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Querying and visualizing financial data: A teaching case applying STEM skills☆

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ABSTRACT

Advanced technologies have dramatically changed the ways that accounting professionals collect, analyze and interpret data. Embracing the prevalent implementation of advanced technologies, accounting is moving towards a STEM discipline and requesting accounting students be equipped with emerging technologies. In response to the increasing requirements from the Association to Advance Collegiate Schools of Business (AACSB) and CPA exams on students' data analytics skills, this case provides you an opportunity to complete the data analytics process by analyzing Dillard's data using Structured Query Language (SQL) and Tableau. Specifically, this case provides an illustration of real-world data analysis, including the use of SQL to extract required data, the use of word clouds, geographic maps, and box-and-whisker plots to visualize data and outliers, an illustration of grouping data by clustering, and using interactive dashboards and narrative stories to communicate results. We aim to use software tools that you are familiar with to inspire your interest in data analytics, helping you understand the enormous power of SQL and Tableau to query, aggregate, analyze and visualize massive data as you build your own data analytics mindset.

1. The case

Dillard's, Inc. is a high-end department store chain based in Little Rock, Arkansas. It offers one-stop shopping for clothes, shoes, bags, accessories, home and beauty products. Dillard's was founded by William T Dillard in 1938. Dillard's family expanded its business empire in the 1960s through acquisition and went public on the American Stock Exchange in 1969. Currently, it operates approximately 282 stores across 29 states. Texas holds the highest number of Dillard's stores, with 57 establishments, closely followed by Florida with 42. All stores are controlled by the Dillard's family.

The company has been collecting daily transactional data in each of its stores for years. The CEO asked you, the manager of the cosmetic department, to prepare a report to summarize company's performance. You need to analyze total sales, discount rate, profit margin, sales growth rate, and return rates as required. Additionally, you are asked to propose an additional analysis on your own. You will access company data through Microsoft SQL Server from Dillard's database. The CEO expects to have an informative review of the Christmas season to help the company improve its holiday sales strategy. Additionally, the CEO would like to compare the performance of different states and brands to help the company make business expansion decisions and sales promotion plans for its different brands. It is a great opportunity for you to impress the CEO with a professional report using your data analytics skills. The data dictionary is presented in Table 1.

After thinking through the analysis, you plan to complete the following five parts:

1) You need to extract data that is saved in different tables. Therefore, you first need to find the connections between tables by generating the Unified Modeling Language (UML) of the database from Microsoft SQL Server Management Studio. It is also a good habit to get sample data of each table first before moving into the in-depth analysis (for example, using the SQL statement SELECT TOP 10 * FROM TABLE). This step will allow you to find missing data, abnormal data, and incorrect format of data recognized by Tableau.
2) Extract data from the Microsoft server:
   a) Write a SQL query to extract TRAN_AMT, ORIG_PRICE, SALE_PRICE, TRAN_DATE, COST, DEPT_DESC, STATE, DEPTCENT_DESC, TRAN_TYPE and TENDER_TYPE from Dillard's database.

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Table 1
Data dictionary.

Name	Data type	Description
TRAN_AMT	Float	Total transaction amount.
ORIG_PRICE	Float	Original selling price.
SALE_PRICE	Float	Selling price.
TRAN_DATE	Float	Transaction dates.
COST	Float	Cost of the products.
DEPT_DESC	String	Brand names.
STATE	String	State of stores.
DEPTCENT_DESC	String	Department descriptions.
TRAN_TYPE	String	Transaction types: purchase or return
TENDER_TYPE	String	Payment types.

b) Analyze discount levels and profit margins.
You need to generate two calculated fields:
DISCOUNT_RATE = (ORIG_PRICE-SALE_PRICE)/ORIG_PRICE and PROFIT_MARGIN = (TRAN_AMT-COST)/TRAN_AMT.
c) Extract the cosmetic department's data.

3) Conduct initial analyses and visualize the results. Specifically, you need to create the following graphs in Tableau:
a) A geographic map that shows the average discount rates of each state. Set 5 % as your targeted discount rate by adjusting the center of the color. Use the "Filters" function to get data for December 2015.
b) A word cloud for the total sales of each cosmetic brand. Add STATE to pages. Get data for Florida.
c) The box-and-whisker plots that show the distribution of the average discount rates of each state on each weekday. Add a reference line for the targeted discount rate of 5 %.
d) A clustering analysis to find natural clusters of cosmetic brands determined by the total sales and average profit margin.
e) A line chart showing the year-over-year sales growth rates by month.
f) Select and create a visualization that clearly presents Dillard's cosmetic department's average return rates by month for 2016. Additionally, compare these rates with the industry average return rate. To calculate the return rate, pivot the column TRAN_TYPE. The average industry return rate for beauty products is 5.21 % (USPS, 2024).
g) Browse the data included in the database, propose a new analysis, visualize the results, and explain your findings.

4) Create a story that will be used during the presentation and highlight important information on each graph.
5) Create a dashboard to enable the interaction between different graphs.

You plan to retrieve data from Microsoft SQL Server in Tableau directly. The other option is to get data from Microsoft SQL Server in Excel and then import data into Tableau. Your analysis will proceed through the following steps in Tableau:

a) Extract, Transform, and Load (ETL) data.
b) Create visualization graphs as mentioned.
c) Create a story and highlight insights of each graph.
d) Create a dashboard and use the word cloud as the filter of the dashboard.
e) Create a static report including screenshots and insights.
f) Prepare a presentation to present and interpret analysis results.

You can decide the color, fonts, styles, etc. Examples of UML and visualization graphs are provided in Figs. 1, 2, 3, 4, 5, 6 and 7. Your work should be similar to these images.

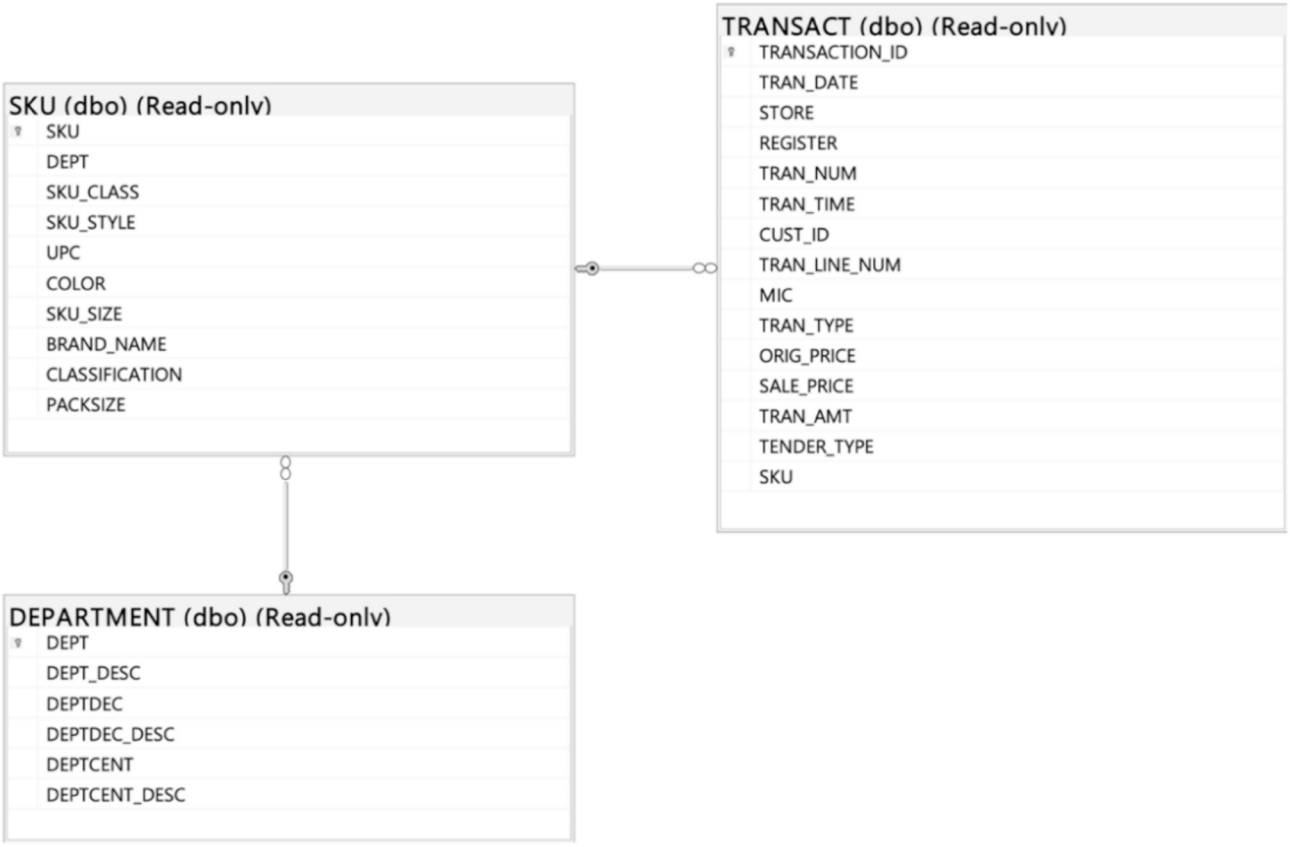

Fig. 1. UML for TRANSACT, SKU and DEPARTMENT tables.

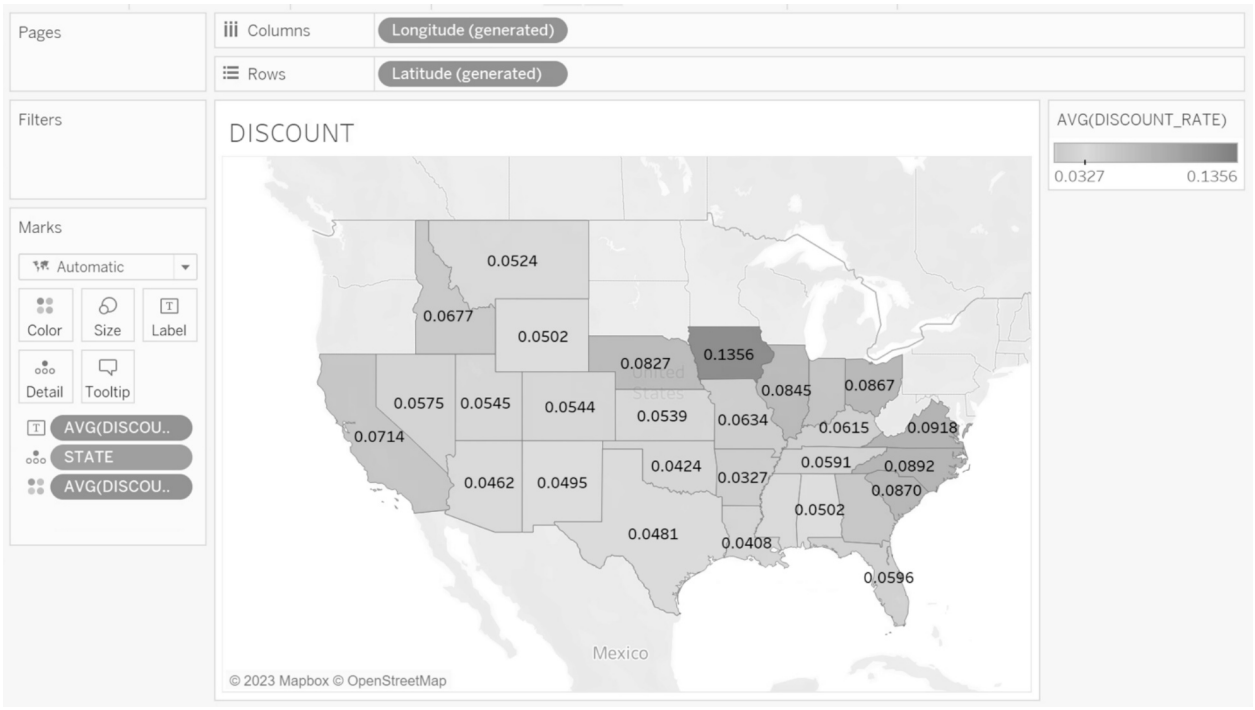

Fig. 2. Geographic map: State average discount rates for the Christmas season (December 2015 to January 2016).

