THE TECHNOLOGICAL UNIVERSITY OF THE SHANNON: MIDLANDS MIDWEST

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Course: **Masters in Data Analytics**

Title of Assignment: **Data Visualisation Project**

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Title: **From Traffic Jams to Fast Lanes**

Declaration

I hereby certify that the material, which is submitted in this report towards the award of MSc. in Data Analytics, is entirely my own work and has not been submitted for any academic assessment other than part fulfilment of the above named award.

Signed: Parimal Ganesh Sawant Date: 08/04/2025

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Glossary of Terms

Outliers: Data points that significantly deviate from the normal range, indicating potential delays or inefficiencies in delivery operations.

What-If Analysis: A predictive technique used to simulate different scenarios (e.g., improved vehicle condition) to measure their impact on delivery time.

Business Intelligence (BI): The process of analysing data and visualising insights to support decision-making and improve operational performance.

Calculated Field: A custom metric derived from existing data (e.g., calculating the average delivery time per city) to gain more specific insights.

Scatter Plot: A type of visualization used to show the relationship between two variables, such as vehicle condition and delivery time.

Heatmap: A data visualization technique that uses colour coding to represent the intensity of values, often used for analysing weather impact.

Route Optimization: The process of determining the most efficient delivery route to reduce time and improve efficiency, especially in high-traffic areas.

Workforce: The total number of employees that are available to work for a company in a particular city or region.

Choropleth Map: A type of map where areas are shaded referencing to a statistical variable (e.g., delivery volume).

What-If Simulation: A technique for predicting outcomes based on changes in variables, like delivery volume or staffing.

KPI (Key Performance Indicator): A measurable value that indicates the working of different operational strategies, such as delivery time or customer rating.

Section 1: Introduction

In the age of digital convenience, the need for timely and effective delivery services has been skyrocketed. Businesses like Zomato operate in a highly competitive market where even a single minute of delay can significantly affect the customer satisfaction and retention. Food delivery platforms are constantly under pressure to achieve their service standards while maintaining their operational efficiency due to growing urban congestion, fluctuating whether and festival peaks.

The project focuses to use Tableau to convert unprocessed raw operational delivery data into meaningful insights and actionable visions. The main goal is to investigate and evaluate the main elements that are affecting the delivery performance with the objective to spot trends and inefficiencies that can be fixed. With the help of interactive dashboard from Tableau to identify the ways in which factors like traffic, whether, vehicle condition, city specific trends, and festival impacts affect the delivery volume and timings.

Data Visualisation here serves as a link between the unprocessed data and strategic decision making. By the use of Tableau tools like filters, calculated field, calculated parameters, and hierarchy map, this project gives stakeholders an easy-to-use and inquisitive experience. The visuals not only serve as analytical tools but also work as story telling devices, narrating the logistics of delivery from traffic jams that caused delays to well-timed fast delivery.

The target audience for this report includes operational managers, data analyst, and decision makers within the company. After interpretation of this report, readers will have a clear understanding of the factors that critically affect the delivery operations and how interactive dashboard can facilitate continuous monitoring and strategic improvement.

In a rapidly growing market where competition is at fierce and customers expect quicker delivery services then before, the ability to harness data for operational improvement becomes not just an advantage but a necessity. Stakeholders can find hidden inefficiencies in operations, spot bottlenecks, and track the success in real time by making the use of Tableau features and interactive dashboards. This project serves as an example with combination of analytics and visualisation which can be used to make future decisions in addition to presenting a narrative of current states of operations.

Section 2: Business background

Zomato connects customers with local and large businesses by providing a simplified delivery network in the meal delivery sector. Its main objective is to maintain excellent delivery service which guarantees prompt and effective food deliveries. It is operating across multiple cities in India, the company serves a huge customer base, offering various types of meals, including snacks, drinks and buffet services. To enhance customer experience, it makes use of technology and logistics techniques effectively to manage deliveries, especially in difficult circumstances like heavy traffic and bad weather.

With the growing demand for food delivery services the company wants to optimise its operations by analysing the delivery factors such as delivery time, vehicle condition, and other types. The delivery person's performance should also be measured as they play a crucial role in maintaining the standards. The company also wants to check for it’s multi-order system on how effectively a single delivery person can handle multiple deliveries in single trip.

The company is currently operating in multiple cities, including the metropolitan areas, which are a unique challenge due to its high traffic congestions. Understanding the geographical distribution of the deliveries and average delivery time with allow the company to plan delivery routes and plan resources effectively. Additionally, data on festival seasons indicate volume of orders and delivery time that might fluctuate based on special occasions, making the business to modify and plan its workforce appropriately.

By utilising data visualisation techniques, the organisation can find out possible difficulties, apply strategic enhancements, and to obtain insights into its performance metrics. By analysing the delivery timings, vehicle conditions and conditions like traffic and weather, the company will be able to improve its operations and keep a competitive edge in the market.

Section 3: Aim of the project

The project goal is to use data visualisation tools to analyse the main elements impacting the overall delivery efficiency. The project examines the data such as delivery time, traffic impact, city wise performance, vehicle and whether conditions, it aims to identify and make improvements in inefficient areas.

The project will help company to solve business problems through dedicated visualisation for each problem.

Business Problem 1: What is the average delivery time, are there any delays or outliers that are affecting the overall customer experience?

