



Multivariate statistical analysis application to determine factors affecting the parcel value to be used mass real estate valuation approaches

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ABSTRACT

Real estate is a form of immovable asset that enables individuals to exert their property rights and provides a form of material guarantee through its economic value. The economic value of real estate, which is reflected in the price, is an aspect that all countries emphasize today by identifying purchase and sale values in market conditions that are removed from large project rumors and speculations. The more the real estate market value is removed from reality, the more negative its effect will be on the cost-benefit of real estate management. This study aimed to identify the main criteria that affect parcel value, which constitutes a basis for real estate, narrow them down to the optimum level using questionnaires and standardize them. A total of 559 experts working in real estate valuation and 1,915 members of the public that play a role in real estate purchases and sales were contacted in Ankara, Konya and Kayseri, all of which are located in the Central Anatolia Region of Turkey. The factor analysis method was applied to the survey data. Grouping was carried out with 10 factors and the results were interpreted.

1. INTRODUCTION

Real estate valuation is important for both countries and people as it can change the economic course. Cities around the world are growing in accordance with their increasing population and requirements, making the knowledge regarding real estate management even more important. In order to effectively use real estate and carry out planning, project designing and investment decisions properly, the value of real estate should be covered in real estate management. A stable economy is only possible if real estate values are distributed normally and transparently, without giving rise to any kind of unearned income or speculation. Real estate can only provide a large contribution to national economies under these conditions. When identified correctly and truthfully real estate values can transparently contribute to the economy taxation, expropriation, privatization, assurance, land registry and cadastre fees, land readjustment and urban transformation.

Real estate valuation is the independent, impartial and objective projection of a real estate, the rights related to real estate and the responsibilities and restraints as described on its valuation day. The calculation of

monetary reserves under real estate valuation is a difficult and complicated task (Açlar and Çağdaş, 2008).

Traditional methods such as comparison with equals, income and cost method, are sufficient for the calculation of a property's value. However, such methods are insufficient when valuing more than one property, also known as mass valuation. In implementations such as the taxing of real estate where mass valuation is in question, advanced methods including fuzzy logic, artificial intelligence, specialized systems, genetic algorithm, artificial neural nets and regression, hedonic and statistical methods, must be implemented in order to create mathematic model(s). Economic models in real estate often explicitly consider the effect of location (Pace et al., 1998). Thus, in order to obtain a mathematic model, criteria affecting the real estate value must be known. As the criteria are high in number and vary according to the regions in which people live in and their lifestyles they affect the model that is created for mass valuation. In other words, there are no standard optimum criteria to create a mathematic model. It is important to use the criteria and the most suitable methods in the most successful way and at an optimum level to obtain mass valuation.

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The aim of this study was to identify the minimum optimum criteria that affect plot value/parcel value by considering improved parcel that have been prepared for the construction of housing as a result of the implementation of a zoning plan, as the real estate types. As a result of the literature review, all criteria were listed, the legal, physical, locational, and neighbourhood features were grouped as the main topics and questionnaires were prepared. Data was collected from Ankara, Konya, and Kayseri, all of which are located in Central Anatolia, according to sample numbers by using face-to-face questionnaires.

1.1. Real estate

Real estate is a group of assets that is positionally stable. The subjects under real estate property can be listed as land, independent sections, and independent and constant rights. Independent and constant rights (right of building, right of fund) are servitudes that can be applied to the deed for 30 years (Turkish Civil Code, No 4721, Article 704). Independent sections are real estate that independent property rights can be applied to in a deed, can be used separately, and by themselves in sections such as a floor, apartment, employment department, shop, store and warehouse of a completed building (Property Ownership Law, No 634, Article 1). In order to construct these buildings, plots, whose cadastral parcels have been regulated in accordance with the zoning law, zoning plan and legislation principles, are required (Zoning Law No 3194, Article 5).

Land is defined as the terrain that is under the effects of soil, climate, topography, main material, hydrology, and all living creatures at varying rates and usually includes agricultural real estate such as, fields, vineyards and gardens (Law on Soil Protection and Land, No 5403, Article 3/ç). Furthermore, empty real estate that is in or near a city, has not undergone any zoning readjustment and has not been used can also be defined as land. The major difference between plot and land, both of which have different economic values, is that a plot has undergone zoning readjustments, while land has not. The subject of this study, was plots brought in compliance with home construction in accordance with zoning plans. Plots are a type of real estate that are the building blocks of a city and are created by local management, away from speculations regarding plot value, in order to meet demands and find their economic equivalent under normal conditions.

1.2. Literature review and problem description

The criteria that affect plot value have been identified, evaluated and listed in scientific, institutional, and organizational studies. Scientific studies consist of academic theses, projects and articles conducted at universities. National survey studies on real estate valuation are studies that are carried out with the aim of weighting criteria (Tiryakioğlu and Erdoğan, 2006; Yalpir, 2007; Timur, 2009) and collecting data regarding the house for value estimation (Üçdoğruk, 2001). In addition, model construction and method development processes have also been performed in such studies. In the survey study conducted by Yıldız (2014), the

valuation commission was inquired regarding the criteria taken into consideration in real estate tax.

