Advanced Science and Technology Letters
Vol.140 (GST 2016), pp.79-82
http://dx.doi.org/10.14257/astl.2016.140.16

A Quantitative Analysis on Institutional Intervention Effect into Urban Transition

Jinho Park[1] Hyoun-Joo Kim[2] Woo-Hyoung Lee [3]

[1] Global School of Media, Soongsil University, Seoul, 156-743, South Korea
[2] Jung-An Architects., Sangdong, Suseong, Daegu, South Korea
[3]Department of Architecture, Namseoul University, Cheonan, 331-707, South Korea
{Woo-Hyoung Lee}, wlee@nsu.ac.kr

Abstract. This study is to substantiate the impact of institutional intervention on urban transition to examine an interrelationship between urban program and urban transition. Also we take novel perspectives to differentiate this study from other theory based urban study by utilizing digital data as a potential resource enabling new interpretation of urban phenomena. For the study, we used the number of new construction indicating physical urban transition at selected area within Manhattan, New York where Special Purpose Districts is implemented and compare the changing patterns of the indicator before and after the implementation for certain period of time. By doing so, we aim to provide empirical grounds for the implementation of urban program with the mathematical analysis by quantifying its impacts on urban transition.

Keywords: intervention time series analysis, ARIMA, exponential smoothing

1 Introduction

Urban transition occurs from complex interrelation between its own autonomous evolution and intentional government's intervention by urban programs. Because of inadequacy at quantifying methods allowing interpretation of the urban transition, the effectiveness of urban program is hard to predict so far. However, in these days, with the magnificent growth of digital industries, enormous amount of data is produced and collected every moment offering different perspectives to the inherent characteristics of urban phenomena. Consequently, it enables more concrete and substantial interpretation by utilizing the data as sources for the mathematical analysis. New research methodology based on an empirical analysis of urban operational mechanism will allow understand causes and effects of urban transition patterns. [1].

2 Our Approach

A time series is a series of data points indexed in time order. Most commonly, a time series is a sequence taken at successive equally spaced points in time. Thus it is a

ISSN: 2287-1233 ASTL

sequence of discrete-time data. Since the temporal change of building uses in Manhattan districts must be a type of time series, we adopt the time series analysis techniques to observe the characteristics of urban data such as temporal trend and event affect. Exponential smoothing is a rule of thumb technique for smoothing time series data, particularly for recursively applying as many as three low-pass filters with exponential window functions. Such techniques have broad application that is not intended to be strictly accurate or reliable for every situation. It is an easily learned and easily applied procedure for approximately calculating or recalling some value, or for making some determination based on prior assumptions by the user, such as seasonality. The simplest form of exponential smoothing is given by the formula:

$$s_t = \propto \cdot x_t + (1 - \alpha) \cdot s_{t-1} \quad (1)$$

where α is the smoothing factor, and $0 < \alpha < 1$. In other words, the smoothed statistic s_t is a simple weighted average of the current observation x_t and the previous smoothed statistic $s_{(t-1)}$. The term smoothing factor applied to α here is something of a misnomer, as larger values of α actually reduce the level of smoothing, and in the limiting case with $\alpha = 1$ the output series is just the same as the original series. In time series analysis, the Box–Jenkins method applies autoregressive moving average ARMA or ARIMA models to find the best fit of a time-series model to past values of a time series [2].

Intervention time series analysis has become a standard statistical method for assessing the impact of an intervention (usually a planned policy change) on a time series of relevant outcome indicators. For the intervention time series analysis, the intervention is described as an event which was applied to the temporal phenomena at a specific time. The intervention can be one and only one event such as 911 attacks or persistent event such as special purpose district program as in our urban transition data.

3 Experimental Results

The range of our analysis covers new constructions of West Chelsea and Hudson Yards districts in Manhattan, NY from 1950 to 2015. We choose the number of new constructions in a year as an urban transition indicator taken from PLUTO [3] since the indices are estimated to be significantly affected by special purpose district appointment. Both districts are appointed as Special Purpose District in 2005. As analysis schemes, we use Holt-Winters method for exponential smoothing and ARIMA for intervention time series analysis. We utilize time series analysis libraries implemented in R and core example is shown in Appendix. Temporal trend of time series can be observed by applying various smoothing operators such as simple exponential smoothing or moving average [4]. Exponential smoothing is commonly applied to make data smooth, as many window functions are in signal processing, acting as low-pass filters to remove high frequency noise. Left plots in Fig. 1 and 2 show observed original data(black) and its fitted data(red) by Holt-Winters method [5]. The comparison between observed and fitted data depicts the overall trend of the