- **Chart Type**: Box Plot
- **Description**: This chart visualises the spread and median value of delivery time across all the different whether, helping to detect consistency and deviations.
- **Insight**: This enables company to identify the delivery performance across all the different whether conditions and isolate extreme delays for investigations.

Business Problem 2: How many deliveries are done in a week and how many delivery agents are required to adjust the increased surge of orders?

- **Chart Type**: Line chart + Parameter (What-If simulation)
- **Description**: A parameter lets user to increase the order percentage and observe the impact on delivery agents required.
- **Insight**: This allows the operational team to assess the staffing needs and plans ahead of the high demanding period, especially during the festivals. In addition, gives an overall number of increases in orders.

Business Problem 3: How many deliveries are performed using different vehicle type?

- **Chart Type**: Bar Chart
- **Description**: This chart categories and count deliveries based on the type of vehicle used such as motorcycle, scooters and electric scooters.
- **Insight**: In order to determine which delivery types, dominate delivery operations and whether more investigation is required in this particular category, this visualisation aids in fleet makeup and performance. It also helps stakeholder to drill down specific vehicle performance and compare it across different modes of transport.

Business Problem 4: How does different vehicle conditions affect delivery times over the time?

- **Chart Type**: Heat Map
- **Description**: The heat map visualises daily average delivery time segmented by vehicle condition (Poor, Average, Good), using colour intensity to reflect the time delays.
- **Insight**: This visualisation clearly highlights how delivery speed could be affected by poorly maintained vehicles that are slow and inconsistent. This chart also includes a filter in dashboard to compare it along with different whether conditions and vehicle types.

Business Problem 5: What is the overall delivery performance index?

- **Chart Type**: Table Chart
- **Description**: This visual summarise 4 essential KPIs such as average delivery rating, total deliveries completed, number of delivery agent and average delivery time. It presents them in a layout for a quick insight.
- **Insight**: The table chart enables stakeholders to quickly assess delivery performance at a glance. Filters embedded inside the dashboard allows exploration based on different vehicles, whether and vehicle type offering content specific performance evaluation.

Business Problem 6: Which states receive the largest number of food deliveries; how many delivery agents are working in each state?

- **Chart Type**: Map (Choropleth View)
- **Description**: Geographic plotting of delivery volumes by state.
- **Insight**: It will guide the operational team with resource allocation and helps to identify the high-demanding locations.

Each business problem is matched with a visualisation, which ensures that stakeholders can interpret the results effectively and use them for planning and strategic intervention.

Section 4: Data Preparation and Exploratory Data Analysis

Data Preparation

The initial raw dataset consisted of variety of columns including the demographic details of delivery agents, order timing details, traffic and whether conditions. The cleaning and transformation of the dataset consisted of the following process.

1. **Handling Missing Values:**
    - 1,854 rows were cleared where both Delivery Person Age and Delivery Person Rating were null. These features critically for performance evaluation.
    - 91 rows with NaN Time Ordered values were dropped to ensure accuracy in time-series analysis.
2. **Standardising Ratings:**
    - All delivery ratings exceeding the maximum value of 5 were corrected to 5. E.g. Some rating had a value of 6 which were changed to 5.
    - 138 rows with missing Delivery Person Rating values were imputed with the median of 4.7 to retain the data integrity.
3. **Time Formatting:**
    - 3,165 entries in Time Order and 3,189 entries in Time Order Picked were converted into decimal to standard time format (HH:MM) for better interpretation of the time.
4. **Categorical Standardization:**
    - Null values in the festival columns were replaced with “Unknown” to ensure completeness in categorical segmentation.
5. **Geospatial Enrichment:**
    - Latitude and Longitude values were used to identify city and state using reverse geocoding.
    - Abbreviated city names were expanded to full names and accurately mapped to states.
6. **Data Type and Format:**
    - All fields were checked and formatted to appropriate types.
    - Delivery Timings and rating fields were aggregated using consistent units and rounding rules.

The data preparation ensures that all the records are ready for accurate analysis in Tableau.

Exploratory Data Analysis (EDA)

Prior to dashboard creation, exploratory analysis was performed to understand the structure, trends and relationship in the dataset. Key findings include:

- **Distribution of Delivery Times**: The average delivery time across the dataset is approximately 26 minutes. The distribution is slightly right skewed with a few long delays spotted by box plot.
- **Delivery Volume by Vehicle Type:** Motorcycle dominate the fleet segment in terms of orders delivered, contributing to over 1/3 of the total deliveries. Electric scooters showed the least contribution indicating low adoption.
- **Vehicle Condition Impact:** Poor vehicles are linked to slower delivery time. The heatmap highlights several dates where high duration is with often poor vehicle conditions.
- **Traffic and Whether Influence:** Weather type like fog and stormy conditions have negative impact on the delivery performance, comparing it to the sunny whether has the fastest delivery times.
- **Geographic Trends:** Western states lead to higher volume in delivery orders. In contrast to the northern states tend to have less volume in delivery.
- **KPI Summary:** The dataset includes a summary of key highlights of operations indicators:
    - Average Delivery Rating: 4.64
    - Total Deliveries: 75,401
    - Unique Delivery Agents: 1,320
    - Average Delivery Time: 26 minutes

The insights of Exploratory Data Analysis guided through a basic understanding of dataset, which further guided with the design of Tableau dashboard. The exploratory analysis also ensured that most of the business questions are answered.