In various studies conducted on a national level criteria were cut down for specific regions using the survey method (Yomralıoğlu, 1993; Nişancı, 2005; Çakır and Sesli, 2013; Unel, 2017) in a way of listing the most important criteria. The employed criteria were generally similar, but differed in order of importance. According to the results of the studies in which the survey method was used, the most important common criteria were determined as basic municipality services, number of licensed floors, view, exit to the street, environment, location of plot in the block, frontage, available space, and the distance to the city center. In addition, it was determined that because the lands were purchased as real estate, the subject of “optimum criteria affecting the plot value” was not handled on a national basis.

Bender et al. (2000) conducted an international survey study on homeowners in Geneva, Zurich and Lugano with eight criteria regarding the environmental quality. They determined that the most important criteria for Zurich and Lugano were distance to the city and quality of view, whereas in Geneva, distance to nature (forest, outdoors, lake, etc.) and level of quietness (lack of traffic, railroads, or airport noises) were the leading criteria. Kryvobokov (2005) conducted a survey study based on 10 location features in Donetsk, Ukraine. A total of 20 people, including valuers, real estate agents, land managers and urban planners were interviewed and the most important criteria which were work place, a popular area, a disturbing location, and the nearest secondary center were determined. In the survey part of the study of Shimizu et al. (2016), house prices were identified by sending questionnaires to those who had purchased a house and evaluations were carried out with housing values in different phases of buyer/seller operations, floor area, age, distance to the nearest station, and travel time to the terminal station criteria.

Institutional studies cover legislation on national and international levels and projects that are carried out by institutions. National legislations cover applications subjects such as taxation, expropriation, privatization, and sales of public lands. The criteria in national legislations were taken into consideration for application. The Real Estate Valuation Pilot Implementation Preparation Survey Study was conducted within the scope of the General Directorate of Land Registry and Cadastre Modernization Project (TKMP, 2008). In the project, 96 criteria were identified as initial list and 37 of them were used for model (Yilmazer and Kocaman, 2020). On an international level, the International Valuation Standards (IVS, 2017), the Uniform Standards of Professional Appraisal Practice (USPAP, 2017), Standards on Mass Appraisal of Real Property (IAAO, 2017), and Guidance on International Mass Appraisal and Related Tax Policy (IAAO, 2014) were reviewed. In addition to the criteria for the legal use of real estate's there are also locational and economic criteria. However, there is no standardization regarding the number of these criteria or their structure.

The criteria used in a valuation project in Bosnia-Herzegovina, consisted of 22 locations, 27 main buildings (field, seismic zone, street width and noise/air pollution),

and 10 independent sections (USAID, 2006). The United Nations Economic Commission for Europe Working Party on Land Administration (UNECE WPLA) conducted surveys in various countries under the name of Land (Real Estate) Mass Valuation Systems for Taxation Purposes between 2000-2001 and Land Administration Systems in 2011 (UNECE WPLA, 2001; 2014). The questionnaires applied within the scope of these studies were about the real estate registration system in particular. There were no questions on the criteria that affected real estate value.

It was reduced to 30 criteria with method of Principal Component Analysis for mass appraisal criteria (Unel and Yalpir, 2017). Criteria of plots were weighted by using AHP method (Unel and Yalpir, 2019a; Bozdağ and Ertunç, 2020); criteria of housing and apartments were employed to prioritize and rank real estate alternatives by methods of the Decision-Making Trial and Evaluation Laboratory (DEMATEL) model and the Grey Relational Analysis (GRA) (Nguyen et al., 2020). Correlation between the dependent variable and the independent variables was measured (Zyga, 2020). It was modelled production and sharing standards and made mass valuation process by developing Geographic Data Infrastructure of non-geographical and geographical criteria (Aydinoglu et al., 2020). In addition, data and maps were disseminated by using open source geospatial software (Mete and Yomralioglu, 2021), updated by valuation method (Miotti and Loch, 2021), reflected location value (Cellmer and Trojanek, 2020).

Organizational studies include reports of appraiser and expert witnesses. The appraiser reports have been prepared for mortgages and credit facilities in loans from banks. The expert witnesses' reports have been regulated expropriation, partition, and inheritance that have been brought to trial. The criteria within the reports were examined, and criteria that were not included, such as servitude, population features and human relations, were added in this study.

Considering the studies in the literature it can be said that there are no optimum level criteria in Turkey or developed countries. It has not been mentioned criteria that have been determined in accordance with the commonly-held and real estate types, standardized and clearly defined. Optimum criteria are main parameters needed for all plot in national. There are many criteria affecting plot value, but which and how many of them to use for mass valuation are not known. Therefore, the study is based on determining the criteria that affect the plot value at the optimum level suitable for use in mass valuation.

The fact that there are not enough studies to create a mass valuation system causes a deficiency and brings about the need to find a solution. According to the literature review, it can be said that studies have mainly been conducted on housing and land and those conducted on plots are very few. However, as there are areas suitable for plots and most of the residential criteria originate from the features and location of these areas it is more suitable if the plot value is determined first.

