Group 1: accessibility analysis of services

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Introduction

1

Accessibility

- Degree of affordability, acceptability and availability of urban services
- Evaluating the accessibility is crucial for urban planning, service provisions, integration of land-use planning transport planning etc.

2

Annelinn

- Largest neighbourhood of Tartu city
- Construction of Annelinn was started in 1970
- Anne II is one of the micro-districts of Annelinn

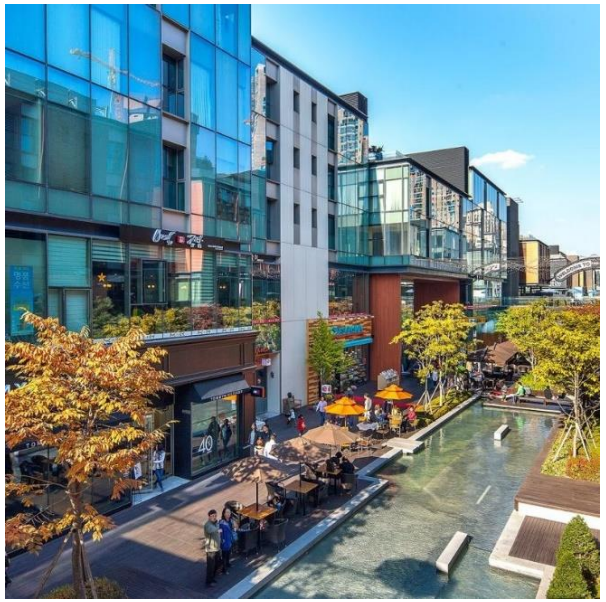
3

Research questions

- Which essential services are significantly more or less accessible than others to Anne II residents?
- How does access to services vary spatially within Anne II?

2. Theoretical overview

Theoretical concepts that enforce service accessibility



Land-use mixing

Land-use mixing promotes the mixing of different private and public services and urban land uses within a neighbourhood.to minimize trips for residents and reduce traffic.

Related to the mixed-use-concept is also the concept of the 15-minute city can also be applied for workplaces, in which all necessary services should be within a 15-minute walk from the place of residence

Social infrastructure/social mixing

Studies on the income and age structure of the residents can decide on the relevance of social infrastructure and help in setting priorities.

A good mix of uses and a well-developed social infrastructure can ultimately contribute to a socially mixed and liveable city.

What services are essential and what service categories there are in study area

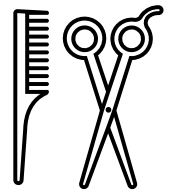
Essential services

Differences in: Target groups; needs; frequency of use

A sufficient number of uses makes neighbourhoods attractive for residents.

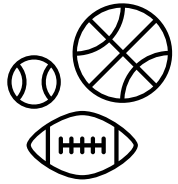
Defined desirable target-distances for ourselves (normally during Participatory formats)

