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Exploratory and Visual Analytics of Mtcars Dataset Using Tableau Tool

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Abstract- The mtcars11 dataset provides complete data about vehicle performance and their corresponding features. The dataset includes essential features which measure fuel efficiency through miles per gallon and provide engine specifications and horsepower and vehicle weight and transmission type and driving conditions. The information assists in examining trends associated with vehicle effectiveness, performance, and operational conduct. Through the use of data visualisation methods on this dataset, we seek to comprehend how elements such as weight, engine power, and transmission type affect fuel efficiency and overall performance. It also aids in recognising patterns under various driving circumstances like traffic and weather. The knowledge acquired can enhance decision-making in automotive evaluation, vehicle development, and performance improvement.

Keywords- Mtcars Dataset, Tableau, Vehicle Performance, Fuel Efficiency Analysis, Bar Chart Analysis, Performance Optimization, Vehicle Weight Impact, Miles Per Gallon (MPG).

I. INTRODUCTION

Data visualization plays a significant role in analysing large dataset and presenting meaning full insights in graphical format. In the automotive industry, analysing vehicle performance data helps in understanding fuel efficiency, engine performance, and the impact of various factors such as weight, horsepower, transmission type, traffic, and weather conditions. The mtcars dataset contains detailed information about different car models and their performance-related attributes ,making it suitable for studying automotive trends and behaviour.

This study uses Tableau, a powerful data visualization tool, to analyse the mtcars dataset through various charts and dashboards. The objective is to identify patterns and relationships between vehicle characteristics and fuel efficiency. By visualizing factors like MPG, horsepower, gear count, and trip distance, the analysis provides valuable insights that can support vehicle design improvements, performance optimization, and sustainable transportation development in the automotive industry

II. LITERATURE SURVEY

Tiziano Bonini studied the methods by which food delivery workers establish support networks through private messaging groups on WhatsApp, Telegram, Messenger, and WeChat. Their research highlights the idea of affordance theory, which shows how users from specific cultural and social backgrounds interact with digital communication tools. Workers use these private groups to exchange information and plan activities and provide emotional support, which helps them build solidarity and fight against the restrictions of platform-based delivery systems [1]. Laetitia Dablanc examined the changes in urban freight systems prompted by the swift expansion.

The platforms connect three user groups, which include senders, couriers, and recipients, to create a delivery service that operates in less than two hours. The research demonstrates how these systems function but also reveals their negative impact, which includes increased traffic congestion and urban infrastructure damage to street parking areas. The authors determine that although immediate delivery improves convenience, it presents considerable obstacles for sustainable urban mobility [2].

C.A.Mello studied how delivery fees affected the earnings of couriers who worked in eight major Brazilian cities. The study uses linear regression analysis to investigate how different platforms and locations proceed with their fixed and variable

charge systems. The findings show that peer-to-peer delivery services have expanded, but their drivers face extended working hours and insufficient earnings which stop them from reaching minimum wage. The situation displays current problems which impact both worker conditions and the economic sustainability of the gig economy [3].

Andrey Aleksandrov investigated Google Play Instants as a novel method for application distribution within the Android environment. This model enables users to utilise applications immediately without needing complete installation, enhancing user experience and lowering entry barriers. The research examines both theoretical and practical elements, determining that although the implementation procedure is quite straightforward, there are constraints for larger or cross-platform applications. The authors recommend additional testing and enhancement to fully achieve their potential [4].

Krushna Madane created an Android application designed to link consumers directly with producers, thus removing middlemen. The supply chain expenses decrease through this method while it provides better visibility across operations. The research shows that these applications can offer various services on one platform, enhancing convenience and accessibility for users, particularly in isolated or under-resourced areas. The authors demonstrate that digital solutions which target consumers can improve operational efficiency while they increase user satisfaction [5].

Shish Pal and his research team studied how people perceive ultra-fast delivery services, which include the new 10-minute delivery system that food delivery services introduced. The research found different consumer responses through survey data because some consumers preferred fast service, but others expressed concerns about food quality, cleanliness and delivery safety. The findings demonstrate that speed serves as an essential factor, but customer satisfaction depends more on service quality and reliability and AI-driven personalisation technologies [6].

Haomin Wen and colleagues provided an extensive review of route and time prediction (RTP) techniques in on-demand delivery services. The research uses machine learning and deep learning techniques to improve delivery performance while reducing transportation costs. The research identifies essential gaps which need better systems for real-time data collection and development of models that can handle multiple users. The authors determine that improvements in RTP can greatly boost customer satisfaction and logistics efficiency. [7].

