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Rome, Italy 6–10 May
Knowing to: Manage the territory, Protect the environment, Evaluate the cultural heritage

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The Effect of Environmental Factors on Real Estate Value

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BACKGROUND AND AIM OF RESEARCH

Environmental factors are largely responsible for the value of property and the quality of environment largely affects the decisions made on the real estate market.

The aim of the study was to evaluate the usefulness of information about correlations between environmental quality and property prices for developing land value maps.

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EVALUATION OF ENVIRONMENTAL FACTORS

The environment is defined as a set of material (physical and biotic) and non-material elements – objects, forces and phenomena that create a mutually interconnected and dynamic system in spatially limited territory.

Scenic value is an important determinant of real estate value, and it is the critical factor as regards the prices of recreational and residential property.

The methods applied in estimations of landscape value rely on hypothetical data supplied by surveys or economic analyses.

An analysis of correlations between property prices and scenic value seems to be the most effective method of determining landscape's effect on real estate value.

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METHODOLOGY

Methodological approach consisted of the following stages:

- preparation of source data and space valuation,
- analysis of spatial structure and spatial interpolation of selected environmental attributes,
- analysis of spatial structure and spatial interpolation of transaction prices,
- development of models describing the correlations between prices and environmental attributes,
- compilation of value maps by cokriging.

ENVIRONMENTAL ATTRIBUTES

Three sets of environmental attributes that influence property value:

- Forest cover – a measure of esthetic and climatic attractiveness.
- The presence of surface water bodies – a measure of scenic and recreational attractiveness.
- Land elevation – the key measure of scenic attractiveness.

ASSESSING LANDSCAPE ATTRACTIVENESS

The assessment method was point valuation, and environmental quality was adapted as a variable in statistical analyses.

Evaluated attributes						Classification	
land elevation		forest cover		surface water		sum of values [points]	Landscape attractiveness category
number of intersections	value [points]	forest area [%]	value [points]	area of water bodies [%]	value [points]		
≤ 25	1	none	0	none	0	≤ 7	(IV) unattractive
26 – 50	2	< 25	2	< 20	4	8 – 11	(III) relatively unattractive
51 – 75	3	25 – 50	4	20 - 80	8	12 – 16	(II) attractive
> 75	4	> 50	6	> 80	12	≥ 17	(I) highly attractive

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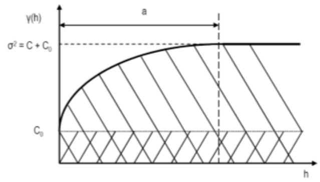
ANALYSIS OF SPATIAL STRUCTURE

An analysis of the indicators of spatial variability involves the determination of the empirical value of differences between variables, measured at two different points, as a function of distance between those points, and modeling the resulting correlations.

Semivariogram:

$$\gamma(h) = \frac{1}{2N(h)} \sum_{i=1}^{N(h)} \left[Z(x_i + h) - Z(x_i) \right]^2$$



$\gamma(h)$ - semivariance
h - lag
C_0 - nugget effect
C - sill
a - range

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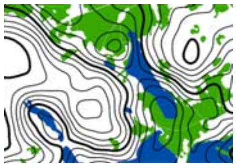
SPATIAL INTERPOLATION - KRIGING

In our study, we used ordinary kriging method. The value estimated by kriging is a weighted linear combination of regionalized random values. The kriging estimator represented by random function $Z(s_i)$ takes on the following value:

$$Z^*(s_0) = \sum_{i=1}^{n} w_i Z(s_i)$$

The weights determined by the semivariogram are assigned to produce estimators that are unbiased and characterized by minimal variance, referred to as kriging variance.



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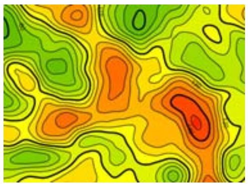
SPATIAL INTERPOLATION - COKRIGING

If the main variable is significantly correlated with additional variables, cokriging methods can be applied to integrate data and develop a land value map.

