Entry Name: **"FHG-Burmeister-MC1"**
VAST Challenge 2022
Challenge 1

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Student Team: Not purely **(**4 Students + 1 Supervisor)

Tools Used:
MySQL
Python (NumPy, Pandas, Matplotlib)
Visualizations developed by the submitting team at Fraunhofer IGD with D3, Three.js, Matplotlib
TypeScript libraries for common statistics developed at Fraunhofer IGD
Web development by the submitting team with TypeScript React, Node.js and Python

Approximately how many hours were spent working on this submission in total?
200 hours

May we post your submission in the Visual Analytics Benchmark Repository after VAST Challenge 2022 is complete?
NO

Video
https://owncloud.fraunhofer.de/index.php/s/1nE8nSLfCxG5PK2

Use visual analytics to analyze the available data and develop responses to the questions to be provided. In addition, prepare a video that shows how you used visual analytics to solve this challenge.

Questions

1 – Assuming the volunteers are representative of the city's population, characterize what you can about the demographics of the town. Provide your rationale and supporting data. Limit your response to 10 images and 500 words.

Figure 1 - Demography Dashboard

We build an interactive dashboard to first get an overview over the attribute distributions among the participants. Then we drilled down into specific subgroups, to find interesting patterns and correlations.

Age and Family

The age distribution in the town is fairly even (Figure 1), indicating a steady population size. People live roughly equally often in single, partner or family households (size 1, 2, 3). It is notable that people with kids are always living in households of size 3, indicating that we might have mainly nuclear families here. Figure 2 shows the snippets from our dashboard, with the respective subgroup selection.

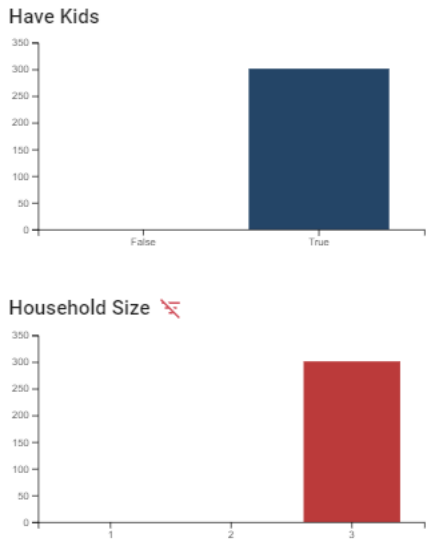

Figure 2 - Households with kids

We found that the educational level slightly affects participants having children, with participants having a higher education being less likely to have children (Figure 3). The fraction of participants having children is similar across age groups (Figure 3), which aligns with the age distribution seen before.