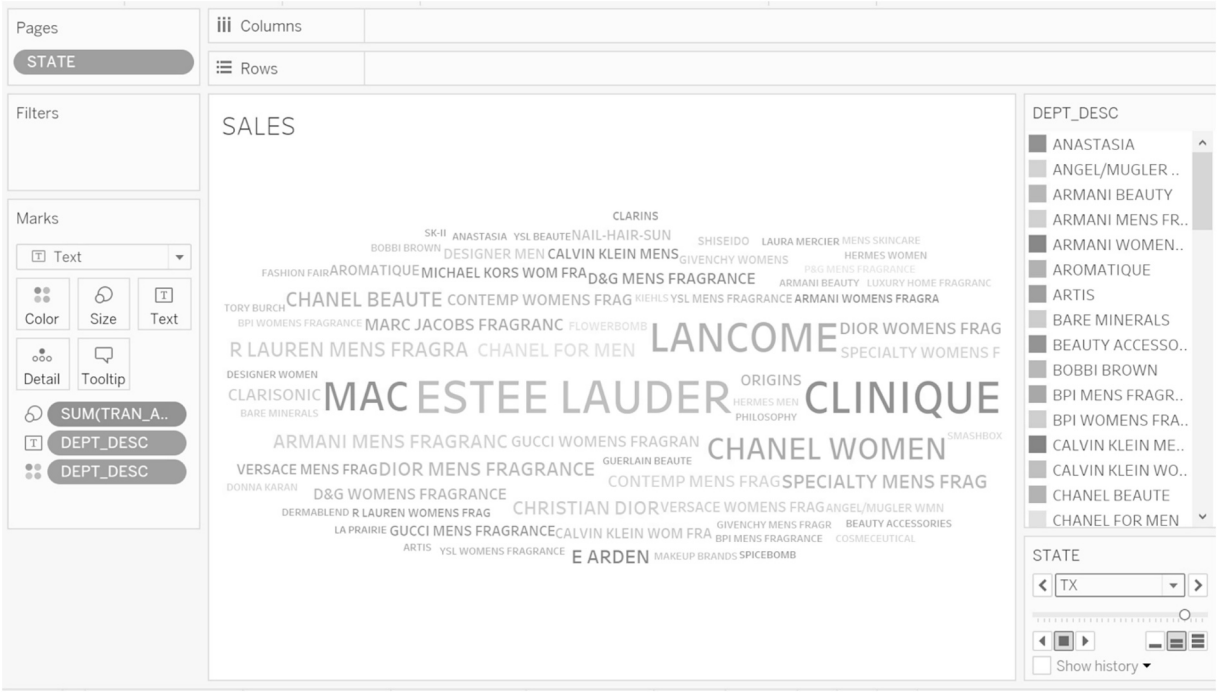

Fig. 3. Word cloud: Total sales of cosmetic brands in Texas for the Christmas season (December 2015 to January 2016).

2. Deliverables

You need to prepare a presentation to communicate your analysis with the CEO and other senior managers. The static report is required to be submitted before the presentation. Specifically, you need to provide the following items:

1) An analysis report (12-point Times New Roman font, single-spaced, one-inch margins) summarizing the key findings, including the analysis of the discount level of different states, the trend of discount levels of states over weekdays, popular cosmetic brands, and natural clusters of cosmetic brands based on the profit margin and total sales. Under each graph, you need to provide insightful discussions about the findings and suggestions by answering the questions below:

a) Analysis of the discount level of states for the Christmas Season (December 2015 to January 2016):

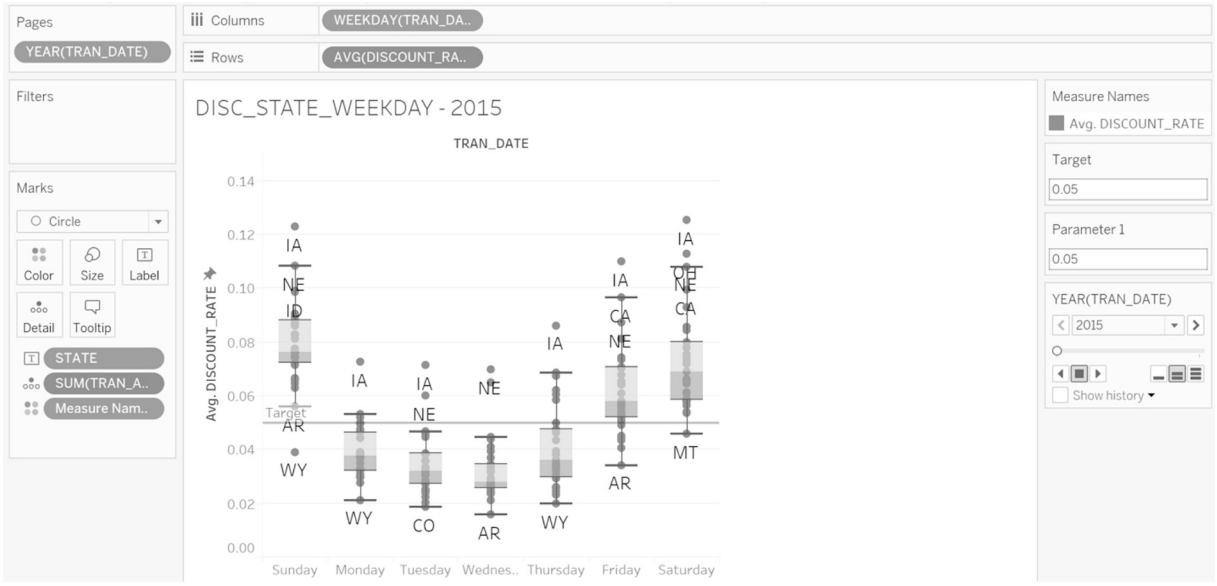

Fig. 4. Box-and-Whisker plots: State average discount rates per weekday in December 2015[1].

[1] Range of Y axis has been manually adjusted for better presentation.

i. Include a geographic map that presents the average discount rates of each state. Add average discount rates as labels. Explain the meaning of colors and the color center you used. Use the "Filters" function to get monthly data. Take a screenshot of the geographic map for the month of December 2015.
ii. List the names of states that meet the target (average discount rate lower than 0.05) of the discount level in December 2015.
iii. Compare the discount rate before (December 2015) and after Christmas (January 2016). What trends do you observe? After Christmas, which state experienced a notable increase in its discount rate?
iv. Are there any other visualizations that are good for this analysis?
v. Which states often offer higher discount rates? Do they achieve higher sales as a result? Is it worth offering higher discount rates? What are your suggestions?
vi. Which states often offer lower discount rates? Do they achieve higher profit margins? Is it worth offering higher discount rates? What are your suggestions?
vii. Explore the discount rates in different months or holiday seasons. Do you observe any trends?

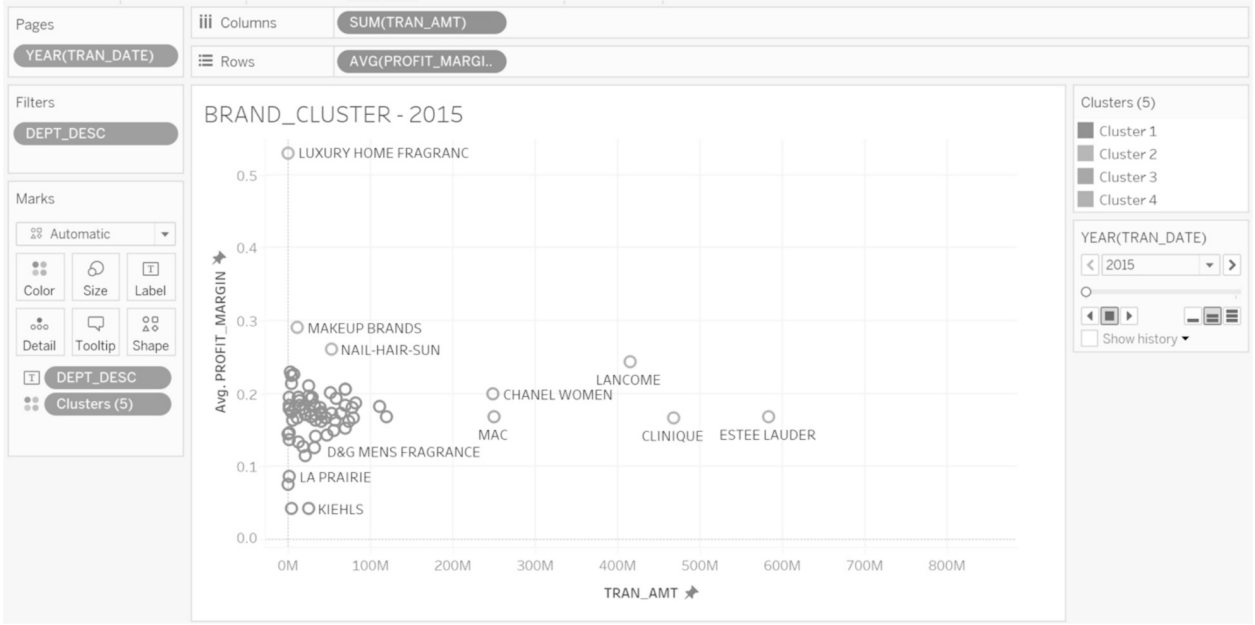

Fig. 5. Clustering analysis: Brand clusters for December 2015 (excluded the outlier).

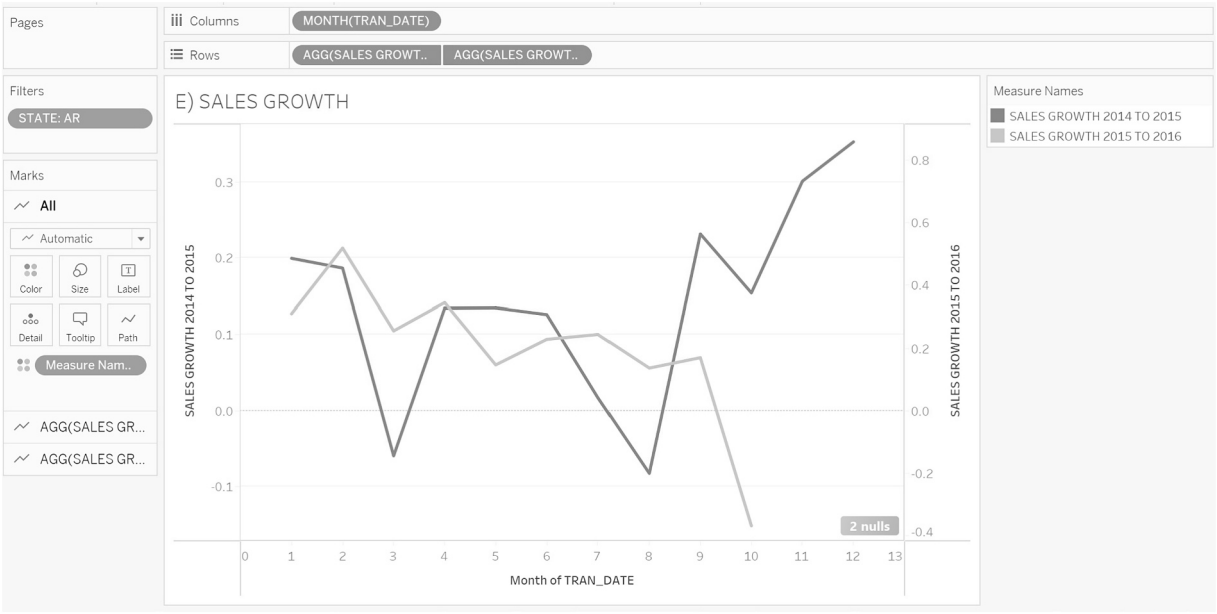

Fig. 6. Trend analysis: Sales growth rates of stores in Arkansas.

