprehensive approach to assessing urban environmental quality, considering both traditional and environmental-economic indicators, and international experiences in greening urban agglomerations (*Larionova et al., 2023*).

This study aims to shed light and create a mechanism (through regression models) to improve the quality of life of the inhabitants of Kruja. The inhabitants' behavior, their physical interaction with the building, the indoor thermal comfort due to construction materials, and the residents' social interaction within the neighborhood will be analyzed, through a questionnaire determining their needs and concerns. Many contemporary buildings in Kruja incorporate standard building materials such as hollow clay bricks for the external coating of buildings and indoor separations. Plaster and plastic paint or graffiti are applied directly on these materials. The supporting structure of the buildings is made with reinforced concrete columns and beams. Most buildings built during the years 1990-2005 are not equipped with thermal insulation materials and incorporate windows without thermal cuts. The building taken into consideration in this study is also a part of this grouping. In isolated cases solar panels are implemented in the upper terraces of the building. Many contemporary buildings in Kruja during this period are designed with accessibility and mobility in mind, featuring ramps, elevators, and wide corridors to accommodate visitors with disabilities.

2. Theoretical framework

The contemporary building located in the city of Kruja, at Marlin Barleti Street, Albania was constructed after the socialist regime during 1990-2005. The building has 7+1 floors, and it has a reinforced concrete structure. The building envelope does not have thermal insulation (thermal protection), and most of the windows are not equipped with thermal breaks. The building is located on a sloping terrain and the main route is from Marlin Barleti Street, almost in the center of the city (*Fig. 1*).

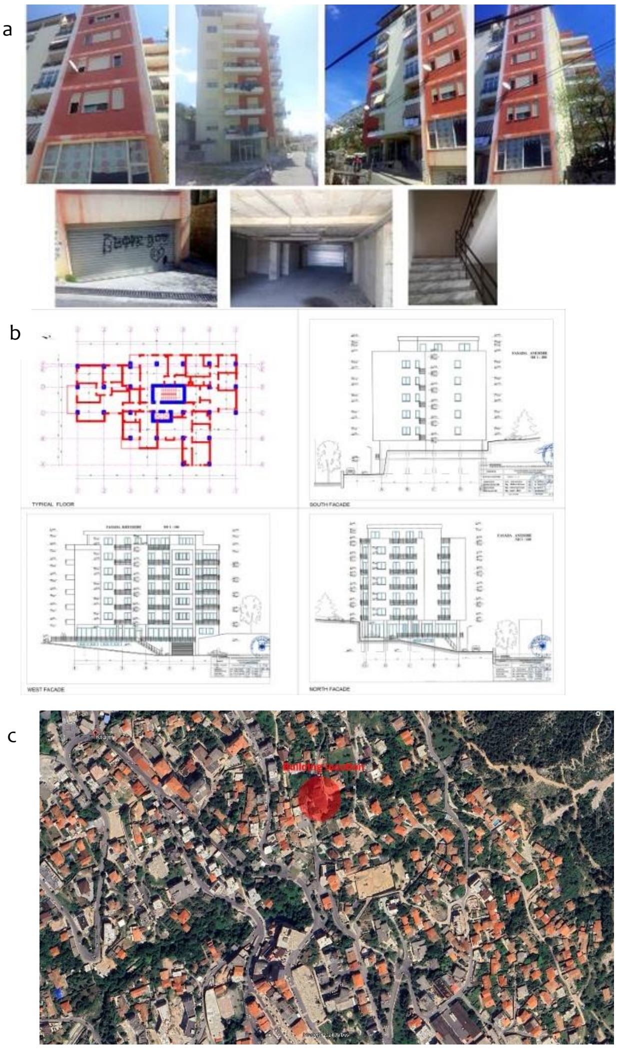

Figure 1: a. Photos of the contemporary building, Kruja, Albania (**Source:** *Authors*); b. Typical plan and facades (**Source:** *Authors*); c. Location of the building (**Source:** *Google Earth*)

A 30-question questionnaire has applied to the inhabitants of the building. The total number of responses was 10, and the age and gender of the respondents were variable.

This study will consider only the questions that are statistically significant for the inhabitants of Kruja (13 questions out of 30).

The average family member is 3.7 people, and the average living time is 5.2 years (*Fig. 2*). It is observed that all the inhabitants were almost from the same region. Most of the apartments are 2+1 ones.

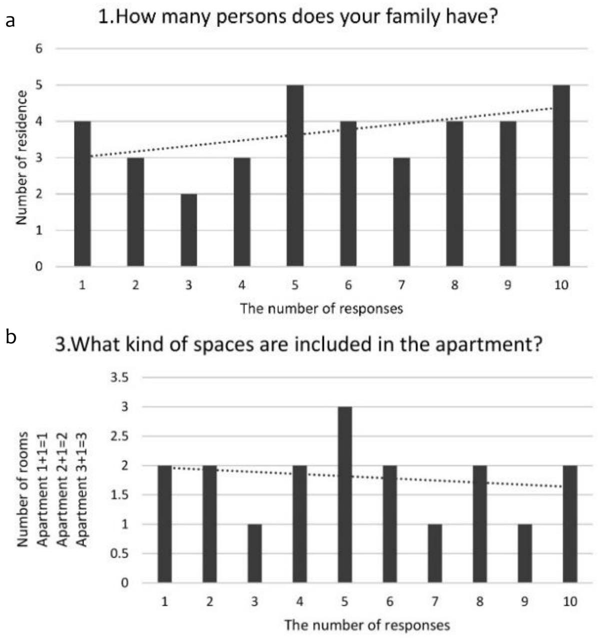

Figure 2: a. Number of family members; b. Number of rooms

Source: *Research Results, 2024*

Most of the inhabitants use electricity as the primary source of heating during winter and they don't have any water leakage in their apartment. According to the responses, the moisture level in the apartments is very low or they don't have any (*Fig. 3*).

