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CHENNAI

CSE3121

Information Visualization

Project Report

On

Decoding Digital Behaviour: A deep dive into mobile usage.

By

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ABSTRACT:

In today's digital age, mobile phones have become an inseparable part of human life. People use them daily for communication, entertainment, work, education, and social interaction. With such deep dependence on smartphones, it is important to understand how people use their devices and what factors influence these patterns.

This project focuses on analysing and visualizing mobile usage behaviour across different cities and demographic groups using Tableau. The dataset used includes information such as user ID, age, gender, city, total app usage hours, daily screen time, number of apps used, and time spent on different types of applications such as social media, gaming, and productivity.

By creating seven different Tableau visualizations and combining them into an interactive dashboard, this study uncovers patterns in mobile usage based on location, age, and gender. The project highlights how demographics influence digital behaviour, which cities have higher engagement, and how app preferences vary between users.

The insights gained from this visualization can help in multiple ways — from promoting digital wellbeing and responsible screen time habits to helping app developers and marketers understand their audiences better. It also shows how data visualization tools can turn complex data into meaningful, easy-to-understand insights that can be used for social awareness, business strategies, and technological improvement.

Keywords: Mobile Usage, App Preferences, Screen Time, Demographics, City Analysis, Data Visualization, Tableau Dashboard, Digital Behaviour, User Insights, Behavioural Analysis.

INTRODUCTION:

The rapid advancement of mobile technology has completely changed how people live, communicate, and interact with the world. Smartphones today are not just communication tools — they are also used for entertainment, education, work, and managing daily life. However, mobile usage patterns are not uniform.

They differ based on a person's age, gender, and city, making it interesting to explore how these factors influence digital behaviour.

This project, *"Decoding Digital Behaviour: A Deep Dive into Mobile Usage,"* aims to study and visualize these behavioural patterns using Tableau. The dataset used for the project contains details such as user ID, age, gender, location, total app usage hours, average daily screen time, number of apps used, and time spent on different categories of apps (social media, gaming, and productivity). By visualizing this data, it becomes easier to identify meaningful patterns and trends that are not visible in raw numerical form.

This study helps in understanding questions like:

- How does screen time differ across cities and age groups?
- Do males and females show different usage patterns?
- Which cities are more engaged in productivity or social media apps?
- Is there a connection between the number of apps used and total screen time?

The analysis not only supports better understanding of digital habits but also promotes awareness about healthy screen time and responsible technology use.

Applications:

- Helps users and wellness organizations understand digital usage trends.
- Assists developers and marketers in targeting user needs more effectively.
- Promotes digital wellbeing and encourages balanced app usage.
- Supports informed, data-driven decisions in technology design and communication strategies.

Alignment with Sustainable Development Goals (SDGs):

- SDG 3 – Good Health and Well-being: Promotes awareness about mental health and responsible screen usage.
- SDG 9 – Industry, Innovation, and Infrastructure: Encourages innovation through data-driven insights for digital industries.
- SDG 11 – Sustainable Cities and Communities: Promotes digital literacy and responsible mobile usage in modern communities.

OBJECTIVES:

The main objectives of this project are to:

1. **Explore Geographic Patterns:**
   Analyse how app usage hours and screen time vary between cities, highlighting which locations show higher or lower engagement.
2. **Understand Demographic Trends:**
   Examine how user characteristics such as age and gender influence their mobile usage behaviour.
3. **Compare App Usage Categories:**
   Study differences in the time users spend on social media, gaming, and productivity apps across different cities.
4. **Reveal Screen Time and Gender Insights:**
   Visualize and compare how daily screen time differs between male and female users.
5. **Identify Correlations:**
   Discover relationships between variables such as number of apps used, screen time, and app category preferences to identify usage patterns.
6. **Develop a Visual Dashboard:**
   Combine all findings into one interactive Tableau dashboard that allows easy exploration of demographic, geographic, and behavioural data.

ABOUT THE DATASET

Dataset Type: Table

The dataset is tabular in nature. It is structured in the form of rows and columns, where:

- Each row represents one unique user.
- Each column provides an attribute or feature of that user (like age, gender, screen time, app usage hours, etc.).