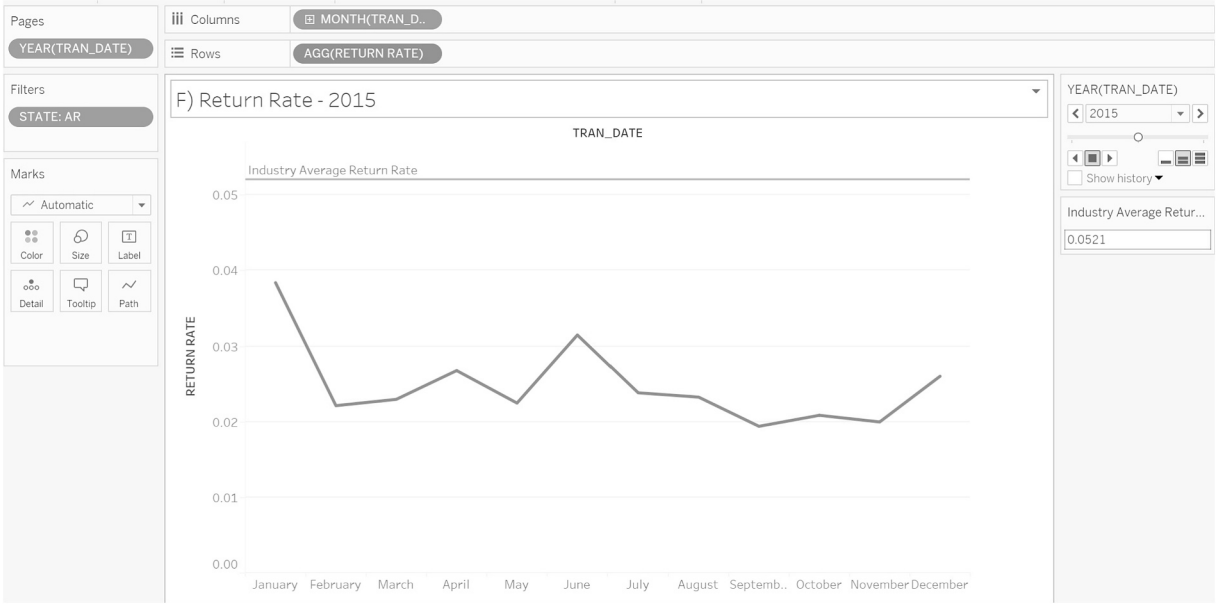

Fig. 7. Return rate analysis: Return rates of stores in Arkansas in 2015.

b) Analysis of sales of cosmetic brands.
   i. Include a word cloud that presents the total sales of the cosmetic brands.
   ii. Add STATE to Pages. Take screenshots of the word cloud for Florida and Louisiana. Discuss the five most popular brands in Florida and Louisiana. Are there any differences in customer preferences in these states?
   iii. Are there any other visualizations that are good for this analysis?
   iv. Do you observe any regional preferences for cosmetic brands? What are your suggestions for department store managers?
   v. Pick one state and 3 brands, and analyze the drivers of sales, such as sales quantity, unit price, or other factors.
   vi. What other data could you analyze with a word cloud?

c) Analysis of the distribution of discount rates of states across weekday.
   i. Create a visualization that shows the distribution of the discount rate of each state per weekday. Use state as labels. Take a screenshot.
   ii. Do you see any trends over weekdays?
   iii. Do you see any trends across states?
   iv. Do higher discount rates necessarily lead to an increase in total sales? Create a box-and-whisker plots that shows the distribution of the total sales of each state per weekday. Use state as labels. Take a screenshot and include it in your report. Discuss the relationship between discount rates and total sales.
   v. What are your suggestions for store managers?

d) Clustering analysis.
   i. Include a cluster analysis that shows the nature clusters of brands based on the average profit margin and total sales. You can decide

the number of clusters that best present the results. Take a screenshot.
ii. How would you name these clusters?
iii. Are there any outliers that grab your attention?
iv. Propose promotion strategies for two clusters.
v. What else could benefit from a cluster analysis?
e) Trend analysis of sales growth rate.
i. Include a trend analysis that shows the sales growth rate by month.
ii. Do you observe any trends throughout the year?
iii. Do you observe any trends over different years?
iv. Are there any unexpected sales growth drops? What are the possible reasons?
v. What is your predicted sales growth rate for February 2017?
vi. What visualizations are good at discovering trends?
vii. What other data could you analyze with trend analysis?
viii. What other analyses could you conduct using sales growth rate?
f) Return rate analysis.
i. Pick a visualization graph that can clearly present Dillard's cosmetic department's average return rates by month for 2016. To calculate the return rate, write a query to pivot the column TRAN_TYPE or generate a Calculated field for returned products directly. The average industry return rate for beauty products is 5.21 % (USPS, 2024).
ii. How is Dillard's performance compared to the industry average? Does it meet your expectations? What are the differences, if any?
iii. Do you observe any trends over the year? What are the possible reasons?
iv. What are the factors that may affect the product return rate? Conduct one additional analysis and test your hypothesis.
g) Your own analysis.
i) How did you conduct your analysis?
ii) What are the key insights?
iii) How could the company apply the analysis results to improve its performance?
iv) Are there any additional analyses you would suggest based on your current analysis?
h) Dashboard.
Include a dashboard that includes the graphs you created. Use the geographic map as the filter of the dashboard. Choose one state and discuss the popular brands, profitable brands, discount levels and profit margins of this state. Make suggestions to the CEO based on the performance of this state.
i) Story
Tableau's Story feature is an effective tool to create compelling narratives that convey data insights, provide context, establish connections between decisions and outcomes, and make a compelling case. Additionally, it serves as a powerful tool for leading presentations with real-time data access. Create a story in Tableau using the graphs you created. Add captions for the key conclusions of each graph. Add notes to the graphs to highlight important information for a more comprehensive analysis.
2) Upload the static report, Tableau file, and presentation slides to the applicable Learning Management Systems (e.g., Canvas, or Blackboard). The slides should be 5 to 10 pages.
3) Show up at the scheduled time for the presentation. Connect your Tableau file to the server. The CEO (the instructor) will ask you questions based on your analysis. You may need to edit your work to find the answers.

3. Teaching note

3.1. Motivation

Data analytics has been widely integrated into accounting practices. With the increasing volume and velocity of big data, accounting professionals are expected to develop a diverse skill set to master emerging technologies such as Tableau, Power BI, Microsoft SQL, Alteryx, UIPath, and Python. For example, financial accounting relies on SQL to efficiently extract, aggregate, and transform data from large datasets. Managerial accountants use data extraction and visualization tools to analyze Key Performance Indicators (KPIs) and support data-driven decision-making. Similarly, tax accountants extract and compare data from various sources to assess tax risks and develop tax planning strategies. These technical proficiencies align accounting with STEM disciplines, emphasizing its dependence on technology, quantitative reasoning, and problem-solving rather than solely traditional bookkeeping practices.

Recognizing the increasing role of technology, the 2018 Association to Advance Collegiate Schools of Business (AACSB) standards strengthened data analytics requirements, as reflected in Standard A5. Specifically, faculty and students are expected to develop the ability to master current technologies and adapt to emerging technologies (AACSB, 2018). The CPA exam accordingly adjusted the exam sections and testing content in 2022. Starting from Jan 1, 2024, candidates need to take Auditing and Attestation (AUD), Financial Accounting and Reporting (FAR), and Regulation (REG) as core exams and choose one out of three discipline exams, including Business Analysis and Reporting (BAR), Information Systems and controls (ISC), and Tax Compliance and Planning (TCP). It is worth noting that all exam sections in the new exam cover technology-related questions. All these moves are pointing toward accounting being considered a STEM discipline.

STEM fields of study include science, technology, engineering, and mathematics. While traditionally accounting is not considered a STEM field, the fact is that technology is playing a crucial role in modern accounting. Today, accounting students not only need to learn fundamental accounting concepts, such as double-entry booking and financial ratio analysis, but also need to master STEM-related concepts, such as data storage, data extraction, data analysis, data visualization, process automation, and information security. For example, accounting students now are expected to be proficient in using advanced technologies such as SQL to extract data from large relational databases and load it to Tableau to analyze data and visualize results. Additionally, accounting professionals need to develop or assist in developing new technologies for different working scenarios, such as automating fraud detection and reporting, improving data security, assisting data-driven decisions, applying XML technologies, and providing suggestions on tax planning.

In response to the shift towards technologies, including Accounting in STEM fields would more accurately reflect the current content of accounting education and practices. Accounting educators and professionals are actively working to incorporate accounting into recognized STEM programs. This designation will enhance the technology skills of accounting graduates, enable them to tackle complex issues, improve data security, foster innovation, and strengthen their employers' technological competitiveness.

Specifically, on June 11, 2021, the H.R. 3855 Accounting STEM Pursuit Act of 2021[2] was introduced at the 117th Congress to the United States House of Representatives Education and Labor Committee to amend the Student Support and Academic Enrichment Grant program to foster career awareness in accounting as part of a well-rounded STEM educational experience and strengthen the earlier exposure of accounting to elementary and secondary students. This act was broadly

[2] As of March 2025, the bills mentioned in this paragraph remain inactive, with no further actions taken since their referral to the committee.

supported by the American Institute of CPAs (AICPA), Center for Audit Quality (CAQ), Diverse Organization of Firms, National Association of Black Accountants (NASBA), Inc., and American Accounting Association. In support of the H.R. 3855 Accounting STEM Pursuit Act of 2021, the S. 3398 STEM Education in Accounting Act was introduced on Dec 15, 2021 (reintroduced on 05/18/2023 as S.1705 STEM Education in Accounting Act). If passed, it would grant states and local educational agencies (LEAs) the authority to utilize grant funds from the Student Support and Academic Enrichment Program to support accounting education. Particularly, LEAs can utilize these grants to establish accounting programs, with a focus on improving access to high-quality accounting courses for students belonging to underrepresented groups up to 12th grade. Following that, the H.R. 3541 Accounting STEM Pursuit Act of 2023 was introduced on May 18, 2023, at the 118th Congress with an additional finding of integrating STEM-designated accounting programs into middle and secondary curricula to expand the accounting profession and the pipeline of accounting majors in higher education. Consequently, a diverse group of young people from various backgrounds would have access to high-quality accounting courses earlier, potentially attracting more students to pursue a career in accounting.

Our paper aims to provide an overview of STEM certification and STEM education in accounting, using a case exercise as an example to illustrate the application of STEM-related tools—SQL and Tableau—in accounting analysis. STEM majors require a diverse set of skills, including (1) mathematics and statistics, (2) data analysis and interpretation, (3) programming and coding, (4) computer and technology proficiency, (5) problem-solving and critical thinking, (6) scientific method and research skills, and (7) adaptability and lifelong learning. Our case provides students with an opportunity to engage in the full data analytics process by analyzing Dillard's data using Structured Query Language (SQL) and Tableau. Writing SQL aligns with the programming and coding skills essential in STEM. Using Tableau to aggregate, analyze, visualize, and interpret data fulfills the STEM requirements for data analysis and interpretation, mathematics and statistics, as well as problem-solving and critical thinking. Our case simulates real-world problem-solving students may encounter in the workplace, such as extracting required data from various datasets using SQL, visualizing data and outliers through word clouds, geographic maps, and box-and-whisker plots, grouping data via clustering, and effectively communicating analysis results using interactive dashboards and narrative stories. This case is designed to help students grasp the immense power of SQL and Tableau in querying, aggregating, analyzing, and visualizing vast datasets. By doing so, we aim to help students build their own data analytics mindset that is in high demand by employers, including the ability to: (1) ask the right questions; (2) extract, transform, and load relevant data; (3) apply appropriate data analytic techniques; and (4) interpret and share the results with stakeholders (Ernst & Young, 2017). As many tools are interchangeable, building the data analytics mindset can help students both apply the skills they learned in the working environment and easily adapt to new analytics software tools in the future.

3.2. Background

3.2.1. STEM and accounting

According to 8 CFR 214.2(f)(10)(ii)(C)(2), a STEM field of study is defined as one that falls within the Department of Education's Classification of Instructional Programs (CIP) taxonomy. Specifically, it refers to fields in the two-digit series that include engineering, biological sciences, mathematics, and physical sciences, or related disciplines. Generally, related fields involve research, innovation, or the development of new technologies utilizing engineering, mathematics, computer science, or natural sciences (such as physical, biological, and agricultural sciences). Modern accounting is not just bookkeeping but requires deep integration with math, emerging technologies, and advanced analytics skills. This shift is evident as 87 percent of employers are favoring accounting graduates who possess advanced analytics skills (AICPA, 2023b).

Accountants play a crucial role in driving and managing technological innovation in finance and business. As technology has significantly changed accounting practices, companies are in high demand for accounting professionals who can develop or assist in developing software and other technologies to enhance the quality and scope of audits, predict trends, assess the risk of fraud, and reduce cybersecurity risks. Incorporating artificial intelligence in accounting software also enables companies to assess real-time financial risks and provide financial, audit, and tax recommendations based on various circumstances. To keep up with these developments, accountants need to have strong mathematical and technological expertise.

