

Urban Modelling

Subjects: Geography

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Urban Modelling is an approach to abstracting reality in an effort to demonstrate, classify and explain urban functions in a simplified manner. There is a long history of modelling in urban studies. Today's models have become more quantitative, computation, and require large data sets and intense computation due to the complex nature of modern cities.

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1. Introduction

Urban models are abstractions of reality that attempt to explain and predict urban spatial patterns and the functions of cities in a simplified manner. As cities continue to grow and become more complex, it becomes essential to create abstractions of reality in order to help predict how certain actions will influence the functioning of the city. Urban scholars and practitioners benefit from the use of urban models, especially those interested in topics such as: environmental impacts, consumer behavior, disaster response and transportation planning.

Historically,^[1] the focus was on urban land use, starting with Burgess and Park's concentric zone model, moving to Hoyt's^[2] sectoral model and finally to Harris and Ullman's^[3] multiple nuclei model. The use of models to explain urban land use also extended to international comparative studies, to include Griffin and Ford's model of Latin American city structures,^[4] and McGee's model of Southeast Asian Cities.^[5] Most of these models focus on residential location as the foundation for the zones in their models. While Hoyt and Harris and Ullman started to focus on economic functions in their models, their models still maintained a strong grounding in residential location.

2. modern approaches to urban modeling

More modern approaches to urban modeling have become more quantitative and computational as technology has improved. Agent based modeling is one of the more popular forms of computation modeling in modern urban studies. Agent based models are focused on individual decision making and the impact that decision can have on the whole system.^[6] Typically game theory, multi-agent systems and Monte Carlo simulations have been used to simulate the actions of individuals within a system. These models help planners predict future actions as simulations show of individuals "should" act based on a specific stimuli.

In contrast, environmental models work to create more accurate depictions of urban environmental problems, their ramifications within the larger urban system and methods of mitigation.^[7] While, Jonas, and Gibbs^[8] concede that the economic approach tends to be dominant, they also emphasize the importance of environmental issues. From "river cleanups," through redeveloping industrial sites for gentrification, environmental aspects have a major influence on urban development. They emphasize that environmental issues have gained traction in recent years and become a major influence on inner city development. The environmental models tend to utilize geographic information technologies (Geographic Information Systems (GIS) and remote sensing) in an effort to estimate environmental impacts within a specific space. When aggregated, these areas show the impact of environmental degradation across an entire urban system. These models can also be predictive in that they can show how an increase in pollution in one area can impact an entire urban area.

Putting the economic and environmental together is a key point of departure for studies that emphasize sustainability in urban settings. Shen, Ochoa, Shah and Zhang^[9] study sustainable development plans for nine cities. In their analysis, they attempt to create a manageable model of sustainable development in cities by reducing the number of sustainable development dimensions to four: environmental, economic, social and governance. Once the authors define the dimensions, they apply the dimensions to the nine cities to look for areas of commonality and areas of departure. The end result is what they view as a method to implement sustainable development programs in cities are various levels of development.

The studies of urban development that emphasize economics or environment, or adopt a sustainability approach tend to emphasize economic and environmental factors and tend to, at best, briefly mention political, cultural and social factors. Typically, the discussions of sociocultural factors are framed within the discussion of economic development or environmental reactions to economic development. These studies tend to minimize the importance of identity, political legitimacy, social networks, political penetration by the government and other factors that also strongly influence urban development. This gap in the literature is addressed through the construction of models that emphasizes sociocultural variables through the lens of a political development model.^[10]

Urban modelers face several problems in the modeling process. First, urban regions are dominated by people, which are extremely difficult to model, both from an explanatory and a predictive perspective. People do not always act in a rational manner, making predictions especially challenging. Second, cities are highly recursive in nature, meaning they not only influence human action, but the structures of cities constantly change due to human actions. As a result, models must constantly evolve as humans influence and are influenced by the urban environment in which they operate. Finally, large, modern cities have populations, economic flows and environmental impacts on an order of magnitude well beyond the cities of the past. As a result, the models needed to explain various functions within a city require large data sets and extremely powerful computational models. This results in both the construction and the results of these models being very complex.

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