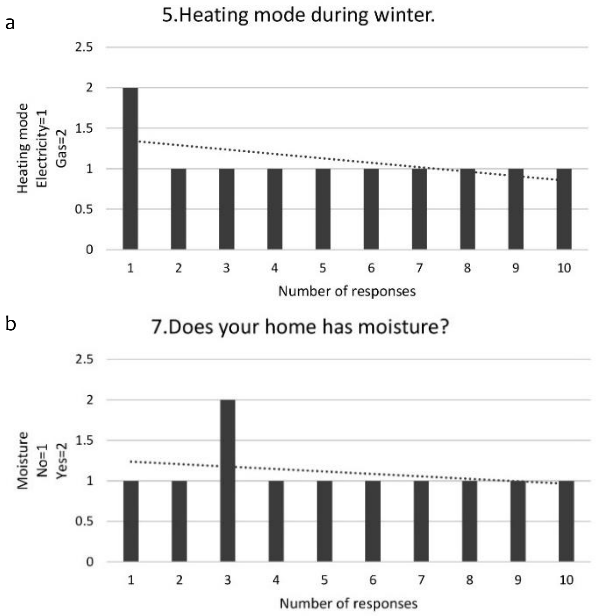

Figure 3: a. Heating mode during winter; b. Moisture level.

Source: *Research Results, 2024*

On the other hand, most of the inhabitants use air blowers (fans) as a primary method for cooling during summer. In summer, windows are open throughout the day; meanwhile, in winter, they are only open once in the morning (*Fig. 4*).

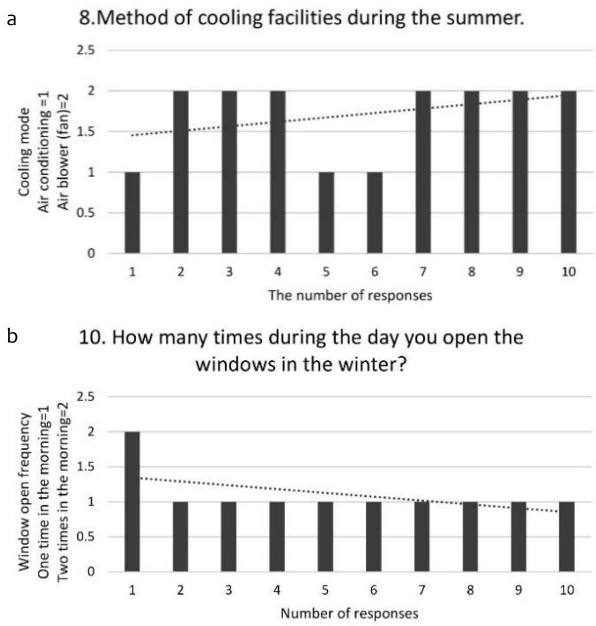

Figure 4: a. Cooling mode during summer; b. Window open frequency during winter.

Source: *Research Results, 2024*

The average monthly spending on water is 6.9 Euros per month. The average monthly spending on electricity is 81 Euros per month (*Fig. 5*).

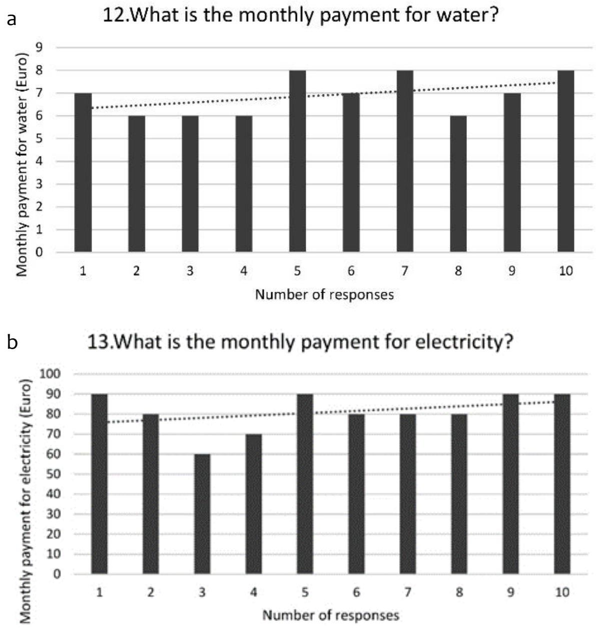

Figure 5: a. Monthly payment for water; b. Monthly payment for electricity.