2. MATERIALS AND METHODS

2.1. Participants and Procedure

As real estate valuation is used in the many areas of social and economic life and is related to many disciplines in respect to implementation, it is of a particular concern to various occupational groups. Therefore, support was received from individuals in occupational groups that work closely with real estate valuation and experienced individuals working in the related public institutions, professional organizations and private sector. The survey questions used in the present study were addressed to valuation experts holding a license granted by the Capital Market Board, people who are assigned as expert witnesses in cases regarding expropriation and elimination of joint ownership, the occupational groups mentioned in the literature (geomatics engineering, real estate and asset valuation, urban and regional planning, agricultural engineering, civil engineering, architecture, economics and administrative sciences, and law) (Erdem, 2018; Ertaş, 2019; Unel and Yalpir, 2019b), as well as contractors and real estate agents. In the survey conducted for citizens, people older than 18 years (Unel, et al., 2017) were preferred among those who applied to the Directorate of Land Registry and Cadastre for real estate purchase and sale.

In April and May 2015, the survey was carried out where experts work. For citizens, it was also made especially in the Directorate of Land Registry and Cadastre where citizens actualize title deed transactions. The survey was applied by asking one by one questions and marking the answers.

There were no standard questionnaires regarding the criteria affecting plot value was. Thus, the criteria used in academic studies, institutional studies, international valuation standards, large scoped projects, and implementations were put in to create a questionnaire. The questionnaires were copied and printed, and the survey application phase took place in two simultaneous stages, as the participants consisted of experts and members of the public. Face-to-face interviews were conducted with the experts in the first stage and with the members of the public in the second stage, with the help of pollsters. The questionnaires took approximately 20 minutes to complete per participant and the entire data consolidation stage was completed within three months. After gathering the survey data, the necessary arrangements were made and the analysis phase was initiated (Figure 1).

2.2. Sample Size

When determining sample size, areas in which groundmass will be measured and their size should be particularly identified. In this study, which was carried out in the Central Anatolia Region of Turkey, features such as density (person/km²), number of electors, population increase rate, net immigration rate, sales in the certificates of ownership, housing mortgages and zoning implementations were taken into consideration

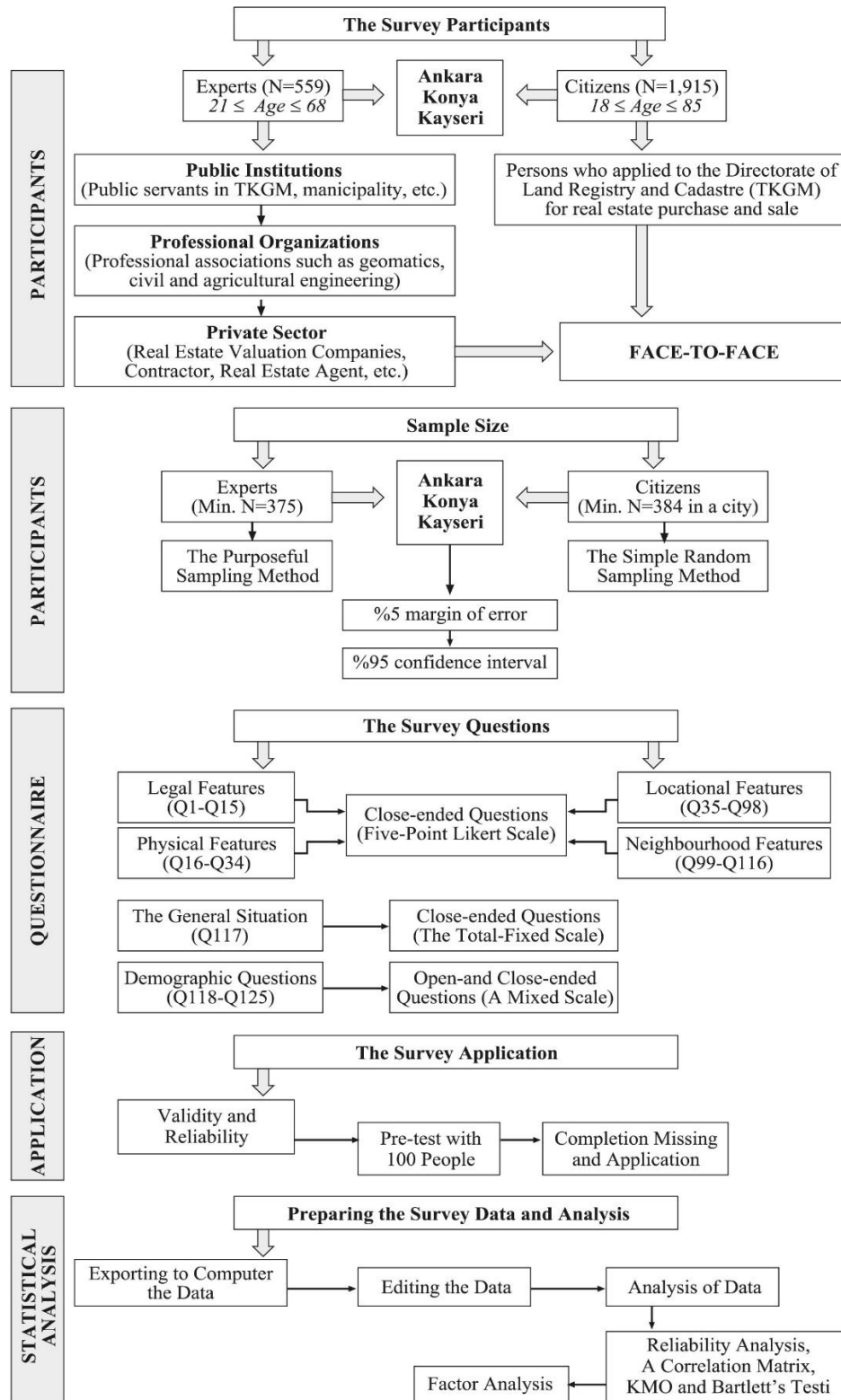


Figure 1. The study procedure

when choosing the cities to represent the region for this study. As a result, Ankara, Konya and Kayseri were determined as the cities to be sampled.