Section 5: Data Visualisation

Business Problem: How many deliveries are done in a week and how many delivery agents are required to adjust the increased surge of orders?

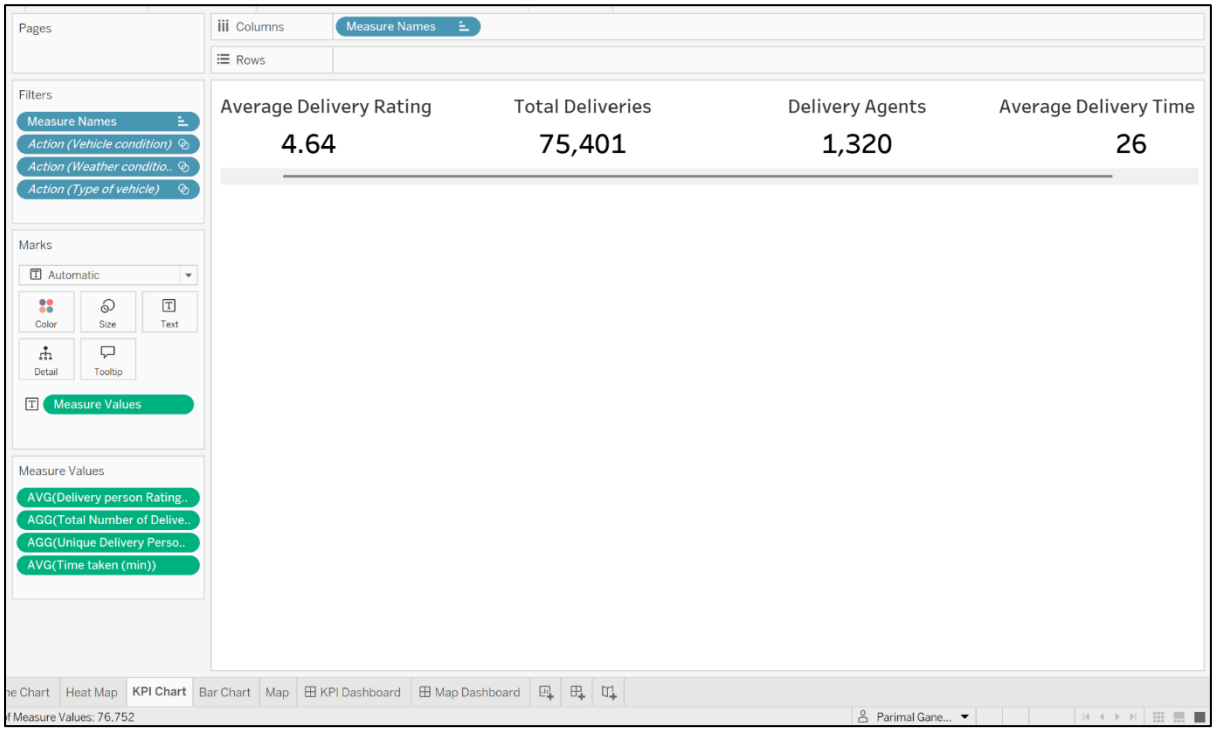

Image 1.1 - Table Chart

What it shows:

The KPI chart provides an insight about 4 key delivery performance metrics.

- Average Delivery Rating: 4.64 – This reflects the customer satisfaction.
- Total Deliveries: 75,401 – This indicated the delivery operations scale.
- Delivery Agents: 1320 – Showing total workforce capability.
- Average Delivery Time: 26 minutes – This shows delivery speed.

Each value is calculated across the full dataset and making dynamic updated based on the filters applied on the dashboard.

Insights:

The Table Chart shows a quick insight on overall performance of delivery operations. A high average rating (4.64), with a moderate delivery time of 26 minutes suggests relatively good service quality. These numbers may vary with the filtered data but they did not show much variations in it.

Business Problem: What is the average delivery time, are there any delays or outliers that are affecting the overall customer experience?