Source: *Research Results, 2024*

Most of the residents are satisfied with their actual living conditions, and they don't think that their home should be restored (*Fig. 6*). Most of the residents would like to improve the furnishing in their apartments to feel better. Hence additional space for living is another important factor for them.

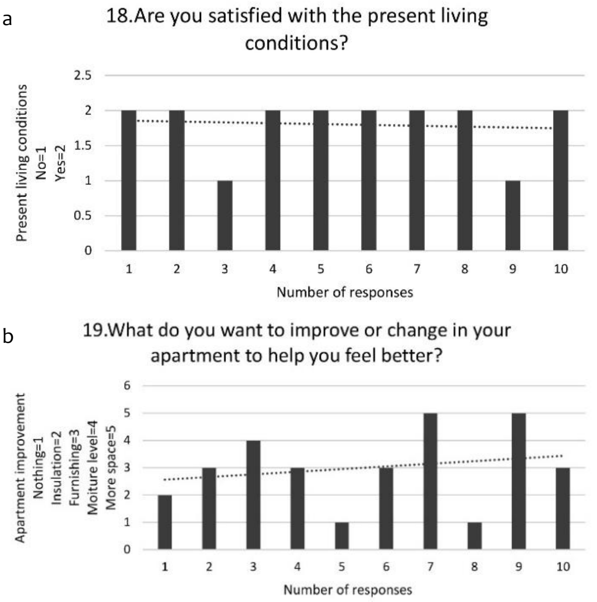

Figure 6: a. Present living condition; b. Apartment improvement.

Source: *Research Results, 2024*

Most residents would rather spend more time with their friends and family (*Fig. 7*). Meanwhile, the elderly prefer to spend most of their time with their family. The orientation of the apartments is mostly facing the South-West. This question refers to the orientation of the living room per apartment.

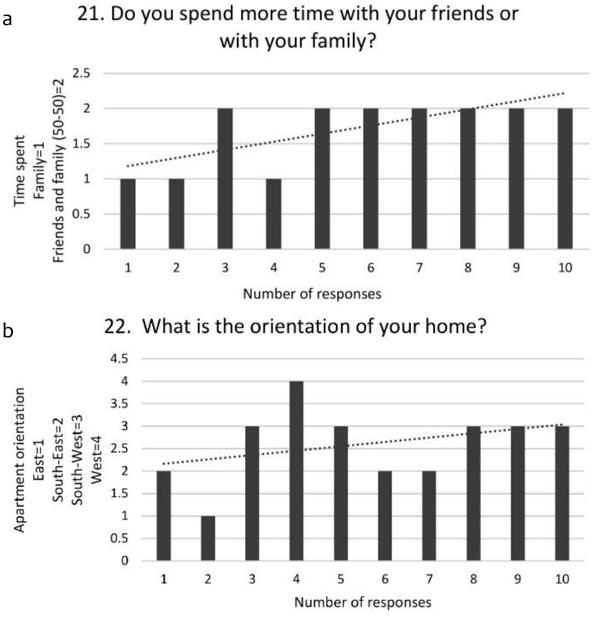

Figure 7: a. Time spent with family or friends; b. Apartment orientation.

Source: *Research Results, 2024*

The average time spent in the living room is 3.4 hours as seen in *Fig. 8*.

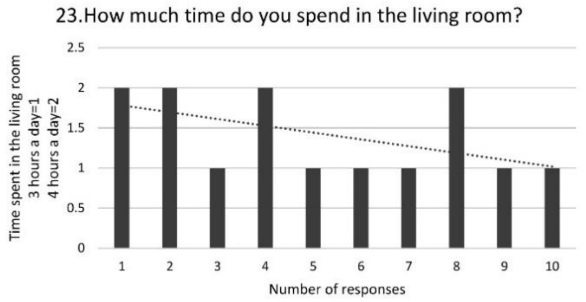

Figure 8: Time spent in the living room.

Source: *Research Results, 2024*

According to the other findings of the questionnaire it is observed that: the inhabitants do not perceive large differences in temperature between inside and outside the apartment; they don't have any water leakage in their apartment; in summer, windows are opened throughout the day; during the day, residents spend the majority of their time in their living area; the inhabitants prefer to get dressed heavily during winter while staying home; they prefer to get lightly dressed during summer; the frequency of apartment painting is 1.5 years during 5 years; during the day they prefer to split their time 50% to 50% at home or outside; the inhabitants would not prefer to change their place of living with another one in the city of Kruja; all the residents use economic lighting bulbs in their apartments; the noise level in their apartments is moderate; residents are unaware of the procedures that must be taken to ensure the structures' effective heating; they do not have detailed information on the insulating materials; the inhabitants possess little knowledge of recycling products or their influence on their surroundings and they do not practice recycling.

3. Methodology for Evaluating the Binary or Tobit Probabilistic Models

3.1 Sample and Data

The sample taken into consideration is a contemporary building constructed after the socialist regime located almost in the center of the city of Kruja. The data are provided by a thirty-question questionnaire applied to the inhabitants of the building. The questions (variables or quality of life indicators) were then subject to the regression models created using EViews 8. The variables that are part of the created models have more than 95% confidence. The rest of the variables that had a significant level of more than 5% will not be considered in the study.