In terms of the sample size, a margin of error of 5% and a 95% confidence interval were identified. Additionally, in terms of the two main participant groups a total of 375 experts and 384 members of the public were determined. The purposeful sampling method was used for the experts, while the simple random sampling method was used for the members of the public. In case of incomplete questionnaires and answers given in the same order, the

sampling amounts were planned to be 500 for the experts and 2,000 for the members of the public. As a result, 559 experts and 1,915 members of the public were reached.

2.3. Criteria Affecting Plot Value

Valuation is a technical matter that is affected by many criteria. Although these criteria include the technical data regarding the real estate, social perspective and thoughts of people are also important.

First and foremost, the technical data determines a real estate’s value. The point where a buyer’s emotions, thoughts, and perspectives are in balance with supply and demand is the value estimation point. Under these

conditions and in accordance with objective criteria, the plot value should not be determined according to price, but instead the price should be determined according to the plot value.

Table 1. The survey questions (the subheadings are written in bold and italic) (Yalpir and Unel, 2017).

Ques. NO	Questions	Ques. NO	Questions	Ques. NO	Questions
NO	A. LEGAL FEATURES	Q42	Proximity to courses	Q86	Proximity to underdeveloped areas
Q1	Property Conditions	Q43	Proximity to Public Institutions	Q87	Proximity to marsh areas
Q2	Full Ownership	Q44	Proximity to governorships	Q88	Proximity to natural disaster areas
Q3	Shared Ownership	Q45	Proximity to Municipalities	Q89	Proximity to not improved river areas
Q4	Zoning Status	Q46	Proximity to Courthouses	Q90	Proximity to Industrial Zones
Q5	The Gross Floor Area	Q47	Proximity to Jailhouses	Q91	Proximity to Graveyards
Q6	Total Construction Area	Q48	Proximity to Security Units	Q92	Proximity to Worship Places
Q7	The number of floors≥10	Q49	Proximity to Police Stations	Q93	Proximity to Business Centers
Q8	The number of floors<10	Q50	Proximity to Military Zones	Q94	Proximity to Parking Areas
Q9	Detached Building	Q51	Proximity to Fire Departments/ 112 Emergency	Q95	The View from the Plot
Q10	Attached Buildings	Q52	Proximity to Attraction Centers	Q96	Mountain, valley, etc. views
Q11	Legal Restraints	Q53	Proximity to Shopping Centers	Q97	Lake, river, stream, etc. view
Q12	Right of Mortgage	Q54	Proximity to Hypermarkets	Q98	City view
Q13	Easement	Q55	Proximity to mini-markets	NO	D. NEIGHBOURHOOD FEATURES
Q14	Annotation of Lease	Q56	Proximity to open/closed bazaars	Q99	Population density
Q15	Plot Area	Q57	Proximity to commercial enterprises	Q100	Education Level
NO	B. PHYSICAL FEATURES	Q58	Proximity to Cultural Centers	Q101	Level of income
Q16	Location of the plot	Q59	Proximity to cinemas/theaters	Q102	Immigrant receiving level
Q17	Corner parcel	Q60	Proximity to historical sites and touristic attractions	Q103	Crime Rate
Q18	Intermediate parcel	Q61	Proximity to Entertainment Centers	Q104	Neighborliness Relations
Q19	Geometric Structure	Q62	Proximity to fairs, concert areas, etc.	Q105	Homeowner/tenant
Q20	Length of the Frontage	Q63	Proximity to sport facilities	Q106	The Surrounding Environment
Q21	Number of the frontage	Q64	Proximity to stadiums/hippodromes	Q107	A popular neighbourhood
Q22	Geometric shape	Q65	Proximity to entertainment venues	Q108	Residential Density
Q23	Technical Infrastructure Services	Q66	Proximity to Green Areas	Q109	Development potential
Q24	Water supply	Q67	Proximity to forest/copses	Q110	Purchasing and selling mobility of real estate
Q25	Electricity, sewer, natural gas, and telephone	Q68	Proximity to recreation areas	Q111	Underground, soil, and aboveground features
Q26	Solid waste collection service	Q69	Proximity to parks	Q112	Slope of the neighbourhood
Q27	Storm drainage	Q70	Proximity to playgrounds	Q113	Geological conditions
Q28	Unpaved road	Q71	Proximity to Public Transportation Points	Q114	Climate Conditions
Q29	Asphalt road	Q72	Proximity to airports	Q115	Air Pollution
Q30	Road Conditions	Q73	Proximity to railway stations	Q116	Noise Pollution
Q31	The Periphery Road	Q74	Proximity to coach station	NO	E. THE GENERAL SITUATION
Q32	Road width≥10 m	Q75	Proximity to tramway, subway and metrobus stations	Q117	Scoring features of legal, physical, locational and neighbourhood
Q33	Road width<10 m	Q76	Proximity to bus stops	NO	F. DEMOGRAPHIC QUESTIONS
Q34	Slope of the Plot	Q77	Proximity to shared taxi routes	Q118	Which city do you live in?
NO	C. LOCATIONAL FEATURES	Q78	Proximity to underpass/overpass	Q119	Age

