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LAND VALUE MAP AS A SOURCE OF INFORMATION  
ABOUT LOCAL REAL ESTATE MARKET

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## 1. Introduction

A land value map can be a highly important source of information, which provides valuable information and enhances the function for various socio-economic purposes concerning the real estate management. These purposes are related to the tasks carried out by local administration bodies within this framework. In Poland, two groups of purposes can be distinguished: those related to the restructuring of the market and long-term goals associated with systematic monitoring of prices as an economic measure of land resources management.

This study presents the principles and methodology of drawing up a land value map, which consists of economic layers, such as a layer of transaction price monitoring, layer of purchaser preferences, layer of uniform value zones. The drawing up process was assisted by the ArcGis 8.3 software package.

In the process, particular attention was paid to the spatial analysis of the factors, which determine the prices, and value of a real estate property. The basic market elements, such as demand, supply and price – which together make up a dynamic system – vary in time and space. Transaction prices, and, consequently, the value of a real estate, are determined by supply and demand. Therefore, the spatial differences in real estate values are caused by spatial differences in these features. The economic characteristics of space, including the value and price of real estate, depend on physical factors and on the spatial structure of an area. These are a specific system of prevalent planning functions the manner of land development, the distances from sites which particularly “attract” or “repel” demand and the specificity of human behaviour and resulting differences in perceiving the attractiveness of particular areas.

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## 2. An analysis of factors affecting the spatial differentiation of land value in urban areas

This study contains an analysis of the factors affecting the spatial differentiation of prices and value of undeveloped land real estates intended for residential building. The study deals with the local market within the boundaries of the city of Olsztyn. The source information for the study was obtained from questionnaires, a study of conditions and directions of land management of the city of Olsztyn, the official map and a site visit:

The spatial arrangement of the city of Olsztyn is complex, which is a result of the natural conditions (numerous lakes and forest areas), as well as of historical factors. The central part of the city is surrounded by residential districts of blocks of flats, typical of the 1960s and 1970s, as well as residential districts of detached houses. The urban area is divided into sectors, which were created in the process of planning. The complexity of the space may have caused the differentiation in the demand for land real estates intended for residential construction.

It is not easy to obtain information from people who intend to purchase a real estate property and, for this reason, the opinions of experts (represented by real estate agents from Olsztyn) were used. The study was based on the questionnaires prepared at the Chair of Real Estate Management and Regional Development of the University of Warmia and Mazury in Olsztyn, which were filled in by 19 agents with at least 2 years of work experience (of the nearly 30 agents in Olsztyn).

The questions in the questionnaire dealt with the following issues:

- characteristics of real estates purchasers and sellers,
- preferences of purchasers and characteristic features of real estates,
- information about the transactions made at a real estate agent's office,
- describing the profile of a real estate agent.

The research aimed at identifying the factors which affect the attractiveness of various parts of the city, which may be the basis for identifying the causes of differences between transaction prices and, in effect, of different values of real estates within the city boundaries. The data obtained from questionnaires showed that when the location of a real estate property is being chosen, it is not only the particular property that is important, its physical features and other qualities, but the image of various districts, shaped by their history, residents' economic status, safety, etc. The analyses conducted to date were often restricted to a general evaluation based on the agent's knowledge of the residents' opinions; such evaluations were not always supported with sufficient substantial evidence.

A common set of factors was established which can be used to characterise particular districts. To each of these factors a mark of 1 to 5 scale was then attributed, depending on the effect on the location's attractiveness, with "1" meaning an adverse effect on the district image, whereas "5" indicating a very positive effect of the given factor on the district image.

Analysed features should significantly affect the transaction prices of real estates in the districts in question. In order to verify this assumption, the degree of variability of transaction prices was established. The population density in a given district was adopted as an additional variable. Assuming the whole variability of prices as 100%, the analysis of correla-

tion was used to determine the percentage share for each feature affecting it. The results are presented in Table 1.

