

ASSUMPTIONS OF THE DEVELOPMENT OF THE THEMATIC SERVICE OF THE AVERAGE PROPERTY TRANSACTION PRICES

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Abstract

One of the main objectives of the project "IRIS – The development of the Integrated Real Estate Information System - Phase II" is the development and inclusion of the average transaction prices thematic portal, based on the data from the Register of Prices and Property Values, in the Integrated Real Estate Information System.

The paper presents the foundation of the development of the thematic service of the average property transaction prices. The range of data collected from the Register of Prices and Property Values and a cadastre for this thematic portal, have been defined. The methods of determination of apartments' average transaction prices have been proposed and verified for different spatial units. The scope of information and methods of its cartographic presentation have been presented. In addition, possible areas of application of information obtained from the thematic portal have been stated.

The paper includes examples of calculations and cartographic visualizations based on the data from the Register of Prices and Values for the area of the Capital City of Warsaw, concerning prices of apartments on the secondary market in 2016.

Key words: *the thematic service of the average transaction prices, the Integrated Real Estate Information System - Phase II project, the Register of Prices and Property Values, the average apartment price, methods of cartographic presentation*

Introduction

The knowledge of property prices is important for many private entities, as well as for people, who want to sell or to buy real estates, banks, real estate agents, property valuers as well as public bodies such as tax offices, Central Statistical Office, state agencies and municipality offices.

In some countries information on average prices of land and residential premises is available in the form of digital maps. They are being prepared by public bodies and private companies operating on the real estate market. In Poland digital maps of apartment's average transaction prices are being drawn up in big cities for instance Warsaw and Krakow. These maps are a part of the urban spatial information system. In recent years maps of the average property prices maps are also the subject of scientific papers, inter alia: (BUDZYŃSKI, KARSZNIA 2014), (CELLMER 2015), (OGRYZEK, KUROWSKA 2016).

In 2011 in Polish legal regulation the concept of map of average land transaction prices was defined. This map is to present average prices of buildings and agricultural lands calculated for units of administrative division of Poland - voivodeships, counties and municipalities (BUDZYŃSKI, KARSZNIA 2014). The map of the average land transaction prices should be prepared within a few years. In the process of designing this map the thematic service of the average property transaction prices will also be developed and implemented. The thematic service is being developed within The Integrated Real Estate Information System (IREIS)- Phase II project.

Material and methods

Thematic service of the average property transaction prices as a main component of the project Integrated Real Estate Information System – Phase II

The Integrated Real Estate Information System (IREIS)- Phase II project involves the design of the new electronic intranet services and public services, as well as the expansion of existing services, understood as the extension of the functional scope and information scope of the service (the range of information processed and returned to the recipient by the service). The central thematic service of average transaction prices of land, built-up land and premises will have a large audience, so the service of publication of average transaction prices will be made available in the framework of the IREIS - Phase II project.

Within IREIS - Phase II it is planned to provide a new average price transaction publication service. The service is to ensure publication of information on average transaction prices of real estate as thematic studies in the form of digital maps based on Register of Prices and Property Values (RPPV) data, statistical data and data from the National Geodetic and Cartographic Resource (NGCR). The service will also allow viewing maps designed based on the criteria set by the user of the service. The new e-service functionalities include:

- generating a thematic study of average transactional prices of real estate in the form of a digital map,
- displaying a thematic study of average transaction prices of properties according to the criteria (eg. type of use, price range, territorial unit, number of transactions, etc.)

The access to the thematic service will be possible through Geoportal for the private users and through IREIS for the public bodies.