Essential services

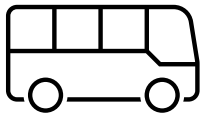


Personal care

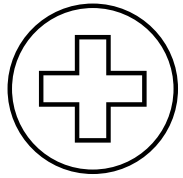
Commercial services



Sport and recreation

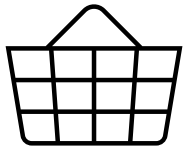


Transport

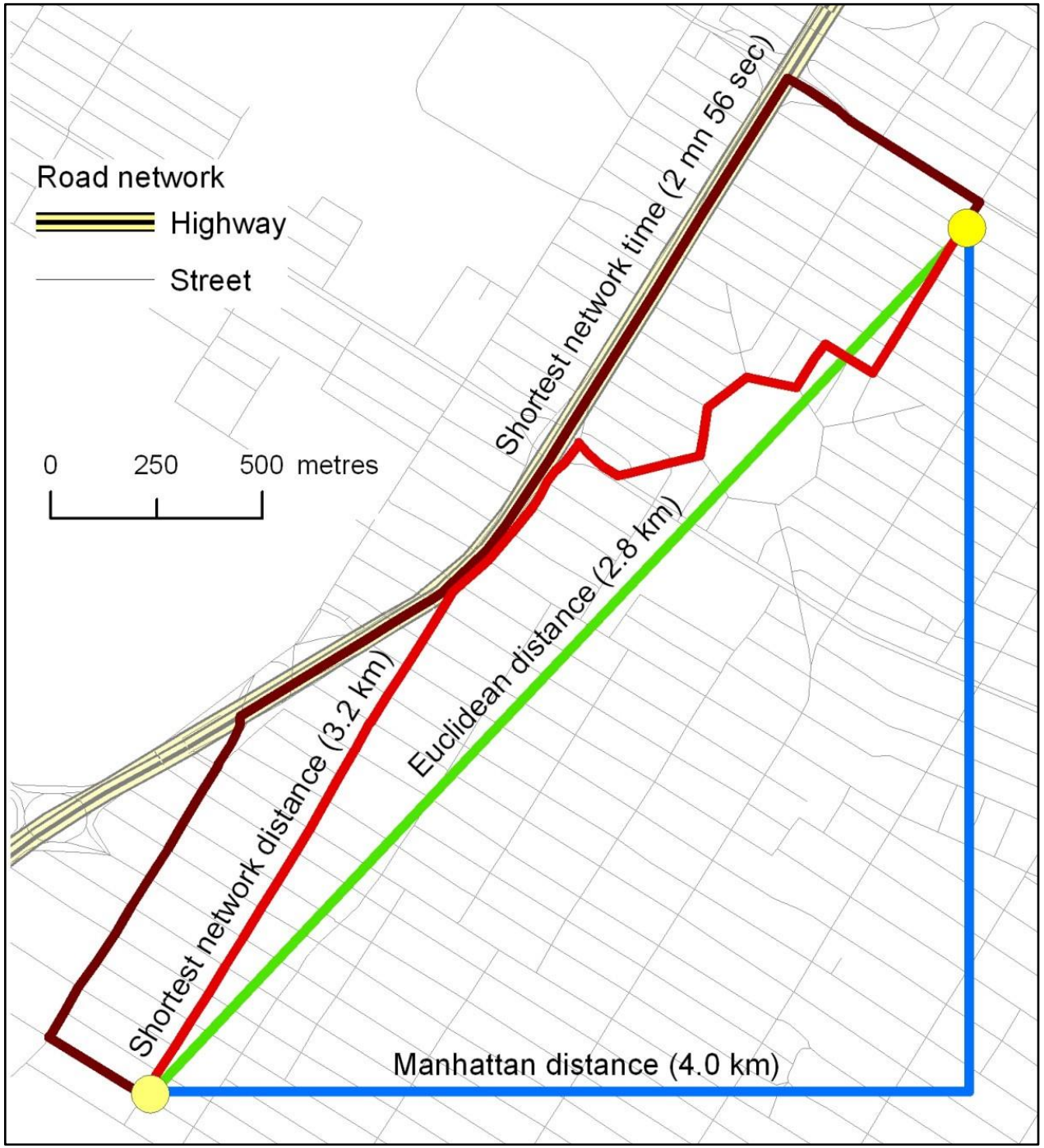


Healthcare

Educational services



Shops



Methods of distance measuring

- **Euclidean distance** is the most popular method of distance measuring but it **lacks accuracy**
- **Manhattan distance** is the distance along two sides of a right-angled triangle opposite to the hypotenuse
- **Shortest network distance** Shortest network distance is the shortest path between two points in terms of distance using a street network
- **Shortest network time** Shortest network time is the fastest path between two points in terms of time using a street network

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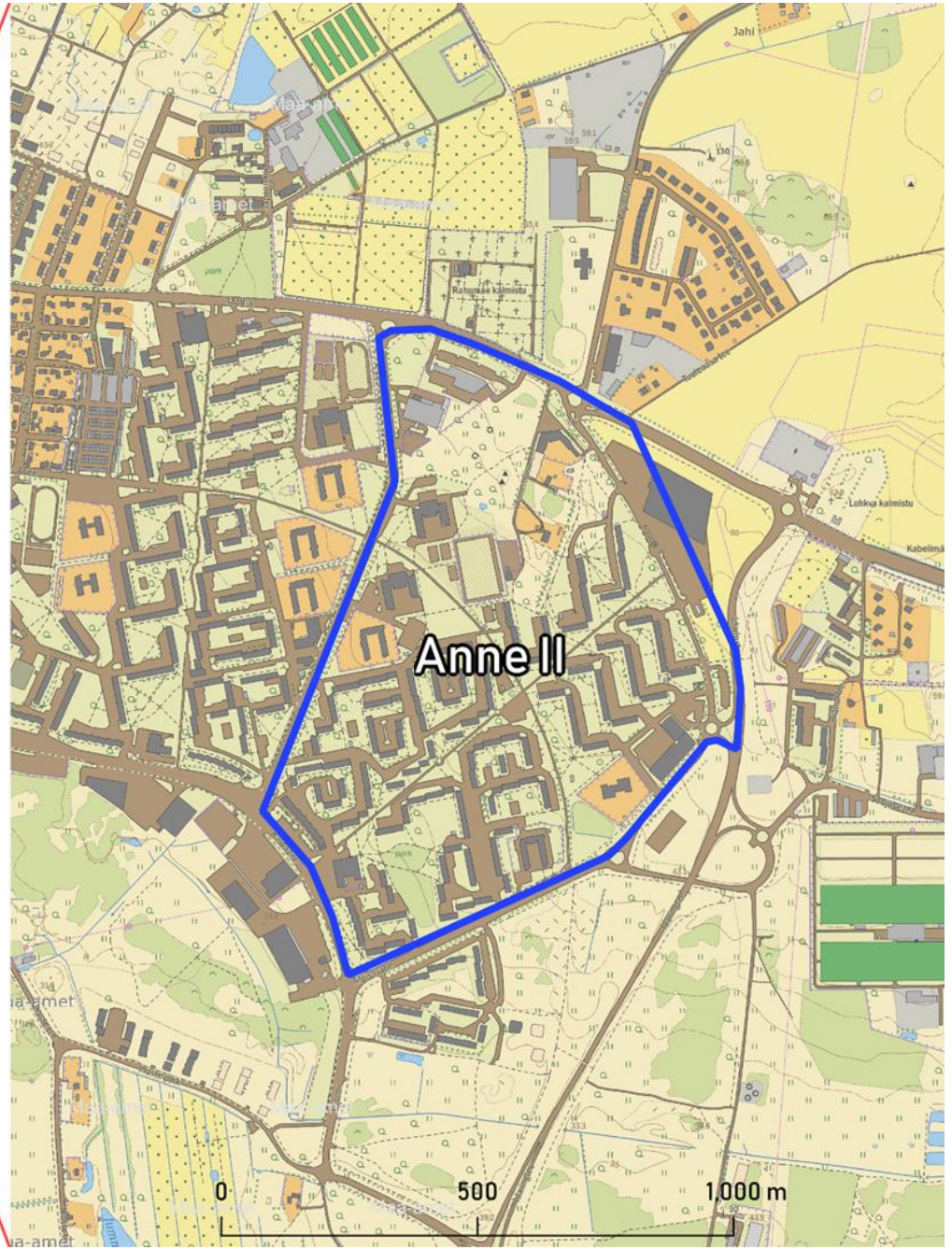
Image: Apparicio, P., Abdelmajid, M., Riva, M., & Shearmur, R. (2008). Comparing alternative approaches to measuring the geographical accessibility of urban health services: Distance types and aggregation-error issues. International Journal of Health Geographics

