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Cumulative attraction and spatial dependence in a destination choice model for beach recreation

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HIGHLIGHTS

- The beach destination choices of domestic tourists in New Zealand are analysed.
- The spatial distribution of beach amenities is an important consideration in choice.
- We include complement and substitute accessibility parameters for each attribute.
- The implications of two site changes are compared for different models.

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ABSTRACT

The destination choices of individual recreationalists are dependent on the spatial distribution of sites and attractions. An important issue in destination choice modelling is how to account for the effects of cumulative attraction from multiple sites and hierarchical processing of potential destinations. This study is concerned with recreational visits to beaches on the Coromandel Peninsula of New Zealand. Each beach has a different combination of attractions with potentially complex substitution patterns. We find that an Agglomerating and Competing Destination Choice model, with differentiated accessibility parameters for each attribute, offers the best fit. It is flexible enough to model different levels of substitutability for different attraction types, yet is tractable in estimation. We compare response predictions of different models for two site-specific changes - closure of a campground and construction of a sea wall. Allowing for more complex substitution patterns results in different predictions for visitation in the wider area.

1. Introduction

Destination choices of individual recreationists collectively determine the demand for beach recreation and the welfare effect they experience from changes to the coastal environment. A common approach to modelling determinants of recreation site choice is by means of random utility models (RUM). This allows the estimation of demand for multiple sites, substitution across sites, and is consistent with utility maximisation theory (Phaneuf & Smith, 2005). Recent applications include domestic tourism in Spain (Bujosa, Riera, & Torres, 2015), Japan (Wu, Zhang, & Fujiwara, 2011) and China (Yang, Fik, & Zhang, 2013), angling in New Zealand (Mkwara, Marsh, & Scarpa, 2015) and lake recreation in Iowa (Smirnov & Egan, 2012).

An important issue in destination choice models is how to account for the effects of the spatial distribution of sites and attractions. There can be spatial dependencies (e.g. when site attractiveness is enhanced or diminished by attractiveness of a nearby site) and/or spatial correlation of errors (e.g. when the attractiveness of multiple sites is affected by an unobserved feature of the area) (Griffith, 2007). Spatially correlated errors violate the assumption of the travel cost method that sites must be substitutes. When sites share unobserved attributes that influence choice behaviour this also violates the assumption of independence of error terms in the widely-used multinomial logit model for discrete choices. Spatial heterogeneity, if ignored, may cause substantial bias in model parameters (Bhat, Dubey, Alam, & Khushefati, 2015).

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For this study we analyse destination choices of recreational visitors to beaches on the Coromandel Peninsula of New Zealand. There is a dearth of quantitative studies about beach recreation in New Zealand, despite the fact that the coast is an important part of New Zealand cultural identity (Kearns & Collins, 2012). The Peninsula has many attractive beaches within close proximity, each with a unique set of features and services. The values people hold for these beaches may be significantly affected by coastal policy and management decisions.

We first review modelling approaches for spatial correlation and multiple destination trips. We estimate an Agglomerating and Competing Destination Choice (ACDC) model that extends previous research (Bernardin, Koppelman, & Boyce, 2009). By using not just one, but multiple dissimilarity measures, we estimate spatial interaction effects for each type of observed beach attribute. We demonstrate that the expanded model allows the simulation of more complex response effects than alternative models. Yet, this model retains a computationally simple closed form, which makes it mathematically tractable in estimation.

2. Theoretical framework

2.1. Travel cost method

The consumption of beach recreation requires the user to incur the costs of travel and access to the site. These costs serve as the implicit price of the trip. An individual can visit only one site at a time and is assumed to choose the site that maximises his or her unobserved utility function for recreation benefits (Phaneuf & Smith, 2005). Multiple-destination trips complicate travel cost analysis because there is the potential for value to be attributed to the wrong site. The most direct solution is to discard multiple-site visitors from the sample. A less drastic approach is to include a dummy variable and price interaction for multiple destination trips (Parsons & Wilson, 1997) or use nested models for additional or "follow on" destinations (Taylor, McKean, & Johnson, 2010). Mendelsohn et al. (1992) treats combinations of sites as additional sites, but this is only practical if there are small numbers of possible combinations. Lue, Crompton, and Fesenmaier (1993) argue that the most appropriate way to allocate costs largely depends on which travel pattern the individual visitor is using. However, in practice it is difficult to distinguish between different patterns such as en-route, base-camp, regional tour or trip chaining. We use the approach proposed by Yeh, Haab, and Sohngen (2006) who allocate travel cost by the proportion of time spent at each site. The assumption is that people spend more time at more highly valued sites.