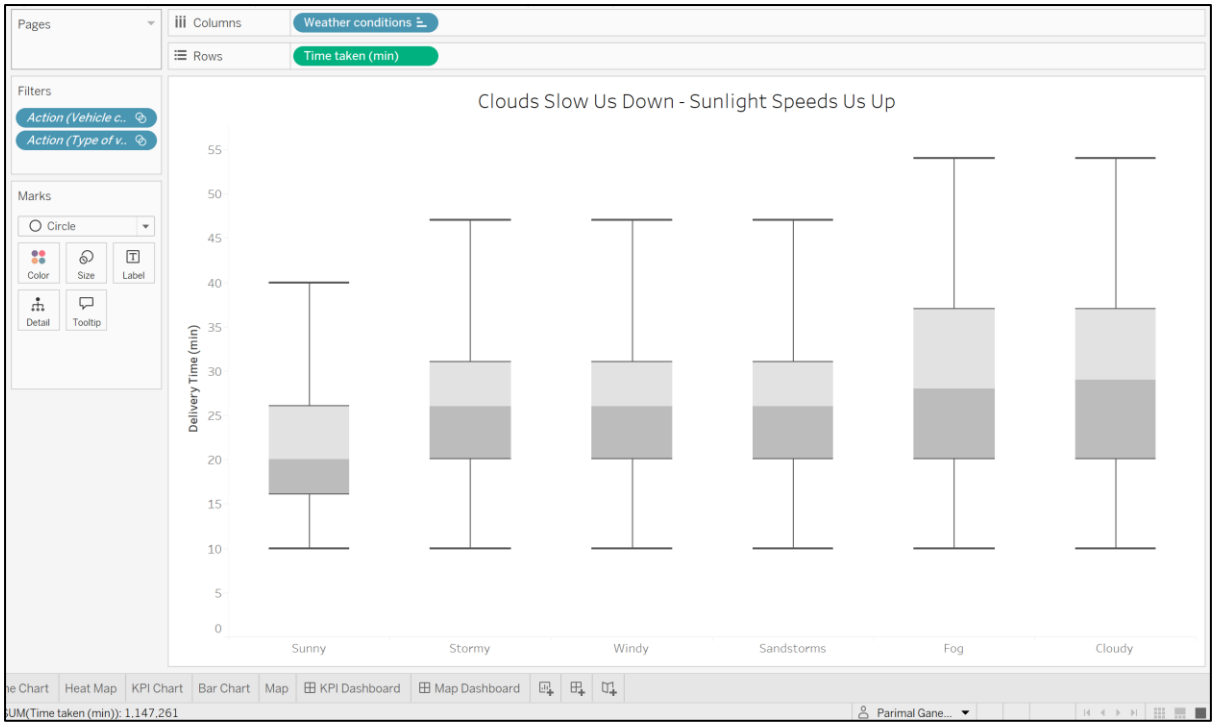

Image 1.2 – Box Plot

What it shows:

The box plot compares the distribution of delivery time across different weather conditions such as Sunny, Stormy, Windy, Sandstorms, Fog, Cloudy.

Each box is plotted with its median, quantile and range to highlight the distribution among delivery timings.

Insight:

Sunny days takes the least time for delivery and more consistent in delivery timings. Fog and Cloudy weather condition exhibit the highest median delivery timings, indicating inconsistent performance. Conditions like Stormy, Windy and Sandstorms show moderate delays but more consistent than Fog and Cloudy weather. This visualisation shows how weather might affect the delays in operational efficiency.

Stakeholders Action:

- Logistics team can adjust the estimated delivery timings based on weather forecast.
- Workforce can be planned accordingly more delivery agents on Fog and Cloudy day to manage delivery load.

Business Problem: What is the average delivery time, are there any delays or outliers that are affecting the overall customer experience?

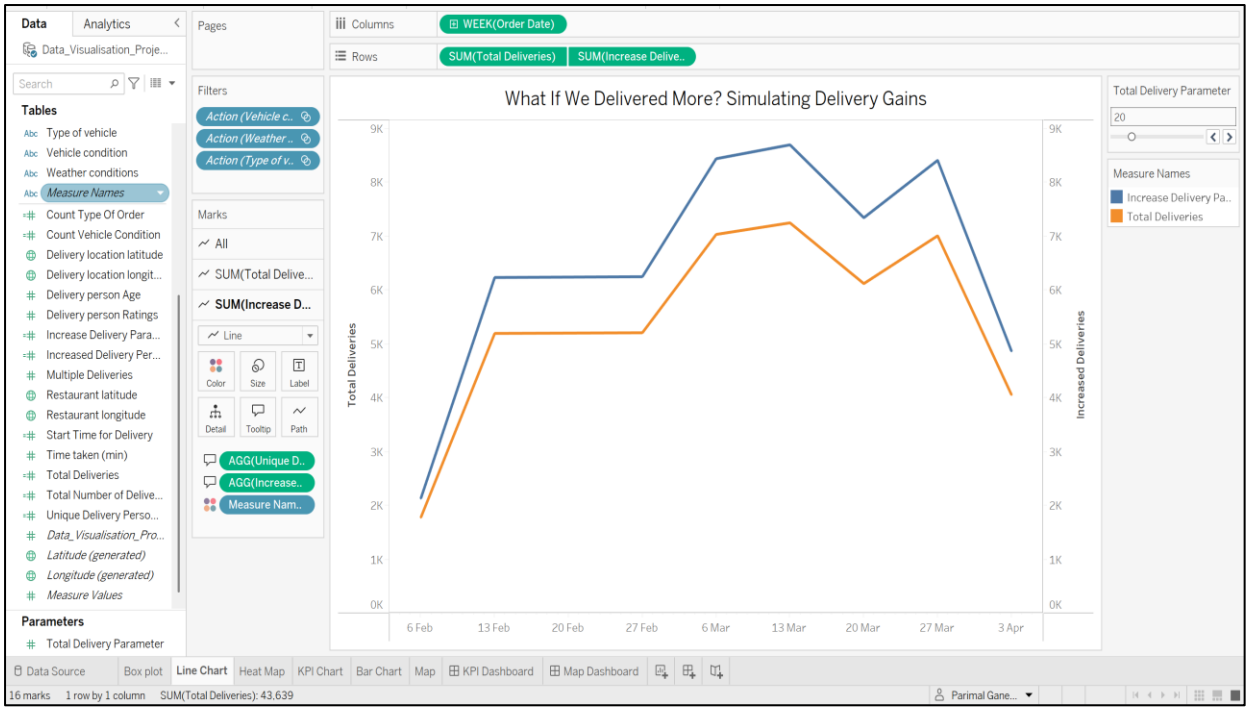

Image 1.3 – Line Chart

What is Shows:

The line chart compares the actual number of deliveries per week with a projected increase with the help of What If parameter slider titled as "Total Delivery Parameter". Users can simulate the percentage increase in order to observe how this affects the demand of delivery agents. The left axis shows the track of actual deliveries while the right axis shows the simulated increase.