3.2 Measures of Variables

This paper will utilize models for scaled Tobit variables and the Binary models Log-it and Prob-it to assess the relationships between the variables (qualitative variables for the quality of the explanatory annexes) based on correlative and causal connections in econometric models. Usually, the binary connection is used to model such phenomena:

$$Y_i = \beta X_i + \mu_i \quad (1)$$

where Y_i equals one (1) when the choice is approved and zero (0) otherwise; this means that:

Y_i = 1, if X_i is greater than or equal to a critical value, X*

Y_i = 0, if X_i is less than a critical value, X*

This model's mathematical expression is as follows:

$$Prob\ (Y_i = 1) = F(\beta' X_i) \quad (2)$$

$$Prob\ (Y_i = 0) = 1 - F(\beta' X_i) \quad (3)$$

In this case, Y_i represents the observed reaction to the response variable, Y, observations. Accordingly, Y_i = 0 indicates a -negative decision while Y_i = 1 indicates a positive decision.

There are three possible forms for the function F: logistic, normal, and probabilistic. The logit function with a cumulative estimate distribution, P, is used in the log-it models in the following way:

$$(Y = 1) = \frac{e^{\beta' X}}{1+e^{\beta' X}} \qquad (4)$$

$$P(Y = 0) = 1 - \frac{e^{\beta' X}}{1+e^{\beta' X}} = \frac{1}{1+e^{\beta' X}} \qquad (5)$$

The conditional prediction of Y values for a given set of X values is regressed to create the probability model. This mathematical assumption is as follows:

$$E(Y/X) = 1*[F(\beta'X)] + 0*[1 - F(\beta'X)] = F(\beta'X) \qquad (6)$$

Maximum variances will be used in conjunction with partial derivatives to estimate the model's parameters. The multiple regression models will be more helpful in this situation since all of the variables that are classified as dependent and independent variables are scaled (categorized according to the levels of the subject of research) and binary (i.e., only consist of 0 and 1), such as:

$$Ln[Pi/(1-Pi)] = Logit = \beta 0 + \beta 1X1 + \beta 2X2 + ... + \beta nXn + \varepsilon i \qquad (7)$$

From where with *Pi* we have symbolized the likelihood of the occurrence of the dependent variable when a phenomenon codified in one of the independent variables occurs or not. We shall execute the antilogarithmic operation [anti-ln(logit) = Pi/(1-Pi)] to get the probabilities. Pi consequently will be:

$$P_i = \frac{e^{\beta_0+\beta_1 X_1+\cdots+\beta_n X_n}}{1+e^{\beta_0+\beta_1 X_1+\cdots+\beta_n X_n}} \qquad (8)$$

In addition to examining correlational relationships like relationship strength and distance, these models are examined for their ability to explain the relationships between the study's variables and their elasticity in scaled causal relationships between the independent and dependent variables (*Gujarati, 2003; Xhexhi et al., 2019; Xhexhi, 2021*).

3.3 Models and Data Analysis Procedure

In total, 5 stable static models have been created using EViews 8. The models that are associated with the "Log-likelihood" statistic are statistically significant at a significance level of p < 5%, or with 95% confidence, based on the model tests. This indicates that the overall structure of such models consists of a logical and probabilistic relationship between variables.

Model 1

Table 1: Model no.1 worked on EViews 8 by the authors

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
The covariance matrix computed using second derivatives

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	3.541667	0.869527	4.073098	0.0000
P1	-0.666667	0.235702	-2.828427	0.0047
P18	0.916667	0.256851	3.568871	0.0004
P22	-0.291667	0.128425	-2.271100	0.0231

Source: *Research Results, 2024*

The probabilistic model equation is:

$$\textbf{Probability}\ \{P_3\} = \frac{e^{\{Y\}}}{1+e^{\{Y\}}} \qquad (9)$$

In cases where the linear logic equation predicts variation in the parameter Y:

Y = 3.541667 - 0.666667*P1 - 0.291667*P22 + 0.916667*P18 + εi

According to the statistical significance of each variable in the model, the student statistic (t-test) reveals that independent variables "P1", "P18" and "P22" are significant in explaining the variation of quality-of-life indicators provided by the questionnaire question "P3" at a significance level of p < 5% (i.e., with 95% confidence). The Prob. column as seen in *Tab. 1* shows that all the variables have a significant level of < 5% and more than 95% confidence. Specifically, P1 - 0.47%, P18 - 0.04%, and P22 - 2.31%. *Fig. 9* is a graphic representation of the probabilistic effect.

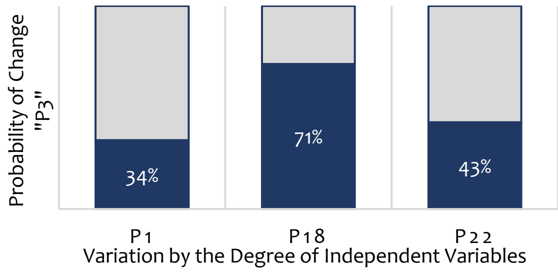

Figure 9: Variation by the degree of independent variables in relation to "P3" (Source: Authors).

