Zürich on the move

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Abstract

Big cities like Zurich attract people from different backgrounds and walks of life. Tracking their movement through the districts of the city can tell us a lot about the city and about people themselves. In this report we use age, gender, marital status and home districts to analyze the distribution of different subgroups of the population. This information reveals details about the demographic of the city and its changes over time.

We use the data to simulate what path a person living in Zurich in the years from 1993 to 2016 might take through the districts of the city. Our simulation takes into account the effects that major events like marriage and children have on people's decisions. We generate 1000 random paths for two different scenarios and compare their outcomes.

1 Introduction

With an overall population of 415,682 (2016) the City of Zurich is Switzerland's largest city. Zurich is home to a strong international banking and finance sector as well as major Swiss and international corporation. Zurich has been repeatedly listed amongst the most attractive and 'livable' cities in the world. As a result Zurich attracts people from within Switzerland and around the world.

The city Zurich is divided into 34 statistical districts (Stadtquartier) that are grouped into 12 boroughs (Kreis). The district sizes vary from 650 to 32,000 residents.

Statistical overviews for overall population sizes, ratio of foreigners etc. are easily available on Wikipedia, see (Subdivisions of Zurich, 2017), or more detailed overviews are provided by the City of Zurich, see (Kreise Quartiere, 2017).

Our project focus on using the subdivision of the data into age, gender and marital status to analyze individual subgroups such as young professionals or families. Moreover, we are interested in changes in the population and movement data over time and seeks to identify which districts attract some groups of people more than others.

2 Data collection

For our project we used data sets on population movements available on "Open Data Zürich" (https://data.stadt-zuerich.ch/dataset). Three data sets captured the number of people moving to Zurich from outside (Set 1), people moving within Zurich (Set 2), and people leaving Zurich (Set 3). The data in these data sets is subdivided by year (1993-2016), districts (to or from which a moved took place), age groups (10 year bins), gender and marital status (Single, Married, Divorced, Widowed). For Set 1 and Set 3 detailed data on the origin respectively destination of the people is available but was not used.

We compared this data against the population data for Zurich (Set 4), which is subdivided by year, district, age and gender.

Sets 1 and 3 contain around 500,000 data points across 24 years, while sets 2 and 4 contain around 300,000 data points.

The original data was given in German. We translated the column names and the descriptors of the main features like marital status, Swiss/Foreign to English. Geographical names were not translated. Throughout this report we refer to the 34 Stadtquartiere as districts, while bigger units are referred to as Kreis.

2.1 Dataset description with summary statistics

From 1993 to 2016 the population of Zurich has increased from 360898 to 415682, see table 1. Between 1993 and 2004 the overall population was

stable, and the influx and outflow of people was balanced. Since 2005 the population has steadily grown at a rate of 4000 people per year, 2000-3000 of which arise from net-migration, while the remainder stems from higher birth rates, see figure 1.

Figure 1 shows the number of people moving to, within and out of Zurich in the time span 1993-2016. The moving in ratio is basically the same, at a level of 10 %. But there are less people moving out in 2016 compared to 1993. The total number of people moving in varies over the years. The ups and down of these numbers appear to track the movement of the Swiss performance index. In particular we can see two major drops in the total numbers: a) around 2000-2002 following the burst of the dotcom bubble and the 9/11 terrorist attacks; and b) during the financial crises in 2007-2008.

Table 1: Table comparing the number of people living in Zurich, moving to, from and within Zurich for 1993 and 2016.

Year	1993	2016
Total population	360898	415682
Incoming	35797	42318
Outgoing	35738	39038
Moving within	39716	45571

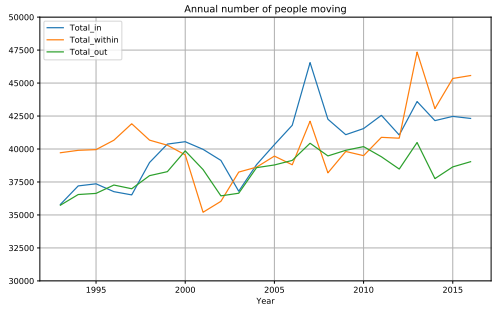

Figure 1: Annual number of people moving

3 Methods with math and description of main algorithms

For our analysis we look at specific subsets of the population according to demographic criteria. We use the groupby command in pandas to calculate totals or percentages of different subsets. We compare results for subsets against each other as well as against larger sets or the overall population.