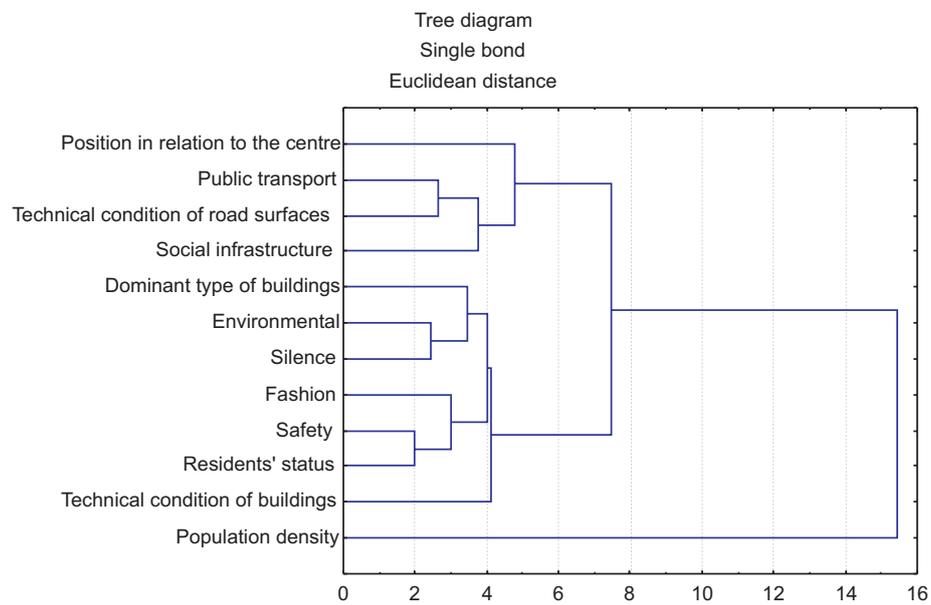
**Table 1.** Degree of explaining the difference in transaction prices with the features under study

	Position in relation to the city centre	Dominant type of buildings	Technical condition of buildings	Environmental conditions	Public transport	Technical condition of road surfaces	Quiet/noisy	Social infrastructure	Fashion	Safety	Residents' status	Population density
<b>Degree of explaining the difference in land prices (in %)</b>	14.39	4.05	2.78	13.53	20.09	23.30	8.26	8.26	0.08	3.17	1.46	0.65

Source: own material

In the case of land real estate, access by road, public transport accessibility and the location affected the prices to the greatest extent. Whether the location was fashionable or not had the smallest effect on the price.

Because of a strong correlation between particular variables which characterised particular districts, the adopted features were grouped according to their similar character. Cluster analysis was used to this end (Fig. 1).

