Optimal Allocation of Public Service Centres in the Central Places of Functional Regions

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Abstract: In the European Union, Member States and their regions are responsible for planning, funding and administration of public services, which should be based also on smart city tools. How smart is a city could be evaluated also by its ability to produce favorable conditions to get urban operators actively involved into spatial innovation dynamics, also to develop the innovative public logistics networks. The method presented supports local authorities and state government’s decision on optimal allocation of regionally based public services. The article is presenting the method for optimal coverage of the state territory with functional regions, where smart city is a center of the activities, and optimal allocation of services influence city growth. Sets of functional regions were modelled using the Intramax method. An optimal regionalization on number of functional regions is presented where the optimal number is chosen according to the cost of services. The case study for Slovenian regionalization for eldercare is presented.

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1. INTRODUCTION

1.1 Formal political region and functional region

How smart is a city could be evaluated also by its ability to produce favourable conditions to get urban operators actively involved into spatial innovation dynamics, also to evaluate which public services are best to be located in the city and what is the optimal functional region which will be covered by these services. Different services in a city as a central place of a region have different optimal size of the territory covered by them. While a formal region is understand as an area having the same characteristics (at least one) and also well-defined border, a functional region is based around something (local labour market (LLM) areas, around their central places, utilities around sources or destination point, even pizza delivery area can be understood as a functional area) and its borders could be fuzzy and changing in a time horizon. Therefore, functional region is an area that is made up of different elementary spatial units (ESUs, e.g. communities, municipalities) that are linked and function as a unit. The participating ESUs could change in a time horizon. Functional region is organized around one or few central places. Dependent on number of functions, which are concentrated in central places, such central places create a highly stratified network of cities. Regarding economic and social cohesion of European Union (EU) regions, which are the main goal of European Spatial Development Perspective (ESDP 1999), the regional state-of-art and especially future development, must be studied as the base for further economic and political decisions. Here, the regions became a subject of complex, open, dynamic nonlinear system of transparent functional connections between smaller and larger territorial areas.

Many researchers (e.g. Bull, 1980; Casado-Diaz, 2000; Tomaney and Ward, 2000; Laan and Schalte, 2001; Andersen, 2002) showed already that the standard administrative regions covering territory of European Member States used as basic entities for policy making, resource allocation, and research do not provide meaningful information on actual conditions of a particular areas. As such, there has been a move towards functional regions. A functional region is defined as a region characterised by its agglomeration of activities and by its intra-regional transport, information and communication infrastructure, facilitating production and services, therefore a large mobility of people, items in production processes and final products, but also enabling services within its interaction borders, which is rarely well defined.

In industrial society, the basic characteristic of a functional region is the integrated labour market, in which intra-regional commuting as well as intra-regional job search and search for labour demand is much more intensive than the inter-regional counterparts. Consequently, the identification and delineation of functional regions are commonly based on the conditions of local labour market. Based on this perception, Smart (1974) delineated functional regions and this “industrial” approach is accepted in the recent literature (OECD, 2002; Cörvers et al., 2009; Casado-Diaz and Coombes, 2011), while the economic shocks like the nowadays’ economic crises require reconsider the labour market perception. In the post-industrial society, intensity of flows of workers and flows of items decline and intensity of services in a functional region is progressing.

A number of regionalisation procedures for delineation of functional regions have been suggested in the literature. A recent review of different approaches and methods is in Casado-Diaz and Coombes (2011). Methods for delineation of functional regions can be divided into rule-based (Coombes et
There were developed several methods to determine functional areas/regions, that can be used for statistical purposes to analyse different aspects of labour market performance (Smart, 1974; Combes et al. 1986; Casado-Diaz, 2000; Van der Lann and Schalke, 2001; Newell and Papps, 2001; Karlsson and Olsson, 2006; Mitchell and Stimson, 2010; Landréa and Håkansson, 2013) and other socio-economic aspects (Green et al., 1986; Tomaney and Ward, 2000; Baum et al., 2008; Karlsson et al., 2008), to evaluate the administrative regions (Slater, 1976; Andersen, 2002; Nel et al., 2008; Cövers et al., 2009), to analyse functional urban regions (Shimizu, 1975; Sykora and Mulček, 2009; Drobne et al., 2010; Manley, 2014), for analyses and applications of transport policy (Krygsman et al., 2009), to analyse housing market areas for housing policy (Goetgeluk and de Jong, 2007; Brown and Hincks, 2007), to analyse commodity market areas (Brown and Pitfield, 1990), to analyse telephone communication patterns (Fischer et al., 1993), to enhance economic development (Freshwater et al., 2013) – but only some of them have been developed for study the location problems and opportunities of services (Shortt et al., 2005; Drobne and Bogataj, 2014). The optimal delineation of functional regions for individual services or group of services has not been subject of scientific investigation.

The location-allocation models which try to answer the question where optimally locating a set of facilities and how to allocate resources are part of colourful and ever growing body of literature also given in the review papers of Rahman and Chandy (1986), Johnson et al. (2005) and in others. However, as far as the authors know it, there is no literature that couples both problems: location-allocation problem of facility location and the problem of optimal delineation of the functional regions. In this paper a method for delineation of functional regions servicing elderly like developed by Drobne and Bogataj (2014) is coupled by a general location-allocation model for servicing in the functional regions on the special way using Intramax method. Here we are looking for such allocation of activities in the potential centres of functional regions, and delineation of these functional regions, that the costs of communication between city as a central place and other areas in the functional region, and other costs of services (including investments) would be minimal, when the functional regions are covering the area of a state as tessellations.

2.1 Intramax procedure

To follow the ideas of functional regions as a local labour market areas (Casado-Diaz and Coombes, 2011), delineation could be made as described in the first part of this chapter. Let us consider the labour commuter as a person in employment whose territorial unit (ESU, e.g. community, municipality) of workplace is not the same as territorial unit of residence. To analyse functionally delineated regions as LLM areas, the groupings have been arranged using the Intramax method, which belongs to the methods of hierarchical clustering.

Regionalisation procedures based on hierarchical clustering were initially developed in the 1970s and 1980s, and were introduced as alternatives to the more ad hoc methods. The methods include Markov chain techniques of Brown and Holmes (1971), as well as the strategy of Masser and Brown (1975, 1977) and Masser and Schuerwater (1980), which is based on refinements to Ward’s (1963) hierarchical aggregation procedures.

The objective of the Intramax procedure is to maximise the proportion within the group interaction at each stage of the grouping process, while taking account of the variations in the row and column totals of the matrix. In the grouping process, two ESUs are grouped together, for which the objective function is maximised (Breukelman et al., 2009):
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