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ALGORITHMIC EVALUATING SYSTEM OF LAND DEVELOPMENT CONDITIONS

Building construction and realty management have similar essence in demand. Especially housing construction is affected by market. Housing stock condition knowledge and new construction locations needs are statistical inputs for decision making field. This short essay introduces new analytical methods and new software utility based on these inputs. These methods were applied on Housing physical availability research (WD 05-07-3) and Young Researchers Project (CZ.1.07/2.3.00/20.0013) in Technical University of Ostrava, Czech Republic.

This evaluation system generates unified disparity indicators for an integrated methodology of housing accessibility and housing quality comparison. This procedure may reveal, quantify and analyze actual micro regional disparities in housing availability.

So called “Index of distinction” shows area units, which indicates many differences in comparison with other area units.

Data processing and analyses interpretation has become a routine work in projects. Computer Aided processing has found an use for a simply data processing tool called “Disparitier”.

The application is divided into modular structures. Modular structure separates the working procedures and according to the focus of the project goal. Modular solution has the advantage of flexibility in functions adjustment. The “Disparitier” application is based on MS Excel sheet, programmed in VBA. The database is divided into selectable sheets. Application user selects a target indicator and generates graphs of analyses, cartograms and sheets. All outputs are in separate XLS file.

Basic statistical functions such a standard deviation, coefficient of variation and Gini coefficient, are applicable to housing availability indicators. These indicators diverge or converge in time series. High levels of these coefficients (in one time unit) mean assumed disparity existence, but these factors are not so threatened by time divergence effect. Divergent time behavior means that disparity effect increases, we can concentrate on that sector, which is more threatened than others stable sectors.

Statistical hypothesis tests (Mann-Whitney Test, Dixon Test, Spearman Correlation Test) refers to data series diversions. Dixon Test shows data extremes, which indicates potential disparity existence. Cluster analysis (k-mean clustering) assign a set of area units into a groups (clusters).

New Index of distinction shows the differences of monitored territorial unit to other territorial units. It's a translated rate of interregional differences. It is a cyclic algorithm of parametric or non-parametric statistical hypothesis test, when one territorial unit is compared with each other territorial unit in the area, and it records “similarity” in the data series.

The algorithm consists of two nested cycles and one medians comparing cycle. Cycles are applied to the calculation of ‘ $A \times A$ ’ matrix, where ‘ $A \times A$ ’ means the number of territorial units. It is performed $(A-1)$ calculations. The test compares the territorial unit with each other unit in the area, and this cycle is gradually applied to all territorial units. The results are fulfilled in tabular ‘ $A \times A$ ’ matrix. This frequency of distinctions is then converted to a percentage occurrence of these cases against the total number of possible cases (the number of territorial units).

Index takes values $\{-1; +1\}$. The higher the index in the positive direction means the difference is more often tested against other territorial units (the value of the indicator is higher than other units), reversely is true for negative indexes.

The absolute value of the conversion shows the frequency of differences. After adding the absolute values of these indices in more parameters, there is evident frequency of differences between territorial units generally, and thus can point to areas where there are some disparities in land deveopement (example of calculation output – fig. 1).

Index of distinction is described:

$$V_i = \begin{cases} 1 & \text{for } |Z_{A,i}| \geq z_{(\alpha/2)} \wedge M_A > M_i; \\ 0 & \text{for } |Z_{A,i}| \geq z_{(\alpha/2)} \wedge M_A = M_i; \\ -1 & \text{for } |Z_{A,i}| \geq z_{(\alpha/2)} \wedge M_A < M_i; \end{cases} \quad (1)$$

where V_i is the value of distinction between elements A & B (territorial units) and direction (positive or negative) relative to a greater or less median;

$Z_{A,i}$ is the result of hypothesis test (Mann-Whitney’s test);

M_A is the median of A data series; M_i is median of B data series.

Index of distinctions is calculated:

$$I_D = \frac{\sum_{n=1}^i V_n}{n-1}, \quad (2)$$

where the sum of element’s distinctions value is the numerator, number of elements is denominator (reduced by 1).

These methods were applied on both the above mentioned researches. Here are some partial results:

Regions of Czech Republic (NUTS 3) were grouped to three clusters. Input indicators were based on new housing construction 2001–2009 yrs. (flats and family houses) and number of inhabitants. The fig. 1 points out the middle region with intensive construction (the capital neighbourhood region).

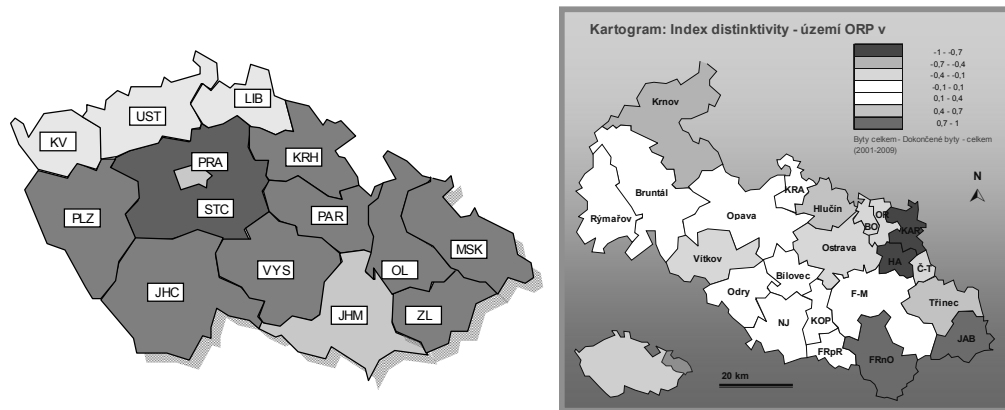


Fig. 1. Cluster analysis cartogram of new housing construction – new flats 2001–2009 – on left figure (Czech Republic, regions NUTS 3) and Index of distinction of new housing construction 2001–2009 (microregions) on right figure

Index of distinction (fig. 1, right side) of new housing construction points out distinctive localities on south-east part of region. Regional urban center does't show distinctive behavior in 2001–2009 yrs.

A new view at housing in terms of differences was performed by above mentioned researches using the software tools and methods. These procedures also summarize the conclusions which are already known in housing regional development, but it can point out new hidden distinctive localities and problematic segments of housing construction.

So-called index of distinction was introduced, which shows the degree of difference between territorial units. Another possible direction of project extension is the implementation analysis results with spatial data in geographic information systems. This procedure can also be done via the “The Disparitier” tool.

These project results may serve to target groups, ie professionals, eventually may be an information resource for urban planning processes. For more information about methods, software and projects visit www.disparity.cz.