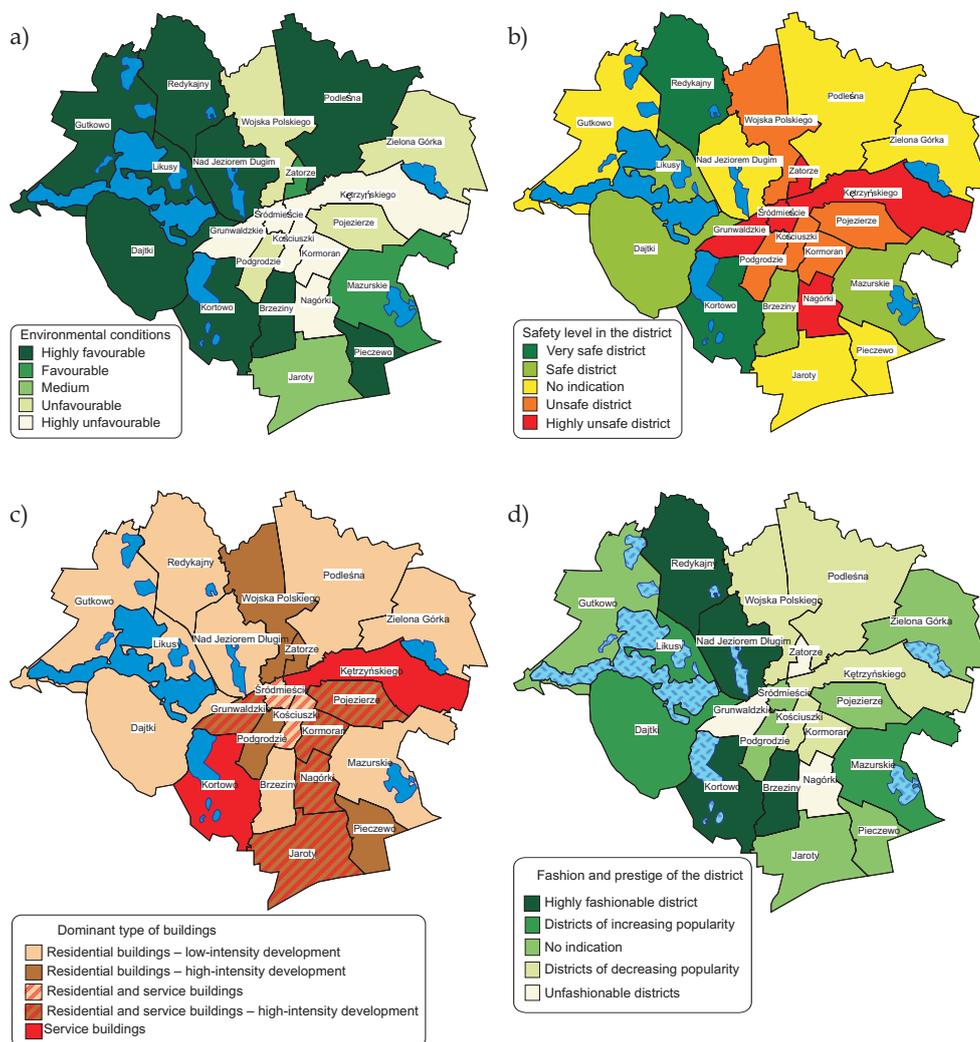


**Fig. 1.** Results of agglomeration of particular features of districts

Source: own material

Based on the analysis, three groups of factors can be established which determine the advantages or disadvantage of real estates in particular districts. These are:

- 1) the factors associated with the position of the location in relation to the city centre (location, transport, access by road) and the level of development of the social infrastructure which is associated with it;
- 2) the factors associated with environmental conditions (proximity of forests and lakes);
- 3) the factors associated with demographic conditions and with the image (fashion, safety, residents' status).



**Fig. 2.** Visualisation of the research results concerning the selected factors affecting transaction prices: a) natural and environmental conditions; b) inhabitants' safety; c) dominant type of buildings; d) fashion and prestige of the areas

The effect of these factors may explain the spatial differentiation of prices of land real estates intended for residential building. The research corroborates the preferences and behaviour of potential purchasers of real estate.

Examples of cartographic visualisation of the results of the research are shown in Figure 2.

### 3. Visualising the results of real estate price and value analysis

While working on the subject layer of transaction price registration, it was assumed that it should provide a user with a broad opportunity of making use of the information contained therein, particularly in conducting their own analyses which aim, e.g. at establishing a real estate price.

The transaction price registration layer should enable:

- a graphic presentation of a real estate which is the subject of a transaction;
- obtaining detailed information about a transaction indicated on the map;
- selecting the real estate properties which were the object of trade, based on selected attribute values;
- presentation of the basic statistic values for selected real estates;
- exporting the data concerning the selected transactions.

Part of the study included the calculation of the transaction price registration layer with the use of ArcGIS software (Fig. 3).