Insight:

The chart reveals that delivery volume can be expected to rise with just a small strategic adjustment or demand surge. As the slider increases the gap between the actual deliveries and projected deliveries increases. These insights are especially important during the festival seasons, weekends or promotional events.

Stakeholders Action:

- Operational managers can use the slider to determine the workflow requirements during projected sales spikes.
- Workforce planners can plan adjusting the workforce for different surge levels.

Business Problem: How many deliveries are performed using different vehicle type?

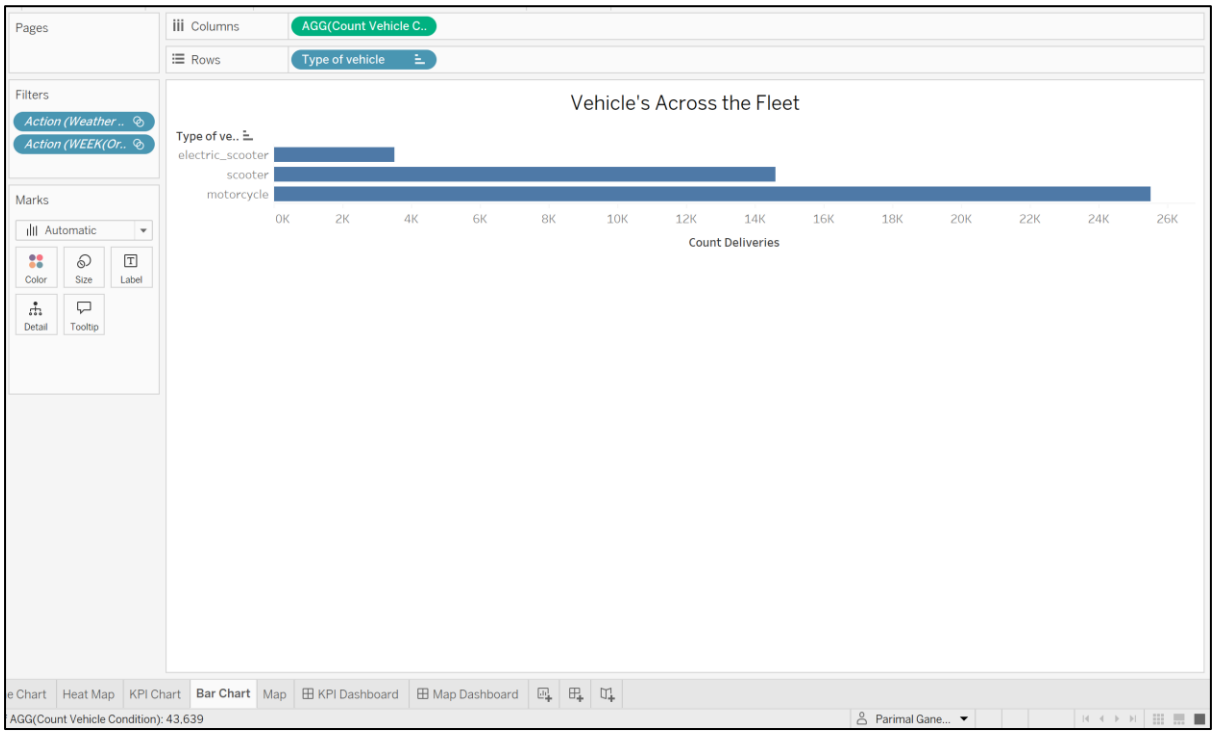

Image 1.4 – Bar Chart

What it shows:

This chart shows that number of deliveries carried out by different vehicle types such as (electric scooter, scooter and motorcycle). The length of each bar represents the total deliveries completed using that vehicle type, suggesting a comparative view of distribution

Insights:

Motorcycle covers the largest to this segment covering 1/3 of the total deliveries done. The minimum contribution to the deliveries is with the electric scooter suggesting the low adaptability in operational areas. Motorcycles are the most relied upon vehicle for deliveries but they are the one with poor conditions which contribute to longest delivery timings.

Stakeholders Action:

- Fleet managers can evaluate whether investing into motorcycle would be good due to its high operational utility.
- Sustainability team may investigate opportunities to invest more into electric scooters as a greener and safer environment alternative.
- Logistic planners could plan the delivery timings and agent allocation based on the vehicle type performance.

Business Problem: How does different vehicle conditions affect delivery times over the time?