Ana Bricia Galindo-Muro and her team developed an advanced electric bike routing system which improves sustainable operations of urban delivery services. The model uses road incline and distance and cycling facilities to improve its energy efficiency performance. The study demonstrates improved route efficiency and reduced carbon emissions through its use of actual data and simulation techniques. The authors identify scalability challenges and computational complexity issues as obstacles that remain unsolved for large-scale applications [8].

Chengyuan Huang and her colleagues carried out a survey to determine whether consumers preferred self-driving delivery vehicles (SDVs) to traditional courier services. The researchers used a random parameter logit model to study how different factors, including delivery costs and package safety and customer privacy and user attributes, affected people who wanted to adopt the system. The research shows that ADVs have significant potential, but their adoption depends on solving problems with system reliability and user trust. The research provides crucial viewpoints which will help drive progress and operationalisation of autonomous delivery systems [9].

Wan Qin and colleagues investigated pricing and delivery approaches in online-to-offline (O2O) instant delivery systems. The research employs analytical models to identify pricing strategies that enhance profitability for retailers. Results show that raising product prices while providing free or inexpensive delivery services may prove to be more effective than imposing separate delivery charges. Moreover, elements like delivery radius and minimum order requirements significantly influence operational efficiency and profit maximisation [10].

III. DATA VISUALIZATION

Table 1:Dataset Attributes and Variables Descriptions:

Attribute Name	**Data Type**	**Description**	**Example/ Unit**
MPG	Float	Fuel efficiency(miles per gallon)	21.0
cyl	Integer	Number of cylinders	6
disp	Float	Engine displacement	160.0
hp	Integer	Horse power	110
drat	Float	Rear axle ratio	3.90

wt	Float	Vehicle weight	2.620
qsec	Float	Quarter mile time	16.46
vs	Binary	Engine type(0=V.1=InLine)	0
am	Binary	Transmission(0=Auto ,1=Manual)	1
gear	Integer	Number of gears	4
carb	Integer	Number of carburetors	4
Driver Age	Integer	Drive age	35
Traffic	categorical	Traffic condition	High
Weather	categorical	Weather condition	Rainy
City	categorical	City name	Mumbai
Latitude	Float	Latitude	19.0760
Longitude	Float	Longitude	72.8777
Date	Date	Date of trip	2024-03-15
Trip Distance	Float	Trip distance	12.5

Visualization Type: Horizontal Bar Chart

The bar graph displays the Average Miles per Gallon (MPG) data of different car models. The x-axis represents the MPG values while the y-axis displays various car models which include Toyota vehicles. The research discovered that the Toyota Corolla provides the highest fuel efficiency with 33.9 MPG while the Fiat 128 follows closely behind with 32.4 MPG. The Cadillac Fleetwood and Lincoln Continental show the worst fuel efficiency because both vehicles operate below 10.4 MPG. The chart demonstrates different fuel efficiency levels between various car models because compact cars show better results than larger luxury vehicles.

Result: The results indicate that smaller and lighter vehicles generally achieve higher fuel efficiency, while larger luxury and performance-oriented cars consume more fuel and produce lower MPG ratings.

