Qualitative and Quantitative Methods for Assessing the Similarity of Real estate[1]

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Key words: similarity criteria, linear and nonlinear correlation, qualitative methods, quantitative methods

SUMMARY

This paper proposes using various qualitative and quantitative methods to establish similarity criteria of real estate. The problem of assessing the similarity is a key issue in the comparative approach to real estate appraisal in which the appraiser selects properties most similar to the appraised one from a collected database.

Algorithms for establishing the degree of similarity may be based on estimating absolute differences between qualitative characteristics.

To combine qualitative and quantitative methods, weights of particular property characteristics in their prices can be included in the above algorithms for selecting similar properties. These weights w_i are determined for example based on the coefficients of correlation r_i between the attribute and the property price, for m attributes:

$$w_i = \frac{r_i^2}{\sum_{i=1}^{m} r_i^2}$$

Thus, when performing the relative comparison analysis or the ranking analysis [Baranska 2010], we take into account only significant attributes of properties selected based on their weights. The correlation coefficients used can be determined based on the ranks assigned to qualitative variables or on the numerical values of these variables resulting from their scaling, which gives them a quantitative character. The correlation coefficients proposed for use are: Pearson's correlation; Spearman's correlation; Kendall's correlation; Gamma correlation; partial correlation; nonlinear correlation.

Similarity can also be assessed only on the basis of a determined number of selected attributes considered to be the most significant characteristics of a given type of real estate. In the case of homogenous markets, the most significant attributes can be selected using so-called beta weights determined from regression coefficients.

This paper presents examples of using various correlation coefficients for selecting the most significant characteristics of property, which have to be the reference point when we estimate the similarity between real estates.

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Jakościowo – ilościowe metody ustalania podobieństwa nieruchomości

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Słowa kluczowe: kryteria podobieństwa, liniowa i nieliniowa korelacja, metody jakościowe, metody ilościowe

STRESZCZENIE

W artykule zaproponowano zastosowanie różnych jakościowych i ilościowych metod do ustalenia kryteriów oceny podobieństwa nieruchomości. Zagadnienie oceny podobieństwa jest kluczowe przy stosowaniu tak zwanego *porównawczego podejścia wyceny nieruchomości*, w którym rzeczoznawca wybiera ze zgromadzonej bazy danych obiekty najbardziej zbliżone do wycenianego.
Algorytm ustalania stopnia podobieństwa może bazować na oszacowaniu absolutnych różnic między jakościowymi cechami nieruchomości.
W ramach połączenia metod jakościowych i ilościowych w algorytmach tych można skorzystać z udziałów wagowych w_i poszczególnych cech nieruchomości w kształtowaniu ich cen, jako kryterium wyodrębnienia obiektów podobnych. Wagi te mogą być obliczane na przykład na podstawie współczynników korelacji r_i między atrybutami i ceną nieruchomości, dla m atrybutów:

$$w_i = \frac{r_i^2}{\sum_{i=1}^{m} r_i^2}$$

Zatem, gdy stosujemy na przykład *analizę porównania względnego* lub w *analizę szeregowania* [Baranska 2010], bierzemy pod uwagę tylko znaczące atrybuty nieruchomości, wybrane na podstawie udziałów wagowych. Wykorzystane współczynniki korelacji mogą być obliczone na podstawie rang przypisanych zmiennym jakościowym lub na podstawie liczbowych wartości tych zmiennych wynikających z ich wyskalowania, które nadaje im ilościowy charakter. Zaproponowano wykorzystanie następujących współczynników korelacji: korelacja Pearsona, korelacja Spearmana, korelacja Kendalla, korelacja Gamma, korelacja cząstkowa, korelacja krzywoliniowa.
Podobieństwo między nieruchomościami może być oceniane tylko na podstawie ustalonej liczby wybranych atrybutów, uznanych za najbardziej znaczące cechy nieruchomości określonego typu. W przypadku rynków jednorodnych, najbardziej znaczące atrybuty mogą być ustalone na podstawie tzw. wag beta, obliczanych ze współczynników regresji.
Niniejszy artykuł prezentuje przykłady zastosowania różnych rodzajów korelacji do wyselekcjonowania najbardziej znaczących cech nieruchomości, które mają stanowić punkt odniesienia podczas dokonywania oceny podobieństwa między nieruchomościami.