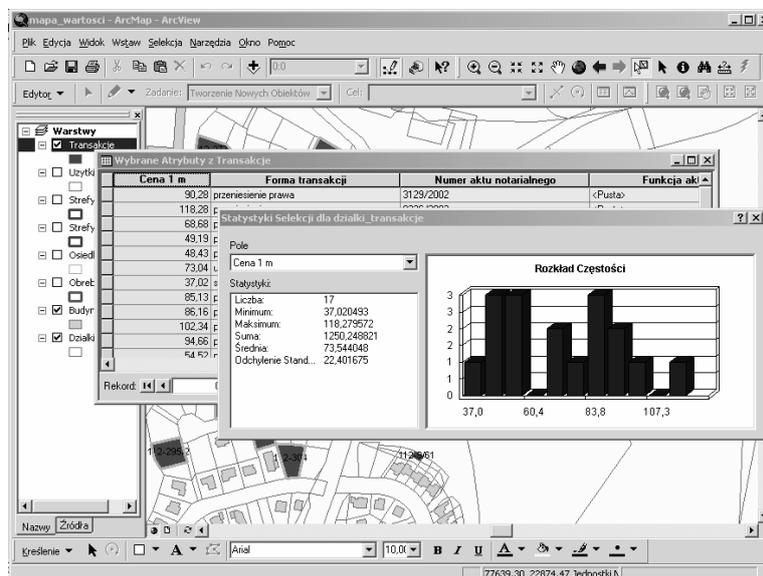
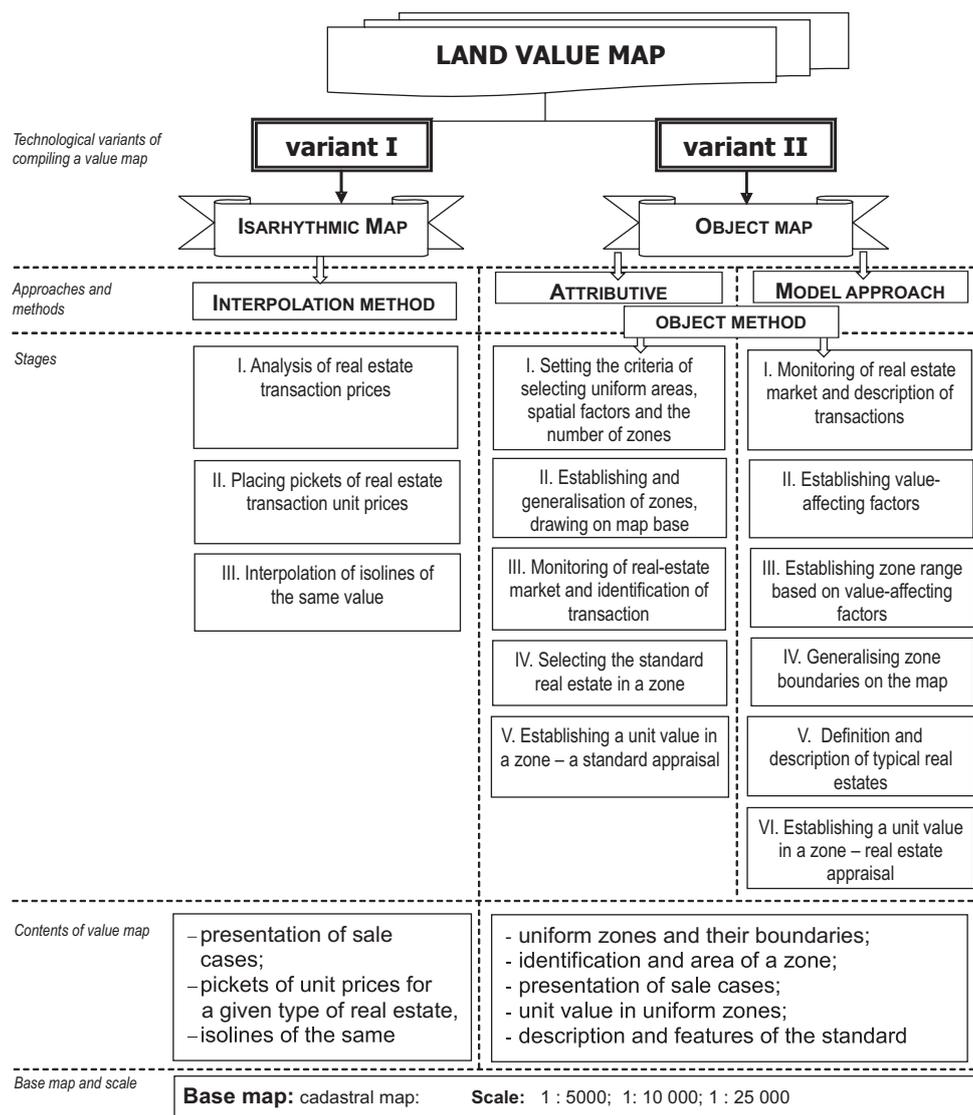