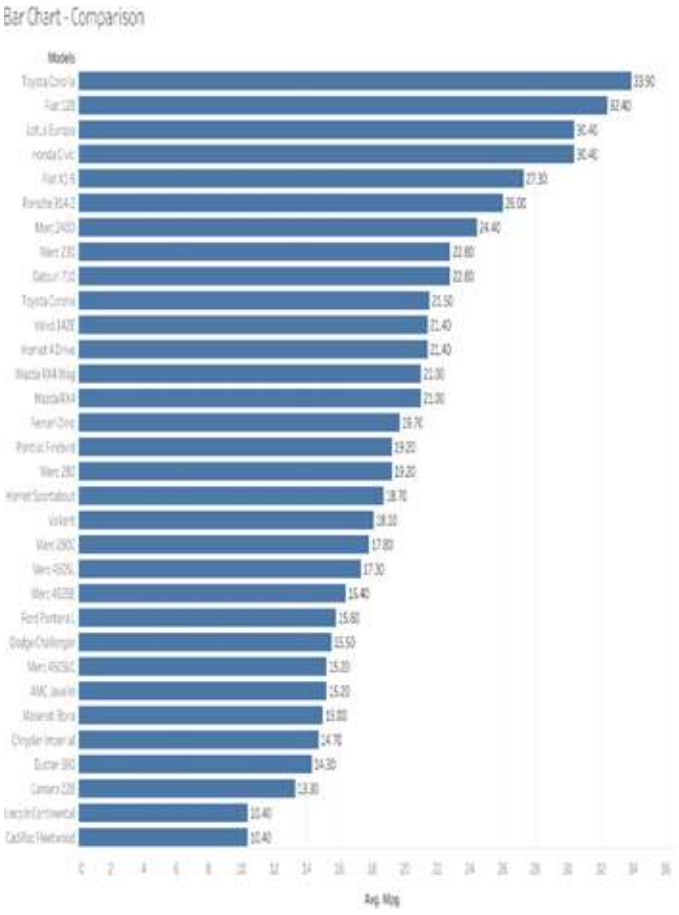

Figure1: Comparison of Average Miles per Gallon (MPG) Across Car Models

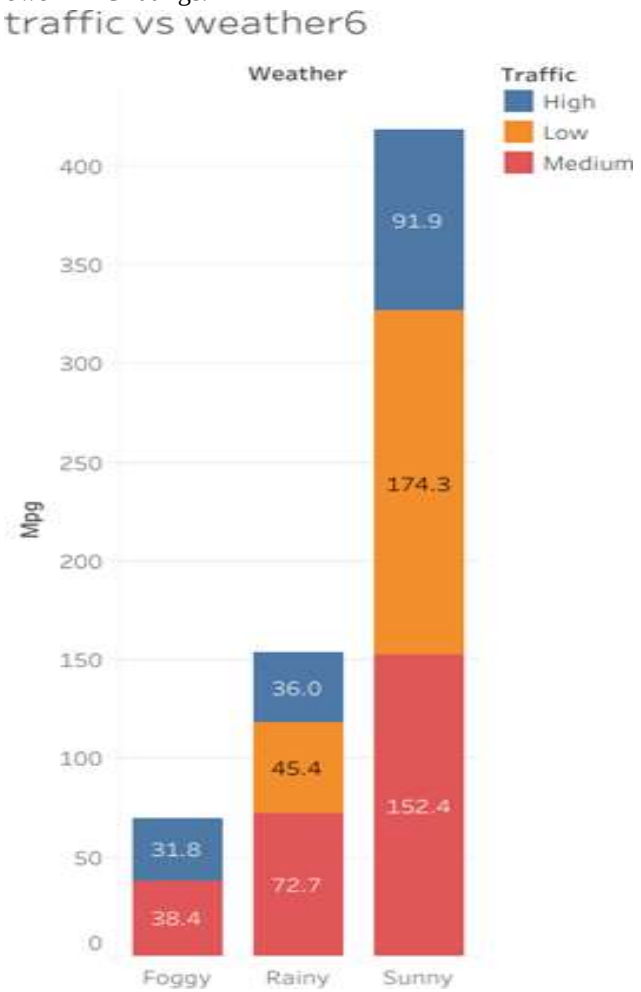

Figure2: Traffic Level Across Different Weather Condition Visualization Type: Stacked Bar Chart

The stacked bar chart displays three traffic levels, which include high traffic and medium traffic and low traffic for various weather conditions. The stacked bar chart displays three traffic levels, which include high traffic and medium traffic and low traffic for various weather conditions. The x-axis displays weather classifications which include 'foggy', 'rainy', and 'sunny', while the y-axis shows the complete traffic volume. The research shows that traffic volumes reach their peak during sunny weather because low traffic accounts for approximately 174.3 units, medium traffic accounts for 152.4 units, and high traffic accounts for 91.9 units. Foggy weather conditions produce the lowest traffic levels across all traffic categories. Rainy conditions show a balanced traffic distribution, positioned between foggy and clear weather.

Result: The result indicate that sunny weather experiences the highest traffic activity, likely due to favourable driving conditions. Rainy weather reduces traffic movement, while foggy weather has the least traffic due to poor visibility and cautions driving behaviour.

