Consumer Data Research Centre

An ESRC Data Investment

Investigation of prescription flows between General Practices and Boots pharmacies via spatial interaction modeling techniques

Lenka Hasova[1], Les Dolega[1], Graeme Cormac[2] and David Rour[2]
[1]University of Liverpool, [2]Boots

Project Background

Understanding the distribution of prescription flows is important for pharmacies to identify new markets and to evaluate the performance of current pharmacies. Analysing prescription flows is becoming increasingly important because prescription demands have increased with the associated increased life expectancy of the population. However, the application of spatial interaction modelling for prescription flows in the literature is limited, which is in part due to the nature of sensitive corporate information and the limited resources of the National Health Service (NHS) to analyse all prescription flows with all pharmacies. We apply several model specifications to estimate and analyse the distribution of GP-Boots pharmacy prescription flows in Merseyside, North-West England.

Data and Methods

The main datasets were provided by Boots and consisted of spatial points of Merseyside GP surgeries, pharmacies and Boots pharmacies and flow data of prescription transition between Merseyside GP's and pharmacies. We applied a number of model specifications for analysing the GP-Boots pharmacy flows. These included an unconstrained model, an unconstrained case enhanced by origin-destination specific demographic variables, a production-constrained specification, an attraction-constrained, and doubly-constrained models using General Linear Models (GLM). We investigated the impact various flow characteristics have on the nature of different flow generating processes. Additionally, we incorporated random effects of the distance to Liverpool city centre using a General Linear Mixed Model (GLMM) to highlight the importance of spatial autocorrelation.

Key Findings

The results of this study suggested that there are different flow generating processes for different flow characteristics. The doubly constrained model had the best estimation of prescription flows greater than 100 prescriptions, accounting for a 78% model fit. However, the posterior predictive check showed that the estimated and fitted distribution had the closest fit for the production-constrained model with flows less than 800m, giving a model fit greater than 90%. These results support the literature that the distribution and availability of health care services are influenced by human behaviour. This is related to the two-stage decision process: people's first choice is the pharmacy closest to them; and their second choice of pharmacy is tied to requirements such as other retail shopping. Furthermore, an analysis of the spatial distribution of prescription flows in Merseyside revealed a clear pattern. As expected, Boots prescription flows were highest for Liverpool, the core retail centre of Merseyside. Conversely, prescription flows were lowest for Southport. We also identified several Boots pharmacies where their performance could be improved by simply relocating the pharmacy or joining together two existent pharmacies.

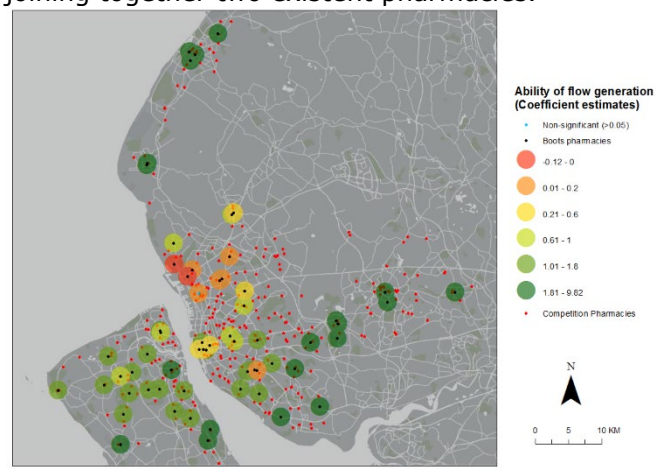

Figure 1. Strength of the Boots pharmacy-GP interaction derived from regression estimates of the best model

By comparing various methods of prescription flow estimation, we have emphasised the importance of spatial effects in prescription flows. These include both spatial autocorrelation and heterogeneity of the movement of patients in space.

Value of the Research

This study provided new insight into modelling prescription flows and has shown a new value in assessing the spatial distribution of GP-Boots pharmacy flows. Due to the limited number of studies in the literature, we applied several specifications to investigate the nature of the prescription flows. This shows that due to the complexity of human decision making, different models perform better on different spatial scales. However, due to the nature of incorporating space through a spatial neighbourhood structure between origin and destination points, the major challenge is in building a spatial matrix of such origin-destination data. Further research could take the scaling effect into consideration as well as ways of incorporating this into neighbourhood structure.