Fig. 3. Presentation of the basic statistic values of transaction prices for selected real estate properties

Source: own study

Among the many methods of graphic presentation of spatial economic effects, there are those based on the analysis of the spatial range of a particular effect, which presents its intensity in particular areas. For land values, the range can be shown in the maps with isolines of the same value or with isolated zones, where a relative uniformity of price-determining factors and, in effect, the land real estate values, are assumed (Fig. 4).



**Fig. 4.** Technological procedure of value map compilation

Source: own study

Another group of value maps are object maps. An area under study is divided into zones which are uniform in terms of the assumed criteria. For each zone, an analysis provides a unit value of the land. The final borderlines are significantly affected by the adopted criteria of isolating the uniform areas, which indicate the use of either an attributive or model approach. In the model approach, the establishing of areas borderlines is preceded by a market analysis, which results in establishing the market characteristics affecting the land value. Based on the selected market characteristics, the borderlines of the isolated zones are established, whereas the land value within the zone are estimated with the use of the value model, produced by the analysis. In the case of the attribute approach, the marking out of the borderlines is based on the selected attributes (features) of land real estate, with the borders adjusted after taking into account the road limits, water courses, railways, borders of urban blocks (uniform build-up) and the borders of areas and residential areas. A map is based on the assumption that isolated zones contain real estates with similar attributes, and consequently, their unit value should be similar.

Part of the work on the drawing up of land value maps consists in developing a method of isolating the zones of uniform real estate, based on the attributive approach. One of the arguments in favour of adopting this approach for further analyses is the difficulty in determining the stable statistical models which would show the effect of particular factors on transaction prices. A general diagram of the concept of drawing up a land value map in the attributive approach is shown in Figure 5.

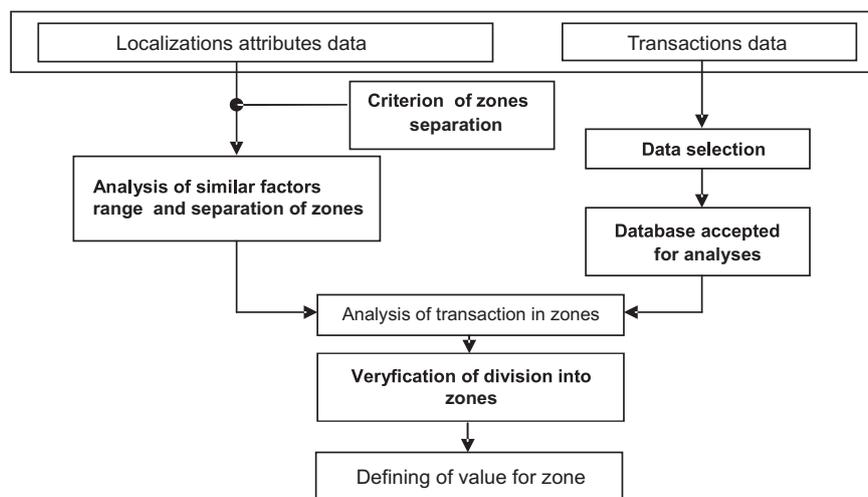


Fig. 5. A general diagram of the concept of drawing up a land value map in the attributive approach

Source: own study

The authors of the present study propose that a map of the value of land, buildings and flats should be based on a numerical cadastral 1:5000 map and generated to smaller scales down to the areas of a commune, county and province. The scope of the study should include separately each commune, within the boundaries of the evidence limits. A commune is in this case the basic unit of the study.