Q35	Proximity to Health Facilities	Q79	Proximity to Unsanitary Areas	Q120	Gender
Q36	Proximity to health center, village clinic, etc.	Q80	Proximity to was disposal areas	Q121	Level of education
Q37	Proximity to State/Private Hospitals	Q81	Proximity to treatment facilities	Q122	Occupation
Q38	Proximity to Educational Institutions	Q82	Proximity to natural gas and tube filling facilities	Q123	Your position in the field of real estate valuation
Q39	Proximity to Pre-schools	Q83	Proximity to petrol stations	Q124	How long have you been working in the field of real estate valuation?
Q40	Proximity to High Schools	Q84	Proximity to base stations	Q125	Any other criterion you wish to add
Q41	Proximity to Higher Education Institutions	Q85	Proximity to energy transmission lines		

In this study, all the criteria affecting plot value were listed with the help of the literature by taking the group headings into consideration (Unel, 2017; Unel and Yalpir, 2019b). As a result, an excessive number of criteria was obtained. The criteria changing the value in the economic market were not taken into consideration to simplify and organize the criteria. Similar criteria were reduced to one and unnecessarily detailed criteria were generalized, and in some cases, grouped. Then, the criteria were turned into survey questions using a language that all the participants, experts and members of the public could easily understand. The survey questions were prepared to determine the criteria that was important to participants when valuating plots. The survey questions consist of six sections (A-F) and have the criteria (A-D), the general situation which was total of main headings (E) and demographic questions (F) (Table 1).

The criteria were divided into four categories, namely legal, physical, locational and neighbourhood features, and the survey questions were prepared under these categories. The questions (Q1-Q116) were designed in five-point Likert scale format. The participants were asked to answer the questions as not important at all (1), somewhat important (2), reasonably important (3), important (4) and very important (5). Considering the fact that the criteria either decreased or increased the value, the participants were asked if the criteria had a positive (+) or negative (-) effect on the value. The criteria that made up the survey questions and the other questions are given in Table 1 with the question numbers (Q1, Q2, Q3, ..., Q123, Q124 and Q125).

After completing the survey research and preparing the questions, a pre-test was applied to 100 people who were in the sampling group in order to test validity and reliability. The necessary corrections were made according to the results of the pre-test and validity was ensured. The most commonly used reliability test, also known as the reliability analysis (Cronbach), was carried out (Kalaycı, 2010; Altunışık et al., 2010; Baş, 2010; Arıkan, 2013) and an alpha factor of 0.918, which was concluded as reliable, was obtained.

2.4. Statistical Analysis

Factor analysis, which is a multivariate statistical method, enables the categorization and understanding of many variations as limited, significant and independent factors (Biçen, 2010). In an effective factor analysis, the desired property is to have a solution that represents the

total data set in the best way, but that also consists of a low number of factors. A good factor analysis result is preferred to be simple and easy to interpret (Altunışık et al., 2010; Biçen, 2010).

Three methods, namely creating a correlation matrix, Bartlett's test, and Kaiser-Mayer-Olkin (KMO) tests, are used to assess whether the data set is suitable for a factor analysis or not (Kalaycı, 2010; Biçen, 2010). After identifying the suitability of the data for factor analysis, the following stages are carried out (Kalaycı, 2010; Altunışık et al., 2010; Alpar, 2013):

- (1) Researching data suitability
- (2) Mathematical model for factor analysis
- (3) Identifying factor amount
- (4) Rotating the factors (rotating axis)
- (5) Interpreting the factors.

In order to carry out processes with a covariance matrix in the factor analysis, variables with the same units of measure and similar variances are required. However, in the correlation matrix, the variations' units of measure and variances are different. Additionally, unless a unit is not specified, solutions are achieved with the correlation matrix, which is used more frequently in statistical software (Özdamar, 2002; Alpar, 2013).

3. RESULTS

According to the results of the study, out of the 559 expert participants 208 were from Ankara (37.2%), 221 were from Konya (39.5%) and 130 were from Kayseri (23.3%). Fifteen percent of the participants were female, while 85% were male. The minimum age of the participants was 21, the maximum age was 68, and 72.1% of them had a bachelor's degree.

Of the 1,915 members of the public that participated in the study, 546 were from Ankara (28.5%), 942 were from Konya (49.2%) and 427 were from Kayseri (22.3%). Twenty five percent of the participants were female, while 75% were male. The minimum age of the participants was 18, the maximum age was 85, and 48.9% had a bachelor's degree.

3.1. Factor Analysis

The survey data in this study consisted of degrees and had no unit. Thus, the correlation matrix was used for the factor analysis. Before the factor analysis, the correlation matrix was scrutinized and the process was conducted by taking the coefficients that showed the relationship between the criteria into consideration.

