Fachhochschule Südwestfalen
University of Applied Sciences

Car Sales Analysis in America using SAP Analytics Cloud

Seminararbeit
In the context of the module Smart Factories with SAP

Sommersemester 2024

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Abgabetermin: 2024-08-11

Wir geben Impulse

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List of abbreviations

MMR	Manheim Market Value
CSV	Comma-Separated Values
SAC	SAP Analytics Cloud
USA	United States of America

1 Introduction

In recent years, the utilization of advanced analytics and cloud-based solutions has become paramount for businesses seeking to leverage data for strategic insights. This seminar paper focuses on the implementation and analysis of car sales data using SAP Analytics Cloud (SAC). The aim is to illustrate how integrating data analytics with cloud technologies can enhance business decision-making and operational efficiency.

Initially, the paper will delve into the theoretical foundations, providing definitions and terminology essential for understanding the project. Key terms such as SAP Analytics Cloud and Python will be explained to set the groundwork for the analysis.

The subsequent chapters will detail the process of dataset selection and data preparation. The chosen dataset, sourced from Kaggle, comprises car sales data from the USA, which underwent rigorous cleaning and preprocessing using Python to ensure its suitability for analysis. This section will outline the specific steps taken to address data issues such as null values, duplicates, and inconsistent formats. Following the data preparation, the integration of the cleaned dataset into SAP Analytics Cloud will be discussed. This involves uploading the data, defining measures and dimensions, and creating hierarchical structures to facilitate detailed analysis. The paper will then present various analytical techniques applied within SAC, including geo-hierarchy and drill-down analyses, with a focus on specific examples.

The final sections will interpret the findings, highlighting the insights gained from the analysis and their implications for business strategy. The paper aims to demonstrate the powerful capabilities of SAP Analytics Cloud in transforming raw data into actionable intelligence, supporting companies in achieving their strategic objectives through data-driven decision-making.

2 Definitions and Terminologies

To provide an overview of our project, it is essential to explain the foundational concepts and terms. Chapter 2.1, 2.2 and 2.3 will define and delineate the key terms related to SAP Analytics Cloud (SAC) and Python. Understanding these concepts is crucial for comprehending the project's scope and objectives

2.1 SAP Analytics Cloud

Analytics and planning tools have been established in enterprises for many years. Originally competing with spreadsheets and specific application systems, an integrated approach for reporting, dashboarding, and interactive analysis has proven effective. These platforms are highly scalable, allowing hundreds or even thousands of users to access company data simultaneously.

The SAP Analytics Cloud (SAC) is an integrated analytics tool that also comprehensively covers planning requirements. The goal was to create a "one-stop shop" for all analytical needs, consolidating various solutions acquired over time. SAP positions the SAC as the standard solution for planning and analytics.

Since its market introduction in 2014, the SAP Analytics Cloud has been designed as a cloud environment, offering a universal analytics platform with various components:

- **Modeling Environment:** A multidimensional approach where structures and data are stored in relational tables within an SAP HANA database.
- **Reports and Dashboards:** Embedded in "stories" and created using a report generator, with extended interaction through analytical applications or Excel integration.
- **Digital Boardroom:** Facilitates high interaction during analysis in meetings.
- **Planning Functions:** Comprehensive processes such as allocations, script processing, and scenario management.
- **Advanced Analytics:** Includes machine learning accessible to non-experts.
- **Data Provisioning:** Powerful import tools are essential for operations.[1]

[1] Vgl.*Controlling mit der SAP Analytics Cloud* (2023), S. 38.

