Spending Habits Visualization

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1 Introduction

Understanding how people spend their money has always been a quite good way to understand how they live. There are multiple aspects that drive consumer spending habits, and many of them come from peoples surroundings. A city, which we all should know, is a collection of many people gathered to a concentrated area. Cities also have certain features and characteristics that make them different from other cities. These can be physical, like accessability of public transportation, or cultural: what kind of people does the city attract? Analyzing spending habits can reveal weaknesses within a city. For example, if we observe people from one city spending substantially more on fuel than people from other similar cities, we should analyze what causes this. Sustainability of peoples spending habits can depend on what the city can offer and what it lacks. The first step to address this issue is to identify it and that is the goal for my project.

In this project, I have chosen three different Indian cities, that are quite similar in nature, and visualized their spending habits in a visually pleasing way. Instead of relying on boring tables and numbers, the visualization uses interactive 3d city maps for each city, with heatmap color coded spending intensities filtered by timeframe and category.

Ultimately, the project demonstrates how presenting data does not have to be just numbers and lineplots to provide the user with valuable insights. The goal was not only to show numbers, but to make the act of exploring them feel natural and even a little bit enjoyable.

2 Data

The visualization in this project is based on public Indian credit-card spending data covering the years 2013-2015. The dataset was obtained from an individual on Kaggle, where the uploader states an affiliation with ACI Limited. However, there is no promise that the dataset is an official release from the company. Therefore, while the dataset is suitable for exploratory visualization, its credibility should be approached critically.

The original dataset contains 26 052 observations. Each observation represents a credit card spending event and contains the following relevant information:

- City: the city in which the transaction happened.
- Date: the timestamp of the transaction.
- Expense type: Categorical label for the purchased product type (e.g. food, bills, fuel).
- Spend amount: the amount of money that was spent.

For this visualization, only three cities were selected: Delhi, Bengaluru and Ahmedabad. This choice was driven by the lack of reliable amount of data for many cities, and also to make comparing the cities easier for the user. This filtering brought the number of datapoints down to 10 525 observations, which is still more than enough for identifying reliable patterns from the data.

3 Visualization

3.1 Methods

Python was chosen as the main programming language for this project. The choice was motivated by my own sanity. It's the language, that I'm most proficient in, and to me, also the most enjoyable to work with. It has extremely good data-processing functionalities, which came to be useful in this project, and I also found an excellent map visualization library, which saved me a lot of tears when coding the map visualization itself. The data for the city buildings was received from the OpenStreetMap library. Also, HTML was used to display the visualization on web.

3.2 Visualization design

For the visualization I decided to use a map-based view. Each city is represented as an interactive city-map with the buildings in the cities colored according to a heatmap color that signals the spending intensity of that city in the user-chosen category and timeframe. Spending intensity is computed as the percentage of spending in a category relative to the total spending during a chosen timeframe. As a design choice, I made the map 3d by adding heights to each building. The heights are completely simulated, because I could not get access to any real-world elevation data. The heights serve no other function than to make the visualization more visually appealing.

