

Using spatial interpolation models to predict residential property market prices

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Abstract

Property valuation is considered to be an important research field for significant production factors such as investors and businesses. In its simplest form, valuation is the determination of the property transaction price on a specific date. Up to now, a wide range of valuation methods exists, according to the properties potential usage or the aim of the evaluation process. Given the spatial nature of the residential properties valuation problem, Geographic Information Systems are recognised as the most appropriate computer-based tool in order to provide price estimations and to support financial decisions. The paper at hand proposes a methodological framework that allows both private and public sector organizations to obtain property price estimations in sufficient time.

Given that comparative evaluation approach is considered the most preferable approach in property investment, a GIS-based approach is developed, aiming to obtain prices' spatial distributions from a set of known estimations. As a result, various interpolation methods are implemented and compared in order to select the most suitable for the city of

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Xanthi, situated in north-eastern Greece.

Keywords

GIS, Real estate, Spatial interpolation.

Introduction: Real estate and GIS

Modern Geographical Information Systems (GIS) software packages are considered as the most appropriate tool for handling spatially related problems. This is mainly due to their capacity to facilitate sophisticated tools for retrieving, storing and analysing spatially referencing data. In the Real Estate (RE) community there is a growing consensus that GIS-based tools can significantly improve the procedures that allow analysts to observe and obtain tensions regarding both rental and sell prices in correspondence with changes to other variables (e.g. census data, land use) (Robbins, 1998).

Among those who are benefited by the implementation of GIS-based tools in RE are property owners, investors and managers, developers, planners, brokers and appraisers. In particular, owners, investors and managers are provided with tools that allow evaluations with respect to the expected performance and implementing comparative analysis of possible investment scenarios. Developers can easily recognize investment opportunities by obtaining underestimated areas that can be bought at low cost. Brokers and appraisers can easily obtain valuation data that can be used in order to provide price estimations. Finally, planners are capable of evaluating the implementation of city plans and proposing reforms when necessary (Zentelis, 2006).

As a result, the implementation of GIS-based spatial

analyses by RE professionals can a/ lead to improvements in productivity, reliability and profitability, b/ consist a major comparative advantage, c/provoke evolutions in RE industry and d/minimize costs of performing RE plans (Robbins, 1998).

Property evaluation models

When referring to residential property valuation, three types of major characteristics are taken into consideration. Namely these are: accessibility to nearby services and local area and structural characteristics. As a result, private sector investments in RE should be unquestionably considered as spatially related decision problems. Additionally, public sector officers should be provided with efficient tools to observe property prices and support decisions among which, taxation seems to be the most important.

As far as those purposes are concerned, the market price of the properties can be estimated via various valuation methods. According to Pagourtzi *et al.*, (2003), valuation methods can be classified into two categories: "traditional" and "advanced". The difference between them is tightly related to the way by which the valuation methods analyse the market. Traditional methods include: a/ comparable method, b/ development-residual method, c/ profit method, d/ investment-income method, e/ cost method, f/ multiple regression method and g/ stepwise regression method. On the other hand, artificial neural networks (ANNs), hedonic pricing method, fuzzy logic, spatial analysis method and autoregressive integrated moving average (ARIMA) can be grouped as advanced valuation methods.

Among RE brokers and appraisers, comparable method is the most widely used approach. The method aims to support

market value estimations through comparisons with prices already known to the appraisers under the consideration of existing differences (e.g. size, age, quality of construction). In general, it is supposed to be the most efficient one in the RE field because of its attempt to balance the forces of supply and demand (Pagourtzi *et al.*, 2003).

