Simulating Social Systems with Matlab - Residential Segregation in Zurich

by

Brechbuehl Sonia and Buechi Jonathan

Semester Project

Fall Semester 2013

Chair of Sociology, in Particular of Modeling and Simulation, ETH Zürich, 2012

Supervising Assistent: Woolley Olivia
Further Assistent: Kuhn Tobias

Simulation of Residential Segregation
using an Agent Based Model in Matlab
blabla

Brechbuehl Sonia, Buechi Jonathan

Chair of Sociology, in Particular of Modeling and Simulation
SOMS, ETHZ
Zurich, Switzerland
2013

ABSTRACT blabla Abstract Abstract Abstract

Contents

1 Individual Contribution

2 Introduction and Motivation

The segregation of people in living areas of cities is a well known phenomena which was investigated strongly in the past. Because we are living in Zurich we would like to find out more about the social situation here. Zurich is a multi cultural city, many people from different origins and social backgrounds are living here. A combination of circumstances and characteristics of people makes their segregational behavior a complex problem. In order to investigate this interactions, in this paper a general model based on the data of Zurich and tries to simulate their segregational behavior due to differences in age, family state and origin.

2.1 Theory

2.1.1 Residential Segregation

Residential segregation can be a result of different origins. Firstly there is the non-tolerance of people towards others of different religion, origin, color, sex, age, income, language etc. It is clear that this segregation aspect is due to individual choices that discriminate [1]. Segregation can also be economically determined, e.g. by housing prices in certain areas, such that certain people can not afford to life in expensive areas which are mostly also more attractive i.e. "better". Like this one can often observe ghetto formation in bigger cities.

This paper only treats the segregation that results from forms of discrimination. The people in the model have different origins, age and family state and a certain tolerance to accept people which are different from themselves in their direct neighborhood i.e. among their first order Von-Neumann neighbors and also in the whole district they are living in.

2.1.2 Agent Based Modeling

Residential segregation is a dynamic and interactive process. Therefore one has to make use of a model which considers each of the actors in it as an autonomous individual,

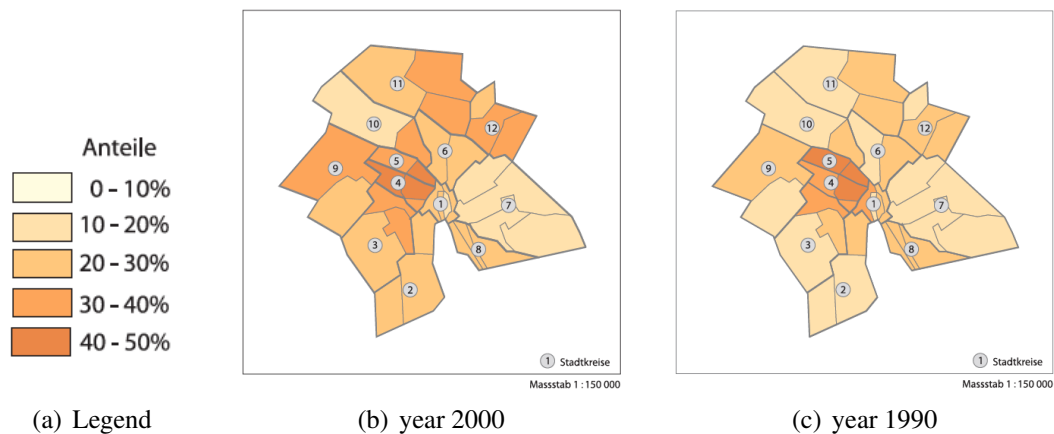(a) Legend   (b) year 2000   (c) year 1990

Figure 1: Foreign resident population in the twelve districts of Zurich [5]

who makes decisions and then moves accordingly in the next timestep. Agent based Modeling (ABM) was firstly used in the late 1940s and is a way to simulate autonomous agents, their actions and interactions with each other and the environment in a system and therefore tries to see the results of this in macro-level phenomena [2]. In this way, ABM is a good choice to simulate dynamically the discrimination based segregation in an area due to choices of the agents [3].

2.1.3 Segregation in the city of Zurich

Using the results of studies done by the statistical department of the government of the city of Zurich [4] and [5], one can easily see that the actual situation in Zurich is quite much segregated.

In figure 1 part b) one can see as an example the foreign resident population in the different districts of Zurich in year 2000. There are districts with very little foreign population like the districts number 7 or 10 and in others like 4 live up to 50 per cent foreigners. Looking at statistics about family situation and age distribution, there is also a segregation visible. Furthermore, comparing the numbers from year 2000 to earlier statistics one can observe trends and movement among the inhabitants. In figure 1 the foreign resident population in year 1990 is shown in image c).

An even bigger difference one can see in the data on the income, wealth and social state of the inhabitants. This aspect, however, is not treated in this work.