The SAP Analytics Cloud integrates analytics and planning functions into a single cloud-based solution. It enables users to turn insights into actions, simulate scenarios for better business outcomes, and generate plans from forecasts automatically. By seamlessly integrating various data sources and providing robust analytical tools, SAC supports enterprises in making informed decisions and effectively planning and executing their business strategies.[2]

2.2 Python

Python is a high-level, interpreted programming language that is widely praised for its simplicity and readability. Designed to be user-friendly, Python is a preferred language for both beginners and experienced developers. It supports multiple programming paradigms, including procedural, object-oriented, and functional programming, which enhances its flexibility and applicability across various domains such as web development, scientific computing, and data analysis.[3]

The language is renowned for its extensive standard library and vibrant community, which contribute to its versatility by providing a wide array of modules and packages. These resources facilitate tasks ranging from data manipulation and machine learning to automation and more. Python's emphasis on readability and conciseness reduces program maintenance costs and boosts developer productivity. Additionally, its compatibility with major platforms and seamless integration capabilities with other languages and tools make it a robust solution for a diverse range of applications.[4]

Python’s dynamic nature allows for rapid development and iteration, making it ideal for projects that require frequent updates and modifications. Its widespread adoption in fields such as data science, artificial intelligence, and machine learning underscores its importance in the contemporary tech landscape.[5] The language’s ability to handle large datasets efficiently and its powerful libraries like NumPy, Pandas, and TensorFlow make it indispensable for data-intensive applications. Python’s syntax, which is designed to be

[2] Vgl.*SAP* (2024).
[3] Vgl.*Oracle* (2024).
[4] Vgl.Litzel/Luber (2018).
[5] Vgl.*Oracle* (2024).

intuitive and straightforward, further solidifies its position as a go-to language for developers aiming to streamline their workflow and enhance their problem-solving capabilities.[6]

2.3 Kaggle

Kaggle is an online platform designed for data science and machine learning enthusiasts to collaborate, share, and compete. It hosts a vast array of datasets, offers tools for model building, and provides a forum for discussion and knowledge exchange. The platform allows users to publish and explore datasets, create notebooks, and participate in competitions to solve real-world problems. This community-driven approach fosters innovation and learning within the field of data science.[7]

Kaggle's competitions attract participants globally, enabling them to benchmark their skills against top data scientists. Companies sponsor these competitions to find solutions to specific problems, offering learning opportunities and potential career advancements for participants. The competitions are not only a means of showcasing skills but also a way to engage with real-world challenges in a competitive setting.[8]

Kaggle provides various resources, including kernels (interactive Jupyter notebooks), discussion forums, and a comprehensive dataset repository. These tools enhance the collaborative nature of data science, allowing users to build, share, and iterate on data science models efficiently. This facilitates a hands-on learning experience and encourages the sharing of best practices within the community.[9]

Additionally, Kaggle offers a tiered achievement system that recognizes and rewards active participation and high performance in competitions. This gamified approach motivates continuous learning and improvement, making it an engaging platform for both novice and expert data scientists. By integrating these elements, Kaggle has established itself as a premier platform for advancing skills and fostering innovation in data science.[10]

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[6] Vgl.Litzel/Luber (2018).
[7] Vgl.Litzel/Luber (2020).
[8] Vgl.Lang (2021).
[9] Vgl.Litzel/Luber (2020).
[10] Vgl.Lang (2021).

3 Data Handling and Analysis

Chapter 3 outlines the comprehensive process of handling and analyzing the dataset used in this project. It begins with the selection of a suitable dataset from Kaggle, followed by detailed steps in data cleaning and preprocessing using Python. Subsequently, it describes the integration of the cleaned data into SAP Analytics Cloud, covering the upload process, definition of measures and dimensions, and creation of hierarchical structures. The chapter culminates with the analysis and visualization of the data, including detailed drill-down and geo-hierarchy analyses to derive meaningful insights.

3.1 Dataset Selection and Data Preparation with Python

Dataset Selection

For the analysis of car sales data in the USA, we selected a dataset from the Kaggle platform, specifically the "Car Sales Data in America" dataset. It contains extensive information on car sales, including the sale date, vehicle details, sale price, and geographic information. The selection of this dataset was based on the relevance of the included information to our analysis objectives, namely examining sales trends, evaluating manufacturer performance, and identifying key factors influencing car sales.