This type is appropriate for table-based visualization tools like Tableau because it is straightforward and easy to process for creating graphs, charts, dashboards, and filters.

Attribute Types:

Attribute types help us understand the nature of each column in a dataset. This is essential in data visualization because different types of attributes require different types of charts or dashboards. Broadly, attributes are classified into three categories:

- Categorical
- Ordinal
- Quantitative

1. **Categorical Attributes:**

These are attributes that represent groups or labels. They are descriptive and not numerical. We cannot perform mathematical operations on them, and their values do not have a natural order.

Attribute Type	**Justification**
Gender	This field has two text-based categories: Male and Female. These categories cannot be ordered or ranked in a meaningful way. They are simply labels that divide users into groups.
Location	This field contains city names. Each is a group or category with no numerical meaning or order. These are useful for grouping users based on geography but cannot be measured or ranked.

2. **Ordinal Attributes:**

This dataset does not contain ordinal data. All ordered attributes here are numeric and belong to the quantitative category (not ranked or categorical).

3. Quantitative Attributes:

Quantitative attributes are numerical and measurable. They can be either discrete (countable) or continuous (can take any value within a range). These allow mathematical operations like addition, average, range, and standard deviation.

Attribute Type	**Justification**
Age	Age is a numeric, countable value representing how old each user is. We can perform mathematical operations like grouping by age brackets, calculating average age, etc.
Total_App_Usage_Hours	This shows the total time spent on apps by a user, measured in decimal hours. It is a continuous numeric variable that can take a wide range of values (e.g., 1.2 hours, 10.5 hours).
Daily_Screen_Time_Hours	This represents the average screen time per day for each user. Since it's measured in decimal hours, it's continuous.
Number_of_Apps_Used	This is the total number of different apps used by a user. Since it's a count (e.g., 14 apps), it is a discrete quantitative value.
Social_Media_Usage_Hours	This indicates how many hours per day a user spends on social media apps. As it can take decimal values, it's continuous.
Productivity_App_Usage_Hours	Shows time spent on productivity apps. Measured in decimal hours; continuous.
Gaming_App_Usage_Hours	Represents daily gaming app usage in hours. Continuous variable that can be analyzed for average or total across user segments.

The dataset used for this project is a structured tabular dataset containing 1,000 records and 10 attributes related to users' mobile application usage patterns and demographics. The dataset type is a table, where each row represents a unique user and each column represents a distinct attribute. Among the attributes, quantitative (numeric and measurable) variables include Total_App_Usage_Hours, Daily_Screen_Time_Hours, Number_of_Apps_Used, Social_Media_Usage_Hours, Productivity_App_Usage_Hours, and Gaming_App_Usage_Hours. These values are continuous and are essential for drawing trends and comparisons. Categorical attributes include Gender and Location, which help in grouping and segmenting users. Ordinal attributes are not explicitly present unless additional data like sleep quality or usage satisfaction were added. This dataset is ideal for visualization in Tableau to uncover insights such as high usage patterns across age or gender groups and to recommend healthier digital practices. This project directly aligns with the United Nations Sustainable Development Goal 3 (Good Health and Well-being) by aiming to raise awareness about excessive screen time and encourage balanced digital behavior through visual storytelling.

Dataset:

	A	B	C	D	E	F	G	H	I	J
1	User_ID	Age	Gender	Total_App_Usage_Hours	Daily_Screen_Time_Hours	Number_of_Apps_Used	Social_Media_Usage_Hours	Productivity_App_Usage_Hours	Gaming_App_Usage_Hours	Location
2	1	56	Male	2.61	7.15	24	4.43	0.55	2.4	Los Angeles
3	2	46	Male	2.13	13.79	18	4.67	4.42	2.43	Chicago
4	3	32	Female	7.28	4.5	11	4.58	1.71	2.83	Houston
5	4	25	Female	1.2	6.29	21	3.18	3.42	4.58	Phoenix
6	5	38	Male	6.31	12.59	14	3.15	0.13	4	New York
7	6	56	Female	3.31	1.04	21	2.02	3.45	2.26	Chicago
8	7	36	Male	4.81	1.52	24	3.76	1.58	3.59	Los Angeles
9	8	40	Male	9.53	8.85	11	2.66	0.28	2.93	Chicago
10	9	28	Male	11.35	12.8	9	3.39	3.05	2.46	Phoenix
11	10	28	Male	1.8	4.11	16	2.14	1.2	0.96	New York
12	11	41	Female	6.88	7.11	21	3.66	1.93	2.32	Chicago
13	12	53	Female	10.71	6.86	21	4.12	0.4	1.23	Phoenix
14	13	57	Female	1.91	7.15	4	0.73	0.74	4.57	Los Angeles
15	14	41	Male	10.07	9.09	11	4.16	1.49	1.68	Houston
16	15	20	Male	4.94	7.11	15	2.7	0.45	4.76	Los Angeles
17	16	39	Male	4.54	6.82	17	4.22	4.55	2.67	New York
18	17	19	Female	11.75	7.17	5	2.16	0.03	3.16	Los Angeles
19	18	41	Male	3.21	8.68	13	1.9	2.42	2.71	Los Angeles
20	19	47	Female	8.63	7.98	23	4.58	0.62	0.65	Los Angeles
21	20	55	Female	10.04	12.1	16	1.26	1.54	1.88	Los Angeles
22	21	19	Female	1.45	1.64	27	4.22	4.63	0.5	New York
23	22	38	Female	8.37	11.83	10	2.42	0.81	3.11	Phoenix

Dataset Link: https://www.kaggle.com/datasets/bhadramohit/smartphone-usage-and-behavioral-dataset

PROPOSED WORK:

Data Preparation

Collected and pre-processed the dataset mobile_usage_behavioural_analysis.csv dataset to create visualizations and dashboard in Tableau.

Visualization Development

Seven key Tableau visualizations were constructed:

1. Average Age Distribution by City: Bar chart showing which cities have predominantly younger or older mobile users, highlighting differences in age group engagement.
2. Gaming App Usage vs. Number of Apps Used: Scatterplot with clustering to expose behavioural patterns—distinguishing heavy gamers with high app diversity from other clusters.
3. Tree Map of City-wise Social Media Usage: Hierarchical rectangles represent the volume of social media usage in each city, helping quickly spot cities with most active users.
4. Location-wise Gender & Screen Time Map: Geo-visual map overlays cities with pie charts for gender ratio; the pie size reflects average daily screen time, providing a dual perspective on place and demographics.
5. Screen Time Distribution by Gender: Stacked bar chart bins daily screen time and divides each bin by gender, showing whether males or females dominate particular usage brackets.
6. Heatmap of App Category Usage by City: Color-coded squares compare average hours spent on gaming, productivity, and social media apps between cities, making clear which cities or app categories stand out.
7. Productivity App Usage Bubble Chart (by City): Bubble chart visualizes productivity app usage volume for each city through bubble size, quickly highlighting the most engaged urban centres.

Correlation and Pattern Analysis

- Investigated if high gaming hours correlate with using more apps overall.

- Compared average screen time and app choice variations between cities and genders, searching for outliers and significant trends.