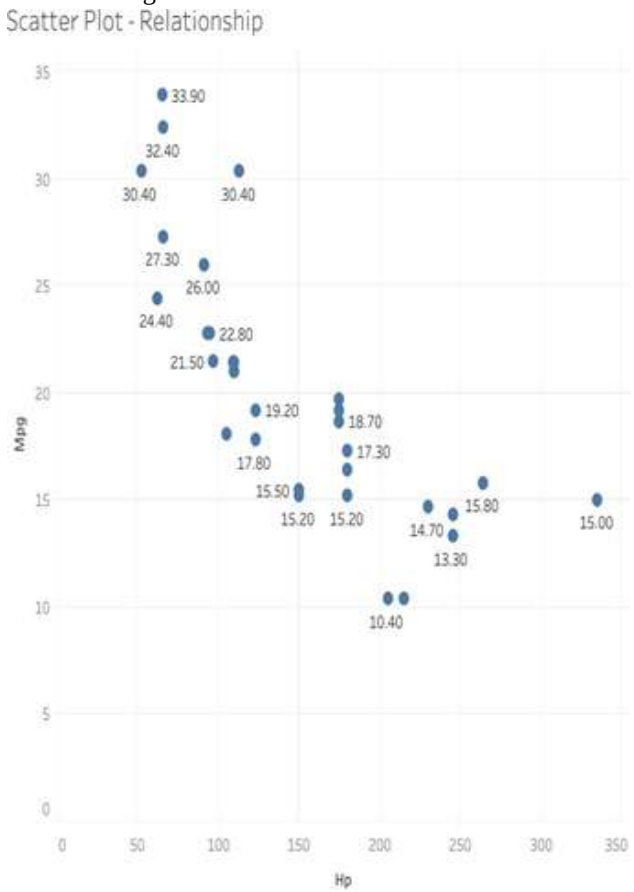

Figure 3: Relationship between Horsepower and Fuel Efficiency

Visualization Type: Scatter plot

The scatter plot shows how Horsepower (Hp) and Average Miles Per Gallon (MPG) values are connected to each other. The x-axis presents horsepower figures, whereas the y-axis indicates the MPG efficiency of various car models. The main observations show that there exists a negative correlation between horsepower and fuel efficiency. Cars with reduced horsepower (approximately 50-100 Hp) generally achieve higher MPG ratings (over 25 MPG) which demonstrates their improved fuel economy. The vehicles with greater horsepower (over 200 Hp) usually achieve lower MPG ratings which range between 10 to 18 MPG. The pattern shows that efficiency decreases when the parameter increases.

Result: The result show a negative correlation between horsepower and fuel efficiency. As horsepower increases, MPG tends to decrease, indicating greater fuel consumption.

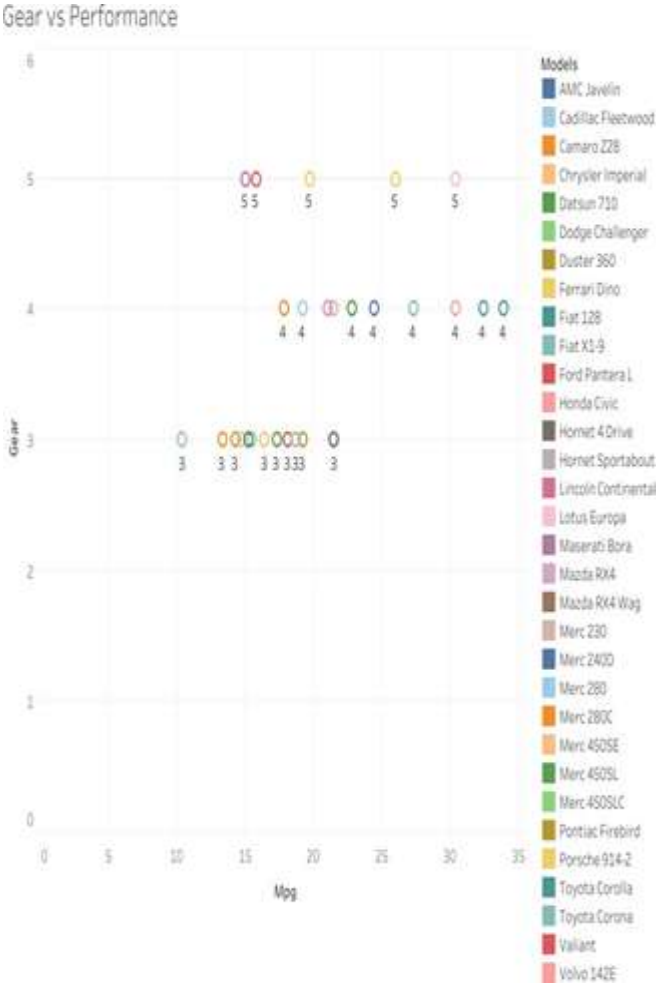

Figure 4: Relationship between Gear Count and Fuel Efficiency

Visualization Type: Scatter plot

This scatter plot illustrates the connection between the Number of Gears and Average Miles per Gallon (MPG). The x-axis shows MPG values, and the y-axis denotes the number of gears for various car models.