3. Data and methods

Study area: Anne II in the context of Tartu



Analysis of service distribution within the study area

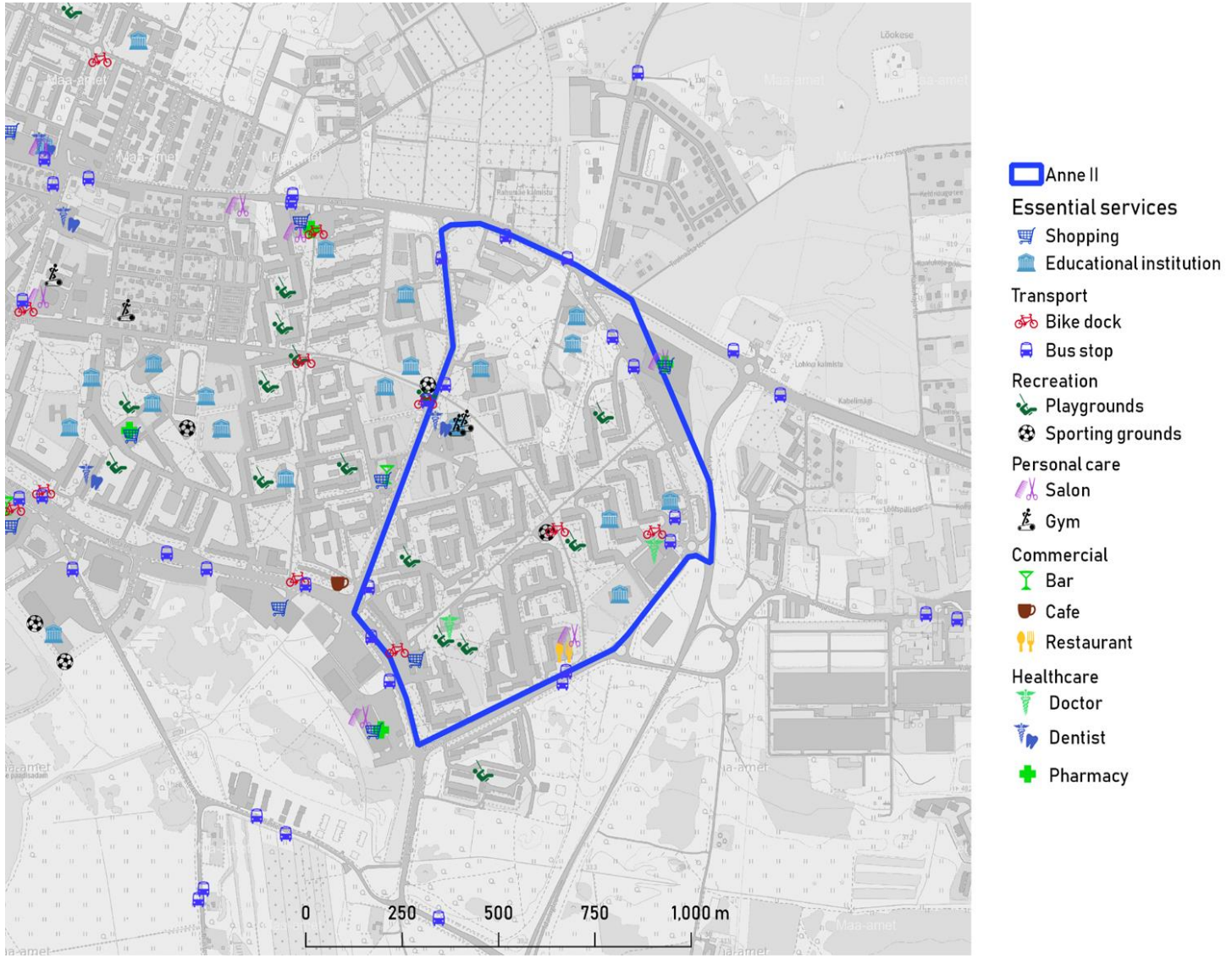
Normality test for minimum distance to service categories

- Kolmogorov-Smirnov test rejects normality below 0.05 significance
- All categories therefore normal

Service categorie	Kolmogorov-Smirnov[a]		Shapiro-Wilk	
	df	Sig.	df	Sig.
Commercial	48	,200*	48	,051
Education	48	,200*	48	,149
Healthcare	48	,013	48	,161
Personal care	48	,200*	48	,457
Recreation	48	,200*	48	,730
Shopping	48	,200*	48	,209
Transport	48	,200*	48	,313