Reliability Analysis

Exactly 99.7% of the total 2,474 questionnaires completed by the experts and citizens were determined to be eligible within the scope of the study. Data regarding 116 questions were collected with the questionnaires. In the reliability analysis, it was observed that the survey was highly reliable in accordance with the result of the 0.918 alpha coefficients (Table 2).

Table 2. Case processing summary and reliability statistics

Case Processing Summary			
		N	%
Cases	Valid	2,466	99.7
	Excluded ^a	8	.3
	Total	2,474	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.918	116

Research on Data Suitability

The suitability of 96 questions, excluding the 20 subheadings (Q1, Q4, Q11, Q16, Q19, Q23, Q30, Q35, Q38, Q43, Q48, Q53, Q58, Q61, Q66, Q71, Q79, Q95, Q106, and Q111), were investigated to determine their suitability for the factor analysis. Therefore, the correlation matrix, KMO, and Bartlett tests were examined. Whether the relationships between the criteria were less than 30% was determined by forming a correlation matrix. Five criteria, including Q7, Q28, Q31, Q102, and Q105, which were under 30% in the correlation matrix, were eliminated and were optimized for the factor analysis of the data set.

The KMO test result of 0.937 (Table 3) indicated “perfect” range and that the number of sampling was very good. According to the Bartlett’s test, the “significance” value ($p < .05$) indicates that there is a high correlation between the criteria. Accordingly, the factor analysis was carried out according to the results of the KMO and Bartlett tests.

Table 3. KMO and Bartlett's tests

Tests	Result
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.937
Bartlett's Test	Approx. Chi-Square 112494.580
df	4095
of Sphericity	Sig. .000

a. Based on correlations

Identification of factor amount

The percentage rates of the eigenvalues and variances of 91 factors were scrutinized. The rate of total variance explained for the 20th factor, whose eigenvalues were 1 and higher, was 62.478%. Thus, the number of factors according to the total variance explained rate was determined as 20. The number of factors equal to approximately 50% of the total variance explained rate was determined as 15. As can be seen in Figure 2, which was drawn with the number of factors of eigenvalues, the curved line starts to become parallel to the horizontal axis after the 10th factor. When this graph is taken into

consideration, the number of factors can be observed as 10.

As can be understood from the results stated above, there were three different factors. The lowest number was selected as the aim of this study was to reduce the criteria. In other words, the number of factors was determined as 10 according to the eigenvalue-factor graph (Scree Plot) and the analysis was repeated in accordance with the 10 factors.

Rotation of the Factors

In order to easily interpret the factors, the rotation process (upright rotating) was applied using the most common method, namely varimax. When examining the rotating factor matrix, the factor loads were taken into consideration. Within this study, factor loads less than 40% were not taken into consideration and were excluded from the analysis as these loads equal low loads in the resources (Büyüköztürk, 2002; Alpar, 2013).

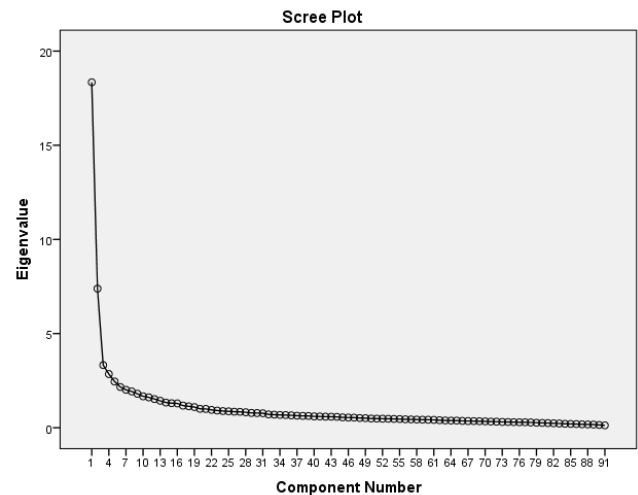


Figure 2. Scree Plot

There were criteria (Q18, Q32, Q33, Q34, Q47, Q52, Q54, Q55, Q56, Q57, Q90, Q91, Q92, Q93, Q94, Q99, Q104, Q108, Q112, Q113, and Q114) that had factor loads under 0.40 in the rotated factor matrix and cyclical criteria (Q36). The cyclical criteria was the criteria that had less than a 10% difference between the factor loads of the prominent one in two factors. If there is a difference more than 10% between the factor loads, it is not a cyclical factor and the largest factor load is taken into consideration. The criteria, which were cyclical and below 40%, were subject to repetitive analyses on an individual basis. This process continued until the conditions that were determined by scrutinizing the rotated matrix as a result of every analysis were met. After all these processes were complete, 22 criteria covering Q18, Q32, Q33, Q34, Q36, Q47, Q52, Q54, Q55, Q56, Q57, Q90, Q91, Q92, Q93, Q94, Q99, Q104, Q108, Q112, Q113 and Q114, were eliminated. The transactions were recorded following the final outcome.