Source: *Research Results, 2024*

Model 2

Table 2: Model no.2 worked on EViews 8 by the authors

Dependent Variable: P8
Method: ML - Censored Normal (TOBIT) (Quadratic hill climbing)
Sample: 1 10
Included observations: 10
Left censoring (value) at zero
Convergence achieved after 5 iterations
The covariance matrix computed using second derivatives

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	3.607914	0.398857	9.045622	0.0000
P3	-0.532374	0.133045	-4.001462	0.0001
P22	-0.316547	0.089249	-3.546773	0.0004

Source: *Research Results, 2024*

The probabilistic model equation is:

$$\textbf{Probability}\ \{P_8\} = \frac{e^{\{Y\}}}{1+e^{\{Y\}}} \qquad (10)$$

In cases where the linear logic equation predicts variation in the parameter Y:

Y = 3.607914 - 0.532374*P3 - 0.316547*P22 + εi

The student statistic (t-test) reveals that the independent variables "P3" and "P22" are significant in explaining the variation of the quality-of-life indicators provided by the question "P8" of the questionnaire, with a significance level of p < 5% (i.e., with 95% confidence). The Prob. column as seen in *Tab. 2* shows that all the variables have a significant level of < 5% and more than 95% confidence. Specifically, P3 - 0.01%, and P22 - 0.04%. *Fig. 10* is an illustration of the probabilistic effect.

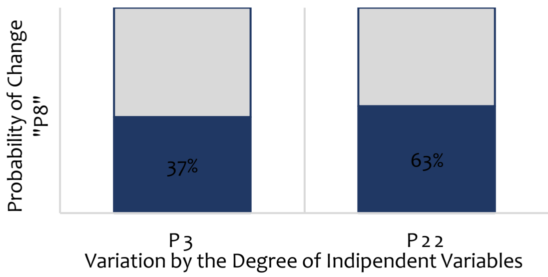

Figure 10: Variation by the degree of independent variables in relation to "P8"

Source: *Research Results, 2024*

Model 3

Table 3: Model no.3 worked on EViews 8 by the authors

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 6 iterations				
The covariance matrix computed using second derivatives				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-3.380530	1.136364	-2.974864	0.0029
P3	0.329758	0.149812	2.201153	0.0277
P12	0.006141	0.002002	3.067563	0.0022
P13	-0.000241	0.000142	-1.699902	0.0891
P23	0.905291	0.270151	3.351055	0.0008

Source: *Research Results, 2024*

The probabilistic model equation is:

$$\textbf{Probability}\ \{P_{18}\} = \frac{e^{\{Y\}}}{1+e^{\{Y\}}} \qquad (11)$$

In cases where the linear logic equation predicts variation in the parameter Y:

Y = - 3.380530 + 0.329758*P3 + 0.006141*P12 - 0.000241*P13 + 0.905291*P23 + εi

The student statistic (t-test) indicates that the independent variables "P3", "P12" and "P23" are statistically significant with a significance level of p < 5% (i.e., with 95% confidence) when it is examined the statistical significance of each variable in the model. The variable "P13" is statistically significant with p < 10%), in the explanation of the variation of the quality-of-life indicator provided by question "P18" of the questionnaire. The Prob. column as seen in *Tab. 3* shows that all the variables (except P13) have a significant level of < 5% and more than 95% confidence. Specifically, P3 - 2.77%, P12 - 0.22%, P13 - 8.91% (will be considered), and P23 - 0.08%. *Fig. 11* is a graphic representation of the probabilistic effect.

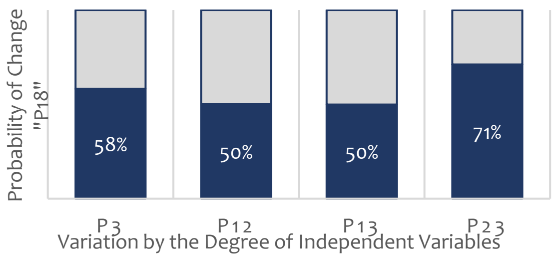

Figure 11: Variation by the degree of independent variables in relation to "P18"

Source: *Research Results, 2024*

Model 4

Table 4: Model no.4 worked on EViews 8 by the authors

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 6 iterations				
The covariance matrix computed using second derivatives				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.600000	1.477835	1.759330	0.0785
P7	-2.800000	0.579655	-4.830462	0.0000
P10	-2.000000	0.648074	-3.086069	0.0020
P21	2.000000	0.648074	3.086069	0.0020
P23	1.200000	0.579655	2.070198	0.0384

Source: *Research Results, 2024*

The probabilistic model equation is:

$$\textbf{Probability}\ \{P_{19}\} = \frac{e^{\{Y\}}}{1+e^{\{Y\}}} \qquad (12)$$

In cases where the linear logic equation predicts variation in the parameter Y:

Y = 2.6 – 2.8*P7 - 2*P10 + 2*P21 + 1.2*P23 + εi

According to the statistical significance of each variable in the model, the student statistic (t-test) reveals that the independent variables "P7", "P10", "P21", and "P23", are statistically significant in explaining the variation of the quality-of-life indicator provided by questionnaire question "P19" at a significance level of p < 5% (i.e., with 95% confidence). The Prob. column, as seen in *Tab. 4*, shows that all the variables have a significant level of < 5% and more than 95% confidence. Specifically, P7 - 0%, P10 - 0.2%, and P21 - 0.2% and P23 - 3.8%. *Fig. 12* is a graphic representation of the probabilistic effect.