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

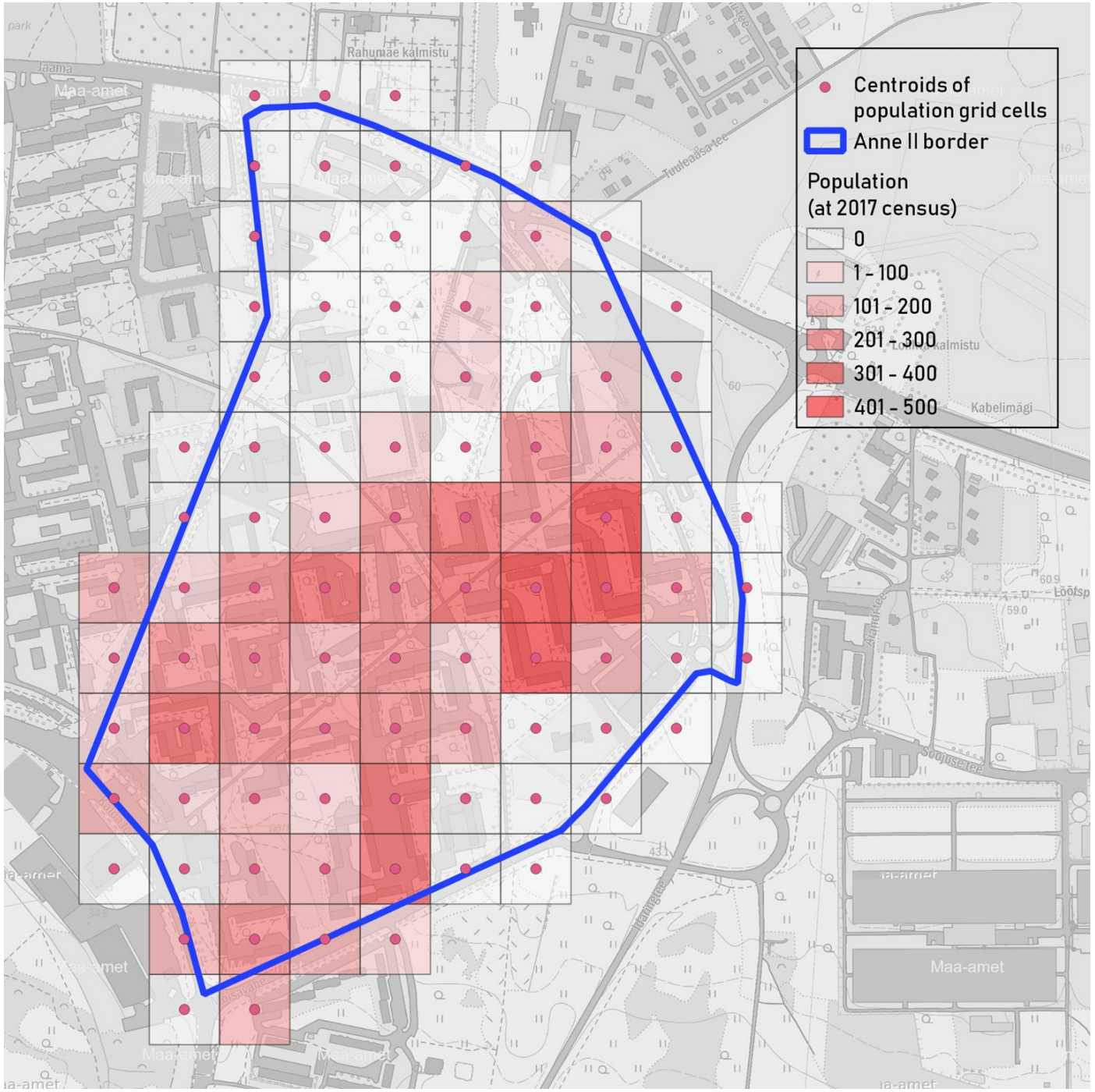


Map of the distribution of services within Anne 2 and the surrounding areas

Population grid based on 2017 census

Population’s distribution

Kolmogorov-Smirnov test for population’s distribution has significance about 0.002, therefore population not normally distributed



Methods

Comparison of means

Comparison of means - minimum distance to nearest service

↓

Excludes zero-population cells and calculate Euclidean distances from population's grid centroids to nearest service type instance

↓

ANOVA to compare means, detect significant variation in mean nearest distance between service types

↓

Most/least accessible service types determined from mean minimum distance

Correlation analysis

Identify correlation between nearest-service-distance and population density

Investigate efficient location of services to Anne II's population

Spearman correlation, because population is not normally distributed (though service distances are)

Gravity-based index of accessibility

1 Accessibility A_i at location i is proportional to service capacity S_j at n surrounding locations and inversely proportional to the distances to these services and to the demand potential V_j at location j

$$A_i = \sum_{j=1}^{n} \frac{S_j}{d_{ij}^{\beta} V_j} \quad (1)$$

2 d_{ij} is a distance (or travel time) between location of consumer i and service j

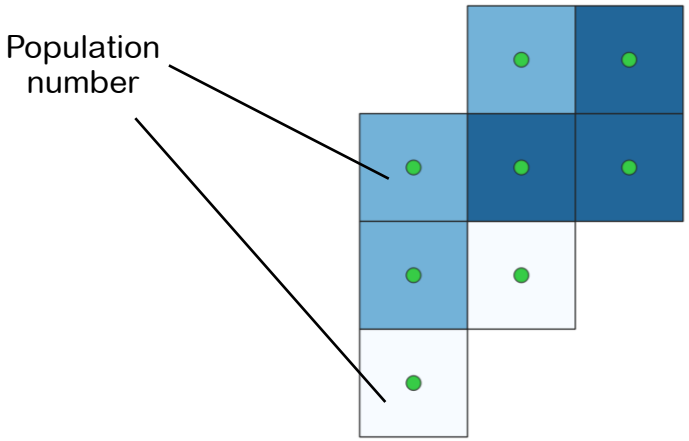
$$d_{ij}$$

3 Population's demand potential V_j at location j is proportional to demand D_k at m surrounding locations and inversely proportional to the distances d_{kj}^{β}

$$V_j = \sum_{k=1}^{m} \frac{D_k}{d_{kj}^{\beta}} \quad (2)$$

Explanation of the gravity model

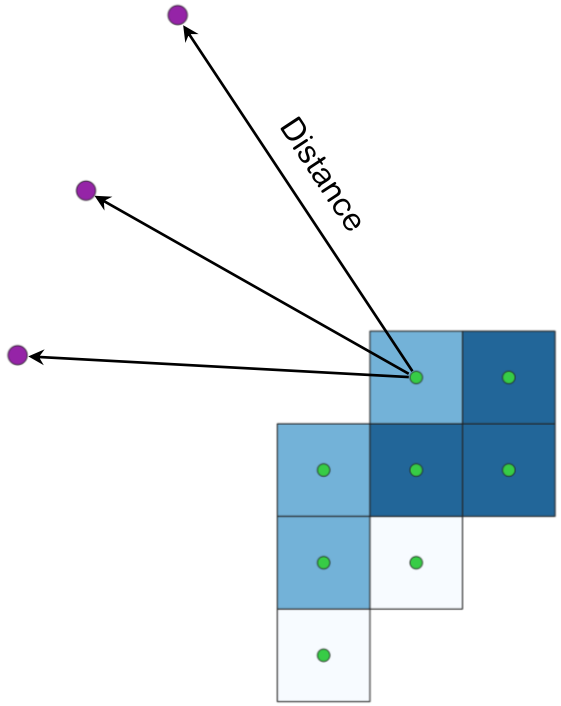
1 Population number in 100 by 100 meters grid