The key findings show that vehicles which have 4 and 5 gears achieve better fuel efficiency because they attain higher MPG results than vehicles which have 3 gears. The majority of 3 gear cars display their fuel efficiency between 10 and 20 MPG which represents the lower to mid MPG range whereas 5 gear models show higher MPG ratings that exceed 20 MPG. The chart shows that increasing the number of gears leads to better fuel efficiency although some categories produce similar results.

Result: The visualization indicates a positive relationship between gear count and fuel efficiency. Vehicles equipped with 4 or 5 gears generally provide better MPG compared to vehicles with only 3 gears. Therefore, higher gear configuration contributes to improved driving efficiency and overall vehicle performance

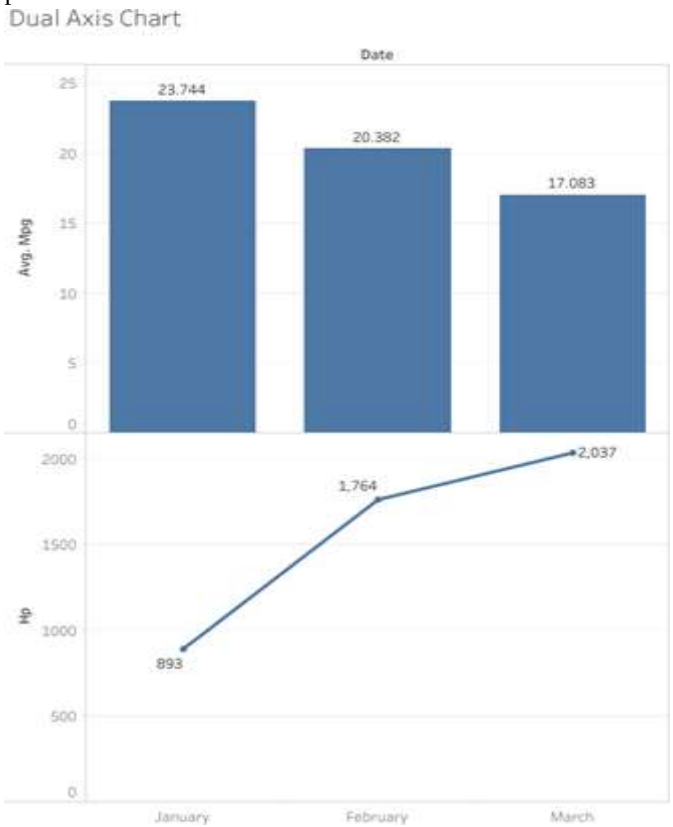

Figure 5: Dual Axis Chart Showing Number of Gears and Average MPG

Visualization Type: Dual Axis

The dual-axis chart illustrates the relationship between the gear count in various car models and their average MPG performance. The research results indicate that cars with over 4 gears attain greater fuel efficiency than those that function with 4 gears. The typical pattern shows that vehicles with 3 gears operate at lower MPG ranges which fall between 10 and 20. The relationship between gear count and fuel efficiency shows a positive trend although some overlap indicates that other factors impact MPG results.

Result: The visualization indicates that vehicles or dataset with higher horsepower tend to have lower fuel efficiency. Increasing HP from January to march corresponded with steady decline in average MPG. Performance enhancement often comes at the cost of increased duel consumption