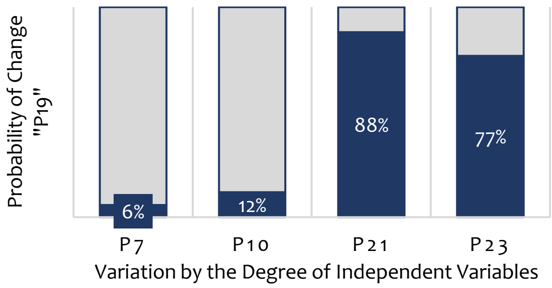

Figure 12: Variation by the degree of independent variables in relation to "P19"

Source: *Research Results, 2024*

Model 5

Table 5. *Model no.5 worked on EViews 8 by the authors.*

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 6 iterations				
The covariance matrix computed using second derivatives				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	1.710280	0.568667	3.007526	0.0026
P8	0.654206	0.241114	2.713260	0.0067
P19	0.205607	0.083591	2.459675	0.0139
P23	-0.485981	0.226160	-2.148834	0.0316

Source: *Research Results, 2024*

The probabilistic model equation is:

$$\textbf{Probability}\ \{P_5\} = \frac{e^{\{Y\}}}{1+e^{\{Y\}}} \qquad (13)$$

In cases where the linear logic equation predicts variation in the parameter Y:

Y = 1.710280 + 0.654206*P8 + 0.205607*P19 - 0.485981*P23 + εi

According to the statistical significance of each variable in the model, the student statistic (t-test) reveals that the independent variables "P8", "P19", and "P23" are statistically significant in explaining the variation of quality-of-life indicators provided by questionnaire question "P5" at a significance level of p < 5% (i.e., with 95% confidence). The Prob. column, as seen in *Tab. 5*, shows that all the variables have a significant level of < 5% and more than 95% confidence. Specifically, P8 - 0.67%, P19 - 1.39%, and P23 - 3.16%. *Fig.13* is a graphic representation of the probabilistic effect.

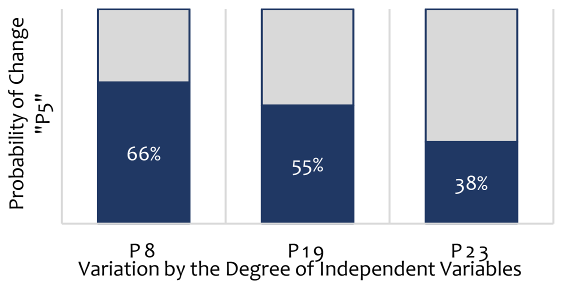

Figure 13: Variation by the degree of independent variables in relation to "P5"

Source: *Research Results, 2024*

4. Results

Model 1

Based on the multivariable Tobit probabilistic regression model, are determined the following correlations from the data shown in *Fig. 9.*

The variable "P1" has a statistically significant negative (inverse) relationship with the scale of the quality-of-life indicator "P3". There is a 34% probability that a one-degree change in "P3" will result in a one-degree increase in "P1" (assuming all other variables remain constant). If the typology of apartments (P1) is decreased by one degree for example from 3+1 to 2+1, the number of family members (P3) will increase by one degree, for example from 2 to 3. This is related to the optimization of the space inside the apartment and the number of residents per m2.

The variable "P18" has a positive and statistically significant relationship with the quality-of-life indicator "P3" scale. With a probability of 71%, the variable "P18" generates a change with a degree of "P3" (if all other variables remain constant). If the level of satisfaction (P18) of the residence for the present living conditions increases by one degree, the typology of the apartments (P1) will increase by one degree for instance 1+1 to 2+1. An additional space for living is necessary to increase the level of satisfaction.

The variable "P22" has a statistically significant negative (reverse) relationship with the quality-of-life indicator "P3" scale. With a 43% chance, a one-degree rise in the variable "P22" will result in a one-degree change in "P3" (assuming all other variables remain the same). If the orientation of the apartment (P22) deteriorates by one degree for instance South-West to West the typology of the apartments (P3) will increase by one degree, for instance from 1+1 to 2+1. The need for good orientation requires more living space for the inhabitants.

Model 2

Based on the multivariable Tobit probabilistic regression model, are determined the following correlations from the data shown in *Fig. 10*.

Apparently exists a statistically significant negative (inverse) relationship between the variable "P3" and the quality-of-life indicator "P8" scale. With a 37% chance, a one-degree rise in the variable "P3" will result in a one-degree change in "P8" (assuming all other variables remain constant). If the typology of the apartment (P3) increases by one degree for instance 1+1 to 2+1 the cooling methods during the summer (P8) will decrease by one degree from air conditioning to air blower (fan). The increase in the living area would bring extra electricity costs for the residents for cooling purposes. Therefore, if the surface of the apartment increases, they prefer the air blower (fan) instead of the air conditioner.

