Improving equity of public transportation planning. The case of Palma de Mallorca (Spain).

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Abstract

Public transport planning requires consideration of equity in access of the population to the transport service. This paper presents a methodology for the analysis of public transport in the city of Palma and its evaluation in terms of spatial and social equity. First, the analysis of supply based on the activity of the bus stops has been performed. Then an AHP multicriteria weighted model over a set of socioeconomic variables has been developed to obtain a public transport demand index. Finally, the analysis of equity has been made using the Gini Index and a sensitivity analysis of bus lines. The results show the distribution of equity for all the 88 districts of city. This paper presents a simple and powerful methodology exportable to transportation planning studies in other geographic areas.

Keywords: transport equity, AHP multicriteria analysis, transport planning, gis-t

1 Background

The practice of public transport planning requires consideration of equity as an essential attribute to ensure balanced use and access of the population to the service [1] [2]. Two types of equity in transportation planning are distinguished: horizontal and vertical. The horizontal is related with spatial justice. It’s oriented to maintain a balanced supply to the needs of all individuals. Vertical refers to the adjustment of supply transport to the unique needs of specific population groups (social justice).

Public transport planning requires the development of a set of tasks as: demand analysis, selection of routes and stops, setting timetabling, etc. The practice of planning requires having a deep understanding of the social situation in order to provide rational solutions adapted to the different needs of the population. In this research we have used the methodology of G. Currie [1] for public transport service analysis. The method has been adapted to our study area and a set of enhancements have been proposed: multi-criteria analysis of socioeconomic information, sensitivity analysis of bus routes. There are scarce effective methods of transport optimization based on the maintenance of social equity. In general, the demand analysis is performed giving more importance to the economic profit of the service rather than considering their social sustainability.

The main objective of this work is to propose a methodology to assess the horizontal and vertical equity of public transport and to test it at Palma municipality.

The study area is the city of Palma de Mallorca (Spain). The planning and management of public transport in Palma is performed by the Empresa Municipal de Transportes (EMT) who depends of the Palma City Council. The EMT has a total of 31 routes, involving a total of 959 bus stops distributed in an area of 19,535 hectares [4]. BUS Transport system in Palma cover the needs of a population of 421,708 people (2013) and 42,457 tourist places [3] distributed in 88 neighbourhoods. Currently its use is predominant by social groups with low income, elderly, women and students.

2 Methodology

In this research we have used the methodology proposed by G. Currie [1] for public transport service analysis. The method has been adapted to our study area and a set of enhancements have been proposed: multi-criteria analysis of socioeconomic information and a sensitivity analysis of bus routes.

2.1 Supply analysis

The analysis of the supply is based on the service level of the bus stops and includes the next steps:

- Geolocation of 959 bus stops.
- Bus stop service level (BSSL). Total buses per day are obtained for each bus stop for 12 hours period on working days.

2.2 Analysis of potential demand

We consider the total population of district as the first indicator of public transport demand.

In order to obtain a social indicator of public transport need (PTN index) for each district an AHP multicriteria analysis has been developed over a set of socioeconomic variables. It includes the next tasks:

- Creation of a socioeconomic database of Palma districts who include: demographic information, population income, economic activity, etc. All the information was provided by the Municipal Palma Observatory [5]. All the variables are normalized in a range of 0 – 1.
- A group of six experts provides weights to each of the variables according with their role in transport need. The average weight value is assigned to each variable. The final value of each district will be calculated using the expression (2).

\[ PTN_x = \sum_{i=1}^{n} w_i x_i \]  

(\(x=\) district ; \(i=\) variables ; \(w_i=\) weight of variable \((i)\); \(x_i=\) value of variable \((i)\))

2.3 Equity analysis

The supply and the demand of public transport have been analyzed jointly to identify imbalances in the transport service. The Gini index has been obtained to detect the level of inequality between public transport service and population or Public Transport Need Index.

Finally a sensitivity analysis of bus routes has been developed to detect their importance in providing equity to the bus service. For this purpose we have calculated the Gini index by performing modification times of each bus route.

All the cartographic information of the study can be found at the web map viewer PalmaBusTransport [6].

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Figure 1: Population, Public Transport Need Index and Equity Maps by districts.

Figure 2: Lorenz Curve

Figure 3: Sensibility of bus lines

References