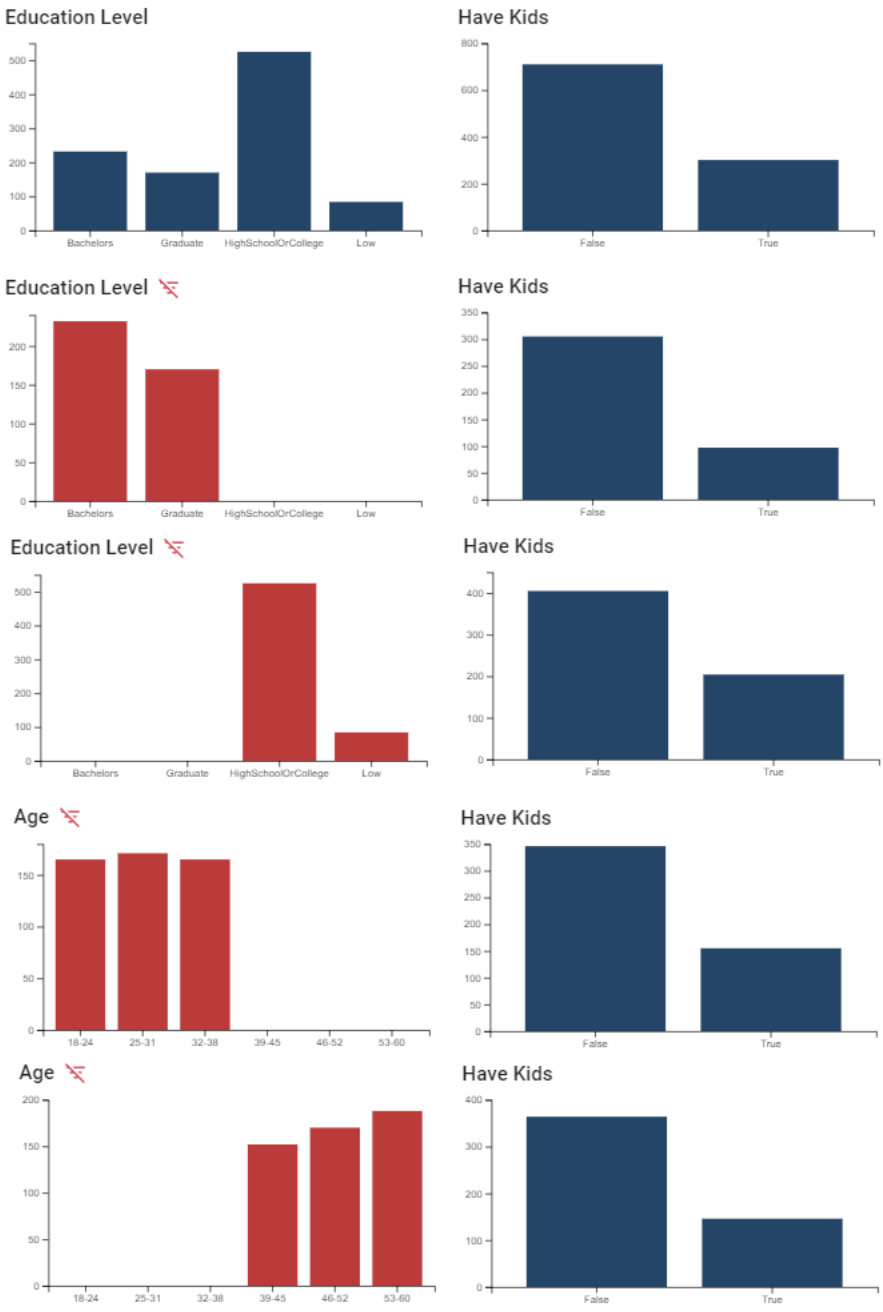

Figure 3 - Influence factors on having kids (one state per row)

Education

The most common education level is “High School or College”. Only a small part of the population has a “low” level of education (Figure 1). About half has a university education. Young adults (18-24) appear to be interested in higher education, with a higher fraction having a bachelor’s degree. Bachelors decline in older age groups, likely in favor of Graduates (Figure 4). Overall, this town appears to host a consistently well-educated population.

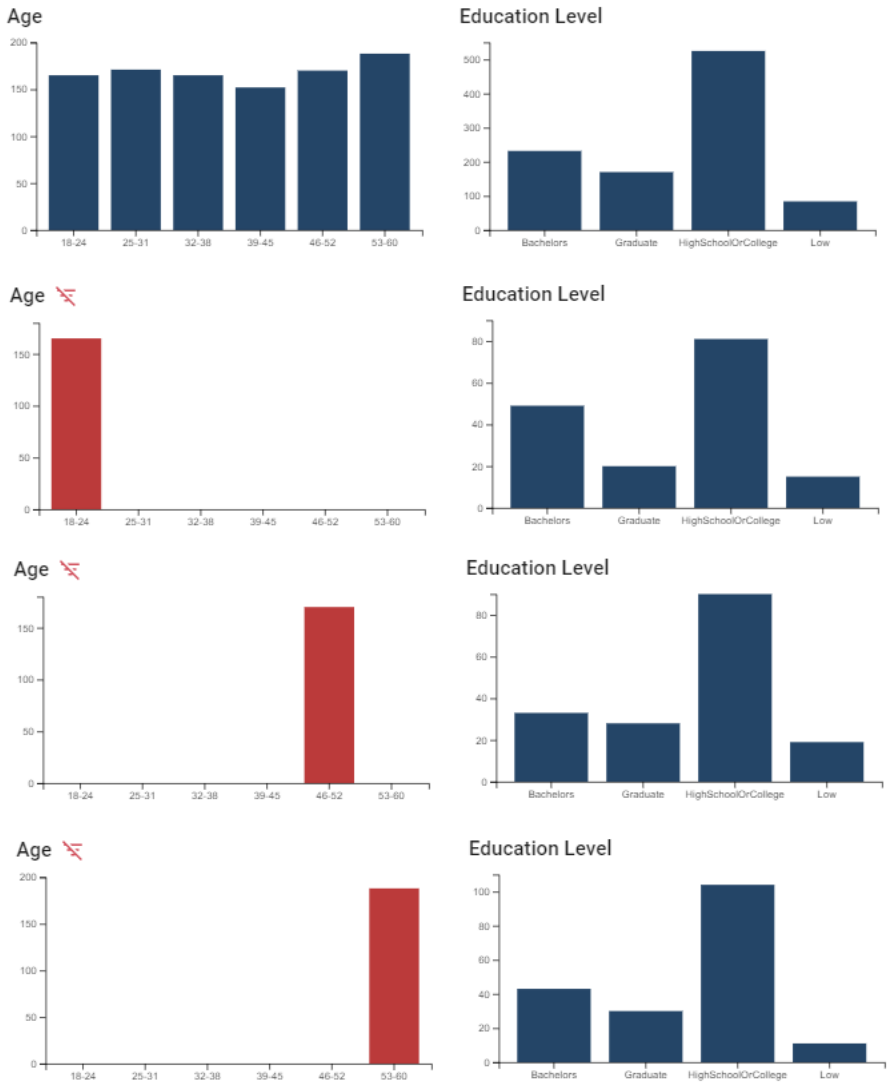

Figure 4 - Influence factors on education level (one state per row)

Financial Status

We have summed up income and expenses for each participant using their financial journal. In Figure 5 the average available balance is visualized for the different education levels. It is apparent that a higher

educational level yields a higher available balance, though every group is able to achieve a positive balance and build wealth in the long term.