2.2 Research Questions

One of the main goals of this project is to find out whether there can be seen different segregational behaviors due to the choice of the tolerance parameter of the agents. In the model there will be six tolerances, three for the Von-Neumann neighbors, one for each criterium, and three for the differences from the agents characteristic and the respective average of all agents in the district. Can segregation be seen in the same extent if one looks only on the district average and not considers the Von-Neumann neighbors (this latter case is what Schelling was been doing in [1] for one dimension).

3 Methods

3.1 The Data

The simulations are run with data provided from the statistical department of the city of Zurich. The data is given as can be seen in table 1. The first column represents the statistical zone, the second column the family state, the third the origin, the fourth the age and the last column the number of persons form whom these criteria are true.

Table 1: Example of data used in the simulation

Statistical Zone	Family state	Origin	Age	Number of people
11104	Einzelperson	SchweizerInnen	45.45695	1661

The age (column 4) is always averaged over the number of people for which the other three criteria (stat. zone, family state and origin) are true.
Unfortunately, it was not possible to get more detailed data on the age as well as data on the income and wealth of the people.

3.2 The Model

The model used is an agent based model with the agents representing each an inhabitant of the city of Zurich. They have three characteristics: An origin, i.e. Swiss or foreign, a family state and an age. Due to reasons explained in the previous section, the

places where they are put in do not have any characteristics the agents can interact with. However, the city of Zurich is divided into twelve districts (see the twelve "Kreise" of Zurich").
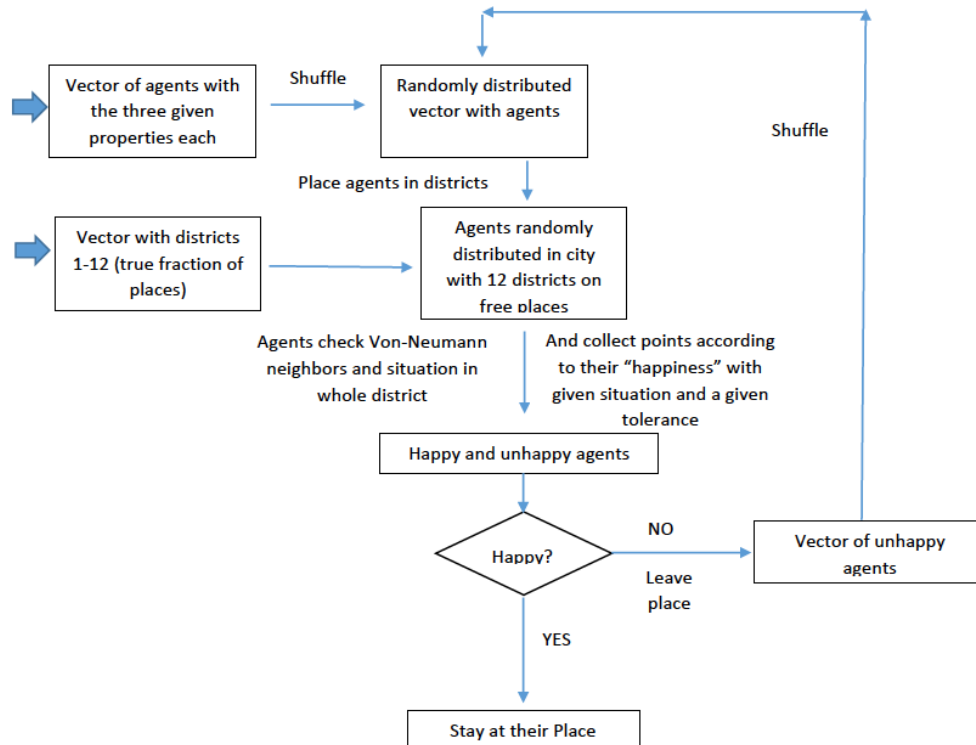
Figure 2: Schematic overview over the model

3.3 Implementation

4 Results

5 Discussion

5.1 Conclusions and Outlook

References

[1] Thomas C. Schelling: Models of Segregation, *The American Economic Review Vol. 59, No 2, Papers and Proceedings of the Eighty-first Annual Meeting of the American Economic Association*, **1969**, pp. 488-493

[2] Li Yin: The Dynamics of Residential Segregation in Buffalo: An Agent-based Simulation, *Urban Studies Journal Limited*, **2009**, pp. 2749-2270

[3] Mark Fossett and Warren Waren: Overlooked Implications of Ethnic Preferences for Residential Segregation in Agent-based Models, *Urban Stud*, 42: 1893-1917

[4] Stadt Zürich, Präsidialdepartement, Statistik Stadt Zürich: Essential Zurich 2013, **2013**

[5] Corinna Heye, Heiri Leuthold: Segregation und Umzüge in der Stadt und Agglomeration Zürich