Project Report

Topic: Car Sales Dashboard Analysis

INT 7213 Business Analytics and Intelligence

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Introduction:

The primary goal of this project is to design and implement an interactive Power BI dashboard that provides a comprehensive analysis of car sales data across multiple dealerships in seven distinct regions. The dashboard serves as a robust Business Intelligence (BI) tool to visualize critical Key Performance Indicators (KPIs) related to car sales, enabling stakeholders to monitor performance, identify trends, and make data-driven decisions.

Incorporating the principles from *The Data Warehouse Lifecycle Toolkit*, the project emphasizes the importance of aligning BI applications with overarching business objectives. By leveraging data transformation, visualization, and dimensional modeling techniques, the dashboard delivers actionable insights into the car sales market, supporting strategic and operational decision-making.

Dataset Description:

The dataset used for this analysis comprises detailed sales records of various car models, along with customer and dealer information. The key attributes include:

- **Car Details**: Company, model, engine type, transmission, body style, color.
- **Sales Metrics**: Price and date of sale.
- **Customer Information**: Gender, annual income.
- **Dealer Information**: Name, region, contact details.

The following calculated measures were added during data transformation to enhance the analysis:

- **Year-to-Date (YTD) Metrics**: Sales totals, average price, and cars sold.
- **Month-to-Date (MTD) Metrics**: Metrics aggregated for the current month.
- **Year-over-Year (YOY) Growth**: Growth rates calculated by comparing current year sales metrics to the previous year.
- **Differences from PTYD (Previous Year-To-Date)**: Variances in sales figures and average price from the prior year.

These transformations were necessary to derive meaningful insights from the dataset and align it with the dashboard's requirements.

Dashboard Overview:

The Power BI dashboard provides real-time insights into the dealership's performance, with features and visualizations tailored to critical KPIs. It includes the following:

1. **Sales Overview**:

    - **YTD Total Sales**: Total sales for the year-to-date.
    - **MTD Total Sales**: Monthly sales figures.
    - **YOY Growth in Total Sales**: Year-over-Year performance.
    - **Difference between YTD and PTYD Sales**: Variances to assess performance trends.

2. **Average Price Analysis**:

    - **YTD Average Price**: Year-to-date average pricing.
    - **MTD Average Price**: Current month's average.
    - **YOY Growth in Average Price**: Pricing trends over the year.
    - **Difference between YTD and PTYD Average Price**: Highlights deviations.

3. **Cars Sold Metrics**:

    - **YTD Cars Sold**: Total units sold this year.
    - **MTD Cars Sold**: Monthly sales figures.
    - **YOY Growth in Cars Sold**: Year-over-Year growth.
    - **Difference between YTD and PTYD Cars Sold**: Variances to track sales volume.

4. **Visualizations**:

    - **YTD Sales Weekly Trend**: Line chart illustrating weekly sales.
    - **YTD Total Sales by Body Style**: Donut chart showing sales distribution across styles.
    - **YTD Total Sales by Color**: Donut chart highlighting sales by car colors.
    - **YTD Cars Sold by Dealer Region**: Map chart visualizing geographical distribution of sales.
    - **Company-Wise Sales Trends**: A tabular grid displaying company-specific sales metrics.

Stakeholders can interact with the dashboard dynamically, using filters to customize views and drill down into specific dealerships, engine type, body style, transmission type, company, and model attributes. This interactivity allows users to address targeted business queries, such as identifying underperforming dealerships or exploring sales trends for a specific company, model or body style.

CAR SALES DASHBOARD

02-01-2022 to 31-12-2023

Sales Insight

YTD Total Sales	$70.8M	23.59%	YTD Avg Price	($0.22K)	-0.79%
$371.2M	MTD Total Sales : $54.28M		$28.0K	MTD AVG Price : $28.26K	

