



Estimating attractiveness, hierarchy and catchment area extents for a national set of retail centre agglomerations



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ABSTRACT

There is a legacy of research aiming to conceptualise and empirically estimate retail store catchment areas, however, a dearth that frames such considerations within the context of retail agglomerations and their position within regional or national networks. As a result, this paper provides an extension to single store or shopping centre retail catchment estimation techniques, and presents an empirically specified and tested production constrained model for a national network of retail centres in the UK. Our model takes into account the spatial interactions between potential customers and a hierarchical network of retail centres to estimate patronage probabilities and catchment extents. The model is tested for a large metropolitan area vis-à-vis real world shopping flows recorded through a survey of shoppers. Finally, we present an open source software tool for custom model fitting, and discuss a range of theoretical and empirical challenges that such a model presents.

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1. Introduction

A retail catchment can be defined as the areal extent from which the main patrons of a store or retail centre will typically be found. The concepts of retail catchments have a substantial legacy of academic enquiry (e.g. Huff, 1964; Fotheringham, 1983; Wilson, 2010) including literature that provides a comparative review of analytical techniques (Joseph and Kuby, 2011; Yrigoyen and Otero, 1998), model input considerations (Birkin et al., 2010; Burger et al., 2009; Hu and Pooler, 2002) and uncertainty analysis (Rasouli and Timmermans, 2013). There is a large body of literature exploring various aspects of retail catchments for a single store or single shopping centre (Huff, 1964; Converse, 1949; Openshaw, 1973; Jones and Simmons, 1993; Lea, 1998; Dramowicz, 2005; Birkin et al., 2010); however, where a larger agglomeration of stores for a regional or national extent are considered, the empirical evidence is more sparse (De Beule et al., 2014).

Indeed, a large proportion of academic and commercial studies are focused on estimating retail store sales or predicting locations for new stores and shopping centres. Within these contexts, retail markets are often geographically limited to a local or subnational extent; however, in reality customers shop in continuous geographical space (Dennis et al., 2002; Birkin et al., 2010), and therefore, an argument can be made that the consistency in the modelling of catchments can be only achieved through a boundary-free approach where model parameters are calibrated at a

national level (Birkin et al., 2010). In addition, generating catchment extents that are estimated consistently so that they enable cross-regional statistics to be derived involves modelling at a national scale. Such a task is complex, and not only requires significant computational resource, but more importantly, requires a trade-off between a number of challenges such as the degree of generalisation and the availability of data to inform model specification.

In this paper we provide an extension to a single store or shopping centre retail catchment estimation technique, presenting a model for a national network of retail agglomerations. The methodology we propose is theory led and estimates catchments for more than 1300 UK retail centres, taking into account spatial interactions between potential customers and these destinations within an estimated hierarchical network of retail centres. The model is fitted at a Lower Super Output Area (LSOA – zones of approximately 672 households; ONS, 2012) level of granularity based on retail centre attractiveness that declines as the distance between consumer domiciles and shopping destinations increases.

Although this paper presents and then empirically tests a model for a UK case study, we would envisage that the presented model with similar inputs, would also be applicable within other international contexts. The commercial and empirical value of such a study is potentially very significant, as the method could be implemented in a wide range of applications that require local insight for a national or regional extent, for example, feeding into broader debates on town centre performance, such as those related to the impact of online sales or other factors impacting demand. Additionally, this study provides an open source software

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tool that enables custom model fitting. It is anticipated that this tool will be useful to various stakeholders such as academics, planners and town centre managers.

This paper also discusses a range of theoretical and empirical challenges that such a model presents. For example, how can a range of retailer types and linked consumer behaviour be measured for a national extent? Or, how can geographic differences that emerge between different facets of the retail centre hierarchy be measured and incorporated into the modelling framework? The paper concludes with discussion on model calibration, including validation methods and recommendations about how we might overcome emergent challenges for estimation of traditional retail catchment models.

2. Theoretical and empirical considerations

The general concept of a retail catchment comprises three major components: supply factors, demand factors and consumer interactions (Birkin et al., 2010); however, when considering a network of retail centres there are a number of other, equally important dimensions and constraints that require consideration (Birkin et al., 2010; Cheng et al., 2007; Clarke, 1998; Dennis et al., 2002). The first of which is the position of a retail centre within a hierarchy of other retail centres. Typically such hierarchy relate to the size, attractiveness and the geographical extent of their composite retailers influence, with those centres towards the upper end of a hierarchy typically offering a ‘multi-purpose and comparison shopping’ experience and acting as a regional hub for employment (Dennis et al., 2002; Teller and Reutterer, 2008), and as such, drawing consumers from a wider area. Conversely, smaller town or district centres will typically serve a different function, be more embedded in local economies (Guy, 1999; Powe and Shaw, 2004), and therefore be patronised more prevalently by local communities.