Legend
- Centroids of the population grid

Population number
- Low population number
- Medium population number
- High population number

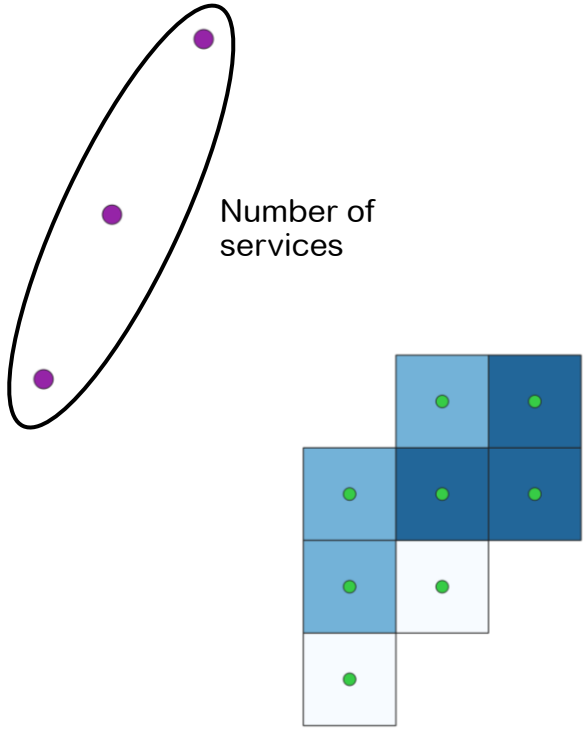
2 Identifying distance to each service point



Legend
- Services
- Centroids of the population grid

Population number
- Low population number
- Medium population number
- High population number