In order to spot and analyze trends we tracked the evolution of particular values over time and plotted them against each other for comparison. Since the population has increased significantly in recent years, we worked predominantly with relative changes, measured in percentages. This allows us to capture whether a feature has followed the overall trend of the population or a group, or deviated from this trend.

For the storyline we created subsets for specific combinations of parameters (age, gender, marital status and district). We calculate their distributions within and across different datasets in order to obtain probability distribution. These were then used to generate random paths through the Zurich districts over time.

4 Results and findings

4.1 Analysis by feature

Age: In all 3 moving scenarios the dominant groups are young professionals ('20-29') followed by mid professionals ('30-39'). Around 50% of people moving to Zurich are '20-29' and 25% are '30-39'. For people moving within Zurich the portion of '20-29' has dropped from 40% to 34%, while that of '30-39' has risen from 25% to 30%. '20-29' are also less likely to leave Zurich, with their share dropping from 45% to 35%. So overall the young professionals have become more settled and stay in Zurich for longer, while '30-39' move more often in recent years.

For young professionals the city center is far more popular than the outer parts of the city. Of the city district Hochschulen and City is the most popular.

The mid professionals move mostly within the city center except for Hochschulen and City, which are unpopular districts for this age group.

The senior professionals like to move to the outern part of the city, where they prefer the nothern part of Zurich.

Families with older children ('10-19') move more often to Zurich then families with young children ('0-9'). But families with young children are almost twice as likely to move within Zurich or leave Zurich altogether. Within Zurich, families prefer to move to the outer districts in particular Saalten, Friesenberg and Leimbach.

The group 60+, pensioners or those close to retirement, is least likely to move into Zurich, and generally this group does not move as much.

When they move they prefer the outer Southern parts of the city while the city center is not very popular with them.

Gender: There are more women in Zurich then men, but their proportion dropped from 52.5% in 1993 to 50% in 2016. In contrast women are far less likely to move than men. Men are more 'nomadic', while women stay for longer in one place.

Langstrasse and Rathaus are more popular amongst women while Hochschulen and City are more popular with men.

Single vs Married: Singles adults make up around half of the population, while couples form around 20-25%. Single adults prefer the center and districts in Kreis 6, 7 and 8, while couples prefer Northern and Western districts and avoid the inner city.

4.2 Origin of people moving to Zurich

In 2016, the majority of people moving to Zurich were naturally from Switzerland (22000). Most of the foreigners (20500) moving to Zurich come from Europe (13500), amongst these Germans are the most frequent movers.

Looking at the people moving to Zurich per 1000 inhabitants, the inner city districts are generally more popular. This trend is particularly pronounced for Europeans. Swiss people distribute more evenly across all districts.

4.3 Distribution of foreigners

In the late 90s foreigners and Swiss people lived more separated. Foreigners made up 40-50 % of the districts in Kreis 4 and 5, while they only represented 15-25 % in other districts. Over time the distribution of foreigners has homogenized and they now represent around 30% of most districts.

4.4 Movements at district level

The inner districts see the highest turn over rates of their population. In particular, for 20-29 year olds in the districts Rathaus and Langstrasse we observe more moves registered than people of that age group living in those districts, as many spend less than a year there before moving on or leaving Zurich.

When we look at the data on a district to district basis then we can see that regardless of size people most often move within their home district. Beyond that moves most often involve Kreis 3 to 6 or 10, 11 and 12.

4.5 Storyline

As shown above different groups of people exhibit different moving patterns. In addition, the priorities and behavioural patterns of individuals change over time. The storyline aims to model these changes by generating a probabilistic path through the districts of Zurich that is influenced by the changing circumstances of the protagonists.

The storyline evolves the personal information (PI) of the protagonists and adapts it according to their life plan. The personal information (PI) contains the year, age, gender, marital status and district of the protagonist. The life plan asks when they will get married, start to have a family and the minimum time they intend to live in the city of Zurich.