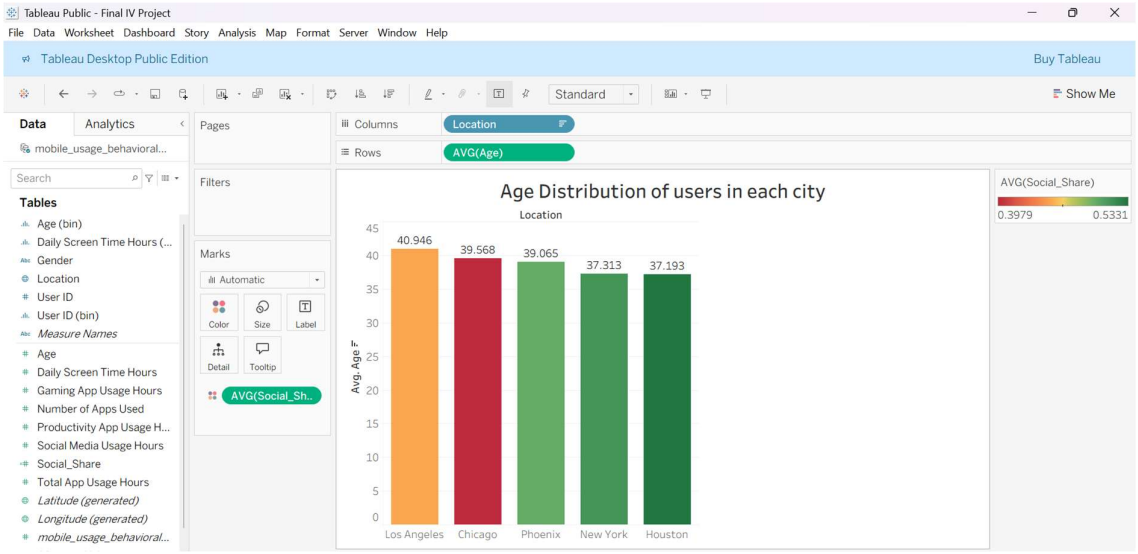
Dashboard Assembly

- All visualizations were combined into a "Decoding Digital Behaviour" dashboard.
- The dashboard includes summary numbers for average screen time, number of apps used, and identifies top cities.
- Interactive navigation provides rapid comparison and exploration across geographic, demographic, and behavioural dimensions.

VISUALIZATIONS:

1. Bar Chart: Age Distribution by City

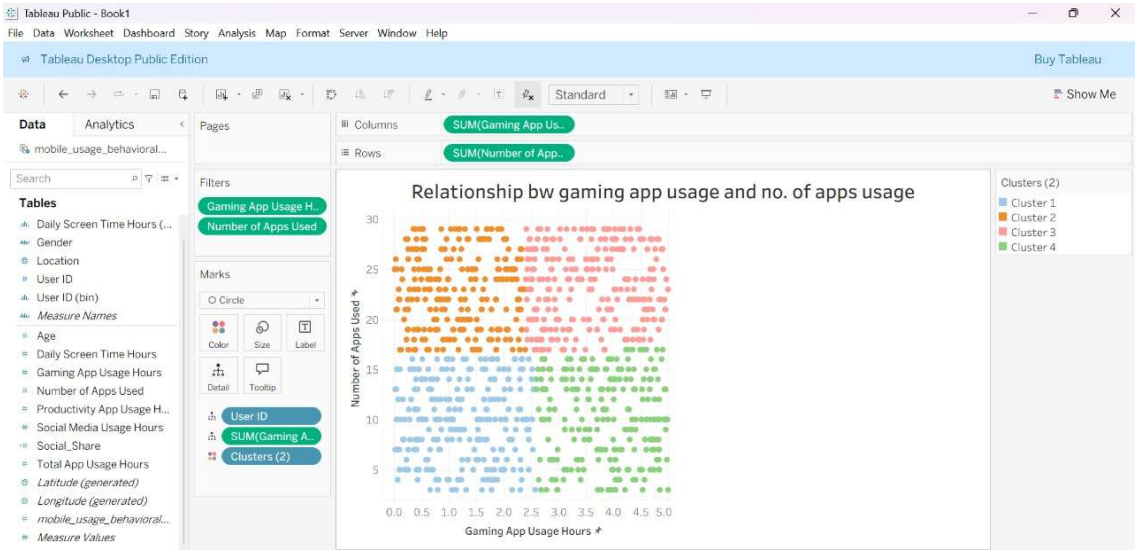
A vertical bar chart where each bar represents a city, with the height showing the average age of mobile users in that city.