Spatial interpolation property valuation models

This paper focuses on the implementation of spatial interpolation models in a real case study aiming to provide spatially sell prices distributed thematic data. The examined methods are applied in the city of Xanthi, in north-eastern Greece, using real data provided by local brokers and appraisers. In particular, 185 residential prices have been obtained that cover a significant part of Xanthi's urban area. The performed analysis aims at providing estimations of the expected market value in any place of the urban area, based on the known values at the observation points using spatial interpolation methods (Longley *et al.*, 2010). Given that, different market values correspond to different apartment or house size. Estimations are obtained in € per square meter. However, the properties' size is not the only parameter that differentiates the sample of the known properties. The property's façade, construction and valuation year, apartment's floor, commerciality in the examined area and the surface area of the main spaces consist the most significant factors that contribute to the final market price of a given property.

To obtain coherent results, each one of the examined property has been classified into categories that are used by the Ministry of Finance in order to derive taxation. Given that a coefficient is attached to each category, the obtained market prices can be altered to a unique resident type.

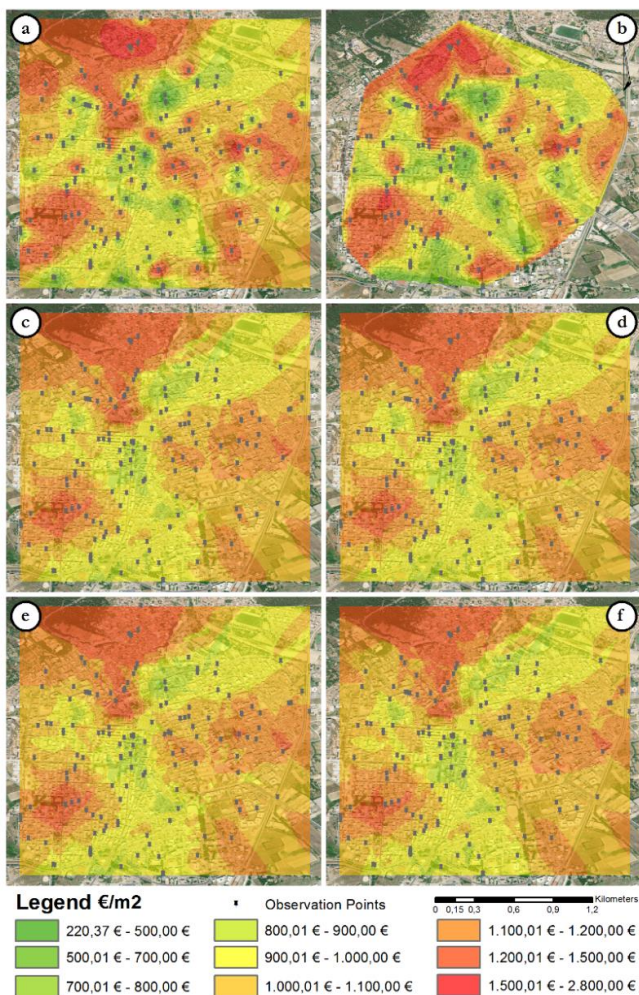


Figure 1 - Residential properties market value estimations
 a/Inverse Distance Weight b/Natural Neighbor c/Kriging with linear variogram d/Kriging with sperical variogram e/Kriging with exponential variogram f/Kriging with Gaussian variogram

As a result, spatial interpolation will provide estimations for a given property type, ensuring coherency (Figure 1). To support framework's calculations, a database model has been developed that supports all the possible alterations and thus allows market price valuations in the examined area. Finally, comparative analysis of the examined interpolation models showed superiority of the Kriging with exponential semivariogram approach (Burrough and McDonnell, 1998).

Conclusions

Comparable method approach is a really efficient method in RE field. When combined with GIS technology, it provides a/ overview of the available information, b/ ability to direct information as far as the properties are concerned, c/ rapid research by using specific criteria. Moreover, through spatial interpolation techniques implementation, a continuous surface of property market values can be established to support financial decisions. The ability of modern GIS software packages to support cross validation analysis enables evaluation of the performed models. In the present study, the implementation of Ordinary Kriging with exponential variogram leads to better results.

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