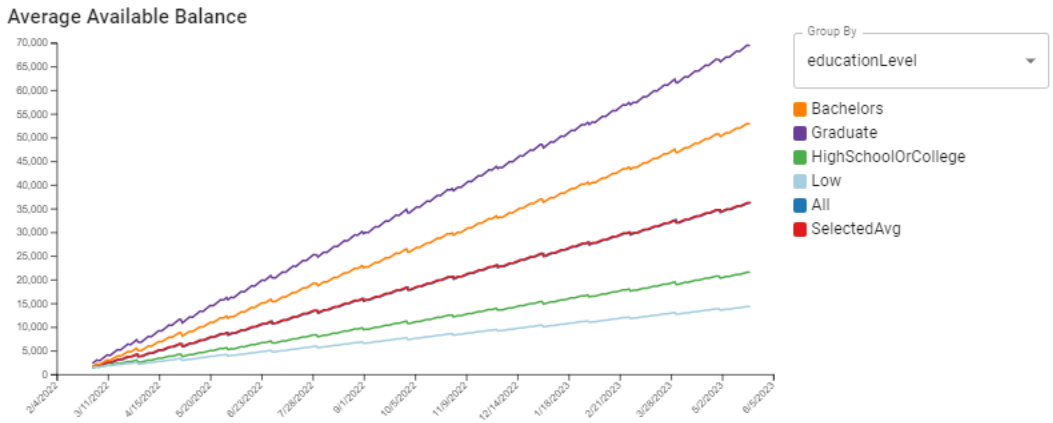

Figure 5 - Financial status by educational level

Figure 6 provides a closer look into the income and expenses of higher and lower educated participants. While costs are comparably similar between both groups, the wage of higher educated people is considerably higher.

Figure 6 - Income and expenses by education level

A common issue is the financial status of families versus singles. Figure 7 shows that there appears to be no financial disadvantage for families.

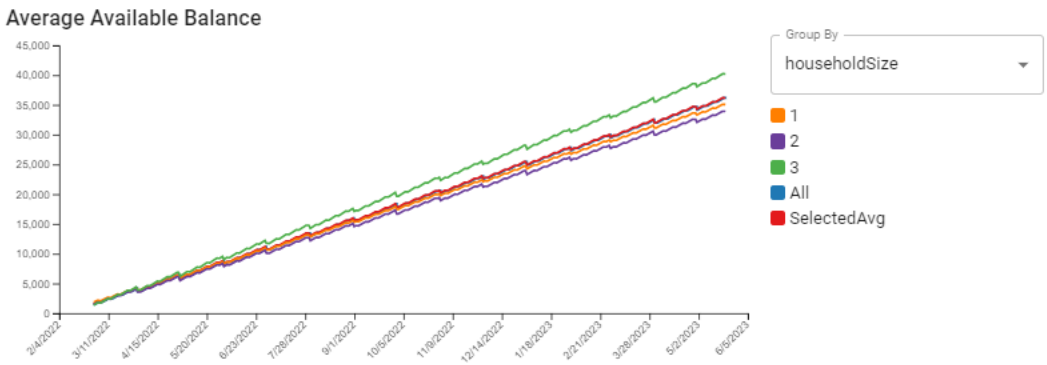

Figure 7 - Financial status by household size

Joviality

The distribution of joviality is about equal (Figure 1). Figures 8 and 9 show that joviality is inversely proportional to economic health: Happier people have higher expenses, lower income and thus a lower available balance.

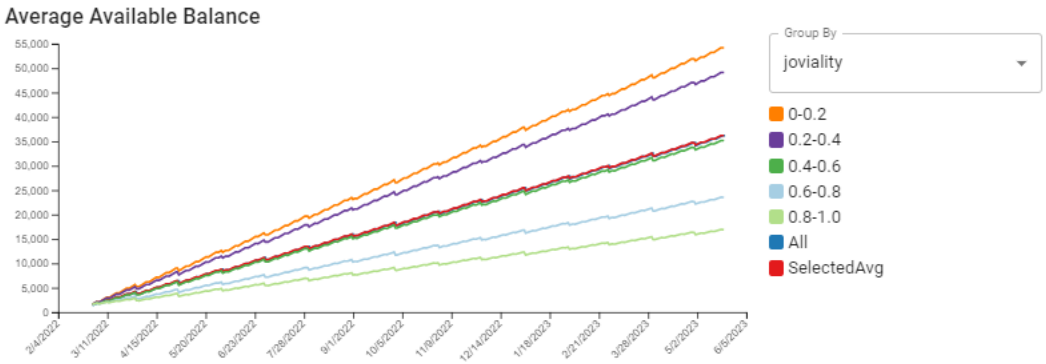

Figure 8 - Financial status by joviality

Figure 9 - Income and expenses by joviality

Participants leaving the study

131 participants did not receive updates after the first month. Those participants must be treated as potential sources of error for further analysis. We discovered that none of them has a higher education, their households are always two persons or larger, and slightly more likely to have children (Figure 10).