YTD Car Sold	2.62K	19.73%
13.3K	MTD Car Sold : 1.92K	

Filters

Engine: All

Body Style: All

Transmission: All

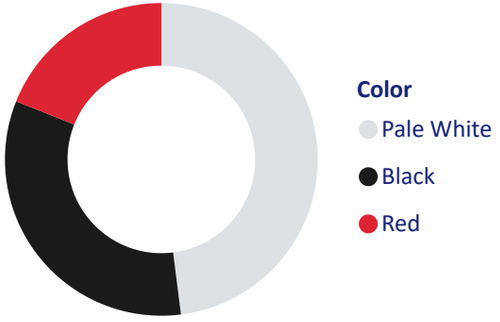
Dealer Name: All

Company: All

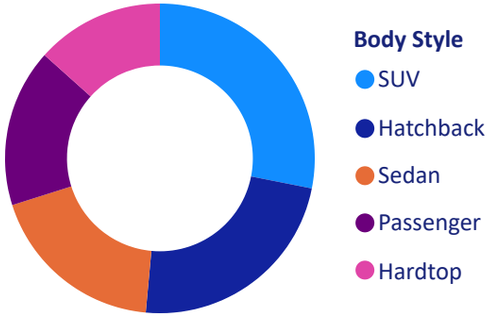
Model: All

YTD Sales by Week

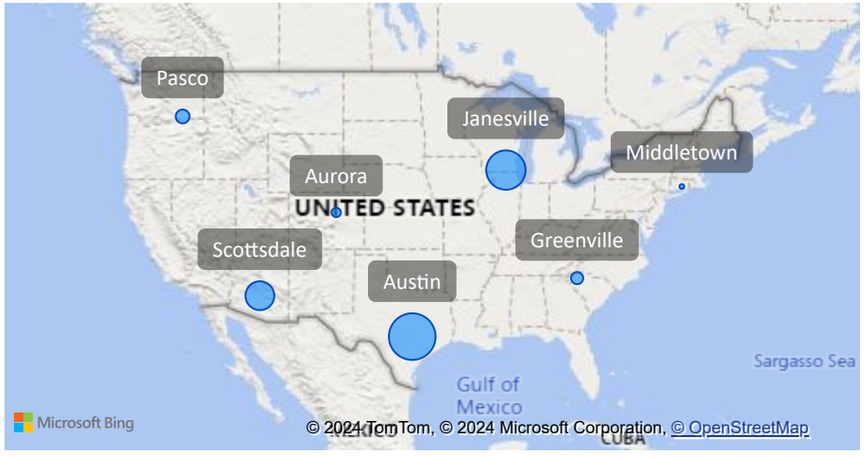
YTD Car Sold by Color



YTD Car Sold by Body Style



YTD Car Sold By Region



Company Wise Sale

Company	YTD Avg Price	YTD Car Sold	YTD Sales	% YTD Sales
Chevrolet	$25.99K	1043.0	$27.1M	7.30%
Dodge	$26.36K	949.0	$25.0M	6.74%
Ford	$28.70K	886.0	$25.4M	6.85%
Volkswagen	$25.40K	718.0	$18.2M	4.91%
Mercedes-B	$26.65K	714.0	$19.0M	5.13%
Mitsubishi	$26.56K	705.0	$18.7M	5.04%
Oldsmobile	$31.56K	622.0	$19.6M	5.29%
Chrysler	$25.91K	618.0	$16.0M	4.31%
Toyota	$29.52K	593.0	$17.5M	4.72%
Mercury	$29.02K	487.0	$14.1M	3.81%
Nissan	$26.91K	473.0	$12.7M	3.43%
Volvo	$27.91K	458.0	$12.8M	3.44%
Pontiac	$29.54K	448.0	$13.2M	3.57%

Analysis, Findings, and Insights:

The dataset spans two years (2022 and 2023), and the dashboard focuses primarily on the latest year (2023), while also comparing key metrics with the previous year (2022). The analysis aggregates data across all dealerships but can be filtered to focus on a single dealership for more granular insights. Below are the key insights derived from the dashboard:

1. **Major KPI Cards**

   A. **YTD Sales Revenue (2023):**
      - The total YTD sales revenue for 2023 is **$371.2M**, showing a significant increase of **$70.8M (23.59%)** compared to the previous year (2022).
      - The **MTD sales revenue for December 2023** is **$54.28M**, contributing strongly to the overall annual performance.

   B. **YTD Average Price (2023)**:
      - The average price of cars sold YTD in 2023 is **$28K**, slightly lower than the 2022 average by **$0.22K (0.79%)**.
      - The **MTD average price** for December 2023 is **$28.26K**, reflecting a stable pricing trend for the month.

   C. **YTD Total Cars Sold (2023)**:
      - A total of **13.3K cars** were sold in 2023, an increase of **2.62K units (19.73%)** compared to 2022.