Qualitative and Quantitative Methods for Assessing the Similarity of Real Estate

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1. INTRODUCTION

The assessment of the real estate similarity is a problem constantly topical in the everyday work of estate experts and real estate market's analysts. One of the essential difficulties here is the selection in a, very numerous often, database containing so called price-making real estate features – these ones that really form its price on a given market. The point is that the assessment of similarity, made on the grounds of such a selection, remained objective, i.e. was reliable. The problem becomes particularly important in the case of mass valuations with a huge database, where it is difficult to pick out the objects similar.

2. QUALITIVE AND QUANTITIVE VARIABLES

A real estate attributes can be divided generally into obligatory and facultative. Obligatory will be the information on the real estate permitting to identify it explicitly in documents and in site. These are, among the others, address data, number of building plot, number of real estate register, number of registering unit, number and name of the district and the like. Whereas, facultative are the features, which can, potentially, influence the real estate prices. They describe the real estate quality, in broad terms. We distinguish among them so called price-making attributes, really shaping the prices.

Facultative attributes belong usually to the qualitative variables. Few of them have a quantitative character by nature, like for example the surface area, transaction date, number of stories in a building. Most of them answer the question "what kind?" not "how much?". For this reason many methods of similarity assessment was adapted to this qualitative character of variables. The similarity often comes down to the identity of a determined number among all analysed features or it is based on a qualitative comparison of the real estate attributes, aiming only to notice differences, without considering how great they are. This is, for example, the case of an analysis of real estate relative comparison. The method has been described in detail in the article [Baranska 2010].

In order to make objective the similarity assessment procedures, the application of different correlations types is proposed to select from a large database containing the variables determining a real estate attraction - the real price-making attributes. To determine the correlation attributes, it is necessary to make a preliminary transformation of qualitative features into the quantitative ones by assigning to them definite numerical scales. The scales result from the intensity of the examined feature and they function as ranks.

3. CORRELATION COEFFICIENTS

Among the proposed correlation coefficients, on the basis of which we can evaluate the part of individual examined real estate features in shaping their prices, are the following:

- Pearson's correlation;
- Spearman's correlation;
- Kendall's correlation;
- Gamma correlation;
- partial correlation;
- nonlinear correlation.

Relation measures mentioned above include both typical measures of correlation relationship between quantitative variables: Pearson's correlation, partial correlation or curvilinear correlation and three types of rank correlation: Spearman's, Kendall's and Gamma – correlation measures more appropriate for qualitative variables. It seems to be interesting to compare the results of evaluating the importance of attributes by different correlation types.

3.1. Pearson's correlation

Pearson's correlation coefficient is the most common measure of the linear relationship between the variables. On the basis of data gathered in a random sample, this coefficient is determined by the following formula:

$$r_P = \frac{\sum_{i=1}^{n}(x_i-\hat{x})(y_i-\hat{y})}{\sqrt{\sum_{i=1}^{n}(x_i-\hat{x})^2 \sum_{i=1}^{n}(y_i-\hat{y})^2}} \quad (1)$$

where:

(x_i, y_i) – values of a two-dimensional random variable,
$\hat{x}, \hat{y}$ – mean values of variables X i Y,
n – random sample size.

This, commonly used, relation measure has however some faults, and one of the most serious is the lack of resistance to the appearance of the cases divergent in the database. Such cases, practically, make impossible to detect real correlation relationships using this coefficient.

3.2. Spearman's correlation

A solution for the problem of Pearson's correlation coefficient deficiency is Spearman's rank correlation coefficient, calculated by the formula:

$$r_S = 1 - \frac{6 \cdot \sum_{i=1}^{n}(i-s_i)^2}{n \cdot (n^2-1)} \quad (2)$$

where:

s_i – rank assigned to the position i after the pairs (x_i, y_i) are arranged in series in relation to one component, for example x,
n – size of a random sample.

In order to determine r_s, a ranking is made first, i.e. every observed value is replaced with its subsequent number resulting from its item in the database sorted in growing order. Next, the ordinary Pearson's coefficient of linear correlation is calculated. The ranking approaches possible divergent observations to the rest, levelling thus their influence disturbing the result. A monotonic nonlinear relationship is transformed by ranking into a linear one. In consequence, the linear correlation Pearson's coefficient, applied to ranks, measures the nonlinear relation force.