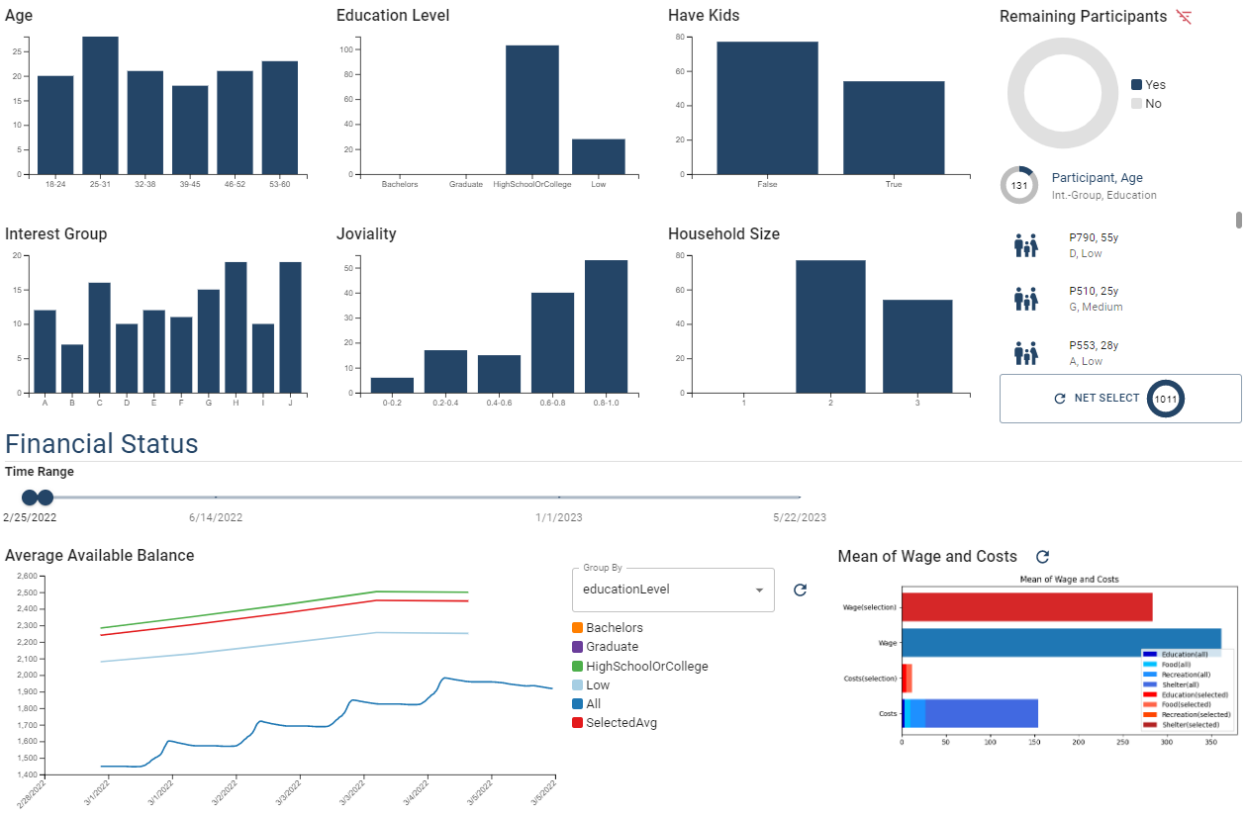

Figure 10 - Statistics of missing participants

2 – Consider the social activities in the community. What patterns do you see in the social networks in the town? Describe up to ten significant patterns you observe, with evidence and rationale. Limit your response to 10 images and 500 words.

Social Network

We used a node-link diagram to visualize the strength of connections between participants. After threshold-filtering on only frequent connections, we categorized the social groups into three social models: Two-point, triangle, and more complex polygons (Figure 11).

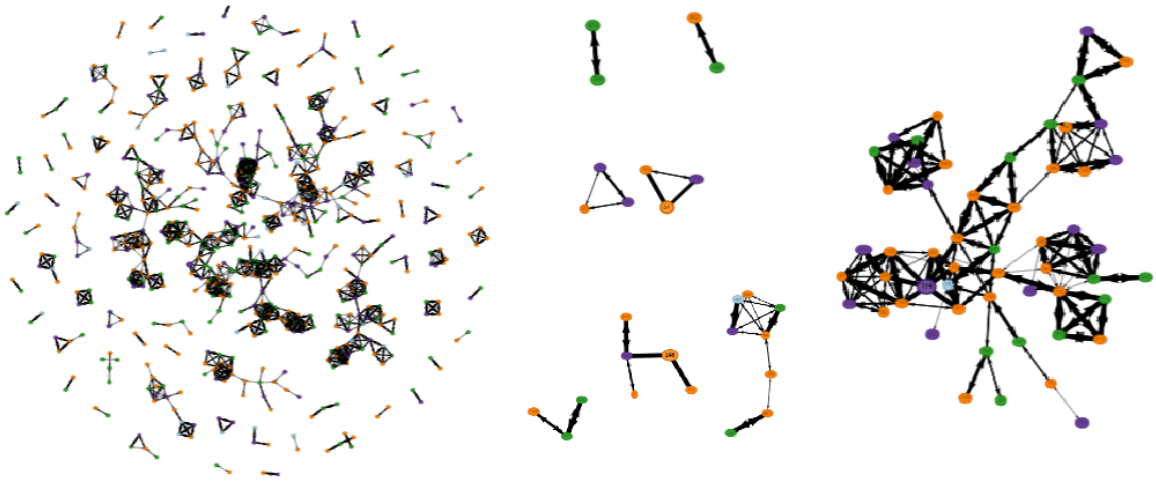

Figure 11 - Social network visualization. The nodes are colored by attribute (e.g. education levels), the strength of the edges displays the frequency of interactions between participants.

When looking at the entire timespan of the study, we found that there are three larger social groups (Figure 12). By plotting their residence locations on the map, we can see that people in the same social network commonly also live in the same area.

One group, whose residents are located at the northwest of the town, consists of mainly higher educated, single, and elder people. Those located in the center of the city (urban area) are lower educated, either really young or really old and more happy (that means they are poorer in some way). Those who are located at the southeast of the town are like those who live in the urban area, except that they are more likely to have a partner.