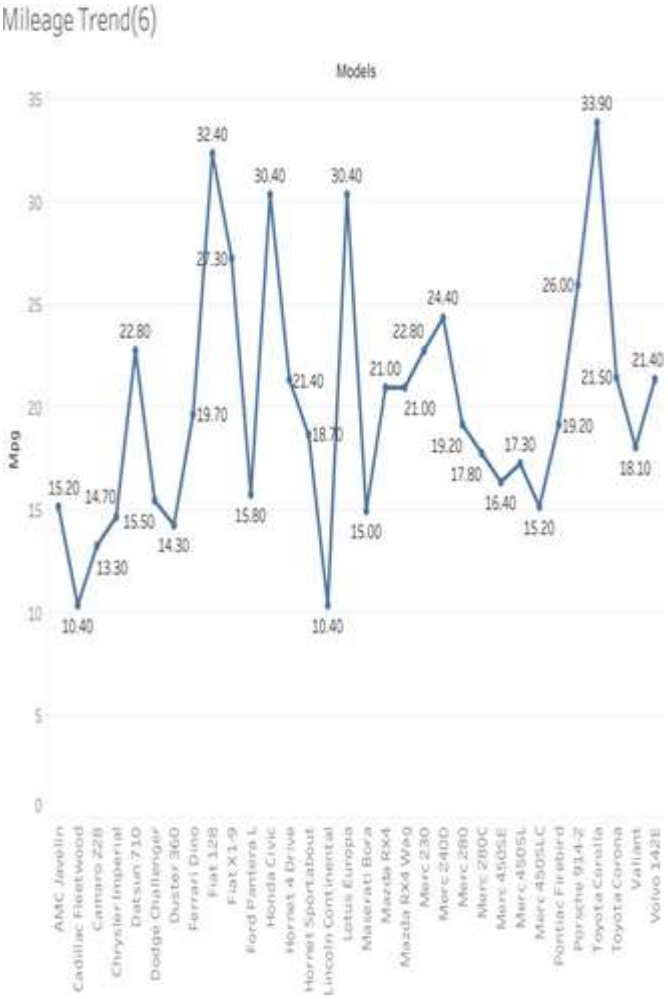

Figure 6: Mileage Trend across Different Car Models Visualization Type: Line Chart

The chart displays multiple mileage measurements which range from 10.4 MPG to 33.9 MPG across various vehicle models. The Toyota Corolla delivers the highest fuel efficiency whereas the Cadillac Fleetwood and Lincoln Continental produce the lowest miles per gallon performance. The trend shows fundamental pattern alterations which result in unpredictable outcomes throughout all examined models. Most vehicles operate at their typical driving efficiency which ranges from 15 to 25 miles per gallon. Compact cars and economical vehicles achieve superior fuel efficiency, while larger vehicles and high-performance cars tend to show lower miles per gallon results.

Result: The Visualization reveals that fuel efficiency varies greatly across vehicle models. Economical compact cars achieve significantly better mileage compared to heavy-performance vehicles. Some vehicles exceed 30 MPG, showing excellent fuel economy. Models with MPG near 10-15 demonstrate higher fuel consumption.

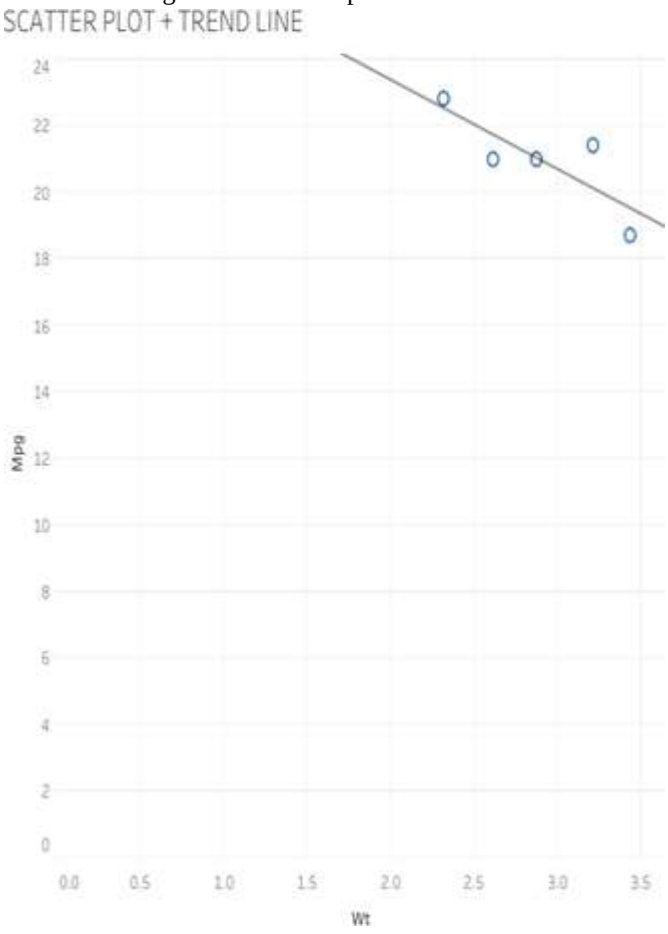

Figure 7: Scatter Plot with Trend Line Showing Relationship between Weight (Wt) and MPG Visualization Type: Scatter plot