2. **Trends and Preferences**

   A. **Sales Revenue Weekly Trend**:
      - Weekly sales revenue for 2023 fluctuates significantly, with a notable drop in the last couple of weeks.
      - The highest weekly revenue was achieved in **Week 36**, with sales totaling **$14.9M**.

   B. **Color Preferences**:
      - For cars sold YTD in 2023, **Pale White** was the most popular color, followed closely by **Black**.

   C. **Body Style Preferences**:
      - **SUVs** and **Hatchbacks** were the most preferred body styles, followed by **Sedans**, reflecting customer demand patterns.

3. **Regional and Company Insights**

   A. **Regional Sales**:

- Among the seven dealership regions, **Austin** led with the highest number of units sold (2,296), followed by **Janesville (2,113)** and **Scottsdale (1,912)**.

B. **Company-Wise Sales**:
- **Chevrolet** topped the YTD revenue rankings across all dealerships with sales totaling **$27.1M**, followed by **Dodge** and **Ford**. Chevrolet also led in terms of total units sold, reaffirming its strong market position.

Data Transformation Applied:

The raw data underwent significant transformations to align it with business needs:

1. **Aggregation**:
   - Summing sales figures for YTD and MTD totals.
   - Calculating company-wise and region-wise sales metrics.

2. **Derived Measures:**
   - YOY Growth: Calculated to track performance changes compared to the previous year.
   - Average Price: Derived by dividing total sales by the number of cars sold.
   - Differences from PTYD: Variances in metrics to highlight trends.

3. **Filtering**:
   - Excluded incomplete or irrelevant records.
   - Focused on the time range from January 2022 to December 2023.

These transformations ensured the dataset was clean, consistent, and suitable for generating meaningful visualizations.

Decision-Support Value:

The Car Sales Dashboard serves as a powerful decision-support tool for the dealerships, providing real-time insights into key performance indicators and enabling stakeholders to make data-driven decisions. By focusing on aggregated data and facilitating comparative analysis, the dashboard addresses multiple layers of decision-making, ranging from operational efficiency to strategic growth. Here's how the dashboard enhances decision support and adds value:

1. **Monitoring and Tracking Performance**
   - The dashboard enables **real-time monitoring** of key performance indicators (KPIs) such as Year-to-Date (YTD) and Month-to-Date (MTD) sales revenue, average price, and cars sold.

- Comparative insights (e.g., YTD vs. Previous Year-To-Date) allow stakeholders to track growth trends and identify areas of underperformance.

2. **Supporting Pricing and Revenue Strategies**
   a) **YTD Average Price Analysis:**
      - The dashboard highlights pricing trends and deviations, enabling informed pricing strategies.
      - The small decline in average price (-0.79%) indicates the need for targeted pricing reviews to optimize profitability while maintaining competitiveness.
   b) **Weekly Sales Revenue Trends:**
      - The fluctuation in weekly sales suggests opportunities to identify seasonal demand patterns, allowing the dealership to optimize promotions or adjust sales strategies during low-performing weeks.

3. **Inventory Management and Optimization**
   a) **Body Style and Color Preferences**:
      - Insights into customer preferences, such as the popularity of SUVs and Pale White cars, guide inventory allocation and stocking decisions.
      - Focusing on high-demand styles and colors minimizes unsold inventory and enhances sales efficiency.
   b) **Regional Sales Performance**:
      - By identifying top-performing regions (e.g., Austin) and areas with untapped potential (e.g., Middletown), the dashboard helps the dealership optimize inventory distribution across locations.

4. **Enhancing Regional and Dealer-Specific Strategies**
   a) The dashboard's ability to filter by dealership and company provides granular insights, allowing for tailored regional strategies.
   b) For example, high sales in Austin suggest maintaining robust inventory levels, while regions with lower sales may benefit from targeted marketing efforts or dealer incentives.

5. **Benchmarking and Competitive Analysis**
   a) Company-Wise Insights:
      - Chevrolet's dominance in both revenue and unit sales establishes benchmarks for other manufacturers. This information can guide partnership discussions, promotional campaigns, and negotiations with suppliers.
      - Comparing performance across brands helps identify gaps in the dealership's offerings, paving the way for strategic additions to the product portfolio.