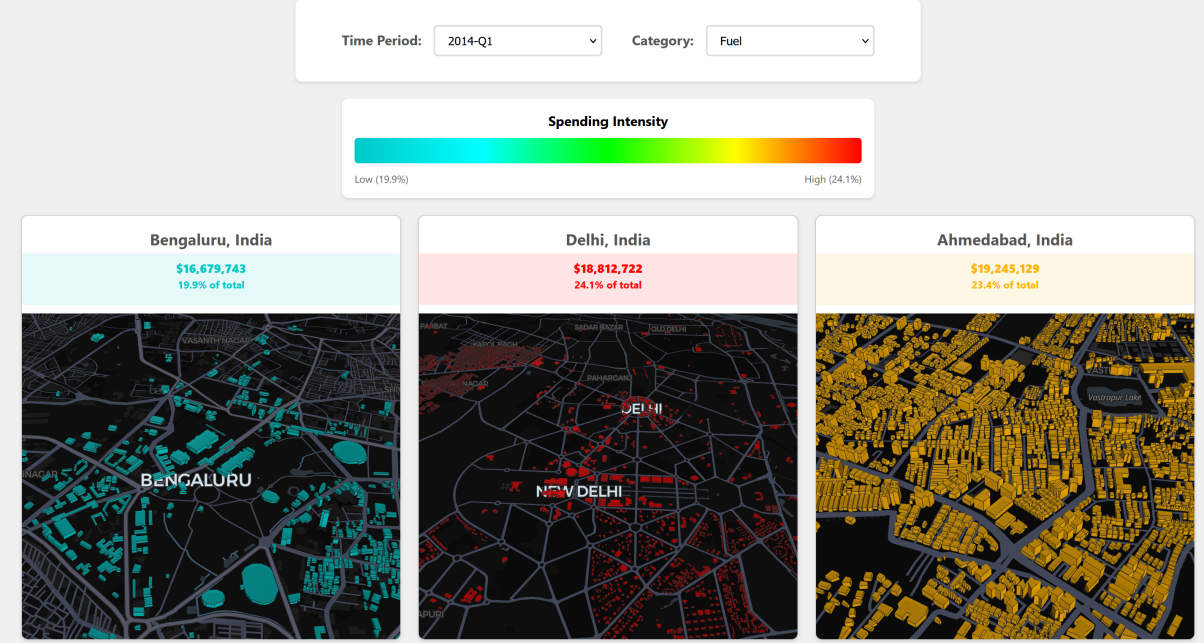

Figure 1: Example screenshot of the visualization

3.2.1 Use of time

Time is an interesting aspect in the visualization not only adding another dimension to the data, but also a narrative dimension as well. While interacting with the visualization, the user moves through time, changing the scenery and seeing new patterns emerge. This

dynamic visualization style is something that I wanted to implement since it makes the user more engaged, and as a consequence, more likely to gain information from the visualization.

In the dataset, the role of time is fairly ordinary. Observations have been taken at different times and that's the end of it. However, this is perfect for drawing out trends and patterns from the data when visualized correctly.

According to Brehmer et al. [1], temporal data can be presented in three dimensions: representation, scale, and layout. In a way, my visualization is rather boring if judged by the aforementioned first two dimensions, since it follows a linear chronological order, which is the result of choosing the most unimaginative choices from both dimensions. However, in the case of wanting to observe real-world temporal sequences, like it or not, this seemingly boring design choice is really effective. As for the last dimension, layout, I have chosen a faceted layout to best support the ability to make comparisons between the cities. The visualization displays the three cities side-by-side in a single row so that the user can view them all at the same time. This allows for easy comparisons between the cities and detecting patterns in the spending habits becomes easier.

Brehmer et al. [1] also discussed the benefits of animated transitions that link narrative points together while preserving the context. In my case, smooth transitions between different time intervals and category changes would help the user to maintain a better understanding of the change happening. Unfortunately, due to the way the maps are implemented, this is not possible in my visualization without a complete rework of the maps, and the change of the map visualization library. This is a notable improvement idea though.

3.2.2 Use of space

Space played a key role in the visualization. I wanted each city to have a clear visual anchor, making it easier for the user to connect the data to a specific location. Using a map for each city provided exactly that: a familiar spatial reference that helps users immediately link the displayed spending patterns to the city they belong to.

As for the physical layout of the visualization itself, my goal was to have all the information available together so that the user does not have to hide any elements to see other. This created a balance optimization problem, where I had to avoid visual clutter while also achieving this goal. Figure 1 shows the solution that I landed on.

4 Conclusion

The goal of this project was to create an intuitive way to display how people in three different Indian cities spend their money, and demonstrate a different way of visualizing information to reveal interesting patterns in data. Understanding how people spend their money is not just an economic exercise, it also promotes sustainability understanding.

Sustainable development relies heavily on identifying where cities support responsible consumption and where they do not. These areas can be difficult to identify, which is why it is important to produce tools to reveal them. Spending patterns are one way to identify problems in a city. For example, high spending on fuel hints at poor public transportation or long commuting distances, and consistently higher spending on restaurants, could reveal social inequalities between cities. These insights give a good starting point for more serious policy analysis.

References

[1] M. Brehmer, B. Lee, B. Bach, N. H. Riche, and T. Munzner, "Timelines revisited: A design space and considerations for expressive storytelling," *IEEE Transactions on Visualization and Computer Graphics*, vol. 23, no. 9, pp. 2151–2164, 2017. DOI: 10.1109/TVCG.2016.2614803.