On July 29, 2022, the AICPA submitted its nomination of adding accounting and related Classification of Instructional Program (CIP) codes to the Department of Homeland Security's (DHS's) STEM Designated Degree Program List, specifically under the "T" for Technology (AIPCA, 2022). Changing the field of study can better present the skills and competencies that accounting professionals are expected to acquire, expand the diversity of the accounting workforce, and accelerate the evolution of accounting curriculums. As a result, more accounting programs will accelerate their incorporation of technology-related courses to meet current market requirements. Eventually, this will lead to more accounting graduates acquiring high technology skills, which are essential for building trust in the market.

Additionally, once it is approved, this classification would allow foreign students with F-1 Visa eligible for an extended period of 24 months for Optional Practical Training (OPT) in the U.S. beyond the standard year. As of July 2023, 57 universities are offering STEM-designated Accounting Programs that they qualified for on their own application (a list of these universities is provided in Appendix A). All of these programs are graduate programs with an emphasis on data analytics, development of software, cloud computing, or other emerging technology innovation skills. The visa extension gives international students of these STEM-designated Accounting Programs authorization to work in the U.S. for 3 years after graduation, which can help alleviate the high demand for accounting professionals in the U.S.

Many STEM core concepts are already included in today's accounting courses and practices, such as: writing SQL to extract relevant data from larger databases; preparing data for analysis, creating data visualizations to analyze data or communicate results; using statistics software to assist decision-making; recording and protecting data using cryptography and cybersecurity; organizing data into relationship databases; transmitting financial data using XML Technology and conducting predictive and prescriptive analytics to address management questions (AICPA, 2023a).

Our case includes several of the aforementioned STEM core concepts. By completing the case, students will review how data is stored in a relational database and how to extract requested data using SQL from a large relational database. After extracting the data, students will need to transform and clean data to prepare it for further analysis. They will then use Tableau to analyze and visualize the data to generate valuable business insights.

Embracing the demands of incorporating analytics skills into accounting education, there has been a growing number of teaching cases published in the last 15 years that use SQL and Tableau to query and visualize data. Prior studies provide examples of using SQL to create and query the data (Lambert, Holladay & Drum, 2016; Lawson & Street, 2021; Lee & Casterella, 2023) and using Tableau to create traditional graphs, geographic maps, and dashboards (Cunningham & Stein, 2018; Hoelscher & Mortimer, 2018; Janvrin, Raschke, & Dilla, 2014; Kokina, Pachamanova, & Corbett, 2017; Weirich, Tschakert, & Kozlowski, 2018). We summarize teaching cases with an emphasis on data analytics in Table 2. While prior literature mostly focuses on helping students practice a few steps included in the data analytics process, our case

Table 2
Prior literature covering data analytics tools.

Citations	Technology/software	Data extraction	Data cleansing	Data analysis	Data visualization
Cheng, Jones and Mobapatra (2024)	Alteryx		yes	yes	yes
Garas and Wright (2024)	UiPath, Alteryx, and Tableau	yes	yes	yes	yes
Lee and Casterella (2023)	SQL and Alteryx	yes	yes	yes	
Nickell, Schwebke and Goldwater (2023)	Power BI			yes	yes
Parlier and Lee (2023)	Excel and Alteryx			yes	
Libby, Schwebke and Goldwater (2022)	Power BI				
Lawson and Street (2021)	SQL		yes	yes	
Presley (2019)	Excel			yes	
Angelo, Ayres and Stanfield (2018)	Excel			yes	yes
Cunningham and Stein (2018)	Tabelau			yes	yes
Hoelscher and Mortimer (2018)	Tabelau			yes	yes
Fay and Negangard (2017)	IDEA and Excel		yes	yes	
Igou and Coe (2016)	Tableau			yes	yes
Kokina, Pachamanova and Cobett (2016)	Excel and Tableau			yes	yes
Lambert, Holladay and Drum (2016)	SQL and Access	yes	yes	yes	
Murthy (2010)	ACL, IDEA, Access, and Picalo			yes	

provides students an opportunity to explore the complete data analytics process, including identifying questions, extracting data, cleansing data, analyzing data, visualizing analysis results, and reporting and presenting results. In addition to data analytics skills, students are able to practice and improve their critical thinking and oral communication skills. The study of Garas and Wright (2024) also presents a comprehensive case that covers the entire analytics process. However, while their focus is on no-code and low-code technologies, our case requires students to write queries themselves for data extraction and transformation. Furthermore, our case tasks students with creating multiple types of visualizations in Tableau.

3.3. Educational objectives

Changing the curriculum to intertwine data analytics and accounting brings opportunities and challenges to accounting majors. To embrace the emerging technology, the accounting curriculum needs to correspondingly adapt to the data analytics requirements. Students are required to be equipped with data analytics skills, including data extraction, transformation, analytics, visualization, etc. We developed this case in response to the evolution of the accounting curriculum to prepare our students for advanced data analysis requirements. Students are able to practice the data analytics skills they learned including data cleaning, data verification, data normalization, data extraction, data analysis, data visualization, data reporting, and business oral communication. By accessing the real company's data (using the Dillard's database), students better understand the database, learn to fix the problems they are facing as they extract and analyze the data, simulate the data analysis and reporting procedures, and build the data analytics mindset. As they are analyzing accounting data of product brands they are familiar with, it reinforces students' understanding of the capability and importance of data analytics. Additionally, our case shows how to create a word cloud and uses box-and-whisker plots to rank information and find outliers as well as uses clustering in Tableau to explore information and patterns hiding behind the data.

Following the case instruction, students are required to extract data, load data, analyze data, visualize data, and more importantly use data to address accounting questions. Students are also encouraged to go beyond the questions often asked by the CEO (included in the Deliverables section) and find additional information that may affect managers' decisions. Specifically, students get the chance to find UML from the Microsoft SQL server, browse and clean data, write SQL queries to exact data in Tableau or Excel, and visualize data in Tableau. The skills students learn from this case can be applied to different workplace settings. It can also help students adapt to other data extraction software or visualization tools, such as MySQL and Microsoft Power BI. The comprehensive case can empower students to build the data analytics mindset to analyze a substantial volume of data that is hard to analyze in Excel and use data to answer questions. Additionally, the exploratory analysis allows students to practice letting the data tell the story and display the underlying patterns.

Specifically, the learning objectives for this case include the following:

- Create database UML.
- Extract, transform, and clean data from Microsoft SQL server using Microsoft SQL Query in Tableau or Excel.
- Create the geographic map, word cloud, and box-whisker-plots to estimate the sales performance, discount level, and profit margin level of cosmetic products of Dillard's in Tableau.
- Conduct cluster analysis in Tableau to explore the nature groups of cosmetic product brands to make better promotion plans in the future.
- Use filters and page functions to drill down into data for different months or states in Tableau.
- Conduct KPI analysis in Tableau by adding a reference line and adjusting the color center.
- Develop the data analytics mindset and critical thinking skills to complete the whole data analytics procedure.
- Produce an analysis report that includes visualization graphs, discussions, and suggestions.

3.4. Case prerequisites

If the instructor uses this case as a capstone project requiring students to complete it independently, students should have a basic knowledge of SQL for data extraction and transformation, as well as advanced visualization skills in Tableau, including creating geographic maps, word clouds, and conducting cluster and KPI analysis. If the instructor teaches the case step by step in class, it is recommended that students acquire basic SQL and Tableau skills before the case is introduced.

3.5. Evidence of efficacy

The case has been implemented in Spring 2021, Fall 2021, Fall 2022, and Spring 2023 in an undergraduate-level accounting data analytics course in the accounting program at a mid-size public university in the midwestern United States. It is a 400-level elective course developed in Spring 2021. All the students were seniors. All classes were delivered in person. The course had enrollments of 10 students in Spring 2021, 16 students in Fall 2021, 6 students in Fall 2022, and 13 students in Spring 2023. Instructors teach the normal teaching material included in the course of accounting data analytics that covers Microsoft SQL and

Tableau throughout the semester. Before introducing the case, students learn basic skills about using SQL clauses to query data (such as SELECT, JOIN, WHERE, ORDER BY, GROUP BY) and use Tableau to visualize and analyze data in Tableau (including editing data, combining tables, creating different kinds of visualization graphs, conduct clustering analysis, and create dashboards and stories). Then, all 45 students enrolled in this course complete this case as a capstone assignment. The case is introduced in week 11 and submitted in week 13 before the final exam. The presentations are scheduled for week 13. Students are required to complete the case individually. Example screenshots are provided to help students check their progress.

We evaluated the efficacy of the case by comparing the accuracy of multiple-choice questions before and after the completion of the case. Students were asked to answer 7 multiple choice questions (3 points each) about data extraction, data cleaning, data analysis, and data visualization before the introduction of the case. After the completion of the case, students were asked to answer the same questions again. Table 3 presents the questions and results of the pre-test and post-test analysis. Results show that students' performance significantly improved on all SQL query questions and most Tableau-related questions (p-value < 0.05 for the first 6 questions). It is worth noting that students' average grades on a complicated SQL query question (question 4) and a clustering question (question 6) notably increased, showing their better understanding of SELECT and WHERE SQL clauses, and the function of clustering. Students' perception of the Story function in Tableau was roughly the same as students already understood this concept well before they completed the case.

3.6. Implementation guidance

This case aims to evaluate data analytics skills students learned at the end of an accounting data analytics course and help students build a data analytics mindset. It can be used in an advanced accounting data analytics course for senior undergraduate students or graduate students. Students need to apply the comprehensive skills they learned to write SQL queries, conduct explanatory and exploratory analyses, and communicate results. This case allows students to estimate financial accounting measures using the data from a familiar department store company. This case can be used as a capstone project that requests students to submit the assignment at the end of the semester. Instructors can customize the required time period and accounting measures as needed. The oral presentation is also optional depending on the schedule of the class.

Alternatively, this case can be used as an in-class practice and require students to use their analysis to complete in-class quizzes. For example, the instructor can introduce the fundamental skills of writing SQL queries and conducting analysis in Tableau over the semester. Students benefit from step-by-step guidance as they learn to use this software but would need the help of a comprehensive case to help them master these analytics skills and practice critical thinking skills. By completing this case, students would be able to use analytics skills to answer business questions, rather than complete a specific instructor's request. With that

Table 3
Evidence of case efficacy.

Skilled related	Question (3 points each)	Pre-test Mean n = 45	Pre-test Stdev n = 45	Post-test Mean n = 45	Post-test Stdev n = 45	P value (T < t, two-tail) n = 45
SQL	1. What is the correct query to extract data for the month of January? a Where month(Tran_date)! = '01' b Where month(Tran_date) == "01" c Where month(Tran_date) = '01' d If month(Tran_date) = '01'	2.267	1.304	2.667	0.953	0.013
SQL	2. Which SQL statement is correct? a. FROM Table1 JOIN Table 2 ON variable1=variable2 b. FROM Table1 JOIN Table 2 ON Table1.variable1=Table2.variable2 c. FROM Table1 JOIN Table 2 IF Table1.variable1=Table2.variable2 d. SELECT Table1 JOIN Table 2 ON variable1. Table1= variable2.Table2	2.333	1.261	2.733	0.863	0.013
SQL	3. SQL clause___is used to filter the data. a WHERE b IF c FILTER d SELECT	2.533	1.100	2.800	0.757	0.044
SQL	4. Which SQL statement is correct? a. SELECT current_liability/current_asset AS current ratio FROM Balance_Sheet WHERE current_asset !=0 AND current ratio >0 b. SELECT current_liability/current_asset AS current ratio FROM Balance_Sheet WHERE current_asset !=0 AND current_liability/current_asset >0 c. SELECT current_liability/current_asset AS current_ratio FROM Balance_Sheet WHERE current_asset !=0 AND current_ratio >0 d. SELECT current_liability/current_asset AS current_ratio FROM Balance_Sheet WHERE current_asset !=0 AND current_liability/current_asset >0	1.933	1.452	2.600	1.031	0.001
Tableau	5. Which statement is incorrect? a. word cloud can be generated based on the frequency of product names b. word cloud can be generated based on the total sales of each product c. word cloud is good at showing the differences between different items d. word cloud is not good at presenting trends	2.600	1.031	2.867	0.625	0.044
Tableau	6. Which of the following best describes the clustering approach to data analytics? a An attempt to assign each unit (or individual) in a population into a few categories. b An attempt to discover associations between individuals based on transactions involving them. c An attempt to identify similar individuals based on data known about them. d An attempt to divide individuals into groups in a useful or meaningful way.	1.800	1.486	2.600	1.031	0.000
Tableau	7. In Tableau, the story function can effectively. a. tell a data narrative b. show interactions between visualization graphs c. provide context d. highlight information	2.800	0.757	2.933	0.625	0.323

being said, this case can help students review and practice the data analytics skills they learned in a business setting and apply these skills to assist managers in making data-driven decisions. Additionally, students were tasked with creating a formal report for the CEO and were required to address the CEO's (instructor's) questions during the presentation. The case evaluates students' familiarity with analytics techniques and financial accounting analysis. Detailed requirements and example analysis screenshots will be provided to help students assess their progress. The solutions include step-by-step instructions, and screenshots of analysis outputs for key steps are demonstrated in section 3.4. Instructors can use the solutions to validate the accuracy of students' submissions or use the solutions as teaching manuals if students have limited analytics experience. The solutions highlight the steps where students frequently make mistakes.