Interpretation of the factors

Ten factors were denominated according to the general characteristics of the criteria in each of the factors (Table 4). When these criteria were scrutinized, it was mainly in accord with the previous grouping. For

example, the first factor (Unsanitary Areas), fourth factor (Technical Infrastructure Services), sixth factor (Entertainment and Cultural Areas), seventh factor (Public Transportation), eighth factor (Green Areas) and ninth factor (Legal Restrictions) were in conformity with the previous grouping. A total of 10 factors were

determined among the four main headings. The Locational Features (5 factors) had to most factors and was followed by Legal Features (3 factors) and Neighbourhood (1 factor) and Physical Features (1 factor). The total variance explained ratio of these 10 factors was found to be 55.072 % (Table 4).

Table 4. Classification of the factors

Factor	Name of Factor	The Number of Question	The Question Numbers of Criteria	Main Title (Features)	Reliability	Variance %
1	Unsanitary Areas	13	Q82, Q85, Q87, Q84, Q88, Q81, Q86, Q80, Q89, Q83, Q116, Q115, and Q103.	Locational	.939	11.866
2	Public Institutions	11	Q44, Q45, Q41, Q46, Q40, Q42, Q50, Q37, Q49, Q39, and Q51.	Locational	.865	7.216
3	Popular Neighbourhood Information	8	Q97, Q96, Q98, Q107, Q101, Q109, Q100, and Q110.	Neighbourhood	.822	5.568
4	Technical Infrastructure Services	5	Q26, Q25, Q24, Q27, and Q29.	Physical	.830	5.206
5	Zoning Status	8	Q20, Q21, Q5, Q6, Q22, Q15, Q17, and Q2.	Legal	.765	5.009
6	Entertainment and Cultural Areas	6	Q62, Q64, Q65, Q63, Q59, and Q60.	Locational	.831	4.796
7	Public Transportation	7	Q73, Q76, Q74, Q77, Q75, Q78, and Q72.	Locational	.781	4.389
8	Green Areas	4	Q69, Q67, Q68, and Q70.	Locational	.840	4.115
9	Legal Restraints	4	Q13, Q12, Q14, and Q3.	Legal	.757	3.518
10	Structuring Conditions	3	Q10, Q9, and Q8.	Legal	.799	3.389
N	General Reliability	69			.876	55.072
2,474						

3.2. Criteria Mitigation Scenarios According to the Results of the Factor Analysis

Factors

The number of criteria in the factor analysis was 96 at the beginning and 69 after eliminating those under 40% and the cyclical ones. In fact, the 69 criteria were reduced to 10. However, these reduced factor headings were generalized names that were not information that had an exact equivalency in terms of plots (Table 4). For example, the Zoning Status factor contained a lot of information regarding plots, such as the length of the frontage, the number of plot frontage, the gross floor area, total construction area, geometric shape, plot area, the location of the plot (corner parcel) and the ownership status.

Assessment of the factors following the re-grading

The sequences in nine different sampling groups, namely general, all experts, all citizens, the experts in Ankara, Konya, and Kayseri, and the citizens in Ankara, Konya and Kayseri, were separately applied the factor analysis. The results of them were reevaluated. The one of mass valuation aims is to estimation the value with the least criteria. It is brought out the most prominent of them accordance with responds of the experts and citizens because they are the actors of the real estate market. Scores were calculated by giving 10 points to the factor in first place and 1 point to the last one. The points of each factor were calculated and are presented in Table 5. The first five factors that received the highest points were Zoning Status (89), Technical Infrastructure

Services (82), Unsanitary Areas (72), Structuring Conditions (57), and Popular Neighbourhood Information (55), respectively.

Table 5. Total points of the factors arranged in order according to the factor analysis (**Point Scoring in Factor Analysis**)

Factor	Name of Factor	Scoring in Factor Analysis
1	Unsanitary Areas	72
2	Public Institutions	30
3	Popular Neighbourhood Information	55
4	Technical Infrastructure Services	82
5	Zoning Status	89
6	Entertainment and Cultural Areas	13
7	Public Transportation	35
8	Green Areas	48
9	Legal Restraints	14
10	Structuring Conditions	57

Discrimination and generalization of the factors

It is not possible to collect all of the factors as information regarding the plots. In such cases, some should be separated and generalized. It may not be possible for all of the criteria in factors of Unsanitary Areas, Public Institutions, Technical Infrastructure Services, Entertainment and Cultural Areas, Green Areas, and Legal Restrictions to be close to a plot or found

within a plot together. For this reason, there is no need to separate these factors. However, the Zoning Status had to be separated, the Public Transportation factor had to be generalized according to transportation status and the Structuring Conditions factor had to be separated and generalized.

The Zoning Status factor included the criteria of length of the frontage, the number of plot frontage, the gross floor area, total construction area, geometric shape, plot area, the location of the plot (on the corner parcel) and the ownership status when modularized. The Public Transportation factor was generalized as proximity to intercity public transportation points, proximity to tramway, subway, and metrobus stations, and proximity to bus, shared taxi, etc. stops. In the Structuring Conditions factor, detached or attached building was generalized as building design and the number of floors was dissociated as a separate criterion. As a result, 20 criteria that affected plot value were achieved (Table 6).

Three scenarios were produced by both factor analysis, re-scoring of nine different results and generalization-decomposition. The criteria in the last scenario conformed to the definition. Although optimum criteria for the Central Anatolia Region were determined in form a sufficient number of and the most appropriate,

it can be adapted for all plot in Turkey by adding/extracting some criteria. However, it should be given final decision after it is validated with market sampling.