The ordinary kriging estimator is a linear combination of weights and data representing variables at sample points in the vicinity of estimated point s_0:

$$Z^*(s_0)=\sum_{j=1}^{N}\sum_{i=1}^{n} w_i^j Z_j(s_i)$$



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OBJECT OF THE STUDY

SOURCE DATA

- topographic maps
- field observations
- geoportal
- real estate prices

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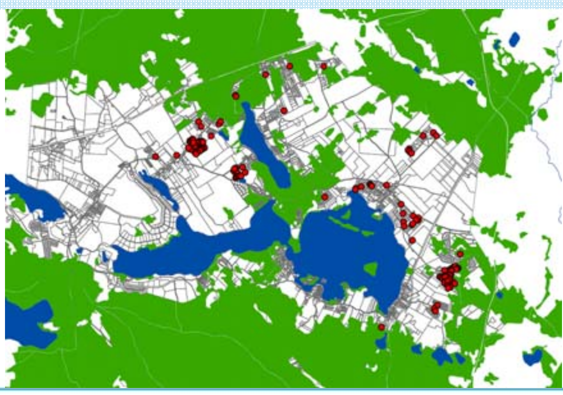
SOURCE DATA - TRANSACTIONS



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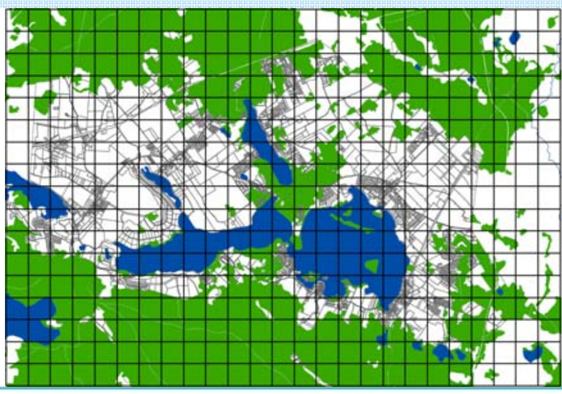
DIVISION INTO EVALUATION UNITS



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CLASSIFICATION OF LANDSCAPE ATTRACTIVENESS

Category	Number of evaluation units	Percentage of evaluation units
IV	183	43.06
III	179	42.12
II	63	14.82
I	0	0.00
Total	425	100.00

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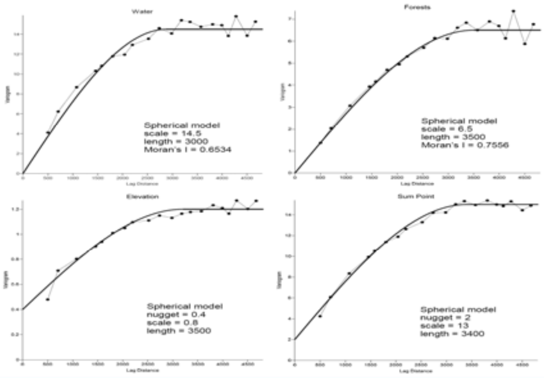
SPATIAL STRUCTURE - ENVIRONMENTAL ATTRIBUTES



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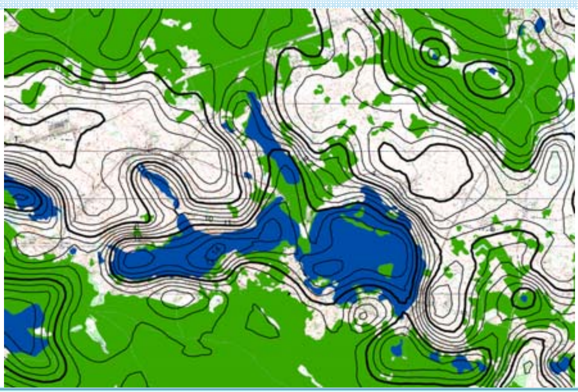
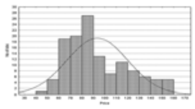
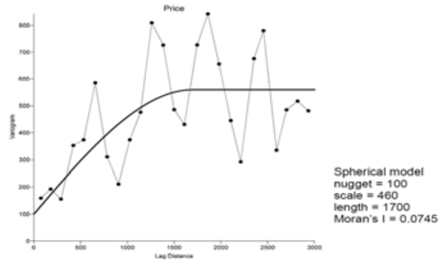
MAP OF ENVIRONMENTAL ATTRIBUTES