The range of data collected for the purpose of the thematic service of average property transaction prices development

The source of data for the thematic service of average property transaction prices is the RPPV. According to § 74 Regulation of Ministry of Regional Development and Buildings Construction from March 29th 2001 on register of lands and buildings, this registry contains the following data: a price of a property, an address of a property, a number of cadastral parcels included in a property, a type of a property, an area of a land property and other available data on property and its parts. Most of the data gathered in this register is derived from cadastral database. This is an identifier and an area of a cadastral parcel. In case of a building this is the identifier, the main and detailed function, the usable area. In case of a premises this is the identifier, the function, the usable area, the number of chambers in the premises and the number of storey on which the main entrance to the premises is located. In addition, other important data may be downloaded from cadastre to the thematic service: the type of land use, the type of building and the date of completion of building construction. Based on the above mentioned data, average unit prices can be calculated and presented in the thematic service.

The methods of calculation of average property transaction prices

In the thematic service average property transaction prices will be displayed for units of administrative division of Poland - voivodeships, counties and municipalities. In addition, it is proposed to calculate the average property price in bigger cities for the units of internal division of these cities, for example districts.

To propose methods of calculation of average property transaction prices for above mentioned spatial units, the concept of average should be defined. An average is a measure of the central tendency of the observed variable - in this case the unit property transaction price (HOZER, KOKOT, KUŹMIŃSKI 2002). The arithmetic mean and the median can be used to determine the central tendency.

The numerical distance of the arithmetic mean from the median may determine the degree of heterogeneity of the set of statistical units – unit property transaction prices, indicating the usefulness of using the arithmetic mean in the description of this set. A significant difference between the arithmetic mean and the median means that the set of statistical units is heterogeneous. Then the median should be used for calculation of the average property transaction price (BUDZYŃSKI 2014).

In the process of calculation of the average unit transaction price of apartments and other kinds of real estates, it is important to remove prices outliers - too low and too high prices, from the set of prices. Too

low prices are sometimes errors in the RPPV, for example a garage was registered as a residential unit and its unit price is several times lower than the unit price of an apartment in the same location. The transactions between relatives also often result in too low prices.

For calculation of the average unit transaction price it can be assumed that unit prices outliers are if $P < Q_1 - 1,5 \times (Q_3 - Q_1)$ lub $P > Q_3 + 1,5 \times (Q_3 - Q_1)$

where:

P – unit price

Q1 – the first quartile for the set of unit prices

Q3 – the third quartile for the set of unit prices

After removing unit prices outliers from the set of unit prices, the unit average property transaction price - the arithmetic mean or the median will be calculated based on only market transactions. Then these final prices will be presented in the thematic service.

The scope of information presented in the thematic service

In the thematic service average unit property transaction prices will be presented for voivodeships, counties, municipalities and in case of bigger cities for the units of internal division of these cities, for example districts. Average unit transaction prices will be calculated for land, built-up land and premises. Unit price is related to 1 m² of land, 1m² of usable area of the building and 1m² of usable area of the premises, respectively.

Average unit transaction prices are calculated based on all market transactions in the spatial unit or a part of them in case of calculation using other data from RPPV. Calculations can be performed taking into account the following variables:

- a type of land use, an area of land property;
- a type of building, a main function of building, an usable area of building, the date of completion of building construction;
- a function of premises, an usable area of premises, a number of chambers in the premises, number of storey on which the main entrance to the premises is located, the date of completion of building construction in which the premises is located.

In addition, the thematic service may allow its users to see cadastral precincts in which the properties are sold.

In the thematic service average unit property transaction prices can be presented on the background of data obtained from General Geographic Objects Database (GGOD) or other databases available through Geoportal. In case of displaying average prices for an area of units of internal division of bigger cities, unit property transaction prices can be presented on the background of the data contained in the IREIS, primarily cadastral data.

The cartographic methods of presentation in the thematic service

Spatially referenced statistical data are the basis of visualization. Data transformations and analysis are the first and necessary step of the further effective data visualizations (KORYCKA-SKORUPA, 2015). Appropriate presentation methods are provided for this purpose. There are two groups of methods depending on the nature and character of the data. These are qualitative and quantitative methods. For the data contained in IREIS, quantitative presentation methods are indicated (SOSNOWSKA & KARSZNIA, 2016). In particular, for the purpose of the thematic transaction price service the choropleth map has been proposed. Usually the choropleth map is dedicated to show the relative data. There exist various methods of choropleths map class intervals determination based on statistical measures like median, arithmetic mean, standard deviation or natural breaks (JENKS, 1967).