3.3. Kendall's correlation

In order to calculate tau-Kendall correlation coefficient, we must combine the observations into all possible pairs, and next, divide the pairs into three disjoint categories:

- **compatible pairs** – variables compared within two observations change in the same direction, i.e. they are both larger in the first observation than in the second, or they are both smaller. Let's denote the number of the pairs as z,
- **incompatible pairs** – the variables change in the contrary direction, i.e. one of them is larger for this observation in the pair, for which the other is smaller. Let's denote the number of such pairs as m,
- **combined pairs** – one of variables has equal values in both observations. Here belong the pairs, which do not fit in defined previously categories, that is, their number is *n-z-m*.

Then, tau-Kendall estimator is determined by the formula:

$$r_K = 2 \cdot \frac{z-m}{n(n-1)} \tag{3}$$

where:

z – number of compatible pairs,
m – number of incompatible pairs,
n – size of random sample.

Kendall's tau is the difference between the probability that compared variables will set in the same direction for two observations and the probability that they set in the opposite direction.

3.4. Gamma correlation

Gamma statistics is recommended in the cases, when data contain many combined observations (third category described in 3.3). Within basic assumptions, it is the equivalent of the Spearman's or tau-Kendall's correlation, while in respect of interpretation and calculation it is more similar to the tau-Kendall coefficient. Gamma coefficient is also based on the probability, which is the difference between the probability that the arrangement of two variables is consistent and the probability that it is inconsistent, divided by 1 minus probability of occurring combined observations.

3.5. Partial correlation

The coefficient of partial correlation is the measure of the relationship of two random variables, considering the influence of all other variables, analysed in parallel. It can be determined on the basis of the correlation matrix *K*, containing coefficients of Pearson's correlation for all pairs created in the analysed system of random variables:

$$r_{ij} = \frac{-Ad(K_{ij})}{\sqrt{Ad(K_{ii}) \cdot Ad(K_{jj})}} \tag{4}$$

where:

$Ad(K_{tl})$ – algebraic complement of the element *tl* of the correlation matrix *K*.

Comparing the coefficient of the total Pearson's correlation and of the partial correlation for a selected pair of variables, we can determine the influence of the other random variables on the relationship in this pair.

3.6. Nonlinear correlation

If the relationship between two variables *X* and *Y* has a visible nonlinear character, that can be expressed by a determined function *f*, then, the measure of the relationship between them is a nonlinear correlation, expressed by the formula:

$$\rho = \sqrt{1 - \frac{\sum_{i=1}^{n}\left(y_i - f(x_i)\right)^2}{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}} \tag{5}$$

where:

f – model dependence of the variable *Y* from the variable *X*,
y_i – empirical values of random variable *Y*,
$f(x_i)$ – model values of dependent variable *Y*,
$\hat{y}$ – mean value of variable *Y*,
n – size of the random sample.

All correlation coefficients take the values within the interval [-1,1]. Rank coefficients r_S, r_K, r_G are measure of the monotonic relationship. They are all resistant to the diverging cases.

In order to estimate the magnitude of the differences between individual coefficients of correlation, we can create the confidence interval on the determined confidence level *p*, for example *p*=0.95. Then, as approached, we will consider the correlations, which values belong to the confidence interval.

The confidence interval for the coefficient of Pearson's correlation is determined using the following formula:

$$r_P \in \left(\frac{e^{2 \cdot z_1} - 1}{e^{2 \cdot z_1} + 1}, \frac{e^{2 \cdot z_2} - 1}{e^{2 \cdot z_2} + 1}\right) \tag{6}$$

where:

$$z_1 = \frac{1}{2} \cdot ln\left(\frac{1 + \hat{r}_P}{1 - \hat{r}_P}\right) - \frac{u\left(1 - \frac{\alpha}{2}\right)}{\sqrt{n-3}}, \qquad z_2 = \frac{1}{2} \cdot ln\left(\frac{1 + \hat{r}_P}{1 - \hat{r}_P}\right) + \frac{u\left(1 - \frac{\alpha}{2}\right)}{\sqrt{n-3}} \tag{7}$$

$\hat{r}_P$ – estimator of Pearson's correlation coefficient determined from the sample by formula (1),
$u\left(1 - \frac{\alpha}{2}\right)$ – quantile of the normal distribution for the confidence level 1-α.