3 Counting number of services

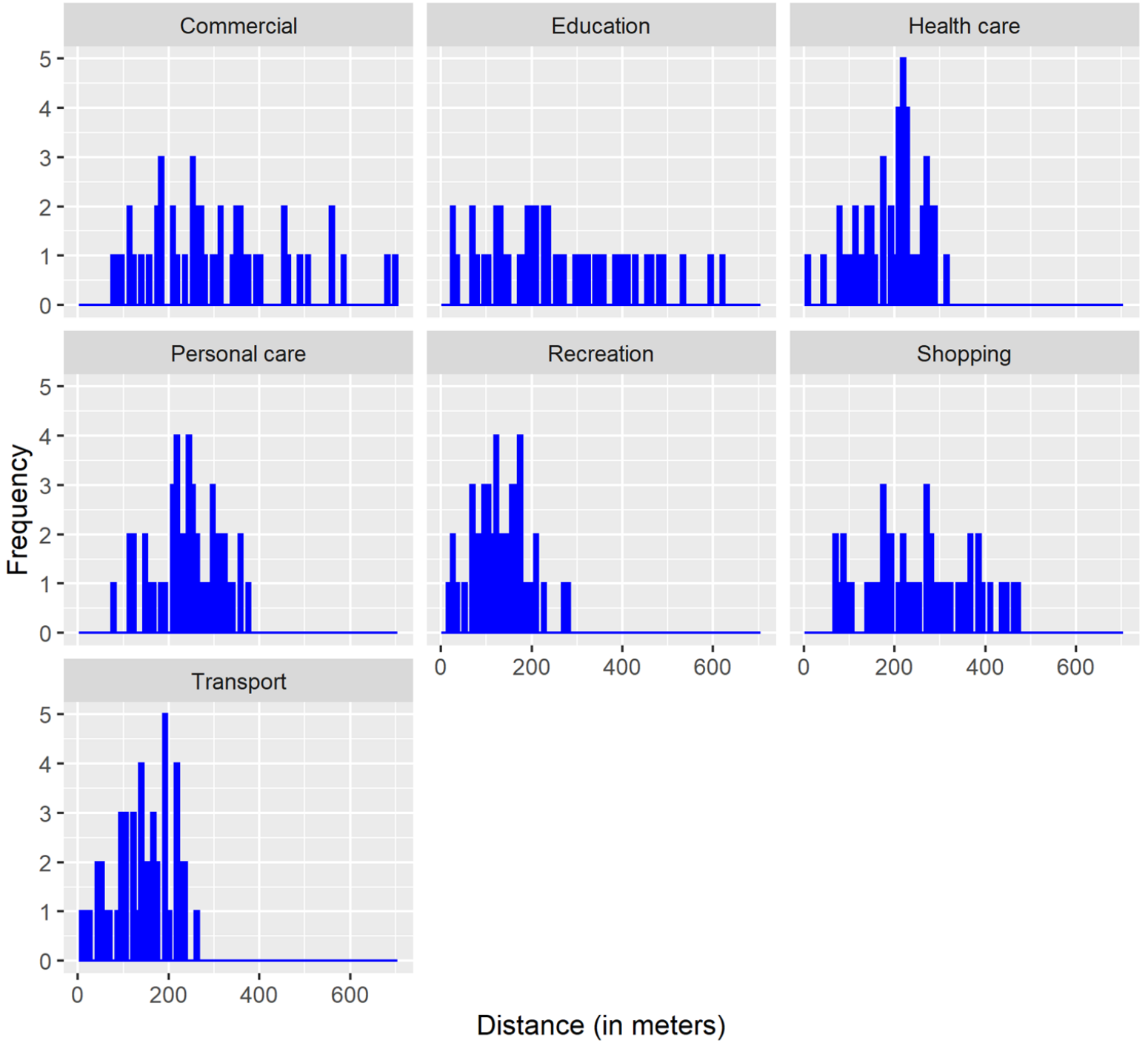


Legend
- Services
- Centroids of the population grid

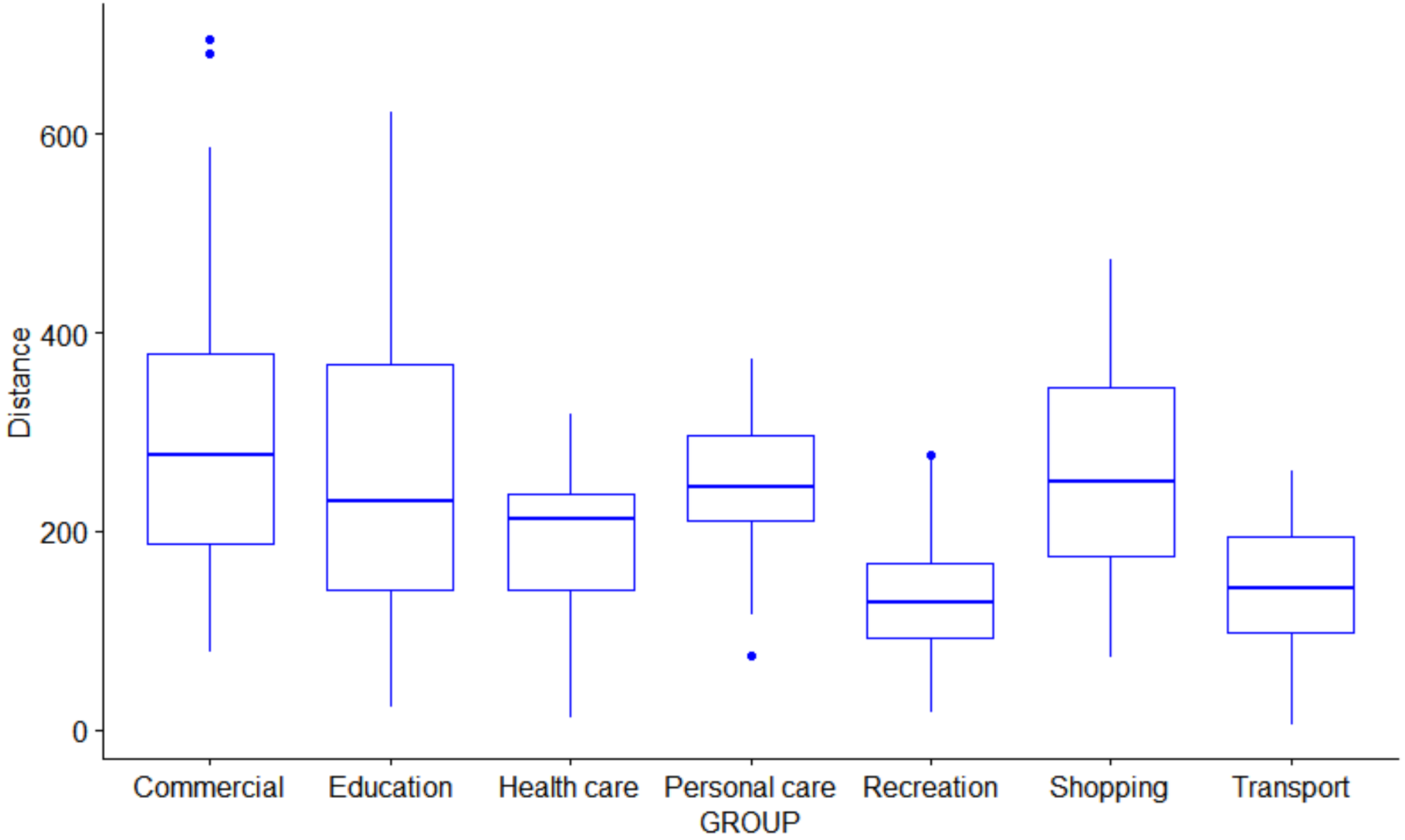
Population number
- Low population number
- Medium population number
- High population number

4. Analysis results

Histograms of all service groups



Box plot for each service group shows differences in the distribution of values within and between the groups



Testing differences between the accessibility of different service groups

ANOVA confirms significant differences between group means

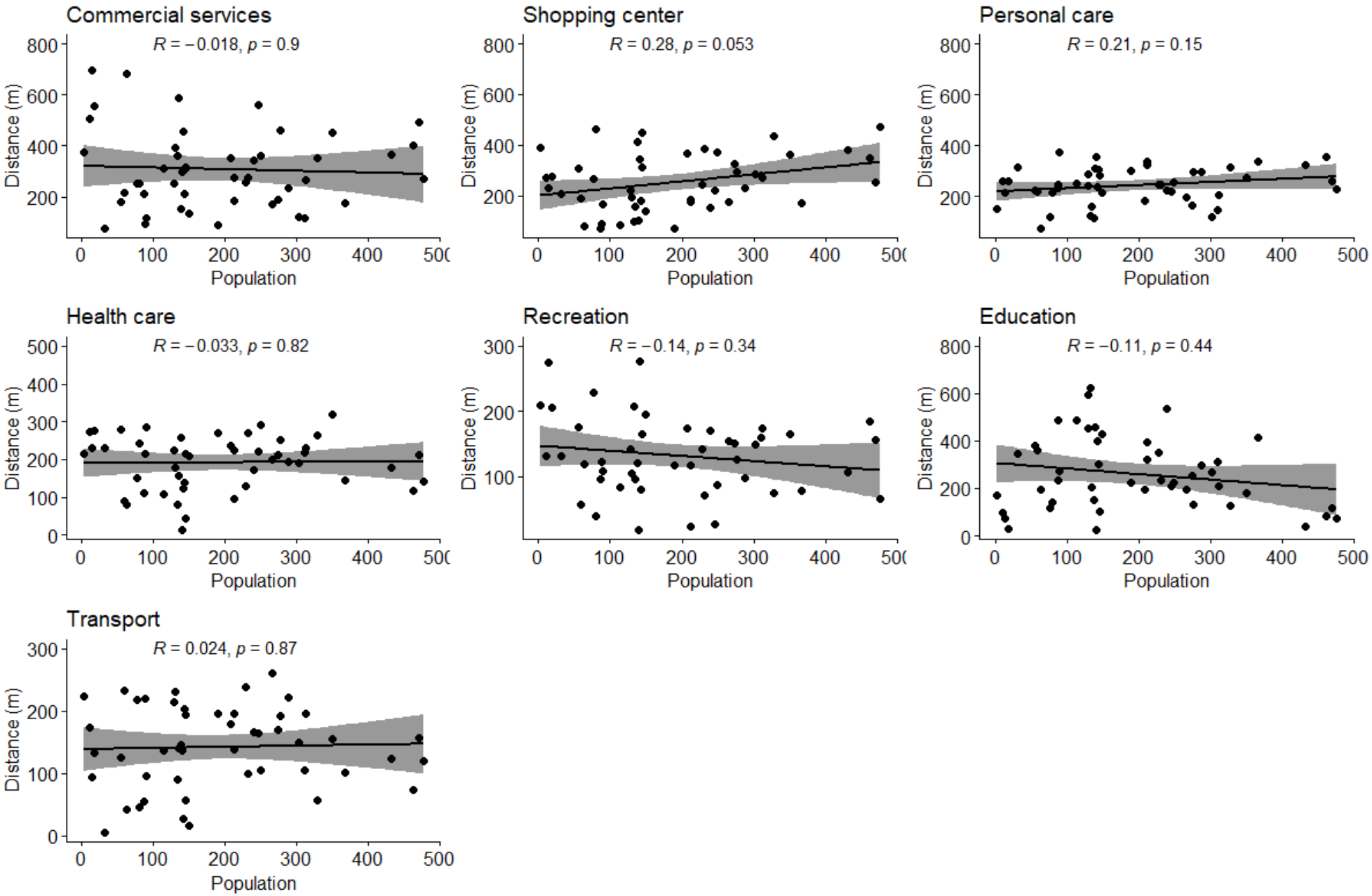
Tukey post-hoc test reveals significant differences in the accessibility of different service groups