Data Preparation with Python

After selecting the dataset, it was necessary to conduct thorough data preparation to ensure that the data was suitable for analysis. The original dataset contained 558,837 rows and 16 columns, with several data issues identified, including null values, duplicates, abbreviations in column names, and incorrect date formats. To address these issues, Python was used as the tool for data cleaning and preparation.

First, the data was loaded into a Pandas DataFrame to enable efficient data manipulation. The initial step in data cleaning involved removing all null values and duplicates, a critical step to ensure the analysis is based on reliable and consistent data. The code for performing these cleaning steps is as follows:

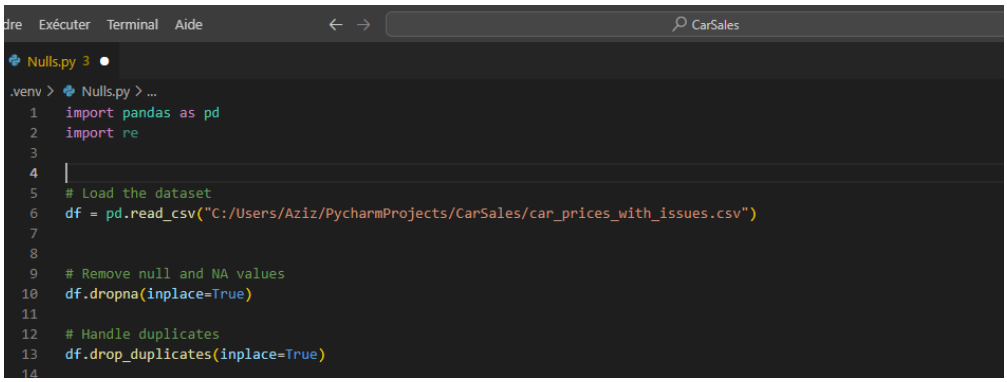

ABBILDUNG 1 DELETING NULLS

Another issue in the dataset was the use of abbreviations in the state column. To improve the readability and consistency of the data, these abbreviations were converted to full names. For instance, "ca" was changed to "California". This was achieved by applying a lambda function to the relevant column:

```
58
59  # Replace state abbreviations with full names
60  df['state'] = df['state'].apply(lambda x: state_mapping.get(x.lower(), x))
```

ABBILDUNG 2 UPDATING STATES

Additionally, the date entries in the dataset were provided in an inconsistent format. To enable proper temporal analysis, the date format was standardized:

```
13
14  # Function to remove timezone from the saledate
15  def remove_timezone(date_str):
16      return re.sub(r' GMT[^\)]*\)', '', date_str)
17
```

ABBILDUNG 3 CLEANING DATE

Following these cleaning steps, the number of records was reduced from 558,837 to 472,323 due to the removal of null values and duplicates. Finally, the cleaned data was saved into a new CSV file, which was used for further analysis in SAP Analytics Cloud (SAC):

```
20
21  # Save the cleaned data to a new CSV file
22  df.to_csv("C:/Users/Aziz/PycharmProjects/CarSales/clean_car_sales_data.csv", index=False)
23
```

ABBILDUNG 4 SAVING THE NEW CSV

Through this systematic data preparation, we ensured that the dataset was free from inconsistencies and ready for detailed analysis in SAC. The use of Python for data preparation enabled efficient and scalable processing of large data volumes, which was crucial for the success of this project.

3.2 Data Integration and Visualization in SAP Analytics Cloud

After the data preparation process, the cleaned dataset was ready for analysis. The next step was to upload the cleaned CSV file into SAP Analytics Cloud (SAC) for further processing and visualization.

We began by logging into our SAP Analytics Cloud account and navigating to the main dashboard. From there, we initiated the creation of a new model by selecting the 'Create' option in the main menu and then choosing 'Model'. This action opened the model creation wizard, which guided us through the process of importing our data.

To import the cleaned data, we selected the option to upload a CSV file and proceeded to upload the cleaned_car_prices.csv file from our local storage. Once the file was uploaded, SAC prompted us to map the data fields correctly. We reviewed and confirmed the automatic field mapping to ensure that numerical fields, such as sales price and odometer readings, and categorical fields, such as state, make, and model, were correctly identified.