The following were the basis for the land value map:

- numeric map of the city of Olsztyn, with a thematic overlay,
- price and real estate value register,
- a study of conditions and trends in the spatial planning of the city of Olsztyn,
- a map of the area physiographic conditions: usability as a building construction area.

The following criteria of isolating uniform zones have been adopted:

- a position in relation to the city centre,
- indications of the study of conditions and trends in the spatial planning of the city of Olsztyn,
- land use,
- and development,
- dominating type of buildings,
- build-up density,
- environmental conditions,
- public transport availability.

The research provided a basis for establishing the borders of the uniform zones. The results of an onsite visit and the presence of market transactions were taken into account. The course of zone borders was adjusted to the existing constant elements of the areas: transport roads, water courses, blocks of uniform build-up and the lines which separate areas of various function and use, as planned in the local spatial plan. If it is possible to adjust their borders to the above constant elements, they should be marked out along the borders of the register plots. When establishing the borders of particular zones it was established that the zones are continuous areas.

The total of 63 zones have been marked out in the area of Olsztyn. The results of this operation for a part of Olsztyn are shown in Figure 6.

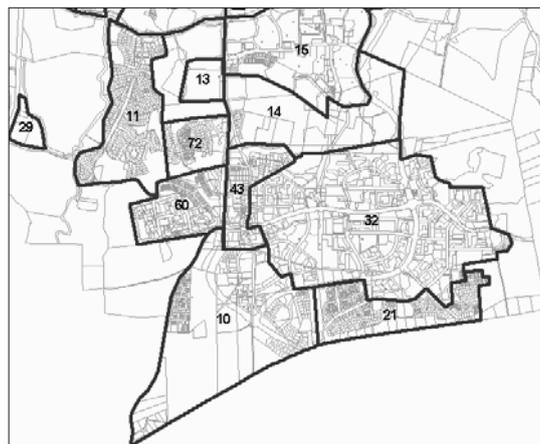


Fig. 6. Marking out the borders of zones of similar average land value

Source: own study

Several factors had to be taken into account in the analysis of transaction prices; the factors are important for the price levels and were not any of the criterion of isolating the uniform zones. The most important of them are:

- transaction date,
- the form of land ownership,
- real estate area.

The analysis of transaction prices was preceded by data pre-selection which resulted in rejecting the transactions whose market character was dubious, and those for which the transaction prices considerably deviated from the average prices of similar real estates (20% of the average prices was adopted as the criterion for rejection).

It was assumed during the study that the average unit value would be established as of 1st January 2004 and will concern a typical built-up land real estate, of an area size typical for a given zone, with the purpose consistent with the dominating function in the spatial plan for a given zone and which is a subject of the ownership title. The average unit value should be understood as the arithmetic mean of the transaction prices, previously adjusted for the above characteristics and rounded to 5 PLN/sq. m. Should the information about the land which is the subject of ownership titles prove insufficient, the prices of land in perpetual usufruct, re-scaled with the adjusting indexes were adopted for analysis.

In order to determine the adjusting coefficient, a linear regression analysis was applied for each zone. A single adjusting coefficient was the ratio of the slope of a regression line and an arithmetic mean of transaction prices in the given zone. An example of a calculation of single coefficients for a transaction date and the area in selected zones is presented.

The value of the coefficient adjusting transaction prices in relation to the passage of time in most zones was situated around 0.6% per month. In many cases, the coefficient values significantly deviated from the mean value, which could indicate the uniqueness of the zone or randomness of the transaction prices. After rejecting results which are considered dubious, the coefficient value was determined as the arithmetic mean of the results for particular zones.