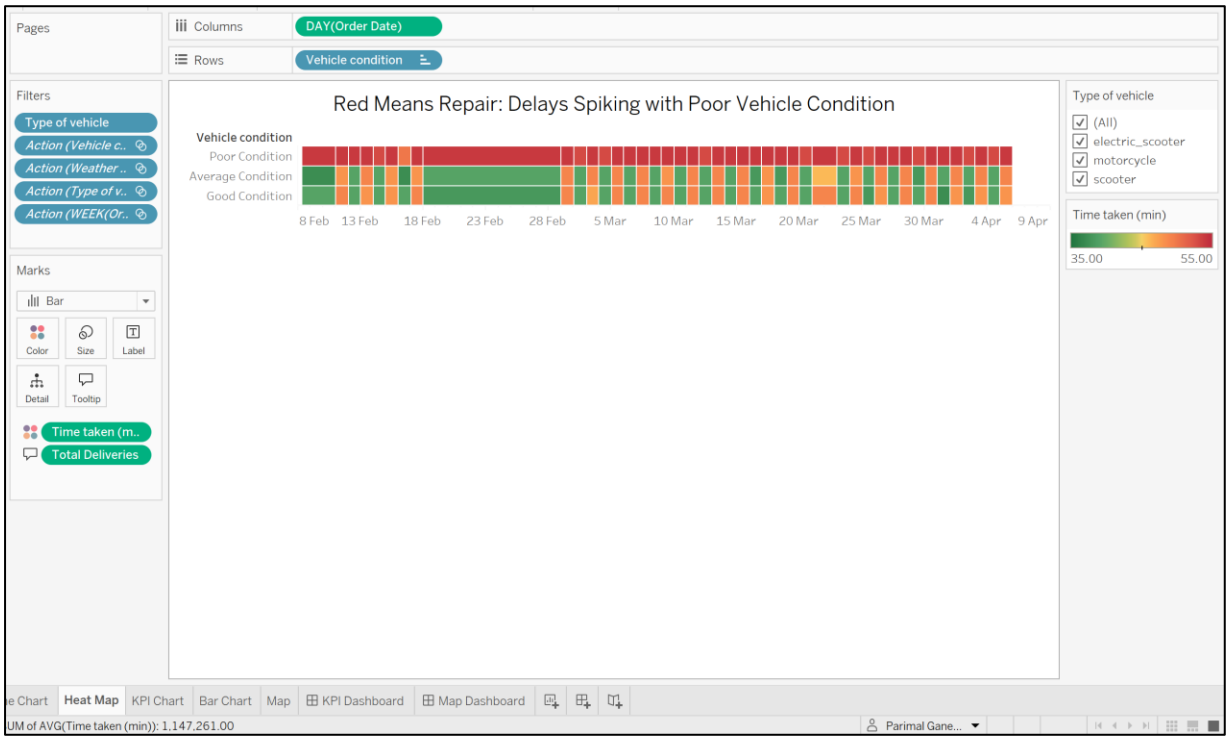

Image 1.5 – Heat Map

What it shows:

The heat map displays average delivery time across different segments of vehicle and vehicle conditions like poor, average and good. Each cell is colour coded based on the average time taken for deliveries on that day, with red colour indicating delays in deliveries where as green colour indicating faster deliveries.

Insights:

The visual clearly shows that deliveries done with poor vehicle conditions consistently lead to higher delivery timings. A deeper analysis of data reveals that the vehicles in poor conditions are all motorcycle vehicles while all the scooters and electric scooters are categorised into good and average category. These findings indicate a reliability gap with the motorcycle vehicles and possible investment opportunity for electric scooters for faster deliveries.

Stakeholders Action:

- Maintenance planners should prioritize inspecting and servicing the vehicles on more frequent basis.
- Fleet managers could expand the segment of electric scooters due to its consistency in delivery timings.

Business Problem: Which states receive the largest number of food deliveries; how many delivery agents are working in each state?