Following the mapping of data fields, we defined the measures and dimensions for our model. Key measures included the Market Value (MMR) and Selling Price, while dimensions encompassed various attributes such as year, make, model, trim, body, transmission, state, condition, odometer, color, interior, seller, and sale date. This step was crucial to facilitate accurate and meaningful data analysis within SAC.

To enhance the analytical capabilities of our model, we created hierarchical structures. For the car data, we established a hierarchy that included make, model, and trim. Additionally, we created a geo-hierarchy to visualize data geographically by state. To do this, we added a new 'Country/Region' column with the value 'USA' and established a hierarchical structure with country at level 1 and state at level 2.

Once all fields were mapped and hierarchies defined, we saved the model. SAC then validated the model to ensure there were no errors in the data import process. With the model successfully validated and saved, we proceeded to create 'Stories' within SAC.

Stories in SAC are akin to dashboards, where we can visualize our data through various types of charts, graphs, and tables.

We created multiple visualizations to analyze different aspects of car sales, such as bar charts showing sales trends over time, pie charts for manufacturer performance, and geo maps for sales distribution across states. These visualizations allowed us to explore the data and derive insights interactively.

After setting up the visualizations, we explored the data to derive insights. We utilized SAC's interactive features to drill down into specific data points, filter data dynamically, and customize views based on various dimensions. The final step involved sharing these insights with stakeholders through SAC's sharing and collaboration tools, allowing team members to comment on and discuss the findings directly within the platform.

By following these steps, we successfully uploaded the cleaned dataset into SAP Analytics Cloud, defined the necessary measures and dimensions, created meaningful hierarchies, and developed interactive visualizations to support our analysis of car sales data in the USA. This integration enabled us to leverage the full analytical capabilities of SAC to derive valuable business insights from our data.

3.3 Geo Hierarchy Analysis of Car Sales in Texas Using SAP Analytics Cloud

In our effort to gain deeper insights into car sales across the United States, we utilized the geo hierarchy feature in SAP Analytics Cloud (SAC) to perform a detailed analysis at the state level. For the purposes of this demonstration and to illustrate the process, we chose the state of Texas as an example. This section describes the methodology and findings of our hierarchical analysis, highlighting the breakdown of sales data for different car brands within Texas.

Initial Overview: Selling Prices per Car Brand

We began our analysis by creating a bar chart to visualize the distribution of selling prices across various car brands within the entire United States. This chart provided an overarching view of the market share by sales revenue for each brand. As shown in the initial screenshot, Ford led the market with a total selling price of $1,201,407,350.00, followed by Chevrolet and Nissan with $642,555,295.00 and $517,293,641.00 respectively.