4. CONCLUSION

Real estate values, which are very important in real estate management, are directly related to the criteria used in mass valuation. As a result, the need to reduce some criteria due to effort, time and cost may arise. There are many criteria that affect real estate value, which vary from region-to-region and person-to-person. In this study, working only on plots did not decrease the number of criteria. As gathering the entire criteria to determine the material value of more than one plot in mass valuation was not possible, the target was to decrease the criteria. A decreased number of criteria will make a significant contribution to both data collection on plots during operations such as taxation, expropriation, assurance, fees, land, plot arrangements, urban transformation, etc. and to the country's economy as revenue receipt. With the diminished number of criteria for plot values and their correct, trustworthy, and transparent calculation, people will gain ground in commerce and investment.

Table 6. Discrimination of some of the factors

Discriminated Factors		Non-Discriminated Factors		Generalized Factors	
No	Factors	No	Zoning Status Factor	No	Structuring Conditions
1	Unsanitary Areas	1	Length of frontage,	1	Building Design (Detached/Attached Building)
2	Public Institutions	2	The number of frontage	2	The number of floors
3	Popular Neighbourhood Information	3	The gross floor area	No	Public Transportation
4	Technical Infrastructure Services	4	Total construction area	1	Proximity to intercity public transportation points
5	Entertainment and Cultural Areas	5	Geometrical shape	2	Proximity to tramway, subway and metrobus stations
6	Green Areas	6	Plot Area	3	Proximity to bus, shared taxis etc. stops
7	Legal Restraints	7	The location of the plot (corner parcel)	Total=20 Criteria	
		8	Ownership Status-Full		

In this study, a survey was used to gather the data and factor analysis was used to obtain a decreased number of criteria. The answers the experts and citizens gave were collected and organized to prepare for analysis. Then, factor analysis was implemented and the decreased number criteria were identified. According to the factor analysis results, 10 factors came to the fore: Unsanitary Areas, Public Institutions, Popular Neighbourhood Information, Technical Infrastructure Services, Zoning Status, Entertainment and Cultural Areas, Public Transportation, Green Areas, Legal Restrictions, and Structuring Conditions.

According to the factor analysis results, the criteria with the most effect on market value in Central Anatolia were determined. The answers given to the question "where?" regarding the building of a house covered most of the criteria determined in this study. In other words, it was concluded that Proximity to **Unsanitary Areas, Public Institutions, Entertainment and Cultural Areas, Public Transportation Points, and Green Areas** should be taken into consideration. As a result of the

analysis the **Popular Neighbourhood Information** included the demographic and social characteristics of people living in the neighbourhood. In addition it was determined as an important group for the experts and citizens as a result of their answers to the survey questions. **Technical Infrastructure Services** was determined as another important criteria group and was one of the features that should be in a plot. However, as the insufficiencies were found to not end until most of the structuring was complete, they were included in the questionnaire and became one of the most important criteria groups. **Legal Restrictions** mean servitudes that are officially registered in the deed registry record for the plot and restrict its use, and constituted an important criteria group. **Zoning Status** and **Structuring Conditions** were some other criteria groups that had an effect on plot value. They contain very important data such as the gross floor area, total construction area, the number of floors, and building design related to the house to be built. While the criteria groups regarding locational features and the variation of Popular

Neighbourhood Information and Technical Infrastructure Services on a regional basis could be identified on micro scale maps, Zoning Status and Structuring Conditions needed to be examined in parcels with large scale maps. As a result, after the unbundling and generalizing of 10 factors, 20 criteria were obtained.

When scored according to all of the samples, the results of the factor analysis showed that the 10 factors decreased to five factors, namely Zoning Status, Technical Infrastructure Services, Unsanitary Areas, Structuring Conditions, and Popular Neighbourhood Information. In case of the decomposition of Technical Infrastructure Services, Unsanitary Areas, and Popular Neighbourhood Information as neighbourhood-based and Zoning Status and Structuring Conditions as parcel-based, they could be decreased to 13 criteria as Technical Infrastructure Services, Unsanitary Areas, Popular Neighbourhood Information, length of frontage, the number of plot frontage, the gross floor area, total construction area, geometric shape, plot area, the location of the plot (on the corner parcel), the ownership status, building design and the number of floors.

The validity of decreased number of criteria was not only region based. It was considered that the criteria could be used throughout the country. In case of extreme conditions, additions could be made to these optimum criteria in line with expert contributions. The results of the survey work are important for the construction of artificial intelligence or machine learning methods that can make automatic valuation in the establishment of the mass real estate appraisal system. The results of this study, which is applied very comprehensively and includes all objective variables that can be used in the estimation of the land value, are available in applications that require many value estimates, regardless of which value estimation method is preferred.

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Author contributions

Sukran Yalpir: Conceptualization, Methodology, Data Curation, Writing-Reviewing and Editing, Validation.
Fatma Bunyan Unel: Investigation, Making the Survey, Analyzing, Writing-Original Draft Preparation.

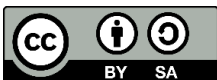
Conflicts of interest

The authors declare no conflicts of interest.

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