We have used the case in a 400-level undergraduate accounting data analytics course. This course uses the textbook "Data Analytics for Accounting" (Richardson, Terrell, & Teeter, 2023) which gives textbook users permission to access Dillard's database through Microsoft SQL Server via the remote desktop of the University of Arkansas. If the instructor does not use the textbook but would like to access Dillard's data that was used in this case, please contact the authors.

We recommend that the instructors complete the case by following the step-by-step instructions as part of their preparation. For textbook users, it may take about 1 to 2 h to complete the case. For first-time users of the server, it may take approximately 2 to 4 h. Please allow additional time if the instructor plans to request data from the corresponding author and set up a separate server connection.

To complete the whole case, students need approximately 8 h. It consists of 2 h of data extraction, 3 h of data analysis and data visualization, 2 h of report preparation, and 1 h of presentation preparation. For students of the data analytics course and information systems course, we recommend allowing students to complete the case in 2 weeks. Instructors may also consider providing a Q&A session during lectures to assist students in making progress and providing them with the opportunity to successfully complete the entire project.

3.7. Recommended solutions

3.7.1. Access Dillard's data

Instructors can get access to Dillard's data from the following methods:

a) If the instructor uses the textbook Data Analytics for Accounting (Richardson, Terrell, & Teeter, 2023), the instructor can request remote desktop accounts of the University of Arkansas for students by following the instructions included in instructor resources. The instructor will also get the server and database information from instructor resources. If so, students can follow the instructions and log in to their accounts to get access to Tableau and the SQL server we used for our case.
b) If the instructor does not use the textbook, the instructor can request remote desktop accounts or a copy of the Excel file by contacting the corresponding author. The corresponding author will also send the instructor the server and database information. Students then can download the Tableau desktop and get a free student license for one year from: https://www.tableau.com/academic/students.

3.7.2. Step-by-step instructions

Step-by-step instructions are provided in Appendix B. Students often struggle with writing queries, particularly with identifying and excluding abnormal values. Additionally, they may forget to filter the data to the cosmetics department in SQL query. While most students can successfully generate the required visualizations, some may need assistance with the word cloud and box-and-whisker plot. An effective way to support students is to schedule a Q&A session where they can ask questions directly. In cases where data loads slowly or fails to load, instructors can provide the following instructions:

- Stop waiting for Tableau to respond after 10 min of waiting if correct server and database information were entered. (Note: It is important to give this instruction to students. If the data or visualizations can't be loaded within 10 min, it is most likely that it won't be loaded. Students may waste hours waiting without this instruction.)
- If Tableau fails to respond within 10 min despite a high-speed, stable internet connection, try logging into the remote desktop accounting later. (Note: Sometimes server issues cause delays. Logging in at a different time may resolve the problem.)
- If the issue persists after several attempts, contact the instructor. (Note: Occasionally, students may be unable to load data into Tableau or create visualizations due to the high volume of data used in the analysis. In this case, instructors can provide a smaller dataset in Excel to help students complete the remaining steps and ask students to submit their SQL queries separately. Based on our experience, most students can complete the cases without this step.)

3.7.3. Example of analysis report

An example of the analysis report is provided in Appendix C. Instructors can contact the corresponding author to obtain a copy of the Tableau solutions.

4. Conclusion

We believe this case presents an engaging and practical real-world scenario that enables students to access the data server of a familiar real-world department store company in the U.S. and analyze product brands they are familiar with. Our comprehensive case shows students the whole picture of data analytics, starting from asking business questions, collecting data, analyzing data, visualizing data, and communicating results, which can help students practice data analytics skills as well as build a data analytics mindset. The case is designed to help students understand how companies use SQL and Tableau to generate valuable information and make data-driven decisions. Instructors can use this case directly in an accounting data analytics or accounting information systems class or use the adapted version of a commonly taught financial accounting or managerial accounting class. In case students have no prior experience learning Microsoft SQL or Tableau, the instructor can first show students how to complete the case (or a specific part of the case) step by step, following the recommended solutions, then ask students to replicate the analysis using a different data period or a different department for practice or a graded assignment. This case can also be extended by asking students to propose additional questions based on their original analyses and conduct additional analyses to find the answers.

We here offer a few additional analyses that can be added to the case: (1) compare the return rate of online transactions and in-store transactions; (2) compare the sales growth rate of online transactions and in-store transactions; (3) compare the return rate of gift card transactions and bank card transactions; (4) compare the sales growth rates between different departments; (5) analyze the relationship between sales and customer distance; (6) analyze if higher discount rates are associated with higher sales; (7) compare the profit margin between different departments; (8) analyze customers' preference on product colors in different regions; (9) analyze customers' preference on product colors in seasons, and (10) analyze the customer retention rates over different states.

Additionally, this case can be adapted to other accounting courses. For example:

(1) Application of this case to the financial accounting course:

This case is primarily designed for financial accounting settings. Considering the complexity of the case, the financial accounting

instructor could:

a. Skip the data extraction and data cleaning steps. Provide the data in an Excel file to students directly.
b. Pick one or two analyses out of analyses a) to f).
c. Assess students' skill levels first. For example, students may not know how to use Tableau or generate word clouds in Tableau. In this case, instructors can ask students to perform some analyses in Excel or show them how to use Tableau first.

(2) Application of this case to the managerial accounting course:
Key Performance Indicator (KPI) analysis can be additionally included in this case. Instructors can ask students to generate parameters in Tableau to estimate if the company meets its targets. Additionally, the design of the case can lean more towards discussing the analysis results and providing suggestions to managers.

(3) Application of this case to the graduate course:
a. To generate new variables and pivot columns, students can choose between achieving this through the SQL query directly or generating calculated fields in Tableau after the data is extracted. For a graduate course, the instructor can request students to complete these tasks using the SQL queries. The difficulty level will be higher if students need to write the SQL query to achieve these functions.
b. For the clustering analysis, graduate students should be asked to check and explain the meaning of the statistical information for the clustering model.
c. Instructors can ask graduate students to collect Dillard's balance sheet account information themselves and merge it with the SQL query. It would enable students to generate and analyze a variety of accounting ratios. Students then can conduct more comprehensive financial statement analysis.
d. Instructors can ask students to review their analyses and identify the abnormal values.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. List of STEM-designated accounting programs (as of July 28, 2023)

1	American University
2	Arizona State University
3	Arkansas State University
4	Bentley University
5	Brigham Young University
6	Bryant University
7	Case Western Reserve University
8	Colorado State University
9	Columbia University
10	Cornell University
11	Florida State University
12	Fordham University
13	George Washington University
14	Golden Gate University
15	Illinois State University
16	Indiana University
17	Lamar University
18	Loyola Marymount University
19	Marquette University
20	Michigan State University
21	North Carolina State University
22	Northern Illinois University
23	Nova Southeastern University
24	Ohio State University
25	Pace University
26	Pennsylvania State University
27	Rice University
28	Rochester Institute of Technology
29	Santa Clara University
30	Seattle University
31	Southern Illinois University
32	Syracuse University
33	Tulane University
34	University of Arizona
35	University of California Irvine
36	University of California Riverside
37	University of California San Diego
38	University of Delaware
39	University of Denver
40	University of Houston
41	University of Illinois Urbana-Champaign
42	University of Maryland
43	University of Massachusetts Boston
44	University of Miami
45	University of Michigan
46	University of Mississippi
47	University of Missouri – Kansas City
48	University of New Haven
49	University of Northern Iowa
50	University of Pittsburgh
51	University of Rochester
52	University of Southern California
53	University of Virginia
54	University of Washington Tacoma
55	University of Wisconsin Milwaukee
56	Wake Forest University
57	William and Mary University

Appendix B. Step-by-step instructions

a) Get UML for the Dillard's dataset.

Log in to the remote desktop of the University of Arkansas > Open Microsoft SQL Server Management Studio > find the dataset WCOB_Dillards and expand it > right-click Database Diagrams > click New Database Diagrams > add all the tables included in this dataset to the diagram. The database diagram is as shown below:

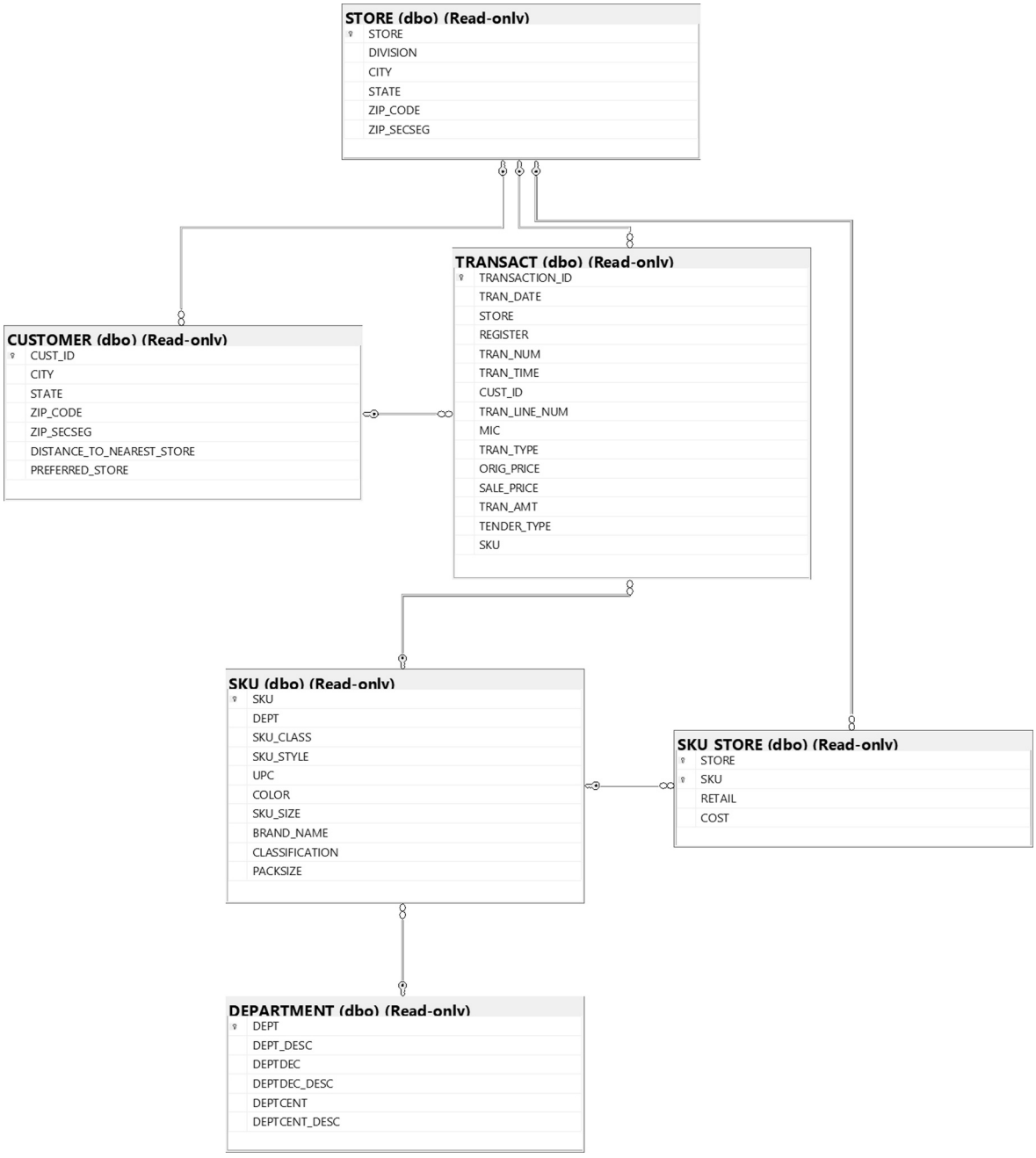

Fig. B1. SQL database diagram.

b) Query data using SQL.