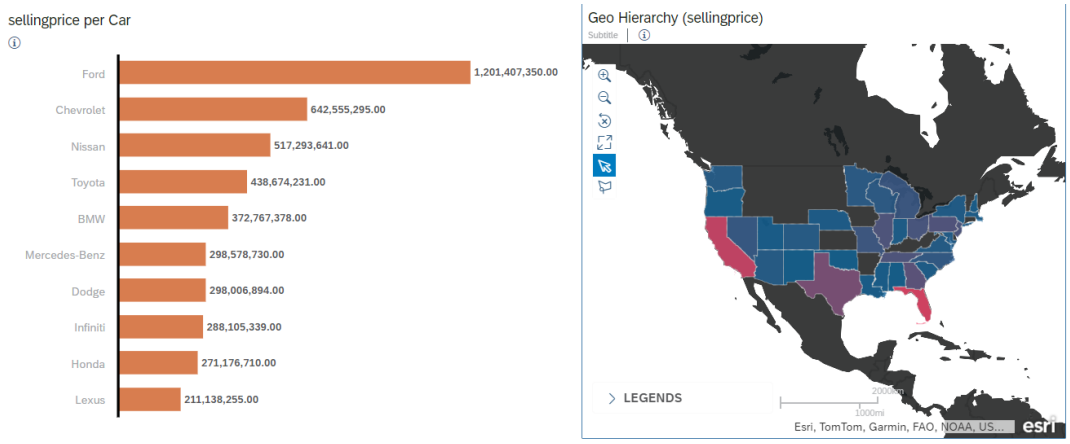

ABBILDUNG 5 STORY OF SELLING PRICES PER CAR BRAND

Drill Down to Texas

To focus our analysis on Texas, we used the geo hierarchy feature to drill down into the state-specific data. By selecting Texas on the map, we were able to filter the data to display only the sales within this state. The subsequent bar chart revealed the distribution of selling prices for different car brands within Texas. As depicted in the second screenshot, Ford remained the top-selling brand with $130,293,557.00 in sales, followed by Chevrolet with $76,458,277.00 and Nissan with $49,313,602.00.

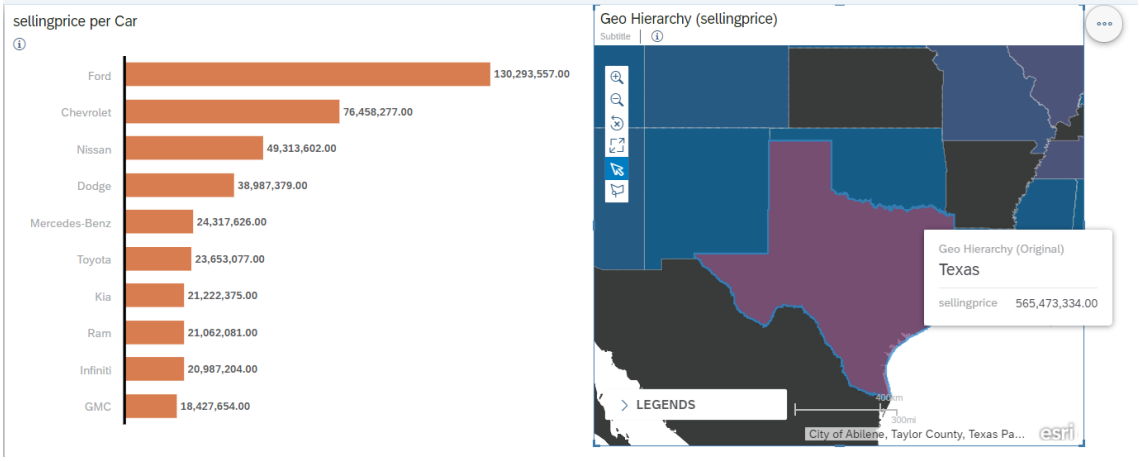

ABBILDUNG 6 STORY OF SELLING PRICES PER CAR BRAND IN TEXAS

Detailed Geo Hierarchy Analysis

To further explore the sales dynamics within Texas, we performed additional drill downs to examine the geographical distribution of car sales across various regions within the state. This involved analyzing the sales data at a more granular level, such as city or

county, to identify regional trends and patterns. The map visualization provided insights into the concentration of sales, with specific regions showing higher sales volumes for certain brands.

Methodological Steps for Geo Hierarchy Analysis in SAP Analytics Cloud

1. **Creation of the Initial Overview Chart:**
    - Using the cleaned dataset, we constructed a bar chart within SAC to display the distribution of selling prices among different car brands across the United States.
    - The chart was configured to highlight the share of each brand, providing a broad understanding of the national market dynamics.
2. **Drill Down to Texas:**
    - Using the geo hierarchy feature, we selected Texas on the map to filter the data and focus on state-specific sales.
    - The resulting bar chart displayed the distribution of selling prices for various car brands within Texas, allowing us to compare the performance of different brands in the state.
3. **Detailed Geo Hierarchy Analysis:**
    - We conducted further drill downs to analyze the geographical distribution of car sales within Texas at a more granular level.
    - This involved examining the sales data by regions, such as cities or counties, to uncover regional trends and patterns.
    - The map visualization highlighted areas with high sales concentrations, providing valuable insights for targeted marketing and sales strategies.