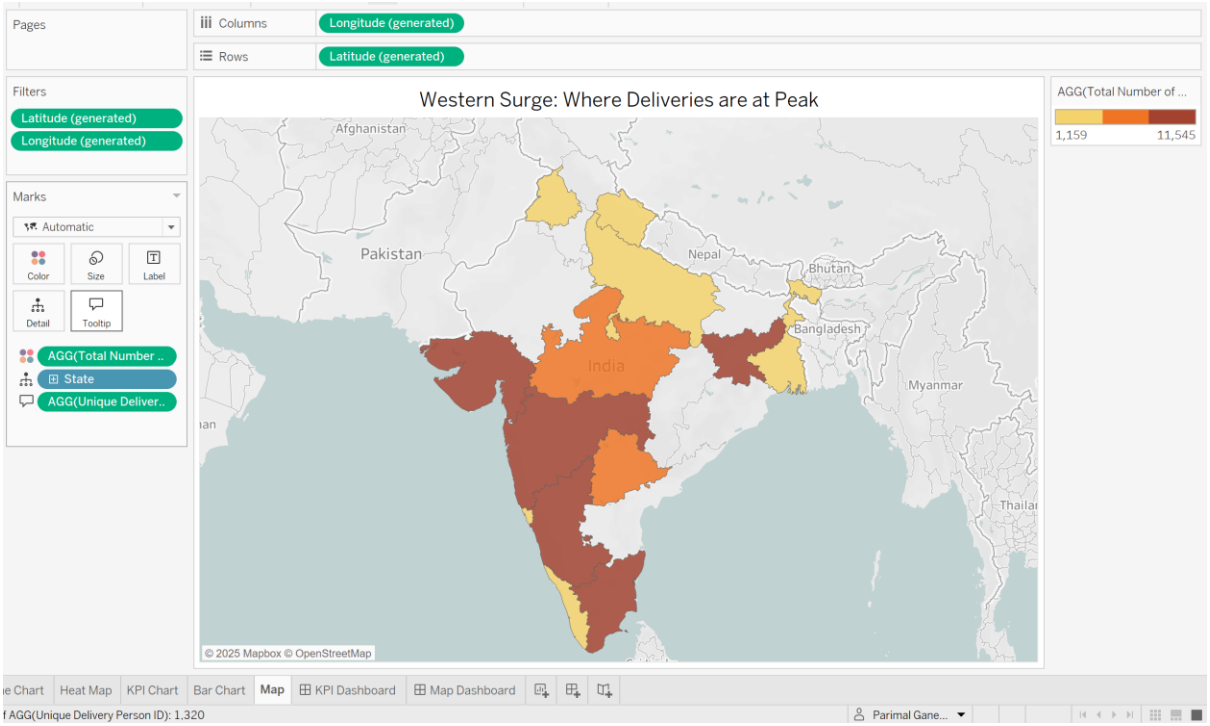

Image 1.6 – Choropleth Map

What it shows:

The Choropleth Map visualises the total number of deliveries done across the states in India. States are colour coded as yellow (fever deliveries) to dark brown (higher delivery volumes). The map also consists of a hierarchy to change between the states and cities for total number of deliveries.

Insights:

Western India particularly Maharashtra and Gujrat show the largest number of deliveries volume, which indicates a strong operational presence and market activity. In contrast eastern and north eastern states demonstrate lower number of deliveries. This shows high demand regions and delivery patterns that could help in expansion strategies.

Stakeholders Action:

- Regional Managers could prioritise promotions or campaigns in low density areas.
- Marketing team could work upon underperforming regions to increase customer acquisition.

Section 6: Ethical Issues

1. Data privacy of Delivery person

When using operational data from food delivery services, the delivery person age, performance evaluation metrics, and even their location from a mobile device may be included. From a business and operational efficiency perspective, these data sets are critical for fleet optimization. However, if not managed properly, they could also infringe on private data concerning personal identity. According to best practices, identifiable information must be anonymized exact PII prior to reporting or analysis. There is a risk of noncompliance with privacy frameworks such as General Data Protection Regulation (GDPR), aside from the erosion of trust within the organizational workforce that can arise if sufficient safeguards are not applied. In your case work, the delivery person's ratings and age were key attributes, but without de-identification, they may allow internal stakeholders to attribute performance to specific people which can lead to bias, discrimination, or other damaging organizational behaviour. As discussed in class, ensuring ethical compliance in these situations implies enforcing privacy protection in all processes from data gathering to dashboard publication.

2. Bias during data representation

Certain geographic areas or features are stored with an under-representing or over-representing bias which can be problematic too. For example, if we take a look at the analysis, scooters while being efficient and eco-friendly, were comparatively underrepresented when it came to for fleet members and motorcycles were overrepresented. This means that scooters were included in the count but not to the degree where they were efficient which might lead decision-makers into thinking that scooters aren't as eco-friendly as they assume. Similar bias can stem out if less populated regions or rural areas have insufficient data. As motorcycles are bifurcated into two distinct categories, decision-makers might include one subset of motorcycles into the scooter category leading to unreliable visual analytics and aggregated data interfaces. Rightful methods of depicting data compel the user to create strategies and restrictions besides cleaning the data itself. In structured systems, these overriding assumptions serve such as screens and context shields that are critical perforation across arbitrary limits enhance equity when the data can be used to fund services or audit operational frameworks.

3. Responsible Use of Performance Metrics

While measurements like delivery duration and customer score can help evaluate operational efficiency, they, just like any KPI, should not be analysed singularly. In our case, delivery time was significantly affected by weather conditions, traffic, and the state of the vehicle, all of which are beyond the control of a delivery driver. If such metrics are set for performance reviews or punitive actions without regard for these externalities, the system is wrongful by design. Data ethics requires that these variables, at least, be interpreted properly, and that dashboards have the possibility to filter data based on influencing parameters such as traffic or weather. Also, discussing the parameters with the stakeholders and cross-training can help reduce the restrictions put on defining the data. It is counterproductive to allow managers to only discover inefficiency, rather than permit them to address the lack of support and draw clear boundaries for accountability and enable accurate monitoring of organizational activities.

4. Transparency in Algorithmic Adjustments

Interactive dashboards frequently come equipped with calculated fields, what-if simulations, or derived KPIs that improve decision-making. However, without adequate documentation or contextual explanation, these constructs can become “black boxes”: aesthetically captivating yet qualitatively algorithmically enigmatic. In your dashboard, parameters such as the delivery increase feature enable stakeholders to simulate operational peaks. However, without an explanation on how the projections are computed, there is a risk of overinterpretation that leads to misinterpretation and overdependence. Ethical analytics entails that users are systematically informed about the methodology of every metric presented, what assumptions are made, and what limitations lie therein. Providing tooltips, describing received and computed formulas, or including additional documentation outside of analytics frameworks like Tableau increases transparency and ensured decision-making. This protects the integrity in analytics platforms by safeguarding against deliberate misuse of insights created from artificial values due to gap filling.