- The chart visualizes how the mean age of users differs across cities.
- Each bar's value is calculated using user ages from the dataset for each location, making it possible to identify generational patterns in mobile adoption.
- This comparison helps reveal which cities have younger or older user bases and guides age-focused digital strategies

2. Scatter Plot (with Clustering): Gaming App Usage vs. Number of Apps Used

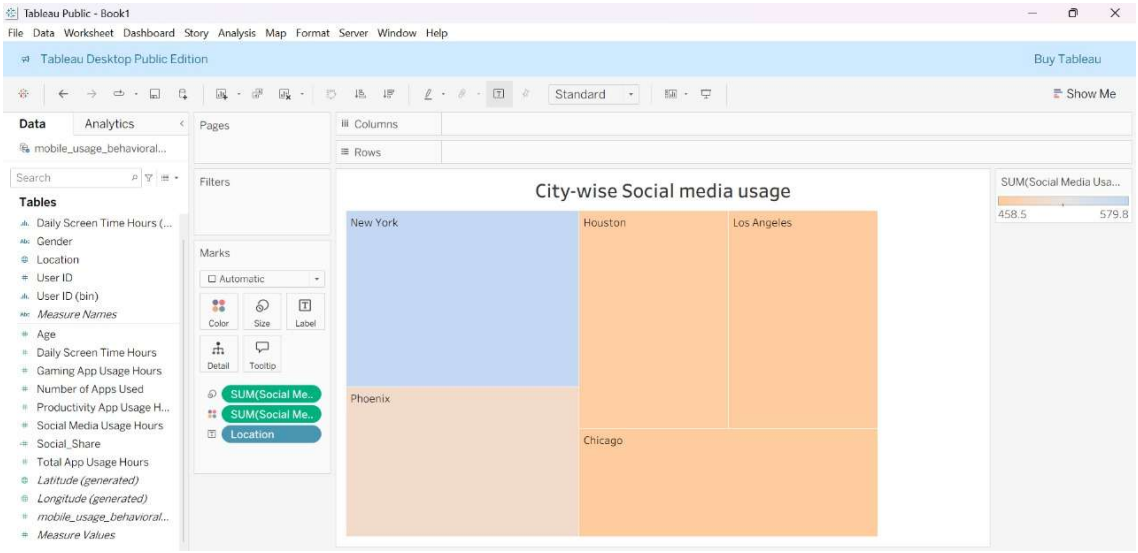
A scatter plot where each point represents a user, plotted by gaming app usage hours (x-axis) and number of different apps used (y-axis), with points grouped by clusters.



- The scatter plot reveals whether heavy gaming app users also tend to use more apps overall.
- Clusters, shown in different colors, represent user segments with similar behavior, which can uncover distinct user groups such as “super-users” or “light users.”
- This visualization is useful for identifying target segments and exploring links between gaming engagement and broader app diversity.

3. Tree Map: City-wise Social Media Usage

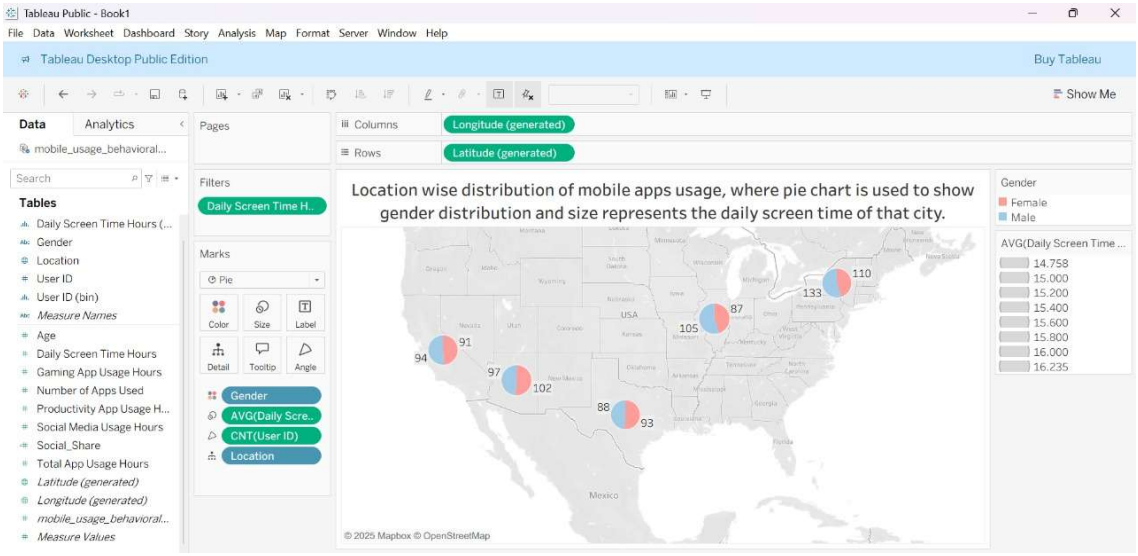
A rectangular tree map with each city represented as a rectangle sized proportionally to its total social media app usage hours.