Tukey Post-Hoc-Test

Service Group (Mean-Differences in meters)	Commer-cial	Education	Health-care	Personal care	Recreation	Shopping	Trans-port
Commercial	0	47	116*	66*	176*	54	166*
Education	-47	0	69*	20	30*	7	119*
Healthcare	-116*	-69*	0	-50	60	-62	50
Personal care	-66*	-20	50	0	110*	-13	100*
Recreation	-176*	-130*	-60	-110*	0	-123*	-10
Shopping	-54	-7	62	13	123*	0	112*
Transport	-166*	-119*	-50	-100*	10	-112*	0

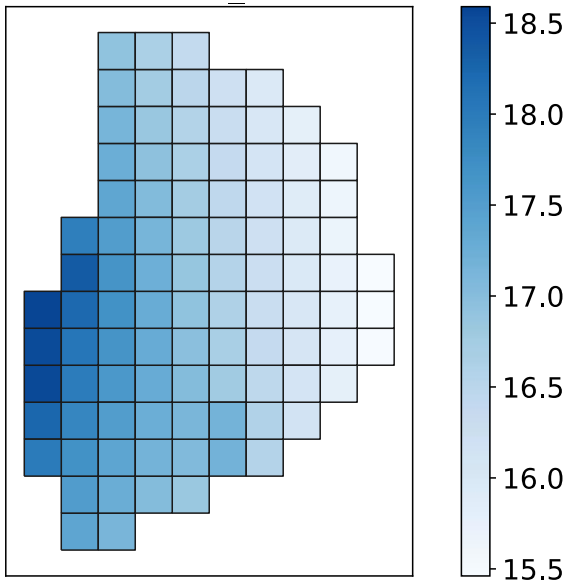
*Significant values.