Users and applications of information on average property transaction prices obtained from the thematic service

Average unit property transaction prices are important information for the following groups of users:

- Chief Surveyor of the Country. Thematic service can be used by Chief Surveyor of the Country in the process of drawing up the map of the average transaction prices of land.
- Fiscal administration. Fiscal administration needs average property prices for tax purposes, inter alia, to check whether the property price is the market price. The tax office compares the

transaction price with average price of similar properties. If the transaction price is too low, the tax office will impose a higher sale tax.

- Central Statistical Office. Central Statistical Office can use information on average property prices in the process of drawing up of statistical reports.
- State Treasury and Self-government units. Information on average property prices can be used by them for preliminary determination of property value in the process of the land management for different purposes such as: estimation of income from the sale of real estates and fees for perpetual usufruct of land, registering values of their properties and preliminary valuation of expropriated real estates (BUDZYŃSKI T. 2012).
- People, who want to sell or to buy real estates and real estate agents. These people are interested in average property prices in order to determine starting price, to negotiate property sold price successfully.
- Banks that give mortgage. Banks need average property prices for preliminary determination of property value, which will be credit collateral, for periodic update of the value of property, which is credit collateral.
- Property valuers, who determine the property value for different purposes. Property valuers primarily can use average unit property transaction prices for the analysis of real estate market.

Results and discussion

Calculation of average apartments transaction prices

Average transaction prices of apartments on the secondary market in 2016 were calculated for each of the district of Warsaw and areas of the internal division of Praga Południe district - areas MSI.

At the beginning, unit prices outliers, fulfilling the conditions contained in formula 1, were removed from the sets of unit prices for districts and MSI areas.

Table 1 contains the numerical ranges specified by the formula no 1 and the arithmetic means and the medians calculated on the basis of the sets of unit prices, included in the numerical ranges, for each of the district of Warsaw.

Table 1. The numerical ranges specified by the formula no 1 and the arithmetic means and the medians calculated on the basis of the sets of unit prices, included in the numerical ranges, for each of the district of Warsaw

District of Warsaw	The numerical range specified by the formula 1 [zł/m ²]	The arithmetic mean [zł/m ²]	The median [zł/m ²]
Bemowo	3400 - 10672	7068	7120
Białołęka	3840 - 8014	5979	5979
Bielany	3724 - 10396	7069	7034
Mokotów	3568 - 12834	8177	7977
Ochota	4433 - 11483	7931	7884
Praga Południe	2906 - 11138	6978	6807
Praga Północ	3110 - 10380	6712	6664
Rembertów	3136 - 7798	5506	5576
Śródmieście	3798 - 16704	10167	9931
Targówek	3203 - 8879	6083	6008
Ursus	3194 - 9902	6559	6569
Ursynów	3449 - 12505	8030	8100
Wawer	2852 - 9096	6007	6173
Wesoła	1148 - 9356	5233	5376
Wilanów	4588 - 11464	8005	8063
Włochy	2652 - 10434	6640	6728
Wola	6797 - 11441	7676	7547
Żoliborz	3802 - 14410	9014	8882

Resource: Own study based on RPPV data

Table 2. The numerical ranges specified by the formula 1 and the arithmetic means and the medians calculated on the basis of the sets of unit prices, included in the numerical ranges, for MSI areas of Praga Południe district.