4. ATTRIBUTES PARTS IN EXPLAINING REAL ESTATE PRICES

Based on the correlation relationship, the measure of which can be the square of the correlation coefficient, we can determine weight parts of individual features of real estate in creating their prices. To estimate relative parts in full space of random events creating probability space, we standardize the correlation square:

$$w_i = \frac{r_i^2}{\sum_{i=1}^{m} r_i^2} \tag{8}$$

where:

r_i – correlation coefficient of attribute i with the real estate price.

On the basis of the weight parts, determined from different correlation types, we could select from a large database of the features describing real estates in a database, the features, which significantly shape market prices. The degree of diversification between these features can be an estimation criterion of the similarity between real estates. Certainly, if we find a definitely nonlinear relationship in a pair *attribute – price*, we put in to the formula (8), in relation to this attribute, the square of the curvilinear correlation, calculated by formula (5).

So-called *beta weights* have a character similar to the weight parts. They are standardized coefficients of multiple regression and they can be calculated, like the partial correlations, on the basis of the correlation matrix *K*:

$$\beta_i = \frac{Ad(K_{0i})}{Ad(K_{00})} = a_i \cdot \frac{\sigma(x_i)}{\sigma(c)} \tag{9}$$

where:

$Ad(K_{0i})$, $Ad(K_{00})$ – algebraic complements of the appropriate elements of the correlation matrix *K*, concerning real estate price, to which corresponds the index '0',
a_i – regression coefficient in the model of multiple regression, standing at the variable X_i,
$\sigma(x_i), \sigma(c)$ – standard deviations of the independent variable X_i and of the price.

Beta weights are a good measure of the estimation of relative degree of real estate prices explaining by individual attributes, on condition however that it is the case of a homogeneous market, where the multiple regression model can be well adjusted to the market tendencies.

5. EXAMPLE

Below we have the tables which include the calculation results of the elements described above and an attempt at their interpretation. The subject of the analyses was the market of dwellings in a Polish town of mean size (40 thousands of inhabitants). The database contained data on 142 transactions, which prices have been updated, i.e. brought up to current date. The dwellings are described using 15-scaled features: town zone (Z), communication access (C), building surroundings (BS), access to the public facilities (PF), building technology (T), technical condition of the building (BC), technical condition of the premises (PC), storey (S), functionality of the flat layout (FF), belonging rooms (BR), parking place (P), housing law (HL), legal loads (LL), surface area (SA), and number of rooms (NR).

Table 1. Different types correlation coefficients of attribute with the premises price, n=142

Attribute	r_P	confidence interval for r_P		r_S	r_K	r_G	r_{ij}
Z	0,432	0,29	0,56	0,335	0,249	0,294	0,065
C	0,490	0,35	0,61	0,369	0,273	0,323	0,133
BS	0,336	0,18	0,47	0,330	0,246	0,284	0,082
PF	0,442	0,30	0,57	0,426	0,328	0,395	0,061
T	0,234	0,07	0,38	0,259	0,187	0,212	-0,108
BC	0,439	0,30	0,56	0,419	0,328	0,372	0,165
PC	0,142	-0,02	0,30	0,123	0,101	0,385	0,145
S	0,066	-0,10	0,23	0,049	0,032	0,038	0,049
FF	0,087	-0,08	0,25	0,010	-0,003	-0,003	0,191
BR	-0,117	-0,28	0,05	-0,117	-0,093	-0,128	-0,042
P	0,264	0,10	0,41	0,273	0,207	0,245	0,044
HL	0,034	-0,13	0,20	-0,010	-0,008	-0,012	0,047
LL	0,071	-0,10	0,23	0,065	0,054	0,262	0,111
SA	-0,043	-0,21	0,12	-0,014	-0,009	-0,009	-0,195
NR	0,184	0,02	0,34	0,190	0,146	0,177	0,147
percent of different				0,00	0,13	0,20	0,40

Table 1 contains the values of different correlation types defined at p. 3, calculated for the premises prices in relation with their individual features. There are also the confidence intervals for Pearson's correlation, determined on the confidence level 0.95. Shaded cells set apart from the rank correlations and partial correlations the ones that are beyond the appropriate confidence interval for Pearson's correlation, calculated for the same pair of variables.