There exists a statistically significant negative (reverse) relationship between the variable "P22" and the quality-of-life indicator "P8" scale. With a 63% probability, a one-degree rise in the variable "P22" will result in a one-degree change in "P8" (assuming all other variables remain constant). If the orientation of the apartment (P22) improves by one degree for instance from West to South-West, the cooling methods in the summer (P8) will decrease by one degree from air conditioner to air blower (fan). The orientation of the apartment is important and directly related to indoor thermal comfort. There is no need for extra cooling facilities during summer if the orientation of the apartment improves.

Model 3

Based on the multivariable Tobit probabilistic regression model, are determined the following correlations from the data shown in *Fig. 11.*

The variable "P3" has a statistically significant positive (fairly) relationship with the quality-of-life indicator "P18" scale. With a 58% probability, a one-degree rise in the variable "P3" will result in a one-degree change in "P18" (assuming all other variables remain constant). A positive one-degree change in apartment typology (P3) for instance 1+1 to 2+1, will result in an increase of present living conditions (P18) with one degree. The inhabitants view apartment size as a key factor in improving living conditions.

The variable "P12" has a statistically significant positive (fairly) relationship with the quality-of-life indicator "P18" scale. With a 50% chance, a one-degree increase in the variable "P12" will result in a one-degree change in "P18" (assuming all other variables remain constant). If the monthly payment for water (P12) increases by one degree, the living conditions (P18) will increase by one degree. The need for additional water supply is important for the inhabitants to improve their living conditions.

Additionally, there exists a statistically significant negative (inverse) relationship between the variable "P13" and the quality-of-life indicator "P18" scale. With a 50% chance, a one-degree increase in the variable "P13" will result in a one-degree change in "P18" (assuming all other variables remain constant). If the monthly payment for electricity (P13) increases by one degree, the living conditions (P18) will deteriorate by one degree. This fact is directly tied to the financial aspect. The residents believe that to enhance their living circumstances, they will need to increase their electrical costs.

The variable "P23" has a statistically significant positive (fairly) relationship with the quality-of-life indicator "P18" scale. With a 71% chance, a one-degree change in "P18" will result from a one-degree increase in the variable "P23" (assuming all other variables remain constant). If the time spent in the living room (P23) increases the living conditions (P18) will be improved too by one degree. A higher amount of time spent in the living room suggests a larger need for better living conditions.

Model 4

Based on the multivariable Tobit probabilistic regression model, are determined the following correlations from the data shown in *Fig. 12*.

Apparently exists a negative (inverse) and statistically significant relationship between the variable "P7" and the quality-of-life indicator "P19" scale. If all other variables remain constant, a one-degree rise in the variable "P7" will result in a one-degree change in "P19" with a probability of 6%. If the apartment improvement (P19) increases by one degree, the moisture level (P7) will decrease by one degree. The inhabitants consider that if they improve their apartment the level of moisture will drop down.

The variable "P10" has a statistically significant negative (inverse) relationship with the quality-of-life indicator "P19" scale. If all other variables remain constant, a one-degree rise in the variable "P10" will result in a one-degree change in "P19" with a probability of 12%. If the frequency of the window open (P10) decreases by one degree for instance from two times in the morning to one time in the morning, the need for apartment improvement (P19) will increase by one degree.

The variable "P21" has a statistically significant positive (fairly) relationship with the scale of the quality-of-life indicator "P19". If all other variables remain constant, an increase of one degree in the variable "P21" will result in a change of one degree in "P19" with a chance of 88%. If the time spent with family (P21) increases by one degree, the need for apartment improvement (P19) will increase by one degree. This is much related to the time spent within the apartment.

The variable "P23" has a statistically significant positive (fairly) relationship with the quality-of-life indicator "P19" scale. With a 77% chance, a one-degree change in "P19" will result from a one-degree increase in the variable "P23" (assuming all other variables remain constant). If the time spent in the living room (P23) increases, the need for apartment improvement (P19) will increase too.

Model 5

Based on the multivariable Tobit probabilistic regression model, are determined the following correlations from the data shown in *Fig. 13.*

The variable "P8" has a statistically significant positive (fairly) relationship with the quality-of-life indicator "P5" scale. If all other variables remain constant, there is a 66% probability that a one-degree increase in the variable "P8" will result in a one-degree change in "P5". A one-degree improvement in the methods of cooling during summer (P8) for instance from air blower to air conditioning, will result in a one-degree improvement in heating mode during winter (P5) for instance from gas to electricity. The need for electricity supply will increase.

The variable "P19" has a statistically significant positive (fairly) relationship with the quality-of-life indicator "P5" scale. If all other variables remain constant, a change of one degree in the variable "P19" will result in a change of one degree in the variable "P5" with a probability of 55%. If the apartment improvement (P19) increases by one degree, the heating mode during winter (P5) will be improved by one degree, for instance from gas to electricity. The residents will increase their need for clean heating using electricity.

