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Exploring spatio-temporal hot spots of land price change with housing transaction data in Seoul

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Abstract:

Evaluating residential property prices or land values is quite important for urban planning and government taxation as well. But it is generally difficult to predict land values accurately due to the dynamics of land prices, particularly in urban areas. Urban land values are mostly affected by natural environmental changes and various social and economic factors (Colwell & Munneke, 1997). Also, such socio economic factors are influencing both temporal and spatial aspects of land value, and therefore spatio-temporal clusters of land price changes will show local variations of land values very well. Specifically, the spatio-temporal hot spots might indicate highly increasing demand of lands in the urban area. In those areas, regulation against real estate speculation must be needed from the public perspective because such areas might impact on other area land prices and ultimately national economic status. Therefore, analyzing spatio-temporal aspects of the land price is essential for efficient urban planning and policy making.

In this study, we attempt to detect spatio-temporal hot spots which are constantly increasing the value of residential property among real estate. Although there are many types of differently designated lands including such as commercial, agricultural, and lands for other usage, we focus on the residential lands to estimate land values in this research. The reason for this is because residential house price is substantially increasing and becoming one of sensitive issues of Seoul house market. Therefore, poor people or younger generation cannot afford such high housing expenses in Seoul. Also, house transaction data is much larger than other land usage data, and therefore it can be utilized for estimating land values more precisely. From 2011 to 2016, over 1.8 million housing transactions of lease and sale happened in Seoul. This big data on housing lease and sale transactions indicates the value of each location where the transaction occurred.

Specifically, we utilize spatial interpolation method including Kriging and differential local Moran's I approach based on housing transaction data in Seoul. Housing transaction data includes every transaction for sales and leases of the house for the particular period. By applying these methodologies, we can visualize spatio-temporal clusters of highly increasing land prices and interpret significant clusters in terms of social factors. In fact, land price distribution has been widely discussed associated with smart growth and urban development (American Planning Association, 2002; Kaiser *et al.*, 1995). However, most studies have focused on urban development and expansion, rather than the changes in the land price. Moreover, many studies have applied remote sensing approach to analyze urban land expansion (Xiao *et al.*, 2006; Magigi & Drescher, 2010). Notably, Hu *et al.*, (2013) applied IDW to interpolate and estimating land prices with land samples. However, IDW has a shortcoming to interpolate the value which is distant from the sample points. In addition, even studies focusing on the land price have dealt with only one temporal period. From this research gap, we use the ordinary Kriging and differential local Moran's *I* to detect and forecast local hot spots of land price changes.

This research has conducted the following steps. At the first step, several transactions for the residential area are consolidated into a single land value indicator. Suppose that the residential rent consists of three factors that are housing price (P), deposit (D), and monthly rent (R). Each factor can be transformed into the value index (V) by the transformation formula below. After calculating the land value index from the transformation, the global trend of the value index is overlaid on each period. Figure 1. Shows the mean value index increased from 2011 to 2016. Then, square cells regularly spaced by 100 meters are generated over study area to perform the ordinary Kriging. After the ordinary Kriging, the land value index is assigned to each grid cell. Finally, differential local Moran's *I* index is calculated based on the difference that value index change between each year.

$$V = 0.75 * 0.005 * P + 0.005 * D + R$$

As a result, the global trend of land value changes from 2011 to 2016 in Seoul is shown in Figure. 1. The mean value index is increasing constantly. The spatio-temporal hot spots of land price change are found where the value index increment exceeds the average value index increasing over Seoul. As a result, seven clusters are detected (Figure. 2).

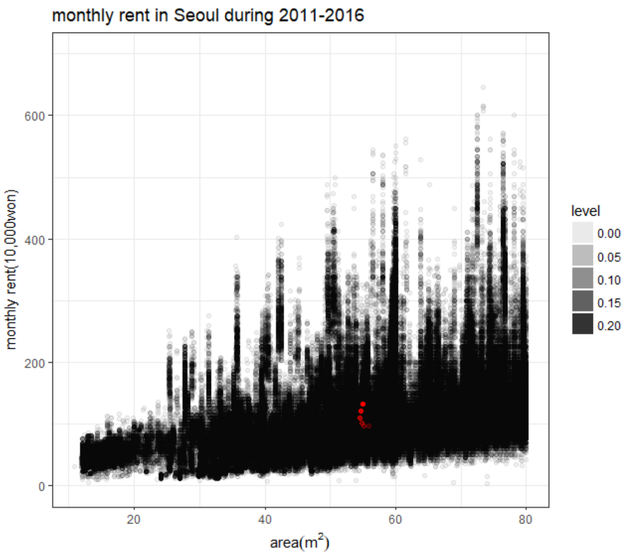

Figure 1 Land value change in Seoul from 2011 to 2016

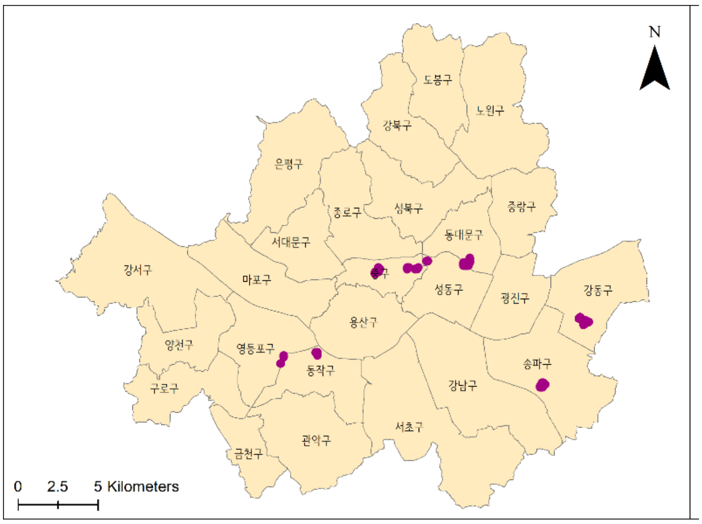

Figure 2 Spatio-temporal hot spots of land value increment

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