MSI areas of Praga Południe district	The numerical range specified by the formula 1 [zł/m ²]	The arithmetic mean [zł/m ²]	The median [zł/m ²]
Gołław	2917 - 11133	7010	6788
Gołławek	3165 - 10129	6653	6581
Grochów	4113 - 8813	6609	6450
Kamionek	3213 - 11041	7108	6958
Saska Kępa	2558 - 13498	8102	7895

Resource: Own study based on RPPV data

The numerical ranges specified by the formula 1, for the needs of exclusion of prices outliers are wide enough. Removing unit prices outliers from the sets of unit prices for districts and MSI areas allowed the average prices to be calculated based on a sets of typical unit prices. Too low and too high transaction prices and incorrect prices in RPPV were excluded and did not affect the average prices. The arithmetic mean and the median calculated for the same area are often similar. The maximum difference between them is 3%.

Sample visualizations designed for the purpose of the thematic service

Within the scope of this paper two sample visualizations have been designed. The visualization have been designed with the usage of the choropleth maps on two detail levels and using two statistical indicators arithmetic mean and median.

The first visualization includes a choropleth map showing the average transaction prices for the city of Warsaw divided into districts. Two statistical indicators have been presented the arithmetic mean and the median for the purpose of the comparison between them. The presentations can be seen on Fig. 1 and Fig. 2. Additionally, average transaction prices in districts are displayed. Optionally also other topographic or thematic data can be included in the presentation in the form of the reference layers.