2.2. Spatial random utility models

The multinomial logit (MNL) model was shown to be consistent with RUM by McFadden (1974) and is the most widely used structure within random utility modelling. However, the independent and identical distribution of the error term results in the property called Independence of Irrelevant Alternatives (IIA). IIA is undesirable when patterns of substitution vary across different types or spatial clusters of alternatives. As McFadden (1978) noted, "there may be a structure of perceived similarities among alternatives" that invalidate this assumption of the model. Early applications of discrete choice models included spatial choices (for example, residential location in McFadden (1978)) but the added complexity of spatial dependence was not often recognised (Pellegrini & Fotheringham, 2002). There are two concepts that help explain the reasons for spatial dependence in destination choices: cumulative attraction (Nelson, 1958) and hierarchical processing.

2.2.1. Cumulative attraction

The theory of cumulative attraction (Nelson, 1958) implies that multiple attractions in an area will draw more visitors than if such attractions were widely scattered. A key component is the principle of compatibility in which total attractiveness depends not only on geographic proximity but also on how complementary the sites are. Complementary sites must be dissimilar in some way, providing different experiences or services. This allows visitors to satisfy a diverse range of objectives and reduce the risk of unrealised expected benefits (Lue, Crompton, & Stewart, 1996). Applications of Cumulative Attraction to tourism research have corroborated empirically the importance of the principle of compatibility (Lue et al., 1996; Weidenfeld, Butler, & Williams, 2010).

2.2.2. Hierarchical processing

Destination choices can involve a large number of destination options. Limited substitutability or hierarchical behaviour is therefore more appropriate than the MNL assumption of unlimited substitutability, typical of fully compensatory random utility models (Drakopoulos, 1994). The role of hierarchical processing has been explored in detail in the area of choice set formation (Decrop, 2010; Pagliara & Timmermans, 2009; Thiene, Swait, & Scarpa, 2017) and also used to explain spatial dependence in destination choice (Schüssler & Axhausen, 2009). The assumption is that destinations are evaluated in spatial or typological clusters.

There are various alternatives, generalisations or extensions to MNL that can be used to model hierarchical choice processes. The multinomial probit (MNP) model is very flexible with joint multivariate normal error terms, rather than the independent and identically distributed (i.i.d.) extreme values in MNL. However, the calculation of a single choice probability requires integration with as many dimensions as there are alternatives, which is not feasible without substantial investment in programming purpose-specific code and simulation techniques. The mixed logit model (Train, 1998) can also capture complex correlation patterns, using random parameters or error components. Thiene and Scarpa (2008), for example, used joint error components for two or more alpine sites that were believed to give sites a higher degree of substitutability, resulting in correlated choice. The limitation is that the number of random parameters required increases with the number of correlations modelled. Again, simulation techniques are required in estimation, which are slow and give estimates prone to simulation error (Klaiber & von Haefen, 2008). Simulation variance adds to the unavoidable sampling variance. The challenge is to specify a computationally tractable model that accommodates the important spatial effects and has a firm foundation in economic theory. We therefore turn our attention to models with closed-form probabilities, which do not require computationally expensive simulation techniques.

2.2.3. GEV models

Hierarchical choice processes can be modelled using the Generalized Extreme Value (GEV) class of models, of which MNL is a special case (McFadden, 1978). GEV models remove the IIA property of MNL by allowing the random components of alternatives to be correlated, while maintaining the assumption that they are identically distributed. The set of alternatives are partitioned into subsets (called nests), which correspond to similarity of influence. Nests may be non-overlapping, as in the