5. Sustainability vs. Operational Pressure

Our analysis showed electric scooters working best in condition and delivery consistency. However, incentivizing a sudden shift to electric vehicles without adequate planning may overload employees and infrastructure. While electric fleets are ideal from an environmental perspective, few cities have charging stations, maintenance shops, or replacement inventories to accommodate immediate adoption. Ethical deployment is done step by step and well-documented, with an involvement of the workforce training, policy changes, and logistical arrangements. A mere sustainability strategy that ignores the operating imperatives as well as employees' welfare may be counter-productive. Preserving green plans with on-ground practicality is necessary for ethical progress, ensuring that technological achievements do not end up at the expense of people delivering the service.

Section 7: Conclusion

The project demonstrates the power of visualisations by uncovering the operational insights withing the food delivery unit. With the use of Tableau complex raw data was converted into intuitive dashboards that provide real-time actionable intelligence for decision makers. From Analysing delivery timings under various weather conditions to checking the health of vehicle to geographical demand patterns, every visualisation served as a glass which showed the inefficiencies and opportunities were bought up into light.

By giving an insight about the core business problems such as optimising the delivery time, improving vehicle usage, managing workforce demands, and identifying regional trends the project provides company a roadmap to improve its delivery performance. The integration of What-If analysis, geographical mapping and KPI summaries give stakeholders not only the summary about current situation but also allows to forecast the future needs and respond to the demand immediately.

Moreover, the project carefully considered ethical implications such as privacy, bias, algorithmic transparency and workforce sustainability, ensuring the importance of data practices in modern environment.

Finally, to summarise with, this project bridges the gap between unprocessed data and strategies. By the use of visual analytics, it will make the company make smarter, faster and more informative decisions helping the organisation turn traffic jams to faster lanes in their journey towards operational excellence.

Section 8: References

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Section 9: Appendices

Dataset

The dataset is sourced from Kaggle and provides an detailed overview of food delivery operations, including key factors such as delivery time, traffic conditions, weather impact, vehicle condition, and city-wise order distribution. It serves as a valuable resource for analysing delivery efficiency and identifying areas for operational improvement.

Screenshots of dataset

ID	Delivery_person_ID	Delivery_person_Age	Delivery_person_Ratings	Restaurant_latitude	Restaurant_longitude	Delivery_location_latitude
0xcdcd	DEHRES17DEL01	36	4.2	30.327968	78.046106	30.397968
0xd987	KOCRES16DEL01	21	4.7	10.003064	76.307589	10.043064
0x2784	PUNERES13DEL03	23	4.7	18.56245	73.916619	18.65245
0xc8b6	LUDHRES15DEL02	34	4.3	30.899584	75.809346	30.919584
0xdb64	KNPRES14DEL02	24	4.7	26.463504	80.372929	26.593504

Image 2.1

Delivery_location_longitude	Order_Date	Time_Orderd	Time_Order_picked	Weather_conditions	Road_traffic_density	Vehicle_condition
78.116106	12-02-2022	21:55	22:10	Fog	Jam	2
76.347589	13-02-2022	14:55	15:05	Stormy	High	1
74.006619	04-03-2022	17:30	17:40	Sandstorms	Medium	1
75.829346	13-02-2022	09:20	09:30	Sandstorms	Low	0
80.502929	14-02-2022	19:50	20:05	Fog	Jam	1

Image 2.2

Type_of_order	Type_of_vehicle	multiple_deliveries	Festival	City	Time_taken (min)
Snack	motorcycle	3	No	Metropolitian	46
Meal	motorcycle	1	No	Metropolitian	23
Drinks	scooter	1	No	Metropolitian	21
Buffet	motorcycle	0	No	Metropolitian	20
Snack	scooter	1	No	Metropolitian	41

Image 2.3

Variable Name	Description	Data Type	Example
ID	Unique identifier for each delivery order.	Nominal	0xcdcd
Delivery_person_ID	Unique identifier for each delivery person.	Nominal	DEHRES17DEL01
Delivery_person_Age	Age of the delivery person.	Discrete	36
Delivery_person_Ratings	Customer rating given to the delivery person.	Ordinal	4.2
Restaurant_latitude	Latitude coordinate of the restaurant.	Continuous	30.327968
Restaurant_longitude	Longitude coordinate of the restaurant.	Continuous	78.046106
Delivery_location_latitude	Latitude coordinate of the delivery location.	Continuous	30.397968
Delivery_location_longitude	Longitude coordinate of the delivery location.	Continuous	78.116106
Order_Date	Date when the order was placed.	Nominal	44604
Time_Orderd	Time when the order was placed.	Nominal	0.913194444
Time_Order_picked	Time when the order was picked up by the delivery person.	Nominal	0.923611111
Weather_conditions	Weather conditions at the time of delivery (e.g., Sunny, Rainy, Foggy).	Nominal	Fog
Road_traffic_density	Traffic conditions at the time of delivery (Low, Medium, High, Jam).	Ordinal	Jam
Vehicle_condition	Condition of the delivery vehicle (scale from 0 to 3).	Ordinal	2
Type_of_order	Category of the food order (e.g., Snacks, Drinks, Buffet, Meals).	Nominal	Snack
Type_of_vehicle	Type of vehicle used for delivery (e.g., Bike, Scooter).	Nominal	motorcycle
Multiple_deliveries	Number of multiple deliveries assigned to a single delivery person in one trip.	Discrete	3
Festival	Whether the order was placed during a festival (Yes/No).	Nominal	No
City	Name of the city where the order was placed.	Nominal	Metropolitan
Time_taken (min)	Total time taken for delivery in minutes.	Discrete	46