new constructions in two districts where high frequency peaks are softened. This paper tackles how socio-economic transition of urban indices by intervention can be quantified. Furthermore, the challenge is expected to open novel problem scopes which investigate the possibility of domain change to analytic space. The pre-intervention series (up until 2005 in our example) is modeled by ARIMA(1,0,0) since the original data is assumed to be stationary. The residual function m_t after intervention is modeled as below, with T=2005,

$$m_t = \omega_0 P_t^{(T)} + \frac{\omega_1}{1-\omega_2 B} P_t^{(t)} \quad (2)$$

,where P be pulse function with 1 only at time T , ω_i be coefficients to be determined and B be backward operator. Function 'arimax' in TSA package of R is utilized to estimate the coefficients ω_i. Right plots in Fig. 1 and Fig. 2 depicts the total intervention effect by special purpose district appointment in 2005. For West Chelsea district, the effect after 2006 is very significant compared to 2005 while the increase gap is not large. However, Hudson Yards district shows different aspect compared to west Chelsea district. While the intervention effect is shown to be very significant right after 2005, the effect decreases dramatically after 2006 and become slight after 2010s.

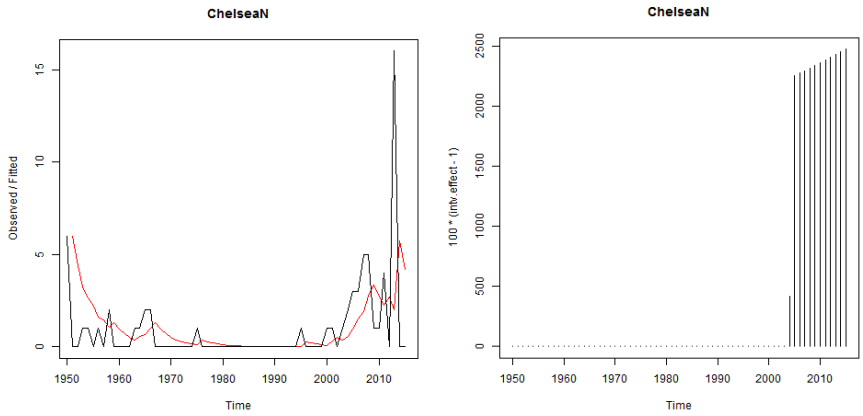

Fig. 1. Observed(*black*) / fitted(*red*) new constructions in West Chelsea district (*left*) and the intervention effect by special purposed district appointment effected in 2005(*right)*

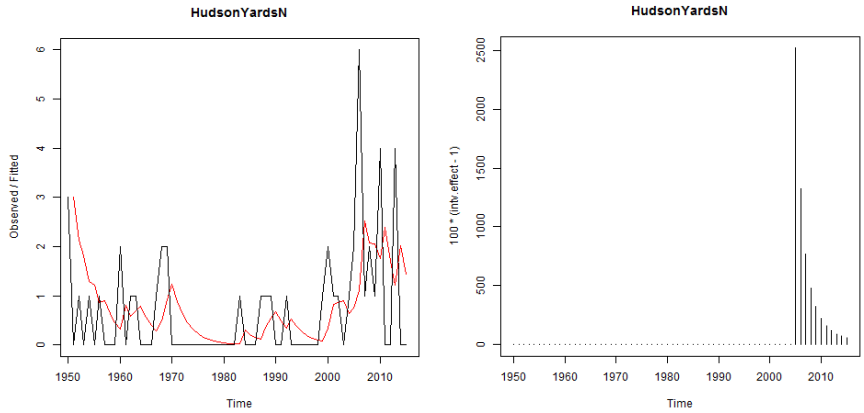

Fig. 2. Observed*(black)* / fitted(*red*) new constructions in Hudson Yards district *(left)* and the intervention effect by special purposed district appointment effected in 2005*(right)*

Acknowledgements. This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) Funded by Ministry of Education (2014R1A1A2059668)

References

1. Lee, Woo H.: Analysis of the Interrelation between Urban Transitional Patterns and Urban Programs, International Journal of Smart Home, Vol. 10, No. 7, 39--46 (2016)
2. http://www1.nyc.gov/site/planning/data-maps/open-data.page
3. Pankratz, A.: Forecasting with Univariate Box-Jenkins models: Concepts and Cases. Vol. 224. John Wiley & Sons, (2009)
4. Montgomery, Douglas C.: Lynwood A. Johnson, and John S. Gardiner. Forecasting and Time Series Analysis. McGraw-Hill Companies, (1990)
5. Kalekar, Prajakta S.: Time Series Forecasting Using Holt-winters Exponential Smoothing. Kanwal Rekhi School of Information Technology 4329008, 1--13 (2004)