Log in to the remote desktop of the University of Arkansas > open Tableau Desktop > under the connect section, click Microsoft SQL Server > enter server and database information > click Sign In. Tableau will then bring you to the page Data Source.

Under the Table section, double-click New Custom SQL > enter the following SQL statements:

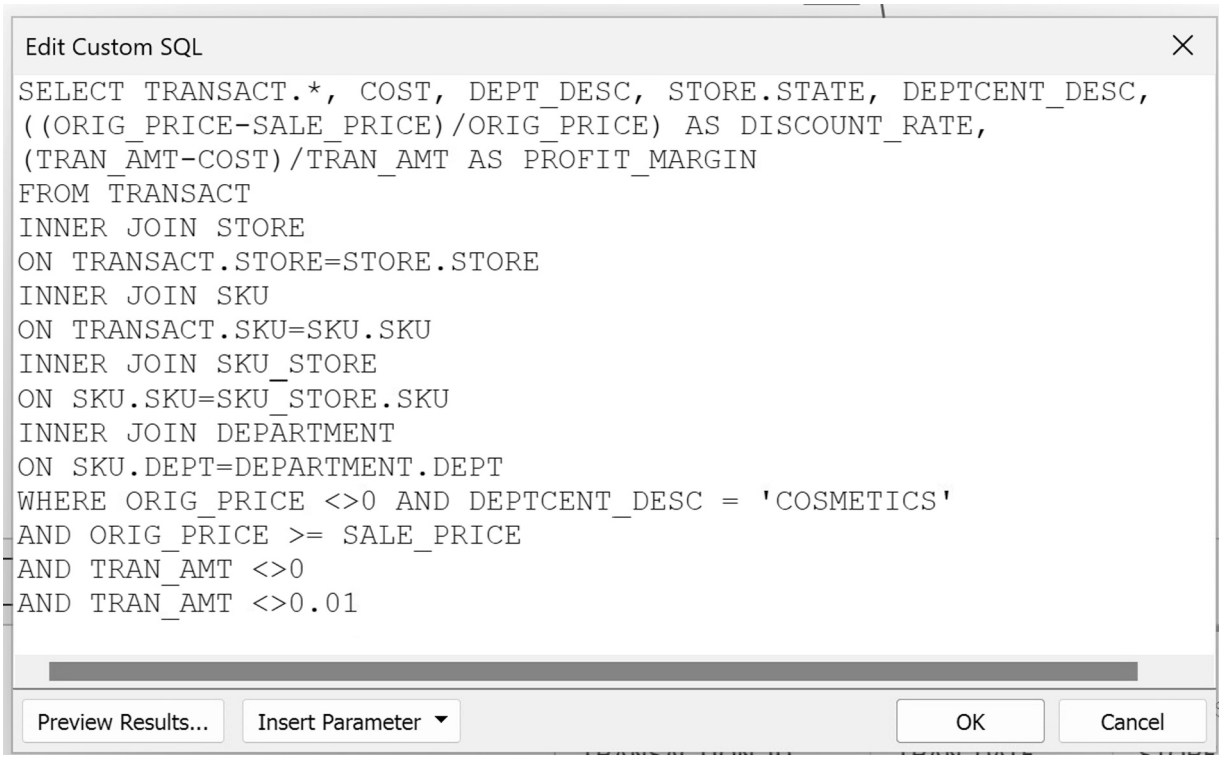

Fig. B2. SQL query.

Note: students may make mistakes when they write the query for the following reasons:

- Name the new calculated filed (DISCOUNT_RATE and PROFIT_MARGIN) wrong. There should be no space between characters.
- Didn't use correct primary keys and foreign keys to join the table. Instructors can guide students to review the UML to find the connections between tables.
- Forget to use the WHERE clause to select data of the COSMETICS department.
- Forget to exclude abnormal data using the statement: WHERE ORIG_PRICE >= SALE_PRICE AND TRAN_AMT <> 0.01.
- Forget to set the rule to calculate (ORIG_PRICE-SALE_PRICE)/ORIG_PRICE. That is ORIG_PRICE <> 0.
- Forget to set the rule to calculate (TRAN_AMT-COST)/TRAN_AMT. That is TRAM_AMT <> 0.
- Use double quotes instead of single quotes for dates.

c) Adjust the data format. Click Update Now to load data. Find STATE > click # > Geographic Role > State/Province.

Note: if students forget to adjust the data format for STATE, they won't be able to generate geographic maps.

d) Create a geographic map to analyze the discount level of states:

- Click the tab New Worksheet next to the Data Source. Double click State > double click DISCOUNT_RATE > go to Show Me > select maps. In the Marks section, click the down arrow next to SUM(DISCOUNT_RATE) > click Measure (SUM) > select Average. The adjusted mark for color is shown as follows:

Fig. B3. Icon for average discount rates.

- Add average discount rates as labels.
- Click the down arrow in the upper right corner of the color description box > click Edit Colors… > adjust the center to 0.05. Add TRAN_DATE to Filters > click Months > click Next > select December > click Appy > click OK.
- Rename the worksheet as DISCOUNT. Take a screenshot.

e) Create a word cloud to analyze the total sales of cosmetic brands.

- Click the tab New Worksheet. Double click TRAN_AMT and DEPT_DESC > click Show Me > Select Packed bubbles > in the Marks section, click the drop-down list, and select Text as follows:

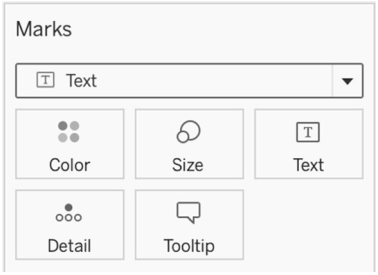

Fig. B4. The marks section in Tableau.

- Add STATE to Pages. In the description table for Pages, find the state of Florida.
- Rename the worksheet as SALES. Take a screenshot.

f) Create a graph for box-and-whisker plots and analyze the distribution of the discount rate of different states per weekday.

- Click the tab New Worksheet. Add TRAN_DATE to Columns > click the down arrow next to YEAR(TRAN_DATE) > click more > select Weekday. Add DISCOUNT_RATE to Rows > adjust SUM(DISCOUNT_RATE) to AVG(DISCOUNT_RATE). Drag State to the Marks section and drop above Label. Go to Show Me > select box-and-whisker plots.
- Click the tab Analytics next to Data as follows:

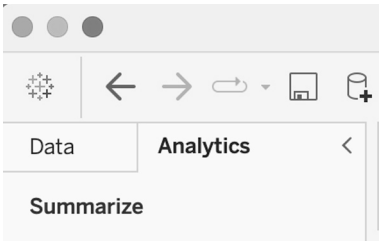

Fig. B5. The marks section in Tableau.

Double click Reference Line > click the drop-down list next to value > select Create a New Parameter… > Enter Target under Name > select Entire Table > Adjust Current value to 0.05 > click OK.

- Rename the worksheet as DISC_STATE_WEEKDAY. Take a screenshot.
- Replicate your analysis and replace DISCOUNT_RATE with TRAN_AMT.
- Rename the worksheet as SALES_STATE_WEEKDAY. Take a screenshot.

g) Clustering analysis.

- Click the tab New Worksheet. Add TRAN_AMT to Columns > add PROFIT_MARGIN to Rows > adjust the automatically generated SUM(PROFIT_MARGIN) to AVG(PROFIT_MARGIN) > Drag DEPT_DESC to the Marks section and drop above Text.
- Click the tab Analytics next to Data > double click Cluster > enter 5 under Number of Clusters.
- Find the brand AROMATIQUE > click it > click Exclude to exclude it from your analysis.
- Rename the worksheet as BRAND_CLUSTER, Take a screenshot.

h) Trend analysis.

- Click the tab New Worksheet. Create calculated fields to represent the sales in 2014, 2015, and 2016.

Fig. B6. Sales in 2014.

- Create calculated fields for sales growth rates of 2015 and 2016.

Fig. B7. Sales growth rate of 2015.

- Add “Sale growth rate 2014 to 2015” and “Sale growth rate 2015 to 2016” to Rows. Add “TRAN_DATE” to Columns, then click the down arrow on its icon and select “Month”.
- Go to “Show Me”, then select “dual lines”.
  i) Return rate analysis.
- Create a calculated field to represent return transactions.

Fig. B8. Return transactions.

- Create a calculated field for the return rate.

Fig. B9. Return transactions.

Note: for graduate courses, instructors can require students to write a query to pivo column TRAN_TYPE. Here is an example of the query:

```
SELECT SKU, STATE, TENDER_TYPE, TRAN_DATE, [P], [R]
FROM
(SELECT SKU.SKU, STATE, TENDER_TYPE, TRAN_DATE, TRAN_TYPE, TRAN_AMT
FROM TRANSACT
INNER JOIN STORE
ON TRANSACT.STORE=STORE.STORE
INNER JOIN SKU
ON TRANSACT.SKU=SKU.SKU
```

INNER JOIN DEPARTMENT
ON SKU.DEPT = DEPARTMENT.DEPT
WHERE DEPTCENT_DESC = 'COSMETICS') AS SRC PIVOT
(SUM(TRAN_AMT) FOR TRAN_TYPE IN ([P],[R])) AS PVT

- Add "RETURN RATE" to Rows. Add "TRAN_DATE" to Columns, then click the down arrow on its icon and select "Month".
- Create a parameter.
  Name: Industry Average Return Rate.
  Date type: Float.
  Current value: 0.0521.
  Display format: Automatic.
  Value when workbook opens: Current value.
  Allowable values: All.
- Go to the tab "Analytics". Drag "Reference Line" to Canvas > select "Table". Next to Value, select "Industry Average Return Rate".
- Drag "TRAN_DATE" to Pages.

j) Create a dashboard.

- Click the tab New Dashboard next to New Worksheet.
- Select the sheets you created (including the geographic map) and drag them to the canvas.
- Click the geographic map > click the filter icon in the upper right corner > click Florida.
- Take a screenshot

k) Create a story.

- Click the tab New Story next to New Dashboard next.
- Drag the sheets you selected to canvas. Add captions for each sheet and highlight the key information.
- Take a screenshot

Appendix C. Example of the analysis report

Student Name:
Date:

This analysis report analyzes the cosmetic department's sales, discount level, profit margin and brand clusters for the period between Jan 1st, 2014 and Oct 17th, 2016.

(a) (i) Analysis of the discount level of states during the Christmas Season (December 2015 to January 2016):

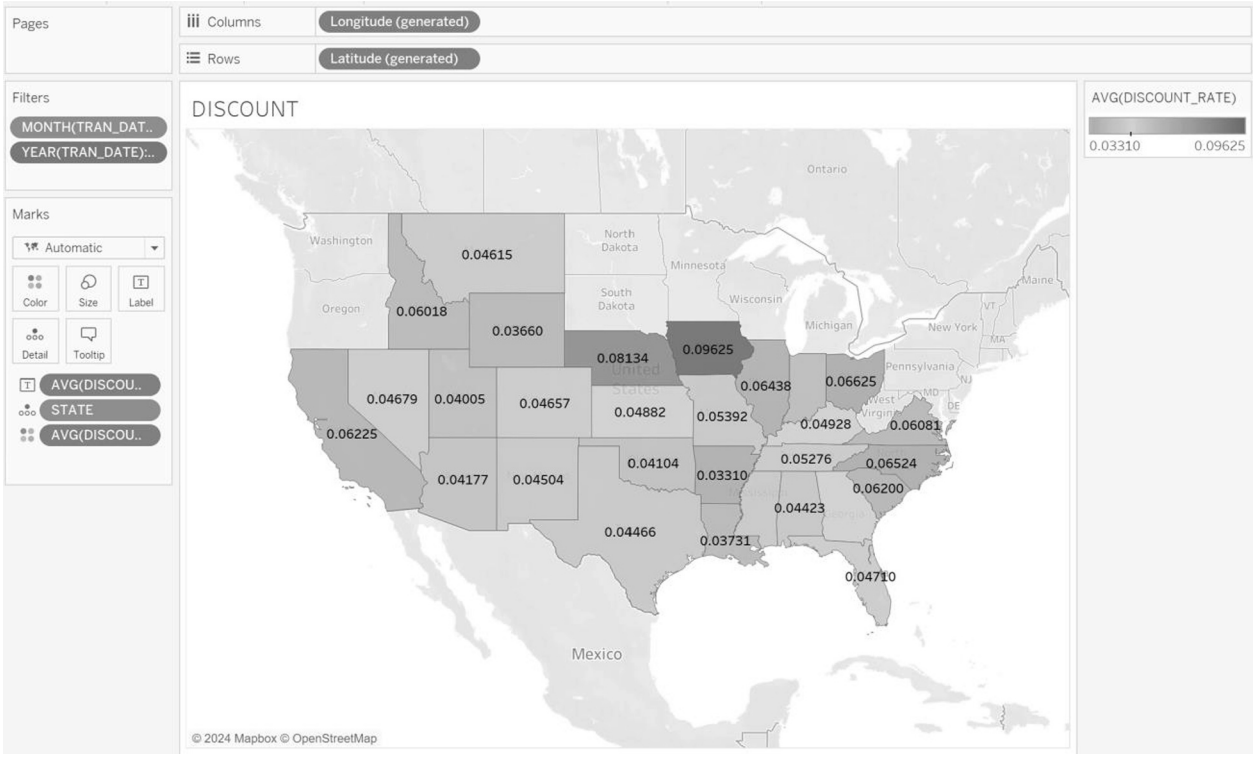

Fig. C1. Geographic map of state average discount rate for December 2015.