2D
3D
DEMOGRAPHY
NETWORK
BUSINESS
GASTRONOMY
Age
Education Level
Have Kids
Remaining Participants
Interest Group
Joviality
Household Size
Social Network
BUILDINGS
LINKS
Time Range
Frequency
Bachelors
Graduate
HighSchoolOrCollege
Low

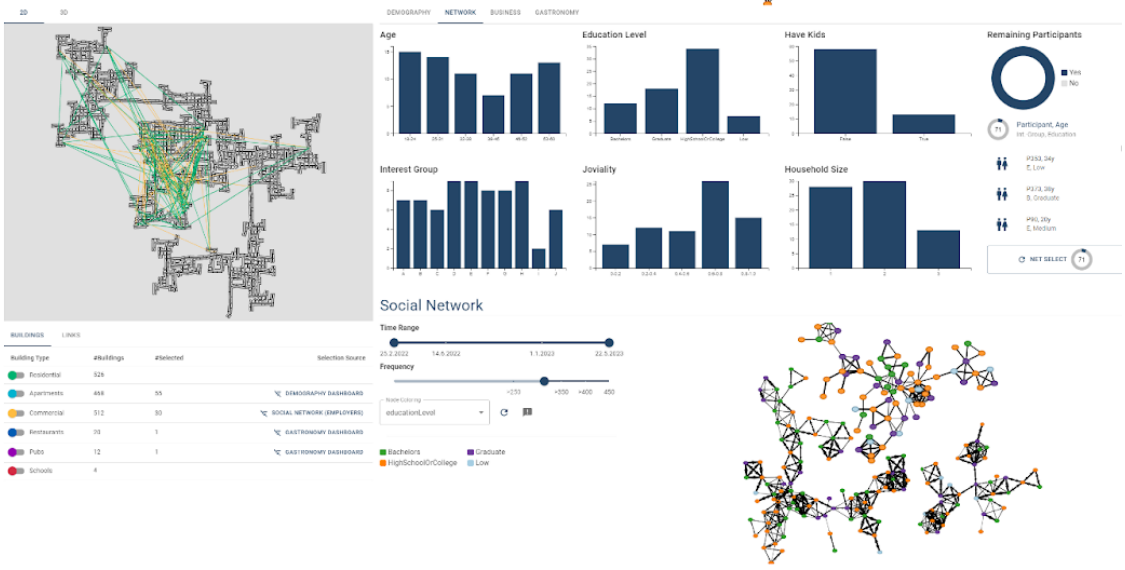
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Figure 12 - Social groups and their locations/statistics. Green lines on the map connect participants' residences, yellow lines residences with their workplace.

One potential reason why social groups are centered in one small area might be because they share common employers. The connections within the social networks are notable similar to the connections between residence and workplace.

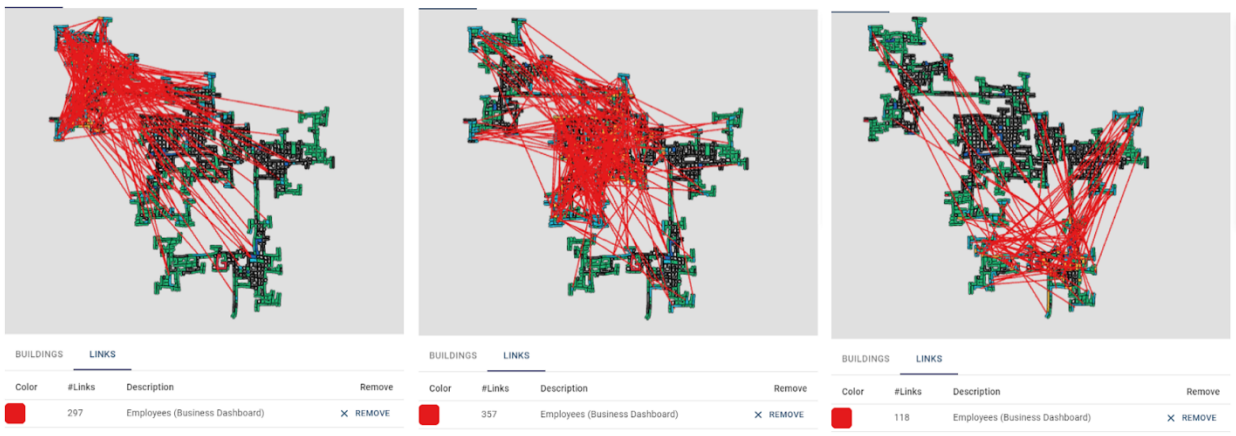

Figure 13 - Connections between residences and workplaces for different city areas

Pubs and Restaurants

In addition to "with whom" are people spending time, we also wanted to know "where". Figure 14 shows our gastronomy dashboard. It can be observed that most residents consistently visit restaurants and pubs over the timespan of the study. Restaurants are visited all around the week, whereas on weekends, the participants go to pubs - preferably in their local neighborhood (see Figure 18, next section).