In most zones a unit price is negatively correlated with land area. However, the results do not seem to indicate a strong relationship between these two features. Similarly, the relationship between the unit prices of the real estates which are the subject of ownership rights and perpetual usufruct was determined.

The unit prices in each zone were determined according to the following procedure:

1. selection of data and the choice of transactions based on which a unit price in the zone will be determined,
2. updating the transaction prices with regard to the transaction date,
3. adjusting the transaction prices with regard to the differences in the real estates area,
4. re-scaling the transaction prices of the real estates which are in perpetual usufruct (when the available information about the price of land – the subject of ownership rights – is insufficient),
5. calculating the arithmetic mean of the adjusted prices,
6. rounding the result to 5 PLN/sq. m.

In the analyses, it was also taken into account that the use of mean adjusting coefficients is not justified in every zone. This applies particularly to the rapidly developing residential areas or those in which the value of a real estate is most affected by its area. In that case the coefficients calculated individually for each zone were applied.

The research resulted in drawing up a map of the mean values of land in the city of Olsztyn. A part of this map is shown in Figure 7.

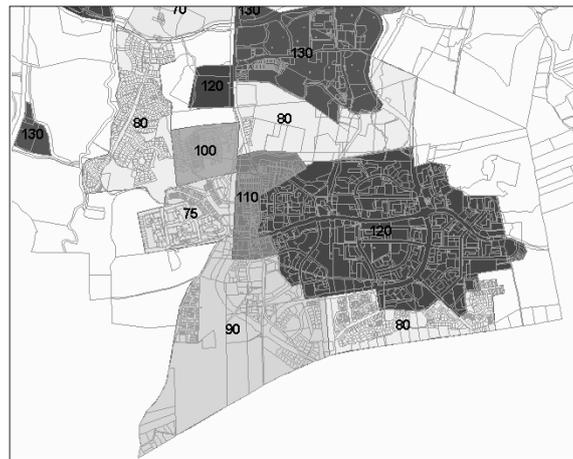


Fig. 7. A part of a map showing land value in the city of Olsztyn  
Source: own study

#### 4. Summary

Dispersion of the source data in many public registers (real estate cadaster, perpetual registers, tax records, statistical records) makes it difficult to carry out more comprehensive analyses of the real estate market. Information in various forms, including maps, processed and sent by various means, e.g. via the Internet, is awaited by many users. In Poland, the need has been seen and attempts are underway to meet it.

Nowadays, in this age of rapid information technology development and software solutions, it is not a problem to process the gathered data, but rather to obtain them and evaluate their usefulness. Hence, much attention is devoted in this study to the system of monitoring the real estate market.

The market, which in many segments is in an initial stage and frequently lacks balance, is not easily described with mathematical formulae. For some time, scientific discussions have been conducted on statistical modelling of the market and explaining the cause-and-effect relationships.

The manner of cartographic representation of the effects taking place in the real estate market can contribute to the progress in the analysis of the preferences of real estate purchasers and in the creation of a system of collecting, processing the data concerning the prices and value of real estate and making such data available to those interested.

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### References

- [1] *Appraisal of Real Estate*. Chicago, Appraisal Institute 1980
- [2] Fanning S., Grissom T., Pearson T.: *Market Analysis for Valuation Appraisals*. Chicago, Appraisal Institute 1994
- [3] Grygorenko W.: *Redakcja i opracowanie map ogólnogeograficznych*. Warszawa, PPWK 1970
- [4] Kucharska-Stasiak E.: *Nieruchomość a rynek*. Warszawa, Wydawnictwo Naukowe PWN 1999
- [5] McDonald M., Dunbar I.: *Market Segmentation*. Palgrave Publishers Ltd. 1998
- [6] Mruk H. (red.): *Analiza rynku*. Warszawa, Polskie Wydawnictwo Ekonomiczne 2003
- [7] Mynarski S. (red.): *Badania przestrzenne rynku i konsumpcji*. Warszawa, PWN 1992