3.4 Drill Down Analysis of Mercedes-Benz Car Sales in SAP Analytics Cloud

In our comprehensive analysis of car sales data within the United States, we utilized the powerful features of SAP Analytics Cloud (SAC) to perform detailed and hierarchical examinations of the data. For the purposes of this case study, we have selected Mercedes-Benz as an example to demonstrate the process and insights that can be derived from such

an analysis. The following sections describe the step-by-step methodology and findings of our drill down analysis.

Initial Overview: Selling Prices per Car Brand

The first stage of our analysis involved creating a visual representation of the distribution of selling prices across various car brands. This was achieved by constructing a pie chart that aggregated the total sales revenue for each brand. In this overview chart, Mercedes-Benz emerged as a significant player, contributing $298,578,730.00 to the total sales, which constituted 6.58% of the overall market share. This initial visualization provided a broad understanding of the market distribution and highlighted the importance of Mercedes-Benz within the dataset.

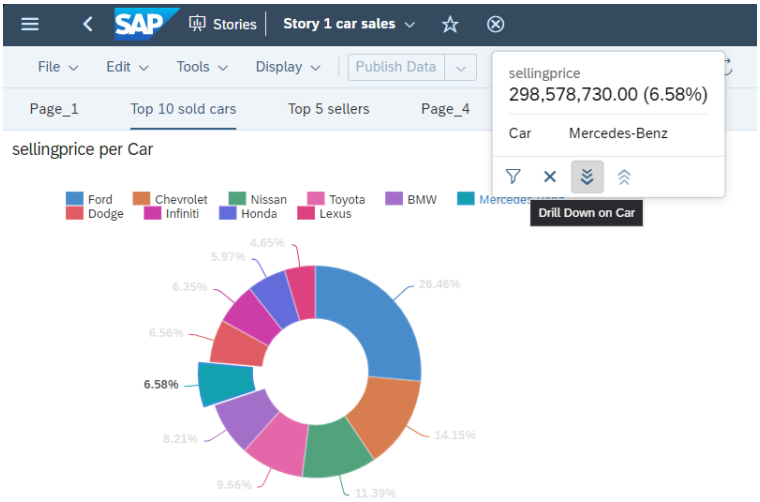

ABBILDUNG 7 STORY OF SELLING PRICES PER CAR BRAND DONUT

Drill Down to Car Classes within Mercedes-Benz

Further refining our analysis, we drilled down from car models to car classes within the Mercedes-Benz brand. This hierarchical breakdown illustrated the distribution of sales across different classes, such as the C-Class, E-Class, SL-Class, and others. The analysis revealed that the C-Class was the predominant class, with sales totaling $77,632,382.00, which represented 27.47% of Mercedes-Benz's overall sales. This detailed breakdown by

car class offered invaluable insights into which categories of vehicles were driving the brand's success.