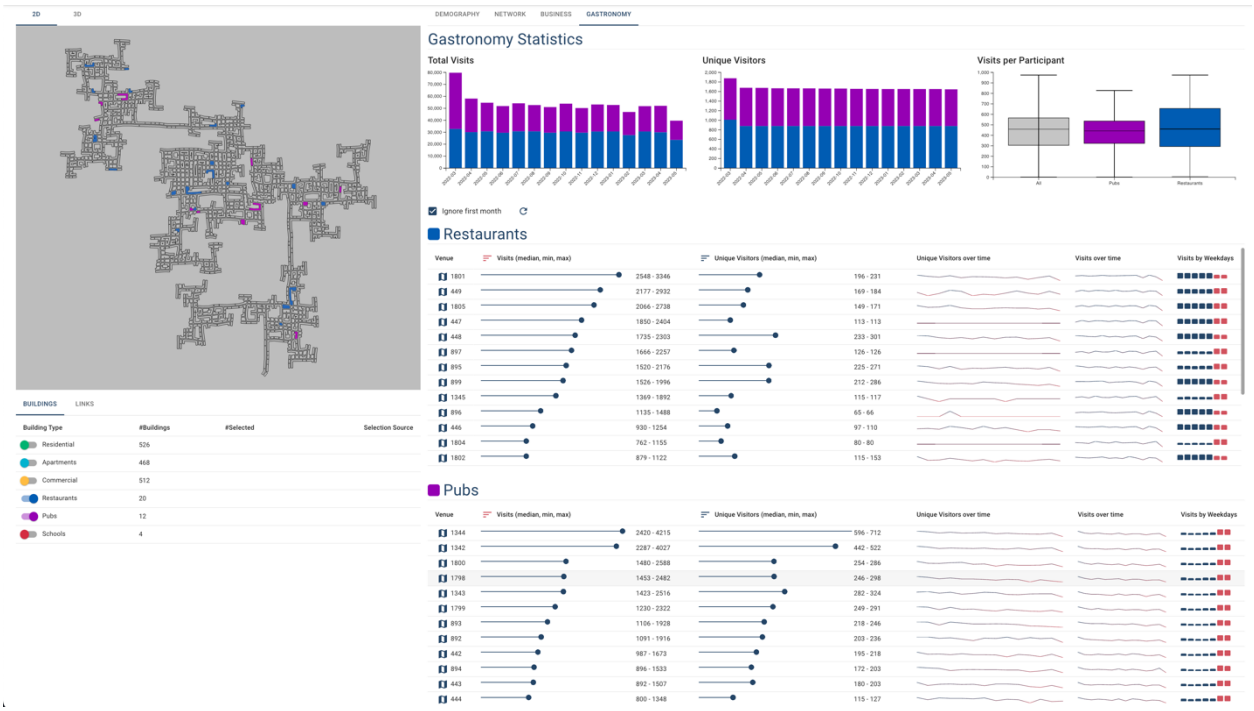

Figure 14 - Gastronomy dashboard

3 – Identify the predominant business base of the town. Describe patterns you identify. Limit your response to 10 images and 500 words.

Commercial Areas

The commercial area of the town is mainly located in the northwest, center and southeast of the town (Figure 15). About 70% of the commercial area is in the city center. It can be seen that most of the commercial areas in each region are in more central locations, and the residential areas are located at the edges around commercial clusters. The most crowded residential areas are in the northwest and in the city center. There are not many empty residential buildings, and they are mainly located at the edge of the town (such as the southern, eastern and southeastern residential areas), while the residential buildings near the commercial areas are all occupied.

Figure 15 - Areas of the city. In 3D the height of a building describes the number of units

Job Market

Figure 16 shows our business dashboard. If the number of jobs and accumulated salary (over all jobs) is an indicator, then we see a quite equal distribution of large and small businesses in the city. Most companies currently offer jobs, which is a positive outlook for the economy. Less positive is, that almost three quarters of all jobs pay below 20$ hourly rate, which is below the current minimal wage for this area.