The last line shows the percent of essentially different rank correlations and partial correlations in relation to Pearson's correlation. As it turned out, Spearman rank correlations are the most close to Pearson's correlation. That means the lack of the cases divergent among the gathered data, as the Pearson's correlation is not resistant to such cases. Pearson's correlations differ the most in relation to the partial correlations (in 40% of pairs), which could indicate that a correlation relationship between two variables in a given pair, in 40% of cases, is influenced by other variables used to describe objects in the database.

It is also notable that all kinds of correlation turned to be statistically significant for the same pairs of variables, which was marked with red types. Therefore, we can presume that all applied relation measures equally well distinguish the essential correlation between variables. For 15 considered features of a real estate – 8 show an essential influence on the dwelling price.

On the basis of different correlation coefficients, the weight parts of individual attributes in the explanation of dwelling prices in a local market have been calculated using formula (8) and put in the table 2. The table includes also *beta weights*. It must be said however, that they are standardized regression parameters for a multiple regression model poorly fitted to the actual market variability. The level of this fitting comes to 43% (coefficient of model determination R^2=0,432). Therefore, direct relating of these elements to the weight parts in this case is not very reliable.

Table 2. Weight parts of the attributes in premises price, n=142

Atrybut	$k(r_P)$	$k(r_S)$	$k(r_K)$	$k(r_G)$	*BETA*
Z	0,16	0,12	0,12	0,09	0,12
C	0,21	0,15	0,14	0,11	0,23
BS	0,10	0,12	0,11	0,09	0,15
PF	0,17	0,20	0,20	0,17	0,11
T	0,05	0,07	0,07	0,05	-0,14
BC	0,17	0,19	0,20	0,15	0,20
PC	0,02	0,02	0,02	**<u>0,16</u>**	0,11
S	0,00	0,00	0,00	0,00	0,04
FF	0,01	0,00	0,00	0,00	0,19
BR	0,01	0,01	0,02	0,02	-0,04
P	0,06	0,08	0,08	0,06	0,05
HL	0,00	0,00	0,00	0,00	0,04
LL	0,00	0,00	0,01	**<u>0,07</u>**	0,09
SA	0,00	0,00	0,00	0,00	-0,29
NR	0,03	0,04	0,04	0,03	0,20

In the table 2, the weight parts differing significantly from the beta weights are marked in pale blue colour. While, the parts the most close to the standardized regression coefficients are marked in vivid blue colour.

If we assume a symbolic limit for the significant value of the attribute weight part in the explanation of dwelling prices on the level of 3%, it turns out that the parts determined on the grounds of three different types of correlation detail exactly the same premises features as the features of significance for creating their prices. These are town zone, communication access, building surroundings, access to the public facilities, building technology, technical condition of the building, parking place and number of rooms. Only the Gamma correlation resulted in isolating additionally two features as essential for shaping prices: technical condition of the premises, legal loads. Weight parts corresponding are marked with bold and underline.

Then, it can be concluded that about a half of considered dwelling features influences significantly their prices, and their selection is possible both on the grounds of Pearson's correlation and of Spearman or Kendall rank correlations. Gamma correlations lead to the results a bit different. For the selected in such a way price-making real estate features, we can apply one of the methods of similarity assessment discussed in detail in the publication [Baranska 2010]. They are relative comparison analysis or real estate ranking analysis.

Similar analyses have been done for the same data in the situation, when the regression model showed much better (satisfactory) matching to the market data (R^2=0,633). So large increase of the degree of model matching was achieved due to the elimination from the database about 10% of cases (17 real estates), which represented diverging values of the variables in relation to the estimated model.

Table 3 is an equivalent of the table 1. Notation of the results here is in conformity with the key used in the table 1. In addition, this time, the same pairs of variables show significant correlations among r_p, r_S, r_K, r_G. They are more of one than in the table 1. We observe more than previously significant partial correlations. It can indicate a larger and, at the same time, more reliable influence of the other variables on the relationship in the considered pair. All the more, that now up to 60% of analysed correlation relationships in pairs *an attribute – the price* is not possible to separate from the influence of the other real estate features.