If you notice, from this scatter plot with trendlines, one side of the Vehicle is vehicle weight and the other side is fuel efficiency (MPG). The trendline expresses the negative relationship quite vividly. The descending trend line shows that weight increases lead to MPG decreases. Lighter vehicles reach higher MPG ratings which usually exceed 21 MPG but heavier vehicles maintain lower fuel efficiency which typically drops below 20 MPG. The general trend stays consistent but small data variations show that other factors probably impact MPG results.

Result: The visualization shows that higher vehicle weight results in lower MPG. Vehicles with lower weight achieve better fuel economy. Weight is an important factor influencing automobile performance and fuel consumption

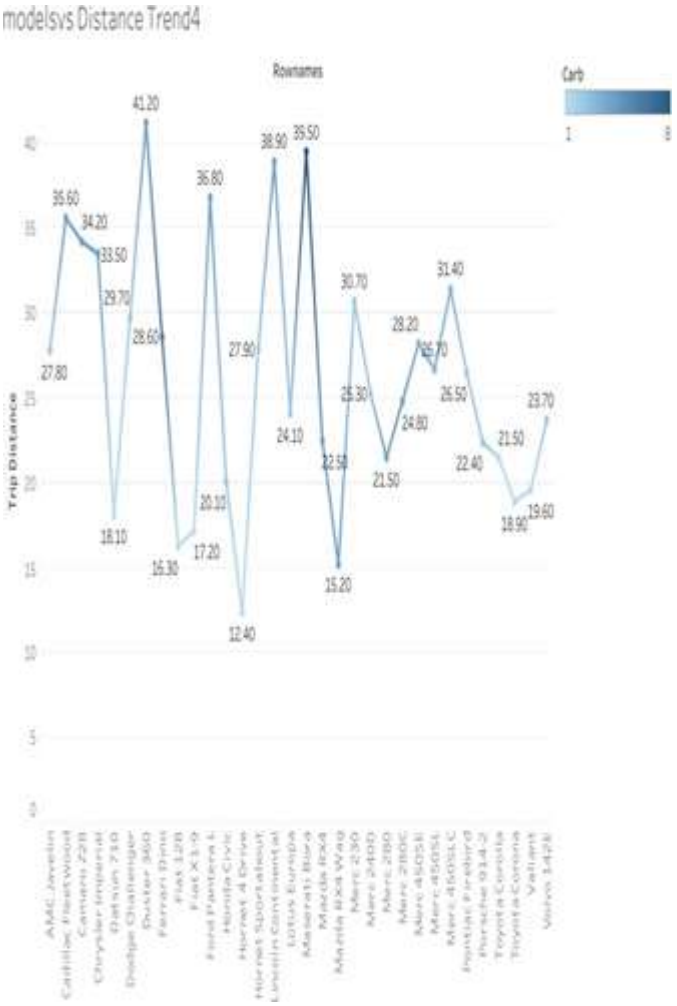

Figure 8: Line Chart Showing Trip Distance Variation Across Car Models

Visualization Type: Line chart

The graph shows how different vehicle models travel various distances, which range between 12.4 and 41.2 units. The Duster 360 and Maserati Bora display extended trip distances, while the Honda Civic and Mazda RX4 Wag show shorter trip distances. The trend shows considerable variability without a steady pattern, suggesting that trip distances vary widely between vehicles. Moreover, the variation in colour implies that an increase in carburettor counts might be linked to longer trip distances, though this connection is not consistent.