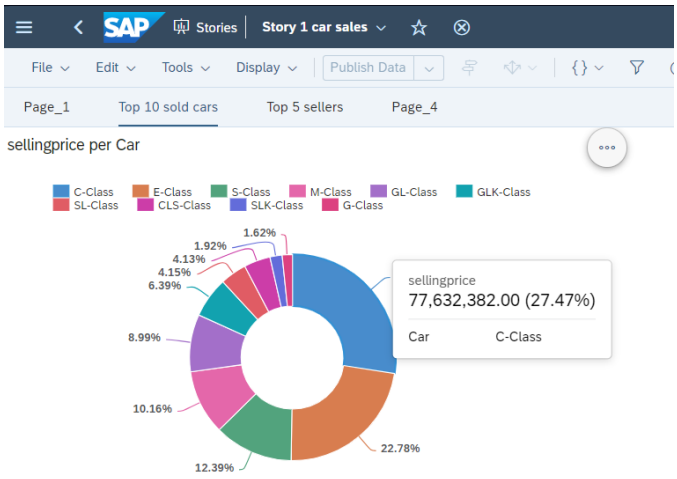

ABBILDUNG 8 STORY OF SELLING PRICES PER CAR CLASS DONUT

Drill Down to Car Models within Mercedes-Benz

To delve deeper into the specifics of the Mercedes-Benz sales, we employed the drill down feature in SAC. This allowed us to disaggregate the total sales of Mercedes-Benz into its constituent car models. The subsequent pie chart revealed detailed insights into the performance of different models. Among these, the C250 Sport model stood out with a total selling price of $28,150,880.00, accounting for 37.93% of Mercedes-Benz's sales. This level of detail enabled us to identify the most lucrative models and provided a clearer picture of consumer preferences within the Mercedes-Benz brand.

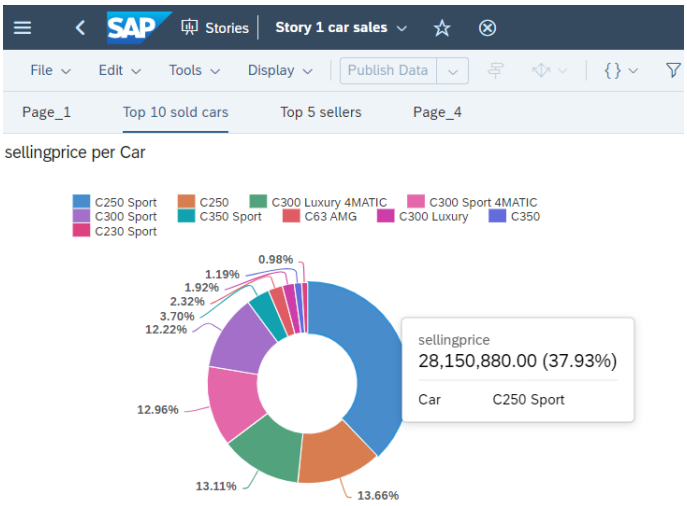

ABBILDUNG 9 STORY OF SELLING PRICES PER CAR TYPE DONUT

Methodological Steps for Detailed Analysis in SAP Analytics Cloud

1. **Creation of the Initial Overview Chart:**
    - Using the cleaned dataset, we constructed a pie chart within SAC to display the distribution of selling prices among different car brands.
    - The chart was configured to highlight the share of each brand, with a specific focus on Mercedes-Benz to set the stage for further analysis.
2. **Drill Down to Car Classes:**
    - We selected the Mercedes-Benz segment in the pie chart and utilized the drill down functionality to break the data into specific car classes.
    - The resultant chart provided a detailed view of the selling prices for each class, allowing us to pinpoint the top-performing models within the Mercedes-Benz lineup.
3. **Drill Down to Car Models:**
    - Continuing the drill down process, we further disaggregated the data from car classes to car models.

- The resulting visualization highlighted the distribution of sales across different models, identifying the most significant contributors to Mercedes-Benz's overall sales.

3.5 Analysis of Car Sales by Seller Using SAP Analytics Cloud

In this analysis, we aimed to gain insights into car sales based on different sellers using SAP Analytics Cloud (SAC). We created a tree map to visually represent the total sales revenue associated with each seller. This section outlines our methodology and findings.

Visualization of Selling Prices per Seller

We constructed a tree map within SAC to display the distribution of selling prices across different sellers. Each rectangle in the tree map represents a seller, with the size of the rectangle proportional to the total selling price.

In the initial visualization, as shown in the screenshot, Ford Motor Credit Company LLC emerged as the top seller with a total selling price of $314,344,025.00. Other notable sellers included The Hertz Corporation with $225,025,865.00, Nissan-Infiniti LT with $216,864,210.00, and Avis Corporation with $185,486,480.00. These sellers collectively contributed a substantial portion of the overall market.