Table 3. Different types correlation coefficients of attribute with the premises price, n=125

Attribute	r_P	confidence interval for r_P		r_S	r_K	r_G	r_{ij}
Z	0,517	0,38	0,63	0,396	0,295	0,347	0,238
C	0,547	0,41	0,66	0,388	0,286	0,334	0,072
BS	0,377	0,22	0,52	0,357	0,265	0,305	0,163
PF	0,490	0,34	0,61	0,453	0,350	0,419	-0,043
T	0,328	0,16	0,48	0,323	0,230	0,262	-0,004
BC	0,524	0,38	0,64	0,483	0,374	0,425	0,238
PC	0,226	0,05	0,39	0,197	0,162	0,647	0,362
S	0,115	-0,06	0,29	0,085	0,059	0,070	0,203
FF	0,017	-0,16	0,19	-0,071	-0,068	-0,082	0,154
BR	-0,084	-0,26	0,09	-0,094	-0,074	-0,101	0,119
P	0,291	0,12	0,44	0,287	0,215	0,254	-0,076
HL	0,112	-0,06	0,28	0,049	0,039	0,055	0,121
LL	0,076	-0,10	0,25	0,069	0,057	0,263	0,202
SA	-0,118	-0,29	0,06	-0,052	-0,038	-0,038	-0,396
NR	0,244	0,07	0,40	0,237	0,181	0,221	0,304
percent of different				0,07	0,20	0,27	0,60

In general, we observe greater than previously differentiation between the correlation coefficients. It is indicated by the percents of essentially different coefficients within their types in relation to the Pearson's correlation, i.e. coefficients being beyond the confidence intervals for r_p. Even the Spearman's correlation shows in one case a significant difference in relation to the Pearson's correlation. Still, these two types of correlation give the closest results.

Table 4. is an equivalent of the table 2 for a full database. The weight parts included here, calculated on the grounds of the correlations from the table 3, can be compared with *BETA weights*, as the multiple regression model sufficiently explains the relationships on the analysed real estate market. So, larger than previously number of pale blue weight parts of attributes in a price proves that not necessarily the same features of a real estate considered as factors independently shaping their prices, shape significantly a dependent variable (by price) in a multidimensional regression model.

Table 4. Weight parts of the attributes in premises price, n=125

Attribute	$k(r_P)$	$k(r_S)$	$k(r_K)$	$k(r_G)$	*BETA*
Z	0,17	0,13	0,13	0,09	0,36
C	0,19	0,13	0,12	0,08	0,10
BS	0,09	0,11	0,10	0,07	0,24
PF	0,15	0,17	0,18	0,13	-0,07
T	0,07	0,09	0,08	0,05	0,00
BC	0,17	0,20	0,21	0,13	0,25
PC	0,03	0,03	0,04	**<u>0,30</u>**	0,25
S	0,01	0,01	0,01	0,00	0,13
FF	0,00	0,00	0,01	0,00	0,12
BR	0,00	0,01	0,01	0,01	0,09
P	0,05	0,07	0,07	0,05	-0,07
HL	0,01	0,00	0,00	0,00	0,08
LL	0,00	0,00	0,00	0,05	0,13
SA	0,01	0,00	0,00	0,00	-0,48
NR	0,04	0,05	0,05	0,04	0,34

Assuming, like previously, that the criterion of considering the weight part as significant on the level of 3% - also in this case, the same attributes turned out to have a significant influence on the price in the event of applying three first types of correlation: r_p, r_S, r_K. Gamma correlation, as previously, gives slightly different results, which is marked by bold and underline in the table 4. The same 8 attributes mentioned above and additionally the technical condition of the premises significantly shape the prices. These results do not coincide with the indications of *beta weights* (essential *BETA* is marked in red colour on the table 4). As mentioned above, it can be due to a different character of the influence of individual independent variables on the dependent variable, treated as a system of variables from the situation, when we consider each variable separately.

6. CONCLUSIONS

Among the correlation coefficients applied to assessing the influence of facultative attributes on real estate market prices, Pearson's correlations and Spearman's or Kendall's rank correlations lead to the convergent results. It allows applying interchangeably these parameters depending on a quantity or quality character of the variables used to describe the real estates.

As it turned, the Gamma correlation leads to slightly different conclusions. However, the differences in relation to the results achieved for the other types of correlation lie in an only slight extension of the database of real estate features recognized as the ones having a price-making character. Then, we can suppose that Gamma correlation is a less restrictive indicator of the dependence degree between variables.

Beta weights assessing the relative influence of independent variables on the values of a dependent variable in a multidimensional regression model, do not lead to distinguish the same significant variables, which generate the weight parts determined independently for each variable.

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