(ii) The geographic map above displays the state average discount rates of the cosmetic department for December 2015. It is noteworthy that the overall discount rate was relatively low in December, and the majority of states met the target discount rate of 5 % for that month. These states include Montana, Wyoming, Nevada, Utah, Colorado, Kansas, Kentucky, Arizona, New Mexico, Texas, Louisiana, Mississippi, Alabama, and Florida.

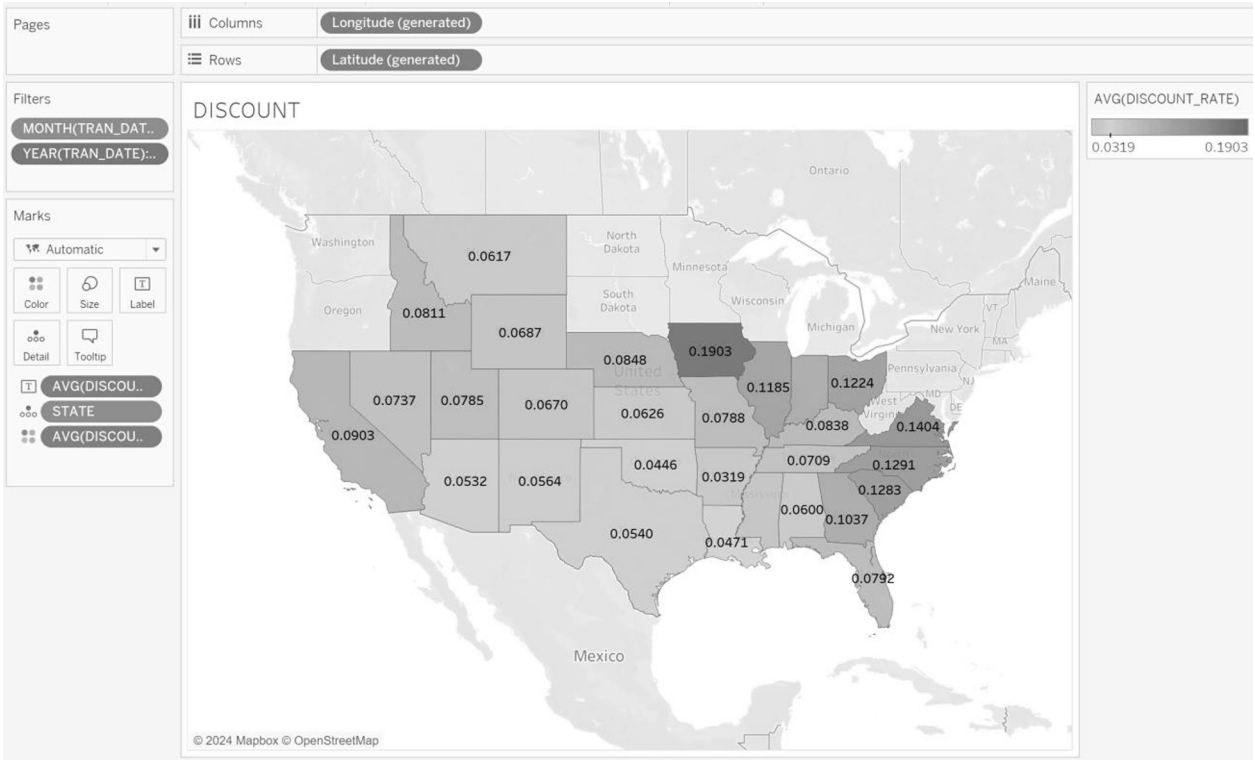

Fig. C2. Geographic map of state average discount rate for January 2016.

(iii) As shown in Fig. C.2, the majority of states offered more attractive discounts in January 2016, with only three states (Oklahoma, Arkansas, and Louisiana) meeting the target. Of note, the discount rate of Iowa experienced a significant jump, rising from 9.63 % to 19.03 %.

(iv) Treemaps may also be a good option.

(v) Stores in Iowa often offer higher discount rates, but their sales are usually much lower than stores in Texas. Based on the current results, higher discount rates are not necessarily associated with higher sales.

(vi) Arkansas often offered the lowest average discount rates (3.3 %) in December 2015, but their average profit margin is relatively low at 15.5 %. In comparison, the average discount rate of stores in Ohio is 6.6 % in the same month, but their average profit margin is 34.5 %. Managers in Arkansas can consider consulting the managers in Ohio and see how Ohio reduces its operating expenses.

(vii) Generally, the discount rates are lower in February, May, and October. Discount rates usually are higher during the Christmas Season.

b) (i) Analysis of sales of cosmetic brands:

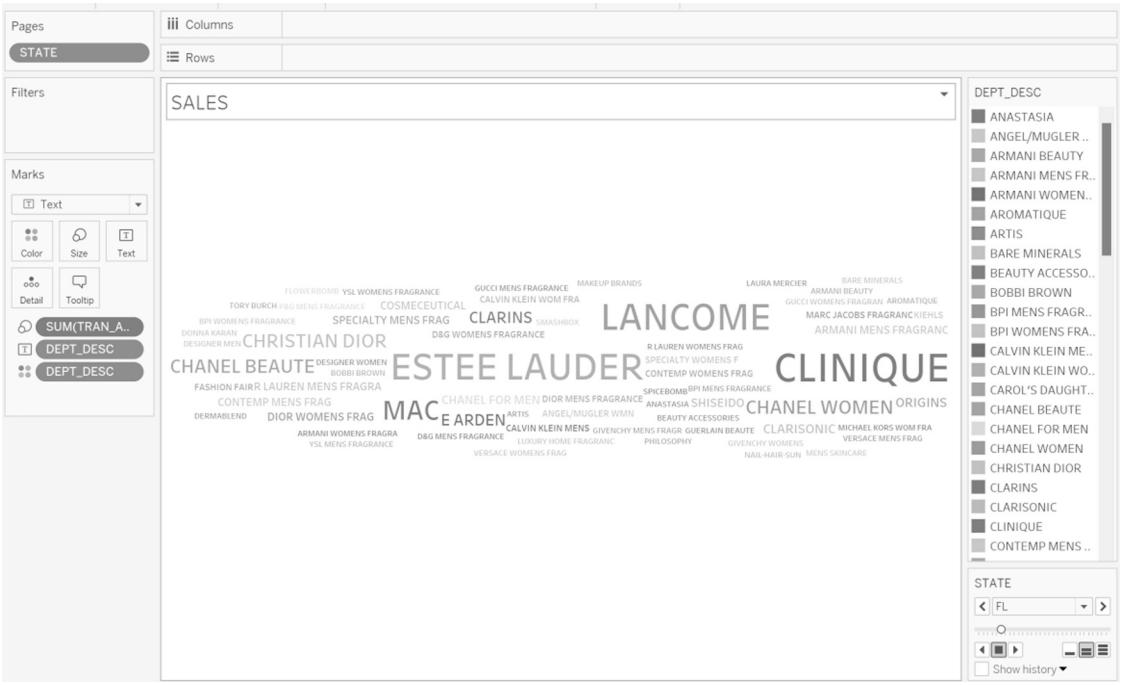

Fig. C3. Word cloud: total sales of cosmetic brands in Florida.

(2) As shown in Fig. C.3, the most popular cosmetic brands in Florida are Clinique, Estee Lauder, Lancome, Mac, and Chanel Women. The sales of these five brands significantly surpass those of other brands. Additionally, among these top five, the sales of the top three brands (Clinique, Estee Lauder, Lancome) are notably higher compared to the other two.

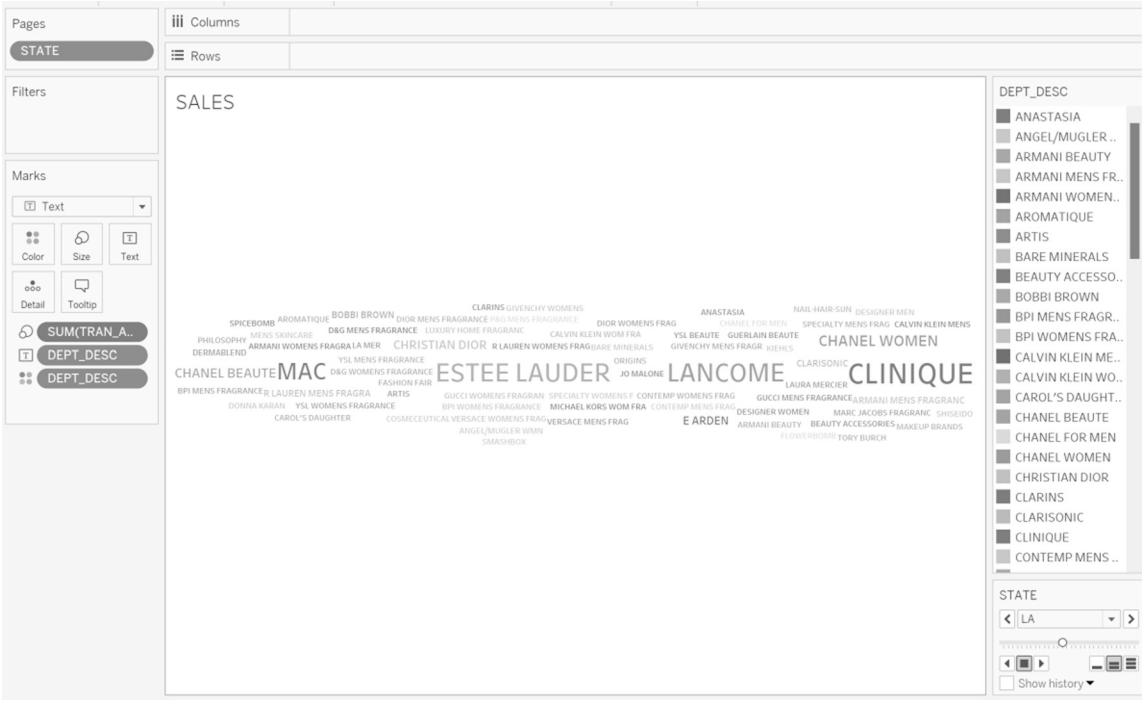

Fig. C4. Word cloud: total sales of cosmetic brands in Louisiana.

As shown in Fig. C.4, the most popular cosmetic brands in Louisiana are Clinique, Estee Lauder, Lancome, Mac, and Chanel Women. It's worth noting that the top 5 popular brands in Louisiana are the same as those in Florida. However, the sales difference between the top 5 brands and other brands is smaller in Louisiana. Additionally, Chanel women's products are less popular in Louisiana compared to Florida.

(iii) Highlight tables and tree maps can also be used to present the sales of different brands.
(iv) Estée Lauder, Lancôme, and Clinique are generally the most popular brands across different states. These three brands typically account for a significant portion of sales in most states. Managers should ensure adequate stock levels for these brands. Additionally, MAC is also popular in many states. Other states might consider offering promotional activities, such as providing trial samples of Mac products to attract more customers and boost sales.
(v) The top three popular cosmetic brands in Arkansas are Estee Lauder, Lancome and Clinique. First, these three brands are generally popular, well-known brands in the U.S. Second, the discount rates of these three brands are generally low in Arkansas, showing customers are not attracted by the high discount rates.
(vi) A word cloud can also be used to analyze the sales and profit margins of different brands. Additionally, it can present sales, discount rates, or profit margins for various tender types, regions, or departments.
c) (i) Analysis of the distribution of discount rates of states across weekdays.