Result: The visualization reveals that trip distance Performance differs considerably across vehicle Models. Some vehicles demonstrate excellent Travel efficiency with values above 35-40. Several Models perform moderately within the 20-30 range .A few vehicles show lower efficiency with Distance below 15-20

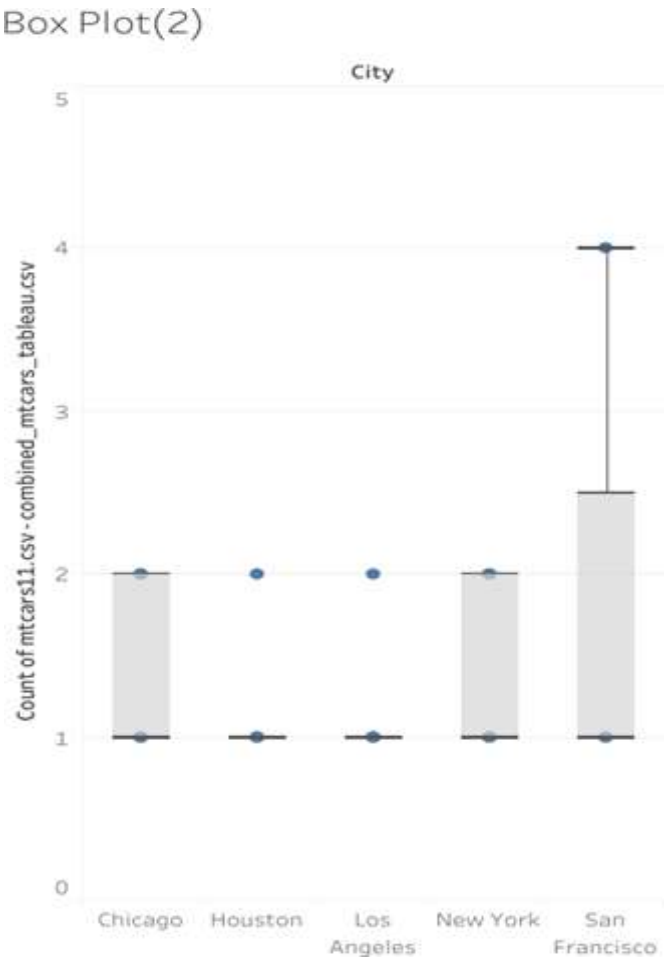

Figure 9: Box Plot Showing Distribution Across Cities
Visualization Type: Box plot

The box plot shows how Chicago, Houston, Los Angeles, New York, and San Francisco distribute their value ranges across their entire territories. Most cities in this study show a small value range that typically remains between 1 and 2 because their measurements show low variability and their patterns show stable results. San Francisco stands out because its value range extends to 4, which shows greater variability than all other cities'. The median values in most cities seem alike, suggesting a stable central tendency, whereas slightly elevated values in a few cities show small variations. In general, the chart indicates that although most cities have consistent distributions, San Francisco shows relatively more fluctuation. Result: Most cities maintain low variability with values concentrated around similar ranges. San Francisco exhibits the highest variability among all cities. The distributions across cities are generally balanced with limited extreme deviations.

IV. CONCULSION

The mtcars11 dataset examination through various visualization techniques provides detailed insights into the factors that determine vehicle performance and fuel efficiency. The study demonstrates that key factors such as vehicle weight and horsepower and gear count have a direct impact on MPG. The analysis shows that lighter vehicles with less powerful engines and more gears achieve better fuel efficiency while heavier high-performance vehicles consume more fuel which results in lower MPG performance.

The visualizations also showcase significant differences among various car models, with compact and economy cars attaining the best mileage, while luxury and larger vehicles demonstrate reduced efficiency. Trends noted in the dual-axis and scatter charts validate the compromise between performance and fuel efficiency, highlighting that enhanced power frequently results in reduced efficiency.

The examination of journey lengths and urban distributions additionally suggests that although external and contextual aspects affect performance, their effect is less reliable than that of inherent vehicle traits. Differences among cities and driving situations indicate the influence of environmental and operational elements, yet these factors do not diminish the significance of fundamental mechanical design.

The research demonstrates how data visualization functions as a tool that uncovers major trends and relationships which exist

within automotive data. The acquired knowledge will help optimize vehicle design while improving fuel efficiency and supporting decision-making processes in the automotive industry. The analytical techniques can be utilized in real-world applications including intelligent transportation systems and performance prediction models.

The study results show that modern automotive design needs to maintain three different design elements, which include efficiency and performance and sustainability. Environmental issues and increasing fuel prices create greater fuel efficiency requirements for manufacturers who develop vehicles through data-backed insights which help them achieve superior performance and improved fuel efficiency. The programme also supports the transition to sustainable transportation systems.

Ultimately, this research emphasizes the promise of combining advanced analytics and machine learning methods with visualization tools to improve predictive abilities. Future studies may include larger datasets, live data, and extra factors like traffic scenarios and driver actions to create more precise and scalable models for analyzing automotive performance.

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