The variable "P23" has a statistically significant negative (reverse) relationship with the quality-of-life indicator "P5" scale. If all other variables remain constant, there is a 38% probability that a one-degree increase in the variable "P23" will result in a one-degree change in "P5". A one-degree decrease in the time spent in the living room (P23), for instance from 4 hours to 3 hours, will result in a one-degree improvement in the heating mode during winter (P5). If residents are less likely to spend time in the living room, they won't need the same amount of heating.

5. Discussion

According to the regression models statistically stable the most important quality of life indicators that interact the most (3 up to 5 times) with the other variables are P18 (present living condition); P19 (apartment improvement); P3 (apartment typology); P8 (methods of cooling during summer); P23 (time spent in the living room) and P22 (apartment orientation). The other variables interact 1 time with each other as seen in Table 6. Meanwhile, the rest of the variables included in the questionnaire are not statistically significant, furthermore, they are not part of the models included in the study.

The inhabitants find the present living conditions, the apartment improvement, the apartment typology, the methods of cooling during summer, and time spent in the living room as the main quality of life indicators above the others. They correlate positively or negatively with almost all the other valid variables. Out of the thirty questions that the study examines, only thirteen seem to be statistically significant based on the models that were created (*Tab. 6*).

Compared to the other studies undermined in the city of Kruja related to the historical and socialist buildings (*Xhexhi et al., 2020a*), the contemporary buildings showed a similar but also a different approach, considering the stable regression models created. The only main statistically stable model that can be found in all the categories is related to the main quality of life indicator "Heating mode during winter (P5)". It is observed that the stock of historical buildings and contemporary building are better linked between each other through the main quality of life indicators "Spaces included in the apartment (P3)"; "Present living condition (P18)"; and "Apartment improvement (P19)"; which are important and sensitive for both categories.

On the other hand, according to a study undermined in Tirana (*Xhexhi, 2023b*), it was revealed that the inhabitant's degree of satisfaction is influenced more by the neighborhood's location than by the buildings' actual state and sometimes additional space is required in order to enhance the quality-of-life parameters. Since the stock of buildings were constructed during the socialist period the inhabitants agree with a total thermal insulation of the buildings.

Tab. 7 shows a SWOT analysis to plan modern and comfortable buildings considering also the finding of the study.

Table 6: Statistically important quality-of-life indicators

Nr.	Quality of life indicators are statistically important (P)												
	P1	**P3**	**P5**	**P7**	**P8**	**P10**	**P12**	**P13**	**P18**	**P19**	**P21**	**P22**	**P23**
Interaction with other variables	1 time	3 times	1 time	1 time	3 times	1 time	1 time	1 time	5 times	5 times	1 time	2 times	3 times

Source: Research Results, 2024.

Table 7: SWOT matrix for modern and comfortable buildings

Strength	Weaknesses	Opportunities	Threats
Innovative design aesthetics.	High initial construction costs.	Adoption of smart building technologies, renewable energies, and smart materials.	Rapid technological advancements.
Enhanced occupant comfort compared to the historical and socialist buildings).	Complexity in integrating new technologies.	Government incentives for green buildings.	Economic fluctuations affecting budgets.
Additional living space compared to the other categories in the city (historical and socialist buildings).	Longer planning and approval times.	Growing demand for eco-friendly buildings.	Environmental regulations changes.
Excellent moisture content in building materials compared to the other categories (historical and socialist buildings).	Potential resistance to change.	Trends towards urbanization.	Market competition.

Source: Research Results, 2024.

In order to enhance the residents' standard of living in the contemporary building in the city of Kruja, the experts must follow the instructions of the study and understand the most important variables that are statistically significant for them.

6. Conclusion

This study will serve as an indicator to analyze the further improvements that might occur in a specific building (and not only) in the city of Kruja, considering the main quality of life indicators.

To enhance the residents' standard of living the experts (urban planners, architects, economists, sociologists, stakeholders, etc.) must consider the important role of the main quality of life indicators statistically significant.

Urban Policies can critically affect many variables within a town, including housing affordability, quality of housing, transport systems, environmental sustainability, and social equity. Proper policies can improve living standards and economic growth as well as sustainable development in urban centers. In contrast, poor ones may worsen issues such as inequality, building construction quality or much worse degrade the natural environment. In this regard, cities must formulate well-designed responsive urban policies for future generations and the citizens' welfare. Urban policymakers must take into consideration the findings of this study to better analyze the city context and the needs of the residents.

Developing an incentive system to enhance building construction, new building materials, new construction technology, involvement of renewable energy mostly from the sun and wind, and optimal location selection based on residents' needs can significantly improve urban planning. By incorporating smart technologies, these incentive systems can offer real-time data and analytics to guide decisions, ensuring that new constructions are not only aligned with current demands but also adaptable to future requirements. Such an approach can led to more efficient, sustainable, and resident-friendly urban environments, with prospective implications for improved quality of life and smarter resource management.

The study could be further advanced by analyzing additional existing buildings within the city of Kruja. This would provide a clearer and more accurate understanding of the resident's needs and their physical and social behavior in Kruja.

7. Funding

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8. Competing interests

The authors declare that they have no competing interests.

Contributions of Authors

Xhexhi K. – Main author, responsible for Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing;

Xhexhi A. – Co-author, responsible for Conceptualization, Supervision, Validation, Writing – original draft, Writing – review & editing.

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