Visualizing Urban Dynamics: Unveiling Patterns and Opportunities for Urban Planning in Ohio

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Abstract— This paper provides a comprehensive analysis and implementation of the VAST Challenge 2022 [1], based on an urban planning dataset of a fictional town of Engagement in Ohio. It highlights the implementation of visual analytics techniques to summarize the demographics, spending habits, and patterns of life.The analysis uses visual analytics tools such as Tableau and Python to provide insightful visualizations and interactive dashboards. The findings highlight the relationships between education and wages, the distribution of rental costs across apartment types, and the impact of spending behavior on the city's economy, distribution of schools in the city, restaurants and pub expenses. The study contributes valuable insights for informed decision-making in urban planning and development in Ohio. The dashboard can be accessed here - https://tinyurl.com/iste782team8

Index Terms— Visual Analytics, Ohio, Tableau, Python, dashboard.

1 Introduction

The challenge [1] describes the fictional town of Engagement in Ohio, which is preparing for rapid growth in the future. To assess what measures need to be taken in order to be better prepared, the city has started an urban planning exercise in which people from the city can volunteer to participate.

The goal of the study is to understand the current situation of the city and identify areas where development can be done. To this end, the city has built an app that collects data from about 1000 users and creates logs of their daily activities. This data is then used to create visualizations to help determine where improvements can be made.

2 Dataset Description

The data source contains comprehensive information on the activities and attributes of residents in Ohio. It includes participant logs, and various attribute details providing significant insights. It also includes information about journals providing insights into the lifestyle pattern of residents. With data on around 1,000 participants, the data source is organized in multiple files as shown in Table 1.

DataSource	Description	Files
Activity Logs	Information about the status of each participant over the data collection period.	72
Attributes	Information about apartments, buildings, employers, jobs, participants, pubs, restaurants, and schools.	7
Journals	Information about check-ins, financial transactions, social networks, and travel	3

TABLE 1: Dataset Description

The dataset was subjected to Exploratory Data analysis, data cleaning, and preprocessing using Python.

3 Visual Analysis Using Tableau

Based on the comprehensive dataset collected from residents of Ohio, various visualizations were created to analyze and explore different aspects of urban planning.These visualizations enabled us to address research questions related to the dataset and gain a deeper understanding.

3.1 Research Questions

A) How does the hourly average wage vary across different education requirements among our participants? *:* The bar chart shown in Figure 1 illustrates the average hourly wages across different education requirements among our participants.This visualization reveals that individuals with higher education tend to have higher average hourly wages.By understanding this analysis, urban planners can focus on promoting education, skills development, and workforce planning to attract higher-paying job sectors. This can reduce wage disparities and foster economic growth, and improve overall socio-economic well-being, creating a prosperous city.

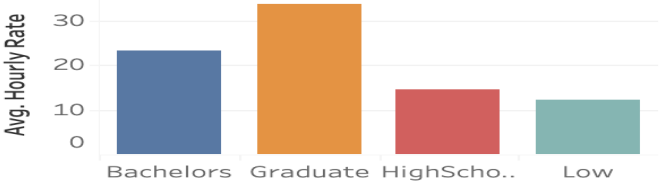

Fig. 1: Visualization to analyze average hourly wages among different education requirements.

B) How does the average rental cost vary with the number of rooms in residential properties? *:* The visualization depicted in Figure 2 provides valuable insights to both tenants and landlords.It can be observed that there is a clear trend where the average rent decreases and the number of rooms in the property increases.This inverse relationship allows individuals to explore more cost-effective options by opting for properties with a higher number of rooms. Landlords

can also benefit by adjusting their rental price strategies accordingly. This visualization aids urban planners in understanding the rental market dynamics and making informed decisions regarding housing policies and resource allocation.

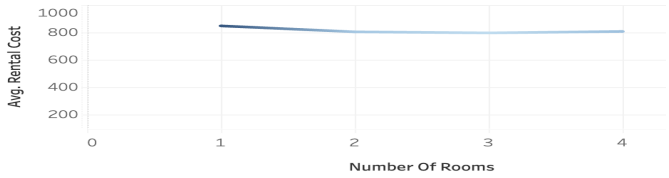

Fig. 2: Visualization depicting the relationship between average rental cost and the number of rooms in residential properties

C) How do the patterns of spending habits differ across the different demographic groups among our participants?: The visualization depicted in Figure 3 reveals variations in expenditure patterns among our participants. While food and recreation expenses are minimal, education expenses are relatively higher and consistent. There are significant fluctuations in rental prices over time. Also, shelter expenses surpass education expenses. The wage level is positively associated with higher spending. This visualization helps urban planners in resource allocation, socio-economic analysis, and retail and service planning creating a more inclusive and sustainable urban environment.