SPATIAL STRUCTURE OF TRANSACTION PRICES



Basic statistics	
Valid n	127
Mean	93.19
Median	86.34
Minimum	48.38
Maximum	157.22
Std. deviation	26.33



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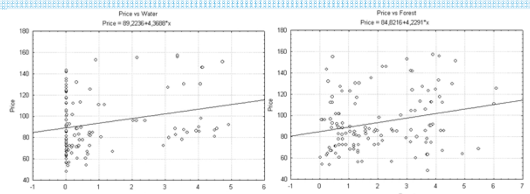
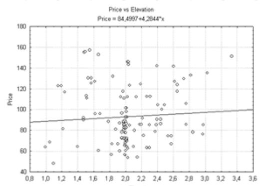
TRANSACTION PRICES VS. ENVIRONMENTAL ATTRIBUTES



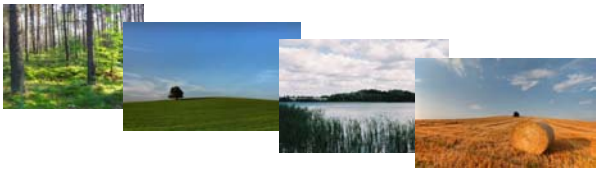


	Water	Forests	Elevation	Price
Water	1.00	-0.09	-0.23	0.24
Forests	-0.09	1.00	0.29	0.24
Elevation	-0.23	0.29	1.00	0.07
Price	0.24	0.24	0.07	1.00

MULTIPLE REGRESSION ANALYSIS RESULTS

Regression Summary for Dependent Variable: Price
$R^2 = 0.33$ $F = 6.29$ $p < 0.0005$

	β	Std. Error β	t	p-level
Intercept	72.409	11.796	6.138	0.000
Water	5.015	1.547	3.240	0.001
Forests	4.376	1.527	2.865	0.004
Elevation	3.724	5.733	0.649	0.517



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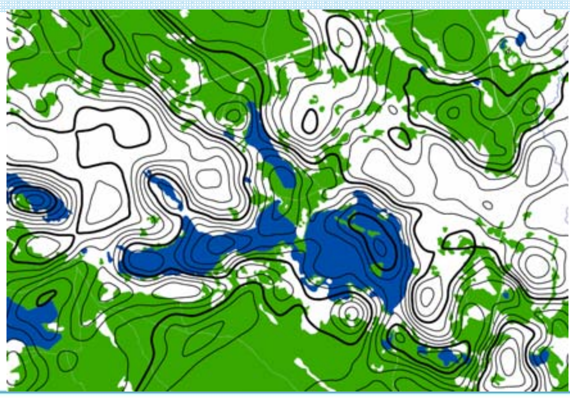
LAND VALUE MAP IN THE ANALYZED AREA



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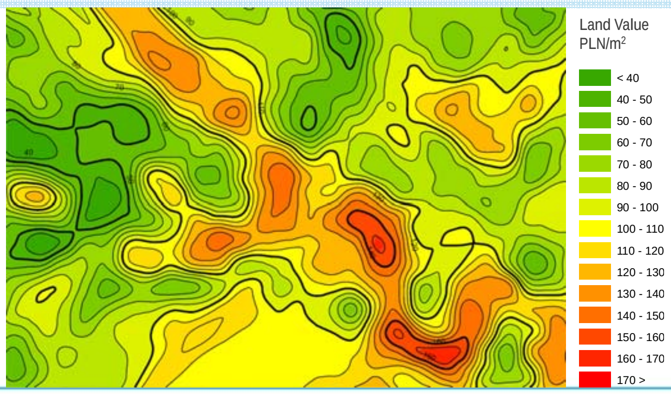

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COCNLUSIONS

The proposed method for analyzing the impact of environmental attributes on the value and prices of property may be a helpful tool in real estate management and spatial planning. It is particularly useful in areas of high scenic value which have been zoned for recreational and residential development.

Cokriging supports the development of land value maps when prices are correlated with variables that are easy to measure based on the existing sources of data. The discussed methods can be deployed not only in environmentally valuable areas, but also in regions where market data are available and the spatial structure of environmental attributes that shape transaction prices is known.

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