# Investigating and analyzing the effects of policy instruments such as the 9-Euro-Ticket and the “Deutschlandticket” on activity spaces and mobility patterns


## Master‘s Thesis of Sophia Fuchs

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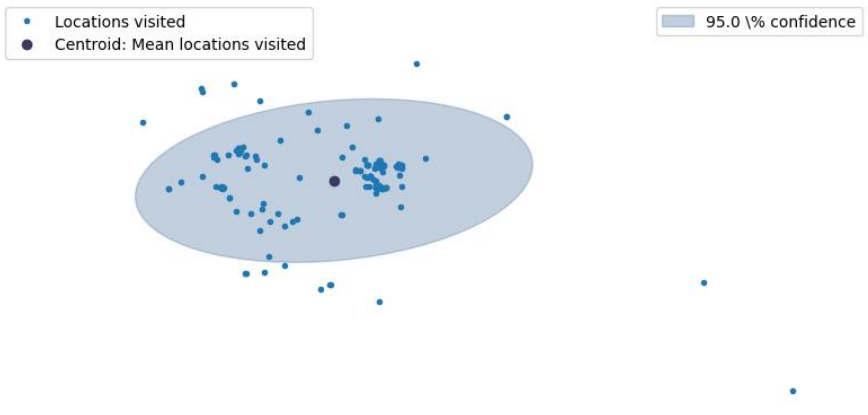
Confidence ellipse

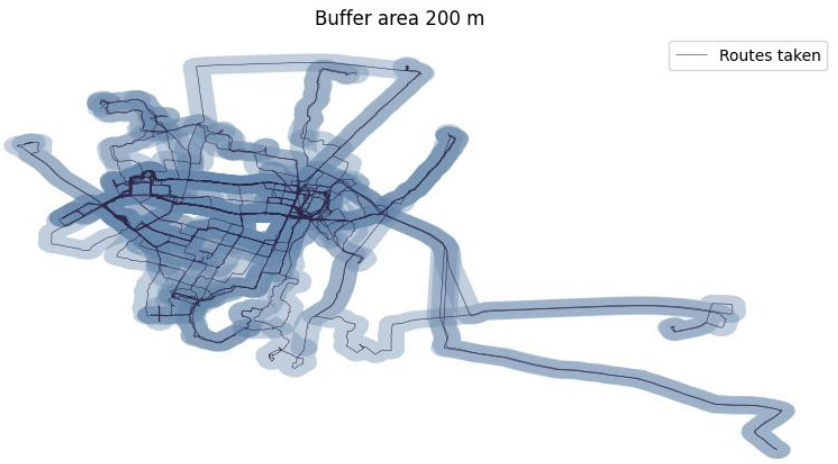



### Motivation & goal

With the introduction of the so-called 9-Euro-Ticket a significantly discounted and nationally valid ticket for the use of local and regional public transport was implemented for the first time in Germany and is continued as the "Deutschlandticket" (Bundesregierung, 2022). Given the distinctiveness of this ticket, there is a significant interest in assessing the degree to which the ticket has impacted the mobility patterns of citizens. Therefore, the Mobilität.Leben study, which included several surveys and a GPS-based tracking app, was conducted and serves as data basis of this thesis. Through this long-term study, it is possible to identify changes in the participants’ mobility behavior in relation to their sociodemographic, temporal and spatial characteristics (Schönfelder & Axhausen, 2003).

Activity spaces (AS), which examine the regularly utilized space of an individual over a specific period, offer the opportunity to gain insights into the mobility behavior and to identify changes and patterns of certain individuals or groups of individuals. Therefore, this thesis aims to be among the first to implement and compare different AS methods using quantitative indicators and to establish a foundation for analyzing large datasets. Within the scope of this thesis, it will be identified whether AS has changed with the introduction of transport policy instruments such as the 9-Euro-Ticket and "Deutschlandticket".

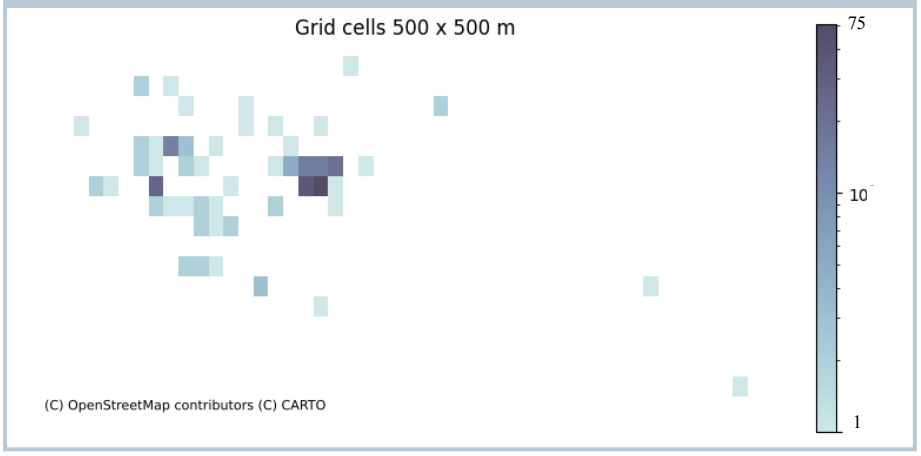
Minimum spanning tree




### Results

The results of the thesis have shown that the different AS methods each possess unique strengths and limitations, particularly in terms of data size, robustness, and sensitivity. These should be taken into account in the respective application case. Furthermore, different methods should be used in order to gain comprehensive insights. In general, the different methods benefit from visualization, while the various indicators still provide benchmarks and enable a direct comparison. Additionally, the results of the descriptive analysis have revealed certain effects and tendencies of the 9-Euro-Ticket and "Deutschlandticket" on AS. However, these could not be unequivocally confirmed by the statistical analysis, which was also not able to identify any specific groups affected by social exclusion within the dataset.

KDE (not smoothed)




### Conclusion & outlook

Regarding further performance improvement of the AS methods, the validity of the visited locations and trips can be investigated in more detail. Currently no weighting of visited locations was conducted in this thesis. However, in order to take into account the observed sensitivity of the confidence ellipse to outliers, the quality of the visited locations could be addressed further in future works. In addition future studies could also examine the classification of a means of transport related buffers more closely.

An extensive pre-processing of the data was also conducted to capture and analyze daily mobility in the Munich area as good as possible. Due to the long duration of the study and the varying intensity of app usage, the pre-processing steps resulted in the majority of participants and trips being filtered out, especially due to the set temporal and spatial boundaries. The previously fixed spatial and temporal boundaries could be made more flexible to increase the dataset size.

Nevertheless, this study is among the first to apply AS methods in the mobility sector in Germany. By examining the three most widely used methods for representing AS, this work provides an important comparison between these methods, offering a foundations for a combined evaluation and further development of these methods.