

Inclusive mobility in the West Midlands – Understanding declining bus patronage by senior residents from smartcard data

Delivering inclusive and healthy mobility remains a significant challenge facing transport authorities in the United Kingdom and elsewhere. Affordable public transport is often considered to be part of the solution, especially with regard to disadvantaged or vulnerable residents. The English National Travel Scheme (ENCTS) was introduced to provide residents of pensionable age with free travel by bus throughout England. But while the scheme has been taken up widely in the country, many transport authorities have experienced a steady and accelerated decline in boardings over the last decade. This trend raises questions about the current role of public transport in delivering inclusive mobility, and in particular, whether the current concessionary scheme is appropriately targeted.

This project analyses smart card transactions of bus passengers in the metropolitan region of Birmingham, known as the West Midlands Combined Authority, a region of 2.8 million inhabitants. The principal objective is to understand declining boarding trends among concessionary pass holders in the region. To achieve this, our main strategy is to identify boarding patterns and link these to contextual datasets. We employ sequence analysis to group concessionary passengers into temporal boarding segments over nearly six years. We then use the information held in the pass holder database to link the sequences to the residential location of passengers and examine their spatial distribution. We estimate spatial patterns using local indicators of spatial autocorrelation (LISA) and characterise them using neighbourhood-level Census statistics and other neighbourhood indicators from consumer data sources.

The smart card data form part of an automated fare collection system in the West Midlands, which currently record approximately 50 million concessionary boardings per year. In order to fully use this data source, we link it to a range of other routinely collected datasets, notably GPS-tracked Automated Vehicle Locations (AVL), ticket machine trackers and timetables. These datasets are crucial to infer passengers' journey characteristics, including location of boarding, alighting point, transfer time, dwelling time, journey distance and duration.

Preliminary results suggest that boardings among concessionary pass holders slowly declined since 2011 and then sharply dropped by approximately 20 per cent since the beginning of 2015. Because boardings per passengers remained stable throughout the period, we find that the decline in boardings is caused by passengers leaving the system altogether rather than by passengers taking the bus less frequently. The geographical pattern of declining boarding trends may therefore plausibly deliver clues on the causes of these declines. The sequence analysis generates seven passenger segments with different temporal boarding profiles over the period 2011 to 2016. The most notable segments comprise 30 per cent of all passengers, who travel regularly throughout the period without interruption. Another segment of similar size indicates rare bus use

with only a few boardings throughout the period. Both segments do not indicate any changes in boardings throughout the period. Further profiles reflect different times at which passengers join the system and show regular patronage thereafter. Two profiles comprise frequent passengers that leave the system, one prior to 2015, another after 2015. It is this latter segment that best matches the overall trend and speed of decline. Adding passenger demographics to the sequences reveals that the drop-out post 2015 can neither be explained by old age and mortality nor by any differences related to gender.

Combining the sequence analysis with spatial analysis, we find that the most frequent passengers tend to live in well connected and less affluent areas, which are located along corridors within a radius of 5 miles from the centre of Birmingham. The radial transport system of the city results in higher levels of service in these areas. The segment of passengers abandoning the service post 2015, however, shows a stronger concentration in inner Birmingham neighbourhoods with higher levels of deprivation and a higher proportion of Asians. These preliminary findings indicate that there is a pronounced spatial and socio-economic component in the decline in bus boardings, whereby formerly frequent bus users, who live in certain central and more deprived areas, tend to abandon the bus.

To explore this further, we intend to link the boarding profiles to time tables, operator codes, and neighbourhood activity and socio-economic information obtained from the Office for National Statistics as well as some consumer data sources. This will be part of a more detailed spatio-temporal contextualisation, in which we seek to infer further details on these residents to eventually establish whether they make fewer trips altogether, use other modes, substitute trips through online consumption, have experienced any changes in public transport accessibility or have faced other changes on the local transport market, including the emergence of new operators or mobility services.

In conclusion, smart card data offer significant potential to identify issues of social inclusion in public transport, but this potential can only be realised through wide-ranging and complex data linkage with other operational and contextual datasets. Further challenges relate to data storage and computational capacity, and we will suggest how these may be overcome to process smart card transactions over long time periods. In view of the impact of concessionary travel scheme on local transport budgets and on residents' mobility and social inclusion, the use of new data sources to understand long-term trends in mobility becomes a pressing priority for transport research and policy.

Authors

Jens Kandt (j.kandt@ucl.ac.uk), Alistair Leak (a.leak.11@ucl.ac.uk)

The Bartlett Centre of Advanced Spatial Analysis (CASA) • University College London