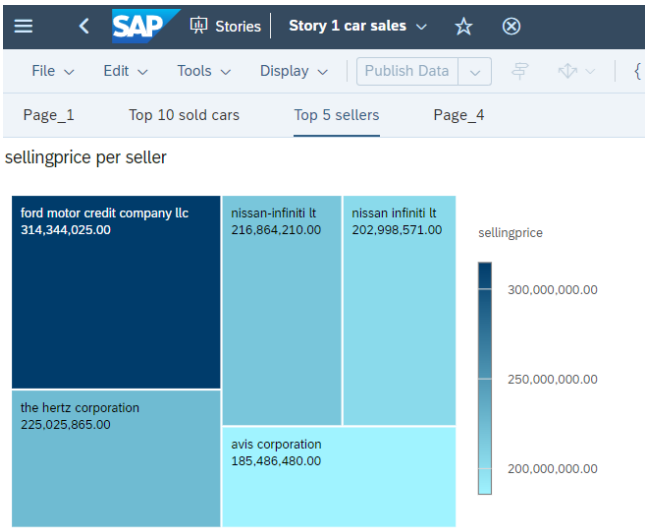

ABBILDUNG 10 TREEMAP OF SELLING PRICE PER SELLER

Insights and Interpretation

The tree map allowed us to quickly identify the leading sellers and understand their market share. By examining the relative sizes of the rectangles, we could observe the distribution of sales among various sellers and the competitive dynamics within the market.

Methodological Steps for Visualization in SAP Analytics Cloud

1. **Creation of the Tree Map:**
    - Using the cleaned dataset, we constructed a tree map within SAC to display the distribution of selling prices across different sellers.
    - Each seller was represented as a rectangle, with the size proportional to the total selling price.
2. **Configuration and Customization:**
    - Labels were added to each rectangle to display the total selling price for each seller.
    - A color gradient was applied to enhance visual differentiation between sellers.

By utilizing SAP Analytics Cloud's tree map feature, we were able to effectively visualize and interpret complex sales data, providing valuable insights into the performance of different sellers in the market.

4 Conclusion

This seminar paper has demonstrated the extensive capabilities of SAP Analytics Cloud (SAC) in transforming raw car sales data into actionable business insights. By integrating various analytical techniques, SAC enables businesses to leverage data for strategic decision-making and operational improvements.

The project began with a solid theoretical foundation, where we defined and delineated key terms and concepts essential for the analysis. Definitions and terminology for SAP Analytics Cloud, and Python were provided to ensure a clear understanding of the tools and platforms used in this study. This theoretical groundwork was crucial for contextualizing the subsequent analysis. Following this, we focused on the selection and preparation of a comprehensive dataset sourced from Kaggle, focusing on car sales in the USA. Python was employed to clean and preprocess the data, addressing issues such as null values, duplicates, and inconsistent formats. This thorough data preparation ensured the dataset was suitable for detailed analysis within SAC.

The next phase involved the integration of the cleaned dataset into SAP Analytics Cloud. We uploaded the data, defined key measures and dimensions, and created hierarchical structures to facilitate detailed analysis. This setup allowed for comprehensive drill-down and geo-hierarchy analyses, which provided in-depth insights into car sales across different regions and brands. Specific examples, such as car sales in Texas and the performance of Mercedes-Benz, were analyzed to illustrate the process and derive meaningful insights. Visualizations created within SAC, including bar charts, pie charts, and geo maps, were instrumental in exploring the data interactively and understanding sales dynamics. The findings from these analyses provided valuable information on sales trends, manufacturer performance, and key factors influencing car sales.

In conclusion, this paper has highlighted the powerful analytical capabilities of SAP Analytics Cloud and its role in supporting data-driven decision-making. By effectively utilizing SAC, along with tools like Python and datasets from platforms such as Kaggle, businesses can gain a competitive edge through enhanced data analysis and strategic planning. The integration of theoretical foundations, data preparation, and advanced analytical techniques underscores the importance of a holistic approach to data analytics in achieving substantial business insights and outcomes.

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