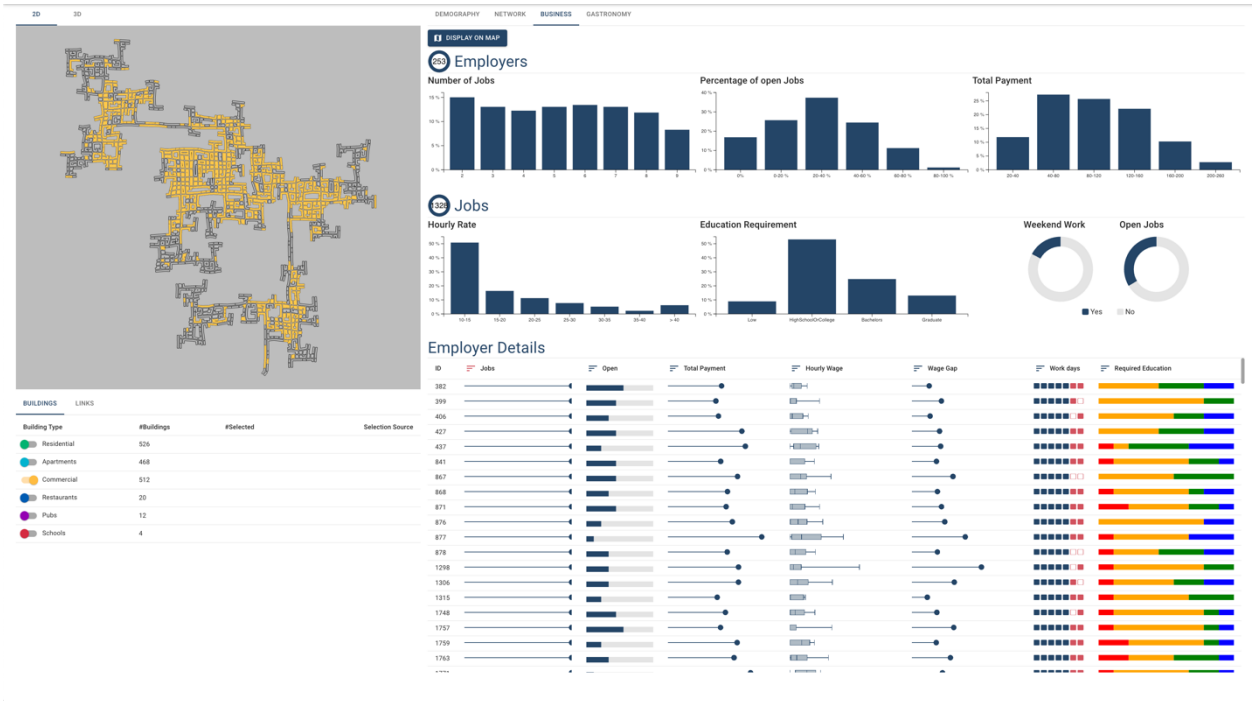

Figure 16 - Business dashboard

In Figure 17 we have explicitly filtered for open jobs. It seems that especially those low-paying jobs seem to be in demand by almost all kinds of companies in all areas of the city.

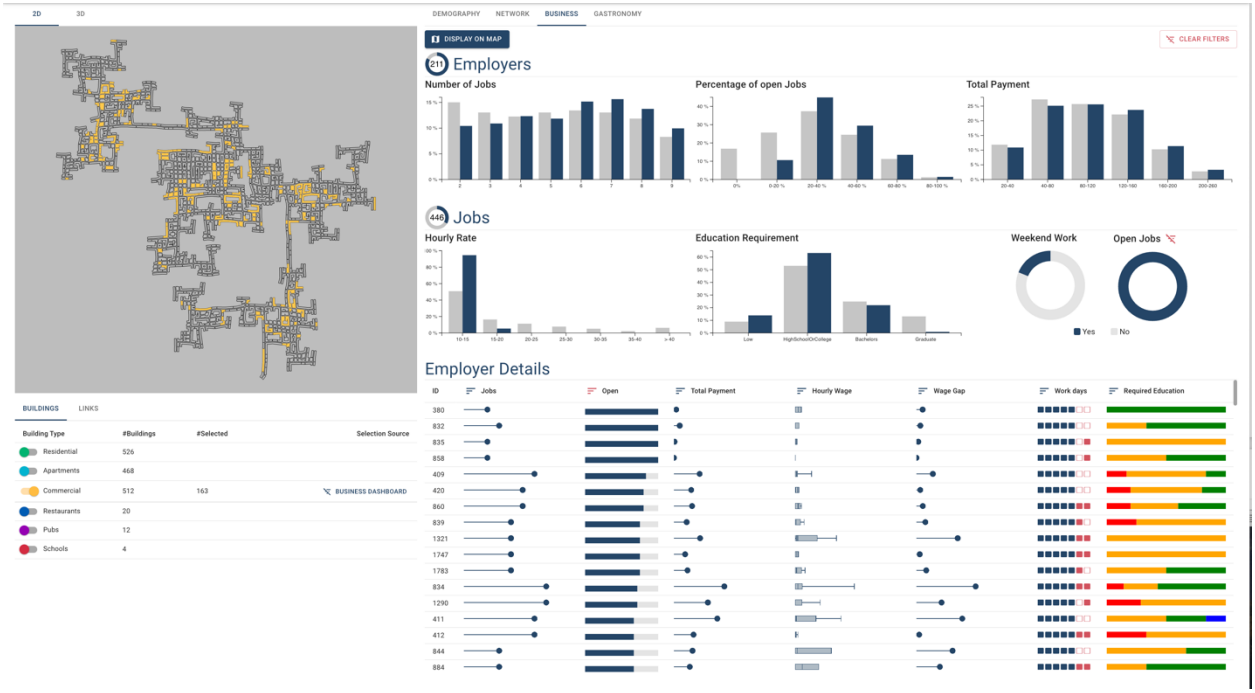

Figure 17 - Statistics for open jobs

Pubs and Restaurants

In the city there are 12 pubs and 20 restaurants, scattered across the city without any noticeable cluster (Figure 14). As presented in the previous section, the peak business hours for pubs are on the weekends, serving mainly local residents. In Figure 18, we can see that the two largest of them are very popular across the city, with people living in almost all areas of the town visiting these pubs.
Restaurants do not display that type of locality, and welcome guests from all over the city. Most venues also see a relatively uniform distribution of visits across the week. Usually there is either slightly less business on either weekends or weekdays, with some notable exceptions, where the difference is significantly larger.
In general, business is quite reliable for gastronomy. The number of visits and unique visitors stays remarkable stable across the timespan of the study (Figure 18). The only outliers are the first month, which includes the participants later missing (see first section), and the first month, which is incomplete.