6. **Operational Efficiency**

a) The integration of aggregated data across dealerships and the ability to drill down to individual dealerships enhance operational visibility.
b) Real-time metrics ensure proactive decision-making, such as adjusting sales targets, optimizing staffing during peak periods, or evaluating dealership-level performance for accountability.

7. **Strategic Growth Planning**
   a) The dashboard's longitudinal insights (2022 vs. 2023) provide a solid foundation for **forecasting and planning**. YOY growth metrics support long-term strategy development, enabling the dealership to scale operations or refine marketing strategies.
   b) Identifying underperforming regions or dealerships ensures resources are allocated effectively to achieve maximum impact.

Aha Moments:

During the dashboard creation, a key "aha" moment was realizing the importance of calculated measures for real-time insights. For example, the YOY Growth metric revealed underperforming regions that were previously overlooked in static reports. Additionally, the dynamic filtering feature allowed stakeholders to customize their view of the data, significantly improving usability.

Another challenge was ensuring the dashboard remained visually intuitive while presenting complex data. Achieving this balance required iterative refinement of visualizations and layouts.

Comparison to Textbook Concepts:

The project closely aligns with several concepts from "The Data Warehouse Lifecycle Toolkit":

1. **Dimensional Modeling**
   a) **Fact and Dimension Tables**:
      - The dashboard design incorporates the core elements of dimensional modeling, including clear segregation between fact data (e.g., sales revenue, cars sold) and dimension attributes (e.g., car details, dealership regions).
      - Facts like YTD sales and cars sold are linked to dimensions such as body style, color, and region, providing intuitive and high-performance querying capabilities.
   b) **Grain Definition**:

- The project adheres to Kimball's principle of defining grain at the most atomic level (individual sales records), ensuring flexibility in aggregating metrics for YTD, MTD, and YOY analysis.

2. **Data Transformation and ETL Processes**
   a) **Data Cleaning and Aggregation**: The project embodies Kimball's emphasis on clean and reliable data. Original raw data was transformed to calculate key metrics like YOY growth, YTD totals, and differences from the previous year.
   b) **Conformed Dimensions**: The use of consistent dimensions (e.g., car body styles, regions) across all analyses ensures enterprise-wide data integration, a hallmark of Kimball's bus architecture.
   c) **Calculated Measures**: Measures such as YOY growth and average prices were derived during the ETL phase, exemplifying Kimball's guidance on creating value through data preparation and transformation.

3. **Business Intelligence Applications**
   a) **Focus on User Needs:** The dashboard design mirrors the textbook's approach of starting with user requirements. By emphasizing actionable KPIs and visualizations, the project aligns BI applications with business processes, enabling stakeholders to monitor performance and make decisions effectively.
   b) **Interactive Features**: Dynamic filters for company, dealership, and body style reflect Kimball's recommendation to provide end-users with flexible, parameter-driven BI applications for maximum usability.
   c) **Visualization Best Practices:** The dashboard leverages effective visualization techniques (e.g., line charts, pie charts, and maps) to present data clearly and concisely, adhering to the principles of user-centric BI design.

4. **Alignment with Kimball Lifecycle Phases**
   a) **Requirements Gathering**: The project began with identifying key KPIs (e.g., YTD sales, average price) based on business needs, reflecting the importance Kimball places on thorough requirements definition.
   b) **Technology, Data, and BI Tracks:** Following Kimball's Lifecycle methodology, the project concurrently addressed the data (ETL), technology (Power BI tool selection), and BI application (dashboard design) tracks.
   c) **Iterative Development:** Consistent with the textbook's recommendation, the dashboard was developed iteratively, with continuous refinement to address data quality issues, enhance visualizations, and meet user needs.

5. **Supporting Business Processes:** The project aligns with Kimball's principle of integrating BI applications into business processes. By focusing on aggregated dealership sales data and regional comparisons, the dashboard directly supports decision-making in areas such as inventory management, pricing strategies, and regional performance optimization.

Citations:

- **Reference:** Kimball, R., Ross, M., Thornthwaite, W., Mundy, J., & Becker, B. (2008). *The Data Warehouse Lifecycle Toolkit* (2nd ed.). Wiley Publishing, Inc. ISBN: 978-0-470-14977-5.

- Mission Jee. (n.d.). *Car Sales Report*. Kaggle. Retrieved November 13, 2024, from https://www.kaggle.com/datasets/missionjee/car-sales-report