Agent Based Modelling of Rental Markets

Daniel Strodel, Class of 2019

Over the past two decades rent in urban areas has sky-rocketed. In the U.S. median rents have increased 70% since 1995 when adjusted for inflation. During the same period real wages have hardly shifted and still have the same purchasing power as 25 years ago. As the proportion of renters in major cities increases the issues of inflated prices and evictions are compounded. Traditional economic models of rent, based on aggregate supply and demand curves, fall short of meaningfully addressing the problem. The purpose of this project is to develop an agent based model of a rental market using statistical software R to explore market dynamics. The model was built in three parts: a musical chairs process, a lottery allocation process, and a price setting mechanism.

The musical chairs process is the first and simplest stage of the model. For one run the model is initialized with a number of units and number of tenants. During each iteration tenants may stand up and leave the neighborhood, move within the neighborhood, or enter. The flows of these processes are controlled by rates lambda alpha and beta respectively. The behavior of this stage was analyzed by tracking the number of iterations until half the neighborhood over the parameter space.

Under only the musical chairs process tenants enter a random lottery if units are scarce. However, there a several ways of altering this lottery and allocation process. Some methods explored when building the model include using a biased hypergeometric to sample from new and original tenants, using a biased hypergeometric to discriminate based on income decile, and using a Gale-Shapley algorithm for stable matching. The Gale-Shapley method incorporates the preference functions of both tenants and users and was included in the final version of the model. The algorithm ensures that no landlord and tenant in the system both prefer each-other more than their current match. When using this method tenant incomes, house prices and house qualities were introduced. Landlords strictly prefer tenants with higher incomes while tenants positively prefer quality and negatively prefer price.

In one analysis I focused on the relationship between income allocated to housing costs and house quality. When the model is initialized tenants allocate between 25 and 40% of their income to housing, however this shifts as tenants leave, enter and circulate. Depending on the parameters controlling tenant flow the curve may shift both ways, leaving poorer tenants in low quality houses paying a high percentage or a low percentage of their income. Further development of the model could help with understanding specific conditions that shift the curve inequitably.

A price setting algorithm built under a previous students work was implemented during the final stages of building the model. The algorithm allows for rents to increase with the market rate, increase with scarcity, and decrease with vacancy. The price setting mechanism was implemented towards the end of the project and has not been analyzed thoroughly.

Further direction for the model may include making the algorithm for tenants choosing to move more complex. For example, lowering the likelihood of a tenant to move if they are the paying lower than the market rate in their current home. Other areas for development include the curves of tenants and landlords' utility function for Gale-Shapley and reworking the price-setting algorithm.

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