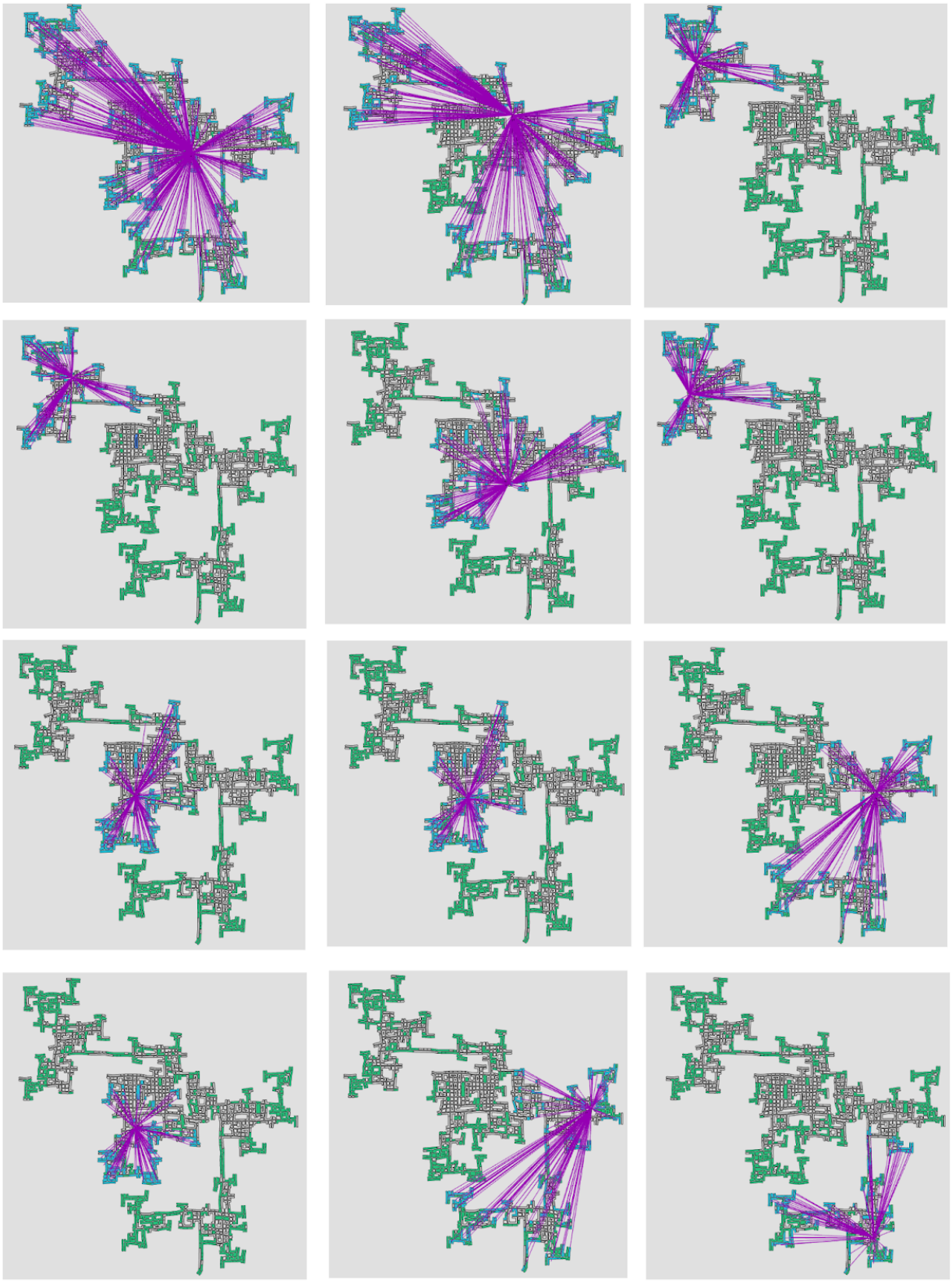

Figure 18 - Visitors of pubs

4 — From your answers to questions 1-3, assemble a one-page summary that provides the key information to share with residents about the town.

The city of Engagement has a **stable population**, meaning it is neither growing nor shrinking. People are about equally often living single, with a partner, or a family of three. Family structures seem remarkably stable (if one assumes from the distribution that no family has more than one child). The **education level is relatively high**, with the majority of participants having at least a high school or college degree. About half of the participants even have a higher university degree. Young people also seem willing to pursue higher education.

Higher Education in this town is the path to a higher salary and towards a job that will less likely include workdays on the weekends, i.e., a more favorable work-life balance. However, even with a lower education level and the town's employers having a large number of below-minimum wage jobs, people are able to close their days with a **positive financial balance**. In fact, one can observe the interesting phenomenon, that people with less money are happier in this city. The trend of employers looking **increasingly for low-paying jobs**, might still be a concerning information for the town.

Affordable living might also be the reason that pubs and restaurants see **steady visits every month**. Pubs and restaurants play an important role in the social life of this city. Pubs act as **local center for their neighborhoods on the weekends**, whereas restaurants (and the two largest pubs) attract people from all over the city on every day of the week. **People tend to either bond in small groups** (two or three people), or are part of **three large social networks**, that are centered in different areas of the town – potentially related to common local employers.

The residential areas are mostly at the edges the town, surrounding a local cluster of commercial buildings. The number of residential and commercial buildings is almost the same, with commercial buildings having the tendency to cluster together, most recognizable in the city center.

A concern for data analysts might be 131 participants, for which no information is available after the first month. Those people display distinctive characteristics in education, financial and family status, and might distort analysis results.