- The tree map displays the cumulative social media engagement volume for each city.
- Larger rectangles indicate greater total time spent by users from that city on social platforms, quickly identifying urban digital hotspots.
- This helps strategize city-focused campaigns and compare the digital footprint among different locations.

4. Geographic Pie Map: Gender Distribution and Screen Time

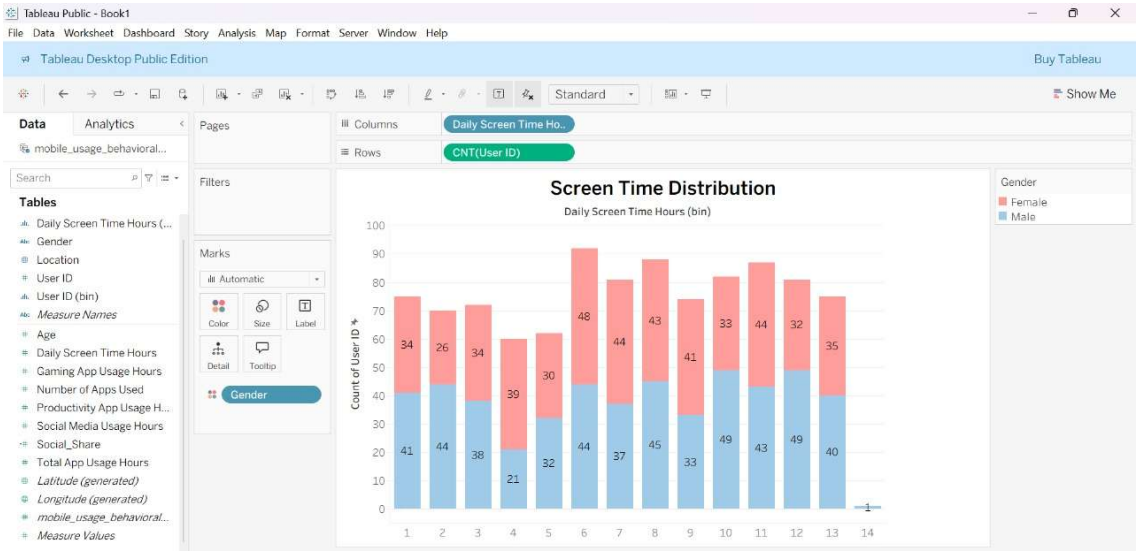
A geographic map with cities marked at their locations, overlaid by pie charts. Each pie chart shows the gender split, and the pie size reflects the city's average daily screen time.



- The map highlights both gender balance (by pie slices) and engagement level (by pie size) for each location.
- It enables a multi-dimensional comparison between cities, identifying where screen time is highest and which gender group leads in usage.
- This visualization is valuable for understanding the spatial dimension of digital behaviour.