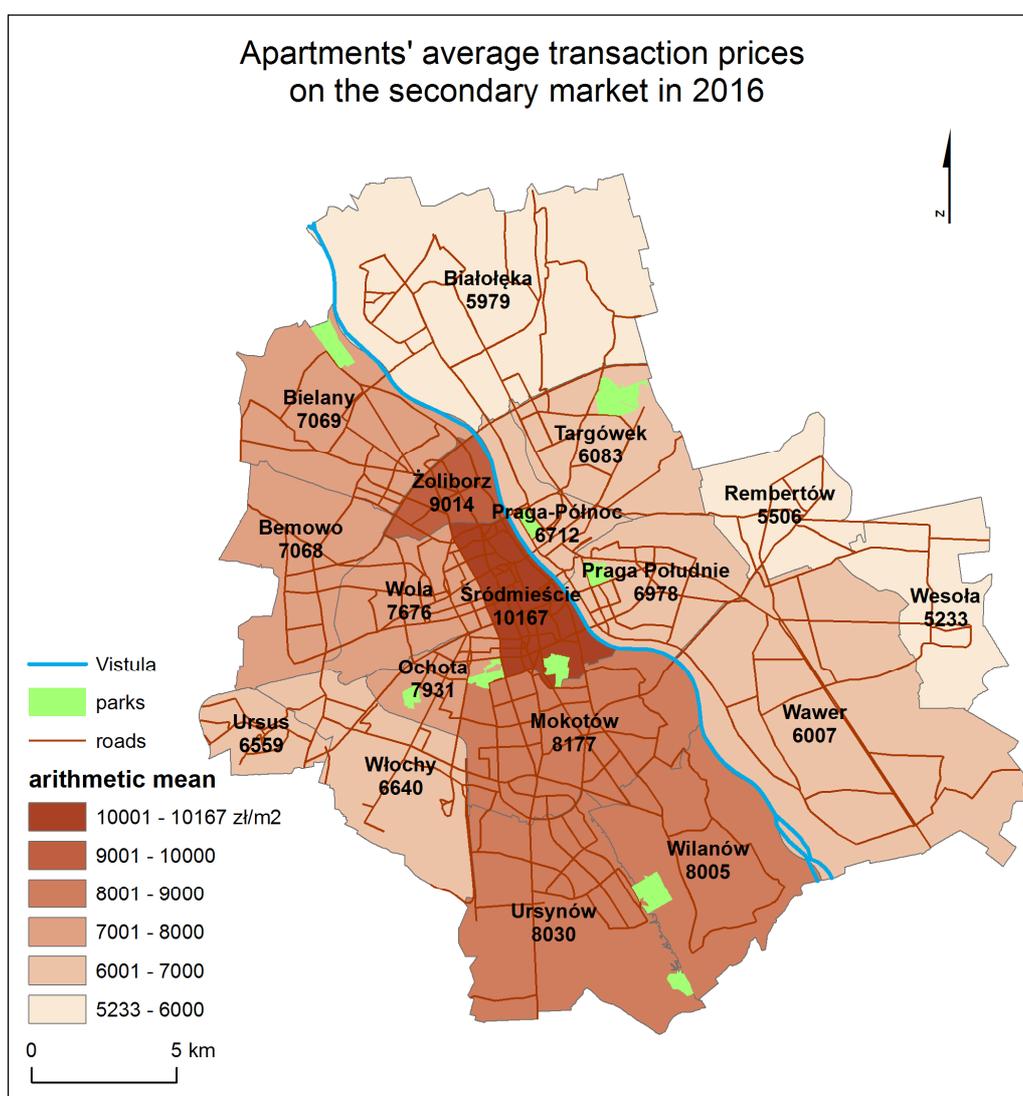


Fig. 1. Apartments' average transaction prices on the secondary market in 2016 based on arithmetic mean. Warsaw administrative area. Source: (authors' own design based on RPPV, NGCR and GGOD data)