The relationship between the functional roles of centres with different sizes have historically been modelled through central place theory (Christaller, 1933), which maintains some relevance within the contemporary context (Dennis et al., 2002); however, from the perspective of retail catchment estimation, there are some serious limitations. An assumption of a relatively uniform distribution of population and therefore static distribution of goods and services are problematic within large urban areas such as London or the post-industrial cities of northern England where polycentric and dispersed spatial structures are characterised by a higher degree of market fragmentation, and as a result, more intense competition between retail centres (Burger et al., 2014). In general terms, retail centre distributions influence competition between groups of centres, driven by the location, form and function of a centre, and how such attributes affect shoppers’ choice behaviours. As such, establishing the position of a retail centre within a hierarchy becomes an important component for modelling of interactions with competitors (Berry, 1963; Fotheringham, 1986; Dennis et al., 2002; Borchert, 1998). There are various ways of establishing retail centre hierarchy that are implemented within both national and international contexts (e.g. Experian,¹ Venuescore² by Javelin Group or International Council of Shopping Centers); however, the methods or metrics used are far from uniform and of varying degrees of transparency. In addition, there is no agreement about how many distinct types of retail centres there are, nor how individual centres should be

assigned to the various categories (DeLisle, 2005). Within the UK context, Government guidelines on defining the network and hierarchy of centres are available (e.g. Planning Policy Statement 4; DCLG, 2009), although they exclude out of town shopping centres and retail parks.

A second consideration when delineating a retail catchment is the selection of one or more threshold values representing the proportion of customers likely to patronise a certain store or retail centre – also referred to as primary, secondary or tertiary catchments. However, although it could be argued that there is some ambiguity when drawing a distinction between primary and secondary retail catchments (Guy, 1999), the most common approach adopted by the leading commercial consultancies (e.g. CACI,³ Savills⁴) defines the primary catchment as the areal extent representing the flow of at least 50% of a particular centre’s shoppers (Savills, 2005; CACI, 2007). The secondary retail catchment area would typically see patronage probability levels between 25% and 50%, and the tertiary above 10%. It should be noted that although these thresholds are useful from an operational perspective, they are pragmatic rather than theory driven choices, and as such, are by no means consistent between applications.

Further to considerations of hierarchy and appropriate threshold values for catchment extents, there are also different theoretical and empirical constraints when modelling retail centres versus those for an individual business. Importantly, the potential catchment areas for various retail or service types are likely to vary substantially as consumers would typically travel greater distances to purchase comparison goods, offered by higher order centres, compared to convenience goods, more prevalently available locally (Dennis et al., 2002; Finn and Louviere, 1990; Fotheringham, 1986; Joseph and Kuby, 2011). Indeed, operationalizing the estimation of catchment areas for retail agglomerations requires some generalisations, as it is not feasible for all potential influences to be quantified when broadening analysis to an entire retail centre or system. A further constraint pertains to the validation of catchments derived for a network of retail centres. Most large retailers collect detailed data on their customers, based on actual purchases and spending patterns, and often these can be used to determine the de facto aerial extent of where patronage is drawn. Similarly, there are commercial survey data available on consumer flows to particular shopping destinations in the UK; however, such data are not nationally comprehensive. Lastly, there is a dearth of empirical evidence about the universality of catchment models, and under what circumstances national models break down. For example, retail catchments in rural areas will typically comprise lower competition and customers will tend to travel longer distances (Calderwood and Freathy, 2014); and as such, may create significantly larger extents than a centre with similar attractiveness located within an urban area.

3. Catchment area estimation techniques

There are numerous ways in which catchments can be delineated depending on the requirements for a particular study, available data, software used or the analytical capability of a practitioner or researcher. The simplest techniques might be to draw buffer rings around a store, or to generate polygons based on the distance and time that customers are willing to travel to a particular centre (Segal, 1999). Drive distance and drive time methods are generally considered to be most valid for convenience store scenarios, where patrons are expected to go to the closest or

¹ <http://www.experian.co.uk/marketing-services/news-retailscape-uk-retail-centres-best-placed-to-thrive.html>.

² http://www.javelingroup.com/retail_consulting_services/locations_analytics/location_consumer_data/.

³ <http://www.caci.co.uk/>.

⁴ <http://www.savills.co.uk/>.

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