5. Stacked Bar Chart: Screen Time Distribution by Gender

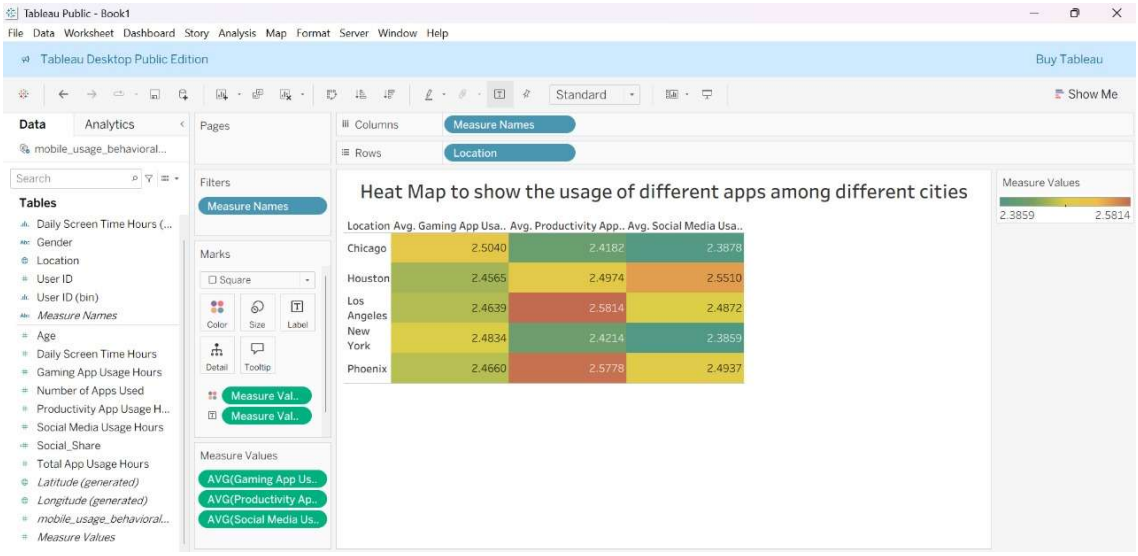
A stacked bar chart with bins for ranges of daily screen time (e.g., 1–2 hrs, 2–3 hrs), each divided into portions for male and female users.



- The chart shows the distribution of users by screen time bracket and by gender.
- It highlights which gender dominates at different screen time levels, making visible the patterns of high and low usage.
- Useful for designing interventions or app features for gender-specific high-engagement or low-engagement groups.

6. Heat Map: App Category Usage by City

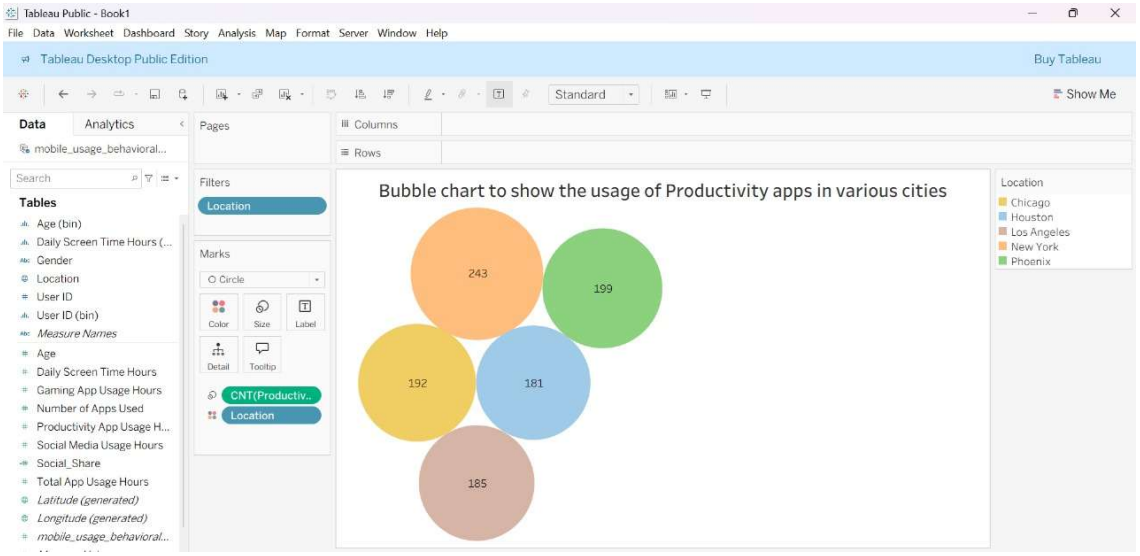
A heatmap grid with cities on one axis and app categories (gaming, productivity, social media) on the other; the colour intensity in each cell indicates the average time spent per category in each city.



- The heatmap visualizes where certain app categories are most popular at a glance.
- Darker shades in a cell indicate higher usage, easily revealing the dominant app types and cities with standout engagement.
- Enhances understanding of local app culture and provides direction for targeted development or marketing.