Correlation between nearest service distance and population per grid square

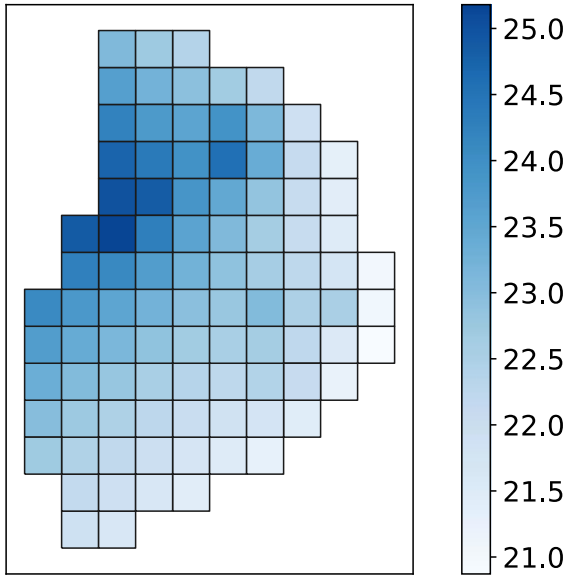


Gravity model for each service type

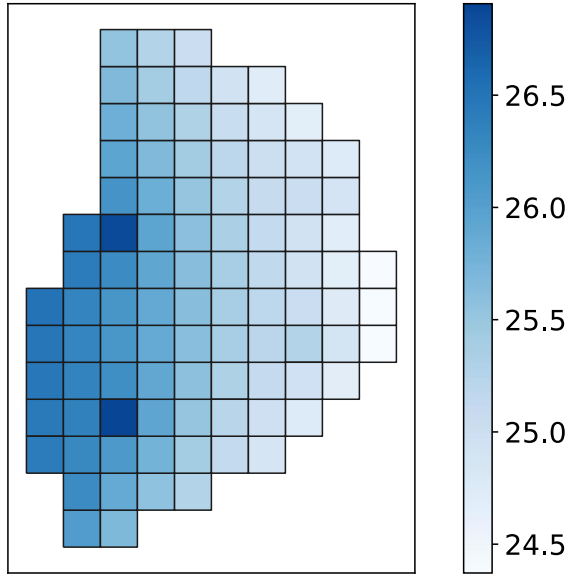
Commercial services



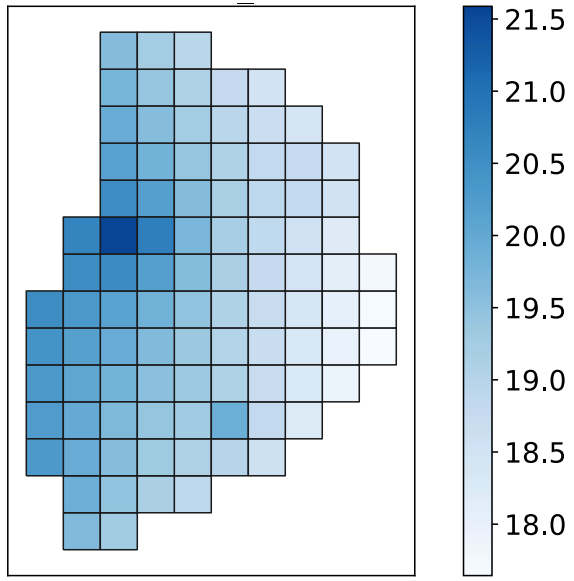
Education



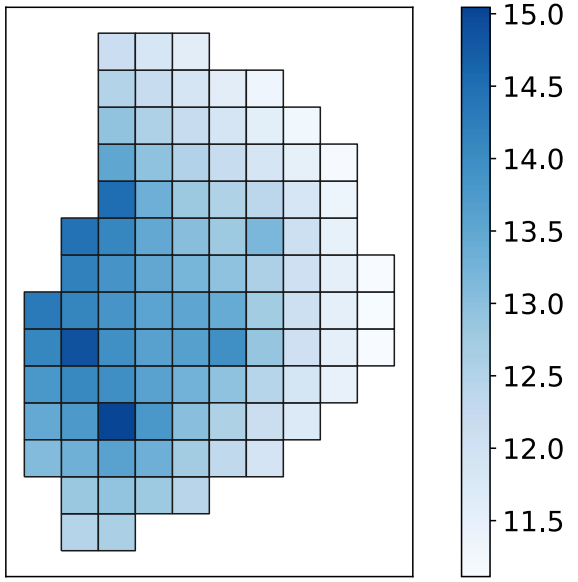
Healthcare



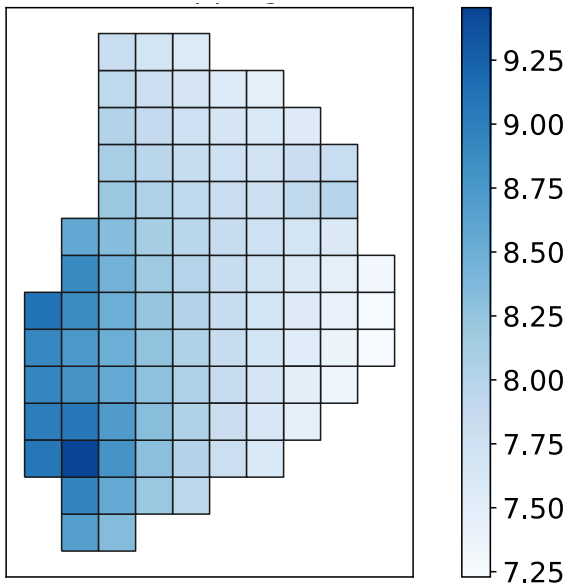
Personal care



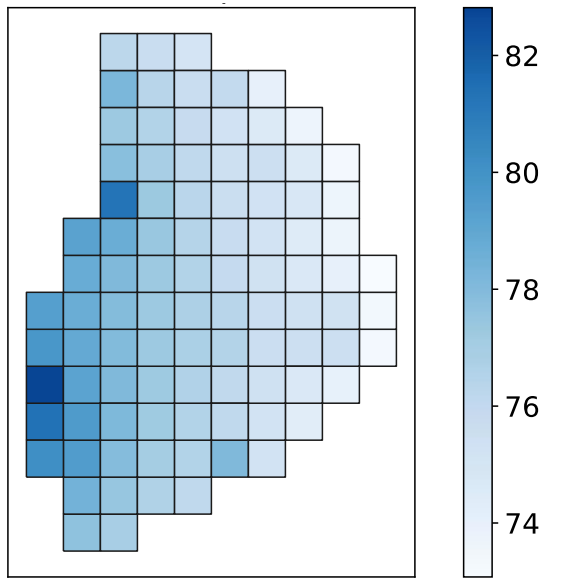
Recreation



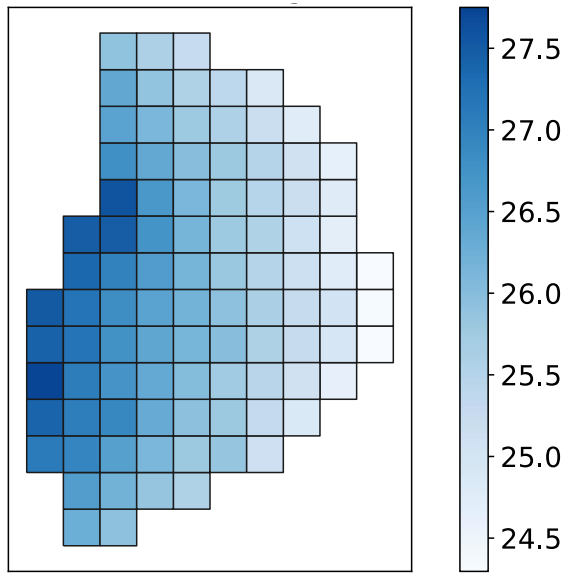
Shopping



Transport



All services, average



5. Discussion

Conclusions and recommendations

1. Number of essential services are good- but without strong identifiable spatial patterns
2. Services have not been placed considering nearby population density
3. Most accessible services: Transportation and Recreation
4. Least accessible services: Shopping, Commercial services, and Education
5. Qualitative data would be more valuable to identify where improvement is exactly needed
6. Construction of more essential services within the district itself, not the periphery
7. Transformation of the area from an almost purely residential district into a thriving mixed-use neighbourhood