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Shopping centre's turnover estimation using microsimulation: an exploratory research in Inverness

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Project Background

Turnover estimation of retail outlets plays a vital role in market analysis. Traditional approaches such as spatial interaction modelling and its varieties are still commonly favoured as an approach to predict the extent of which local residents will patronise individual stores or centres. The approaches assume that the decision to spend money at a particular store is driven by the consumer's characteristics, the store characteristics and spatial distribution of stores, and these models often take advantage of aggregate population data. Retail consultancies are currently seeking new techniques that can take advantage of recent increases in computational power and rich data sets on consumers and retail environment to predict consumer interactions on an individual level. This exploratory research was conducted in the area of Inverness and its outskirts; it aimed to investigate if an agent-based technique to estimate turnover from the bottom up could be a viable alternative to traditional methods.

Data and Methods

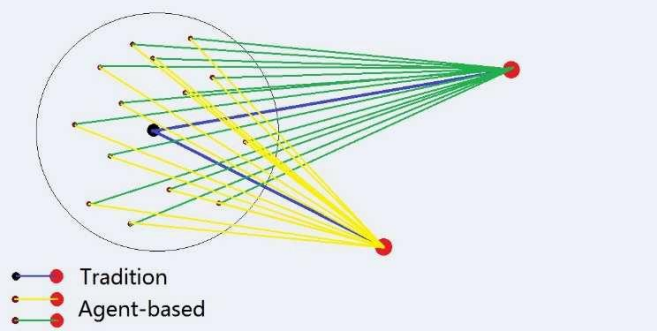
The data for this research provided by CACI included the Acorn consumer classification at the postcode level, data on 5 shopping centres in Inverness (including the number of categories of stores located, price level for each store), and also aggregate shopping behaviour data distinguished by Acorn group type. In addition, household composition by car or van availability and age by sex from 2011 census were also used to gain more of an understanding about households. The Integrated Transport Network (ITN) was used to build the road network in the study area and gain a better understanding of travel times between consumers and shopping centres. With this data combined this research was able to explore population synthesis and microsimulation techniques.

Key findings

This exploratory research was conducted in a hierarchy of steps. A simple micro-inverse-drive-time model which only takes drive time into account when choosing which shopping centre to go to was constructed first to set up the frame for a more sophisticated model. A pseudo-validation can be conducted by comparing the predicted estimation with calibrated money flow from a CACI performed spatial interaction model. As a result, both in-town and out-town turnovers were over predicted. Two main causes were identified: a rather simplistic structure and latent demands. Latent demands cannot be estimated given the limits of datasets.

A micro-multi-factor model was constructed then. In this model, shopping behaviour based on different Acorn group, household composition and car availability as well as travel time were considered to differentiate people's choice of shopping destinations. By comparing with the previous output and output from the spatial interaction model, the output here was an improvement, but it still over predicted turnover. The main cause here was that the weights for each variables were set to 1 which was not realistic. The weights can be set reasonably only if there were data to identify how each variable contributes to individual decision or previous years' real turnover data could be an input for Genetic Algorithm (GA) to optimise the weights.

In conclusion, microsimulation can be a useful technique for store performance prediction. However, in order to be a viable alternative to spatial interaction modelling, more data on consumer behaviour needs to be available in order to estimate how micro characteristics are distributed, and how they influence consumer behaviour.



Comparison between traditional and agent-based turnover estimation.

Value of the Research

This research has presented a potential alternative or even a supplement to spatial interaction modelling for predicting store turnover. Microsimulation allows researchers and analysts to achieve a more detailed prediction of consumer behaviour through the inference of individual characteristics. By taking advantage of new techniques and big data sets produced by the retail industry, more intricate models of consumer interactions can be developed.