7. Bubble Chart: Productivity App Usage by City

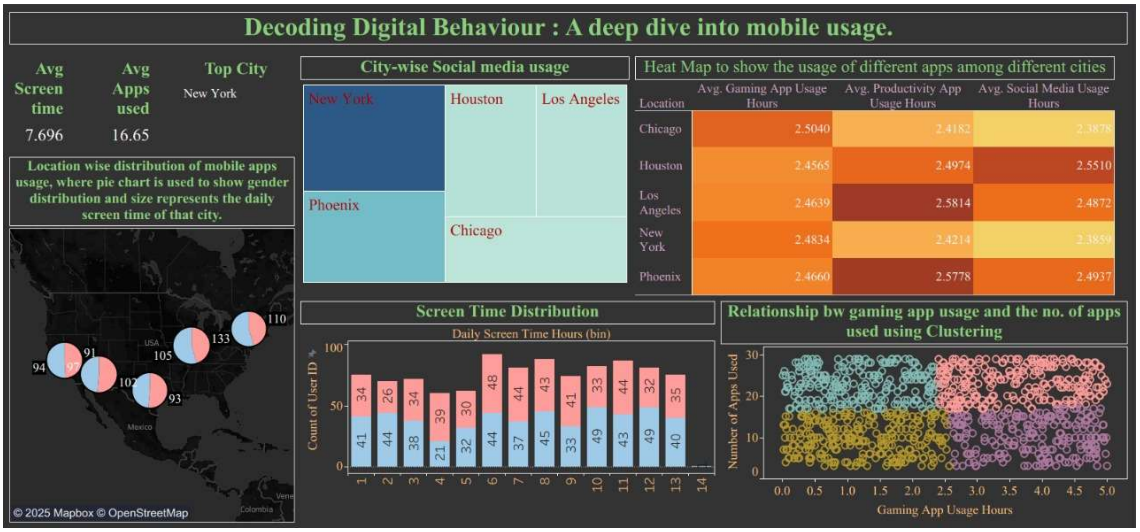
A bubble chart mapping city, with bubble size corresponding to total productivity app usage hours.



- Each bubble's area reflects how much time users in that city spend on productivity apps in aggregate.
- Bigger bubbles instantly identify cities with high productivity engagement, while smaller ones pinpoint less engaged locations.
- This chart is effective for market sizing and assessing regional productivity tech needs.

DASHBOARD DESCRIPTION:

The dashboard provides an interactive and multi-faceted view of how mobile applications are used across different cities, age groups, and genders. It brings together summary statistics and seven targeted visualizations, delivering both high-level patterns and granular comparisons:



- Summary Panel: At the top, core metrics such as average daily screen time, average number of apps used, and “Top City” (the location with highest engagement) are presented for immediate contextual overview.
- City-wise Social Media Usage (Tree Map): Displays each city as a proportionally sized rectangle based on cumulative social media hours, instantly identifying urban digital hotspots.
- Heatmap of App Category Usage: Compares average hours spent on gaming, productivity, and social media apps across cities using colour intensities, helping users spot cities with unique digital habits or focus on specific app types.
- Geographical Gender & Screen Time Map: Shows a map view of cities, overlaying pie charts that split the user base by gender and size them according to average daily screen time. This yields a rich, spatial perspective on where and how mobile technology is used most heavily, and by whom.

- Screen Time Distribution (Stacked Bar): Visualizes the gender breakdown across different daily screen time bins, making it easy to see which gender skews towards heavier or lighter device usage.
- Gaming App Usage vs. Number of Apps Used (Scatter Plot with Clusters): Highlights behavioural clusters among users by plotting gaming engagement against overall app diversity, uncovering user segments like “casuals,” “super-users,” or “focused gamers.”

This dashboard unifies quantitative and qualitative insights on digital behaviour, making it possible to:

- Compare cities at a glance and in detail,
- Drill down into gender splits,
- Detect outliers in app usage trends,
- And support evidence-based decisions for marketers, app designers, city planners, or digital researchers.

All charts are interconnected and visually cohesive, providing a seamless, data-rich exploration experience to guide digital strategy and understand emerging patterns in mobile technology adoption.