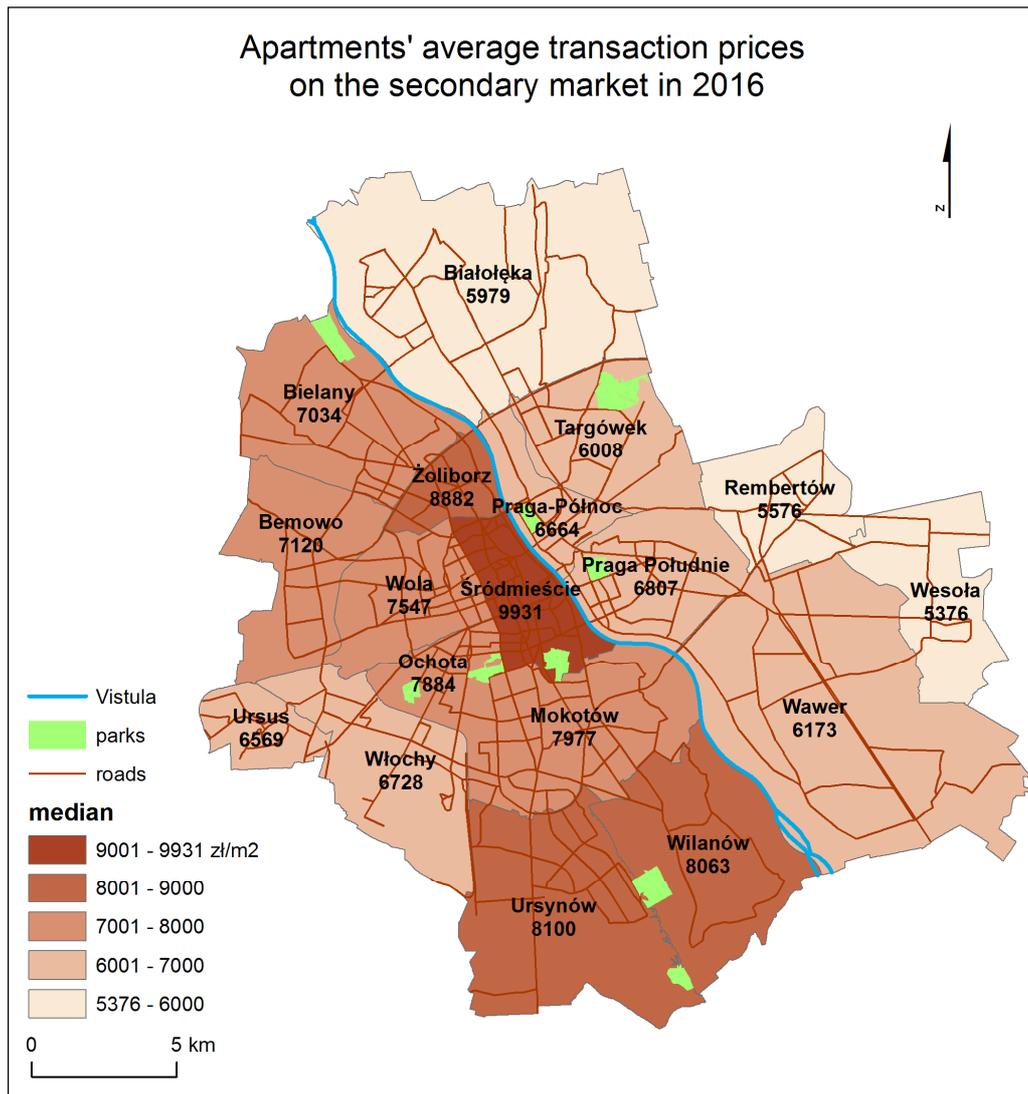


Fig. 2. Apartments' average transaction prices on the secondary market in 2016 based on median. Warsaw administrative area. *Source: (authors' own design based on RPPV, NGCR and GGOD data)*

The second, more detailed visualization covers the district of Praga Południe, broken down into MSI areas. The average transaction prices have also been shown with the usage of choropleth map based on two statistical indicators arithmetic mean and median. The presentations can be seen on Fig. 3. Optionally there are also average prices shown on the map. At a higher detail level, the patterns show areas that were not included in the calculation of statistical indicators because there were no transactions within these units.