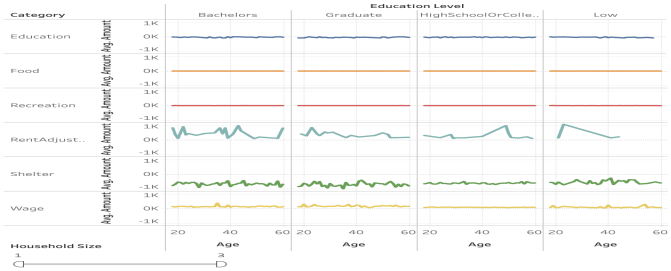

Fig. 3: Visualization of Spending Patterns among Participants

D) How are schools distributed among other buildings in the city?: Figure 4 depicts how schools are distributed across the city among other building types. The red dots represent the locations of the schools while the blue dots represent residential buildings and the brown dots represent commercial buildings. This visualization shows that across the entire city, there are only 4 schools that are not uniformly distributed. This will help urban planners to easily understand which areas of the city require new schools to lighten the burden on the already existing schools and reduce travel time for students.

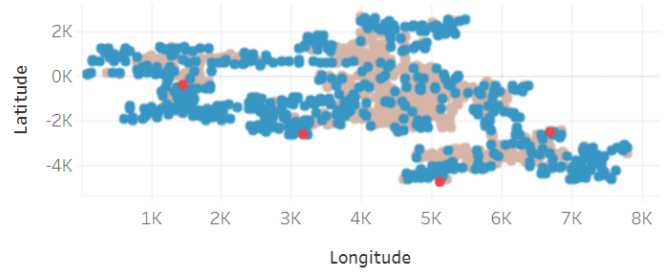

Fig. 4: Visualization of the distribution of schools in the city

E) How do food prices vary across different restaurants in the city, and how do hourly costs in pubs differ across the city?: Figure 5 shows the variation in prices across the various restaurants and pubs across the city respectively. These visualizations can be used by planners to identify if restaurants and pubs cater to individuals with varying financial means.

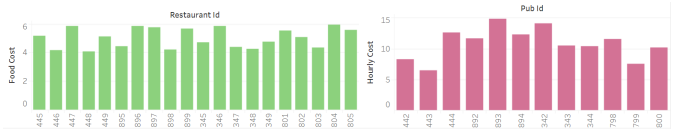

Fig. 5: Visualization of the variance in food price and hourly costs across restaurants and pubs

F) After observing all the above data, what improvements can you suggest for the city of Engagement to be able to deal with future growth?: These are the improvements we would like to suggest for the city: A) Urban planners can focus on promoting access among residents to higher education and collaborate with local employers to create more job opportunities. B) Increase affordable housing options by encouraging more multi-room residential development. C) Urban planners can provide personalized marketing and tailored services to different demographic groups based on their spending patterns and preferences. D) The number of schools can be increased and distributed more evenly across the city. For example, there are no schools serving the northeast side of the city. E) Urban planners can introduce restaurants that charge lesser food costs as at the moment, it seems that all restaurants in the city serve a specific clientele. Hourly costs in pubs on the other hand seem to be more evenly distributed.

4 Conclusion

The visual analysis provides a brief glimpse into the various methodologies that can be used to make Engagement ready for future rapid growth. We have tried to provide actionable steps that can be implemented to make sure the city is able to deal with the strain on resources that occurs when a city experiences growth in population.

5 Future Work

Although the current data provides an array of valuable information, there are certainly a variety of other steps that can be taken to improve the decision-making progress. Here are a few such steps:

Increasing Data Sources: An expansion in the sources used to collect the data can greatly improve the process of decision-making. Instead of the current collection of data just through the engagement app, there could be surveys and interviews that could be conducted.

Predictive Modeling: Predictive modeling could be incorporated in order to identify the effects of the urban planning decisions by helping anticipate future scenarios and evaluate the effects of these decisions.

References

[1] VAST Challenge 2022, https://vast-challenge.github.io/2022/description.html

[2] Visual Analysis Best Practices - https://www.tableau.com/visual-analysis-best-practices