The PI is updated and recorded along the storyline, which runs from the initial year of moving to Zurich to 2016. Every year it updates the PI against the life plan. The marital status is set to 'Married' in the year the marriage age is reached.

The data provides no information whether an adult has children and how many children. Therefore model a family as having a single child and we track the movements of any family through the movement of their child. Thus when the 'family age'-parameter of the life plan is reached the age is set to '0', the marital status is set to 'Single' and a gender is generated arbitrarily for the child. The child is then tracked until it reaches the age of 18. Thereafter the protagonists are tracked according to their own PI again.

Throughout the storyline we use the subsets of data that fit the PI. Decisions are generated from probability distributions that compare the sizes of different PI specific subsets. For the initial move to Zurich we generate a distribution of the districts to which people with the given PI move and make a random selection from it. For every following year we generate a probabilistic decision whether the protagonists stay in their place, move within Zurich or leave Zurich altogether. As long as the time spent in Zurich has not exceeded the minimum stay planned for in the life plan, the option of leaving is suppressed in this decision process.

When the number of movers and leavers together form less than 80% of the total population in that district we estimate the number of people not moving at all that year by subtracting the movers and leaves from the total district population. For large districts this method works well.

However as we observed above for the smaller inner districts the numbers of movements by 20-29 year olds can easily exceed their portion of the district population. Thus for levels above 80% we set the number of those staying equal to the overall population. While this approach will not reflect the underlying reality reliably, it does guarantee that all quantities and probabilities remain positive. Moreover this scenario only occurs for a small number of temporary PI and hence affects the overall distributions only marginally.

The overall time that people spent in a city depends on many different factors. The chance of leaving Zurich after just a few years is significant and not surprising as the portion of people leaving each year makes up almost 10% of the overall population. Thus we expect that on average half the people modelled by our storyline have left Zurich after 5 years. Since some people make a conscious decision to live in Zurich for a minimum time (e.g students at the ETH) we introduce a life plan parameter that captures this decision.

We ran 1000 iterations for two scenarios and collected the final district in 2016:

a) A young woman moves to Zurich for her undergraduate studies, finds a job, falls in love, marries and has a family.

Initial parameters: (Year=1993, age=18, gender='F', marital status='Single', married age=26, family age=30, minimum years=13)

b) A couple moves to Zurich to start a family.

Initial parameters: (Year=1993, age=29, gender='M', marital status='Married', married age=26, family age=30, minimum years=10)

In both scenarios the chance of leaving was over 50% (A=52.6%, B=50.7%). In the remaining cases, the districts Affoltern (A=57, B=43), Altstetten(A=55, B=41) and Seebach (A=37, B=44) formed the top 3 in both scenarios. However Affoltern, Altstetten were far more popular for scenario A. In contrast, Höngg (A=20, B=38) and Unterstrass (A=20, B=33) were significantly more popular for scenario B. As was Fluntern (A=1, B=9), which was very unpopular for scenario A. Looking at the absolute differences our map revealed that Western districts, in particular Kreis 3 and 9, were more popular for scenario A, while the Northeastern districts, in particular Kreis 6, were more popular for scenario B. The 3 inner city districts City, Lindenhof and Hochschulen (all Kreis 1) did not feature in either list.

5 Conclusions

Young professionals between 20 and 39 make up 75% of the people moving to Zurich. They prefer to move to the centre, with Hochschulen and City particular popular amongst 20-29 year old. As people start families they move to the outer districts such as Saalten, Friesenberg and Leimbach. Young families are more likely to move or leave Zurich than those with children in middle and high school.

Women tend to move less often than men, while single young professionals move more frequently than families, older professionals or pensioners.

Overall, we see that moving behaviour and decisions are dictated by personal circumstances. In the storyline we aimed to pick this up in more details. The two scenarios (young single female vs young family) we consider for our iterations show that there are similarities and differences, as some districts are strongly preferred by one group or the other.

References

Subdivisions of Zurich, Wikipedia, 2nd September 2017.
<https://en.wikipedia.org/wiki/Subdivisions_of_Zurich>

Kreise Quartiere, Stadt Zurich, 2017.
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