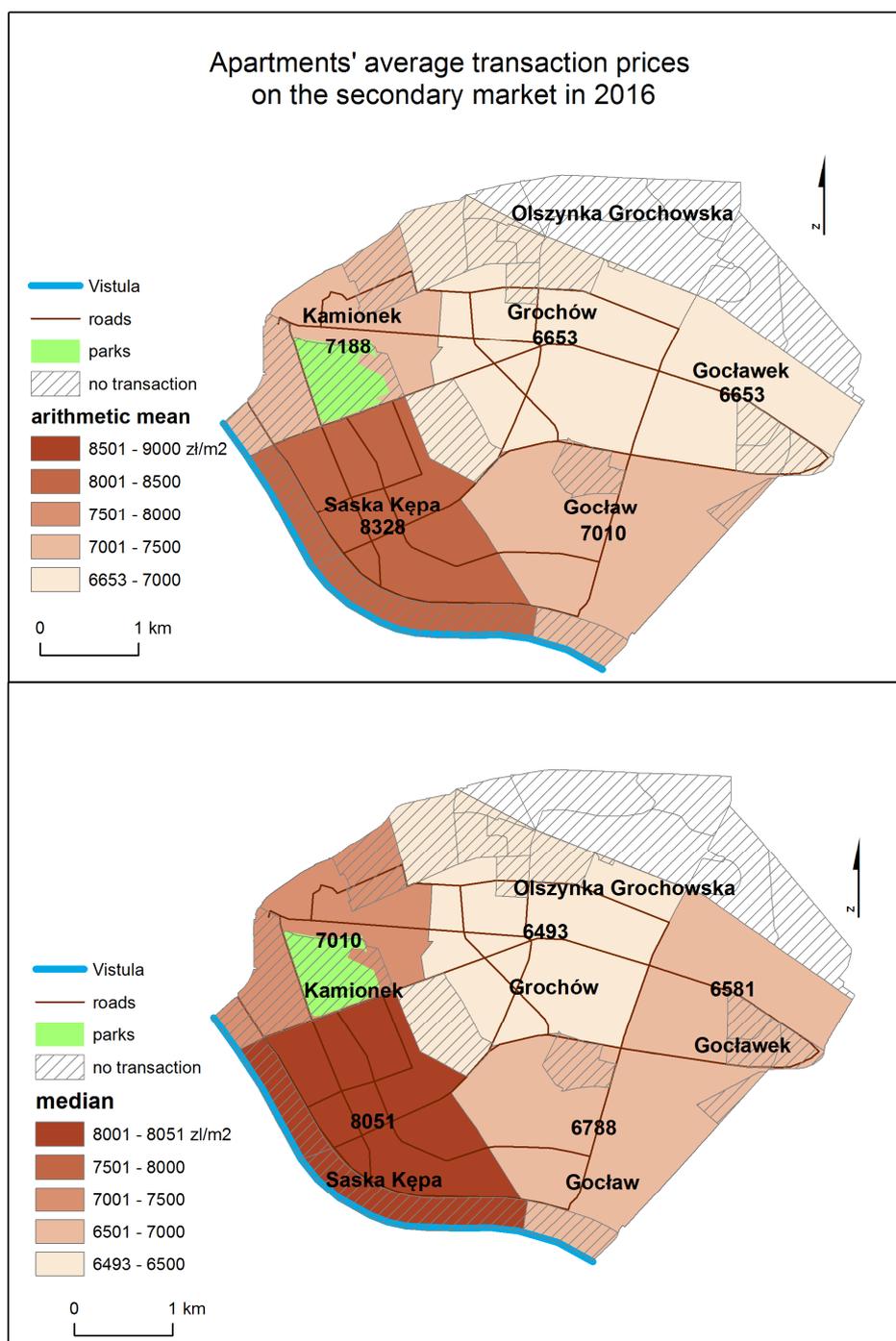


Fig. 3. Apartments' average transaction prices on the secondary market in 2016 based on arithmetic mean and median. Praga Południe district. Source: (authors' own design based on RPPV, NGCR and GGOD data)

The service may also provide other cartographic methods of presentation or optionally further background topographic information. The service can also be integrated with WMS, WFS or other services and portals.

Conclusions

The thematic service of the average property transaction prices, developed within IRIS – Phase II, will be the first national service, providing information concerning average transaction prices of land, built-up land and premises. The access to the thematic service will be possible through Geoportal for the private users and through IREIS for the public bodies.

The information concerning the average property transaction prices will be provided with the usage of two descriptive statistics - arithmetic mean and median. In the presented research the arithmetic mean

and the median calculated for the same area – the district of Warsaw or the area of MSI, are often similar. The maximum difference between them is only 3%. In this case the usage of both arithmetic mean and median is acceptable. In order to correctly calculate the average real estate transaction prices in the given area, first the outliers should be removed from the sets of unit prices for districts and MSI areas. In the presented examples, the usage of formula 1 allowed the elimination of erroneous prices as well as the prices, which for various reasons, were not typical market prices.

The class intervals of choropleth maps proposed in the sample visualizations presented in this paper should be adjusted to the range of average transaction process considered as well as to the detail level of the presentation. The wider the transaction prices range, the wider range of the class interval. The optimal class number in the choropleth depends on the statistical distribution of the data (PASŁAWSKI, 2006). For the purpose of the average transaction process visualizations the Authors propose the number of classes from 5 to 7 in order to assure the choropleth map readability. At the same time, in order to assure the consistency of presentation and visualization on lower detail levels, for instance for the area of the country, the class intervals should be designed as multiplicity of the numbers 10 or 100 zł per m² in the case of land or as multiplicity of the numbers 100 or 1000 zł in case of built-up areas and residential premises.

Moreover for the purpose of designing the average prices on the higher detail level other cartographic methods of presentation can be implemented, for instance isolines. In addition, in order to obtain information about the exact value of the average property transaction price, the service should also be able to display it. This is particularly important when the difference between the average prices for two adjacent areas is small and they are assigned to two different classes as on Fig. 2 and Fig.3. Furthermore for the purpose of better prices explanations and analyses additional thematic layers coming from topographic databases can be integrated in the average prices thematic service. For instance the data concerning more detailed river or road network, restricted areas.

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