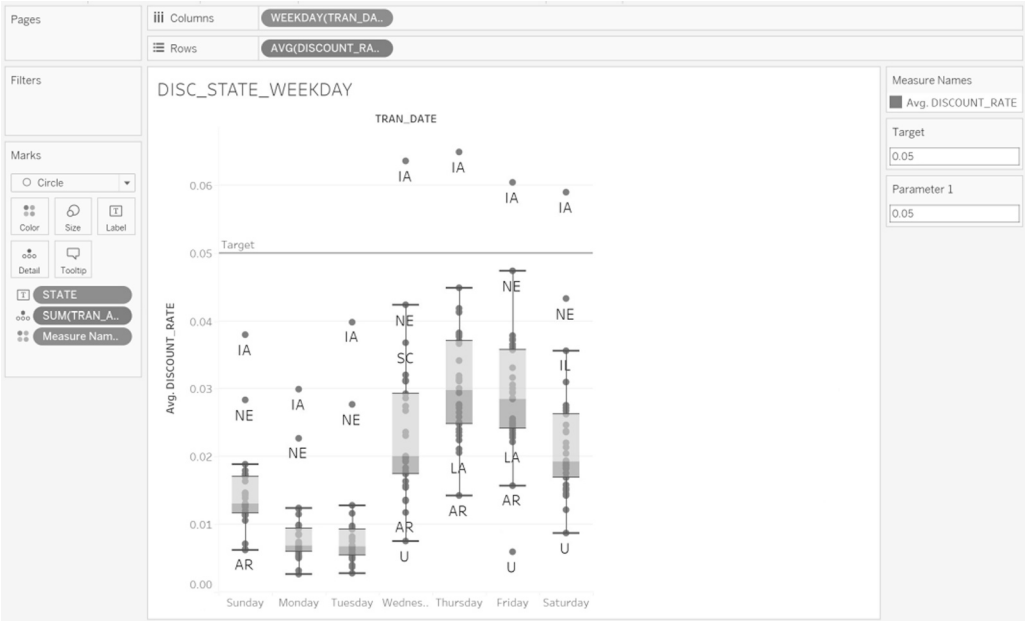

Fig. C5. Box-and-Whisker plots: state average discount rates per weekday.

(ii) Fig. C.5 illustrates the distribution of state average discount rates per weekday. It reveals that the majority of states meet the target of 5 % excluding Iowa, with fluctuations mostly ranging between 0.7 % and 3.7 %. However, on Thursdays and Fridays, the discount rates are notably higher with a wider dispersion.

(iii) The average discount rates in Iowa are consistently higher than in other states. Conversely, the average discount rates in Arkansas and for online sales are lower than those in other states.

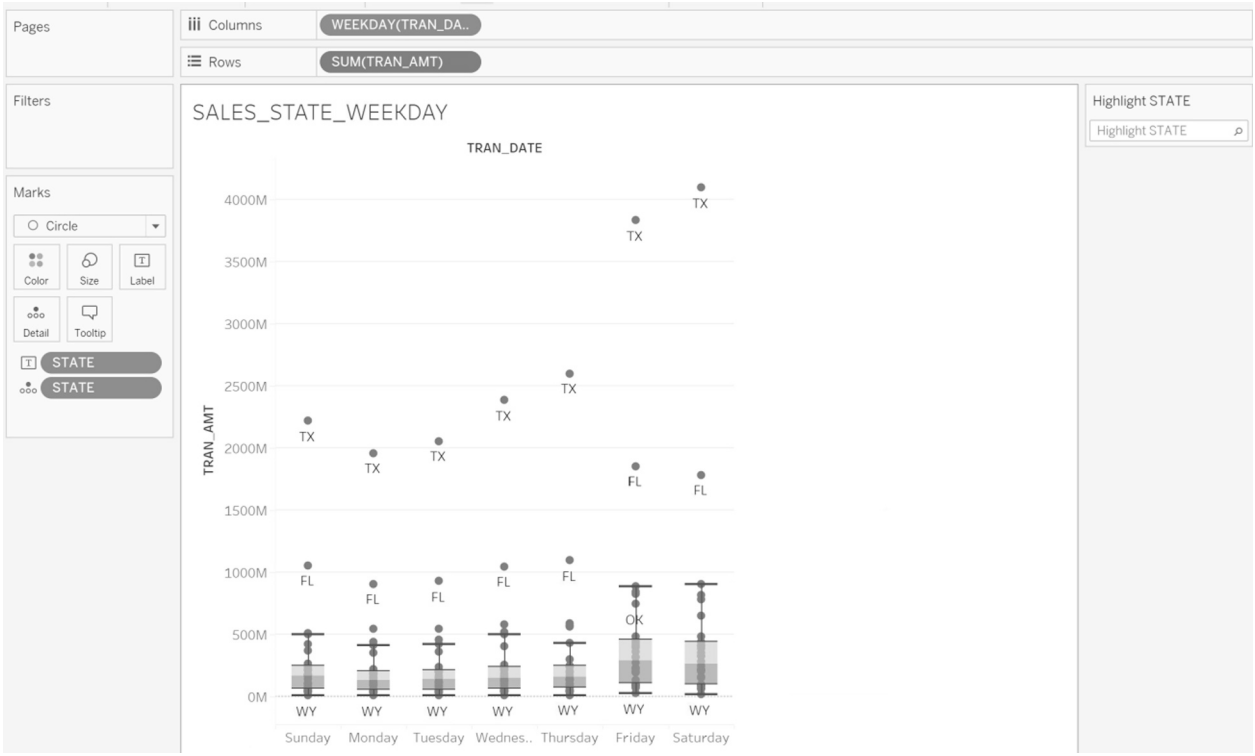

Fig. C6. Box-and-whisker plots: state total sales per weekday.

(iv) Fig. C.6 displays the distribution of state total sales per weekday. It is interesting to note that despite the significantly higher discount rates offered on Thursdays and Fridays, it did not result in higher sales on Thursdays. Surprisingly, the sales on Saturdays are noticeably higher with lower discount rates. Moreover, there seems to be no apparent cause-and-effect relationship between discount rates and total sales.

(v) While many stores offer higher discounts on Thursdays, sales on these days are usually lower than on Fridays and Saturdays. This may be due to a higher volume of customers on Saturday. In this case, managers might consider increasing the discount rates on Thursdays to boost the profit margin and implementing promotional activities on Saturdays to further enhance sales.

d) (i) Clustering Analysis.

Fig. C7. Clustering analysis: brand clusters.

(ii) Fig. C.7 presents the clustering analysis of cosmetic brands based on the average profit margins and total sales. There are four clusters – Profit Winners (cluster 1), Sales Winners (cluster 2), Popular Brands (cluster 3), and Bad Performance (cluster 4).

Fig. C8. Clustering analysis: brand clusters (excluding the outlier).

(iii) The profit margin of Carol' Daughter is abnormally low. Fig. C.8 presents the same analysis, excluding the outlier Carol' Daughter.
(iv) Cluster 1: Profit Winners, are highly profitable but experience low sales. To attract new customers, our company could consider offering discounts or providing free samples of these products. Additionally, we can send free samples of these products to customers who purchase items from the Sales Winners cluster.

Cluster 2: Sales winners are the most popular brands. To further capitalize on their popularity, our company can strategically place these products in prominent store locations or feature them prominently on the cosmetic products' webpage to attract a larger customer base. Given the mid-level profit margin, instead of offering discounts, our company could consider providing more generous gifts to incentivize purchases.

(v) We can also conduct cluster analysis to analyze customers' behaviors. We can better understand the demands of different groups of customers to provide customized services.
e) (i) Trend analysis of sales growth rate.

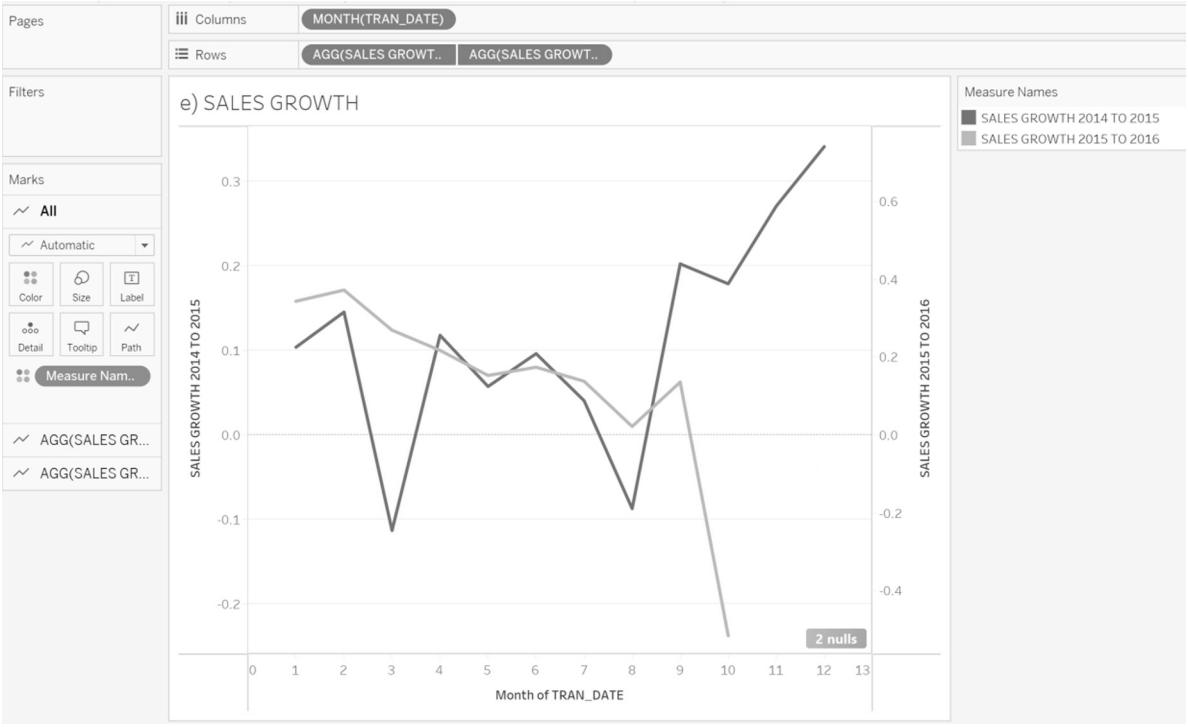

Fig. C9. Trend analysis of sales growth rate.

(ii) Sales fluctuated significantly between January and August 2015, then increased rapidly after August until the end of the year. Although the sales growth rates decreased between January and August 2016, the decline was smoother compared to 2015.
(iii) Since we only have partial data for October 2016 and missing data for November and December 2016, we can only compare the sales growth rate between January and October for 2015 and 2016. We observed that sales generally decreased from January to August in both 2015 and 2016. The sales growth rates dropped sharply in March and August 2015, but not in 2016.
(iv) The sales growth rates dropped sharply in March and August 2015, but not in 2016. These two declines in 2015 followed sales increases in February and June. The drops may have been caused by the cessation of promotional activities offered in February and June 2015. This issue appears to have been addressed in 2016.
(v) Based on the sales growth rates for 2015 and 2016, we can predict that the sales growth rate for February 2017 may be close to 20 %.
(vi) The line chart is especially good at discovering trends.
(vii) We can apply trend analysis to examine the trends in sales volume, profit growth, and other financial data.
(viii) We can use the word cloud to compare the sales growth rates of different brands. Additionally, we can use the geographic map to compare the sales growth rate of different states.
f) (i) Return rate analysis.

Fig. C10. Return rate analysis.

(ii) Dillard's cosmetic products' return rates are lower than the industry average in most months, excluding January. This is better than I expected. The higher return rates in January are understandable, as it follows Christmas and many customers may need to return or exchange gifts.
(iii) The return rates remain stable, ranging from 3 % to 4 % between February and October. However, as the discount and holiday seasons arrive, the return rates increase and then drop again in February.
(iv) The following Fig. C.11 presents the return rates of different types of payments. It showed the return rates of gift card transactions are much higher than other types of payments.

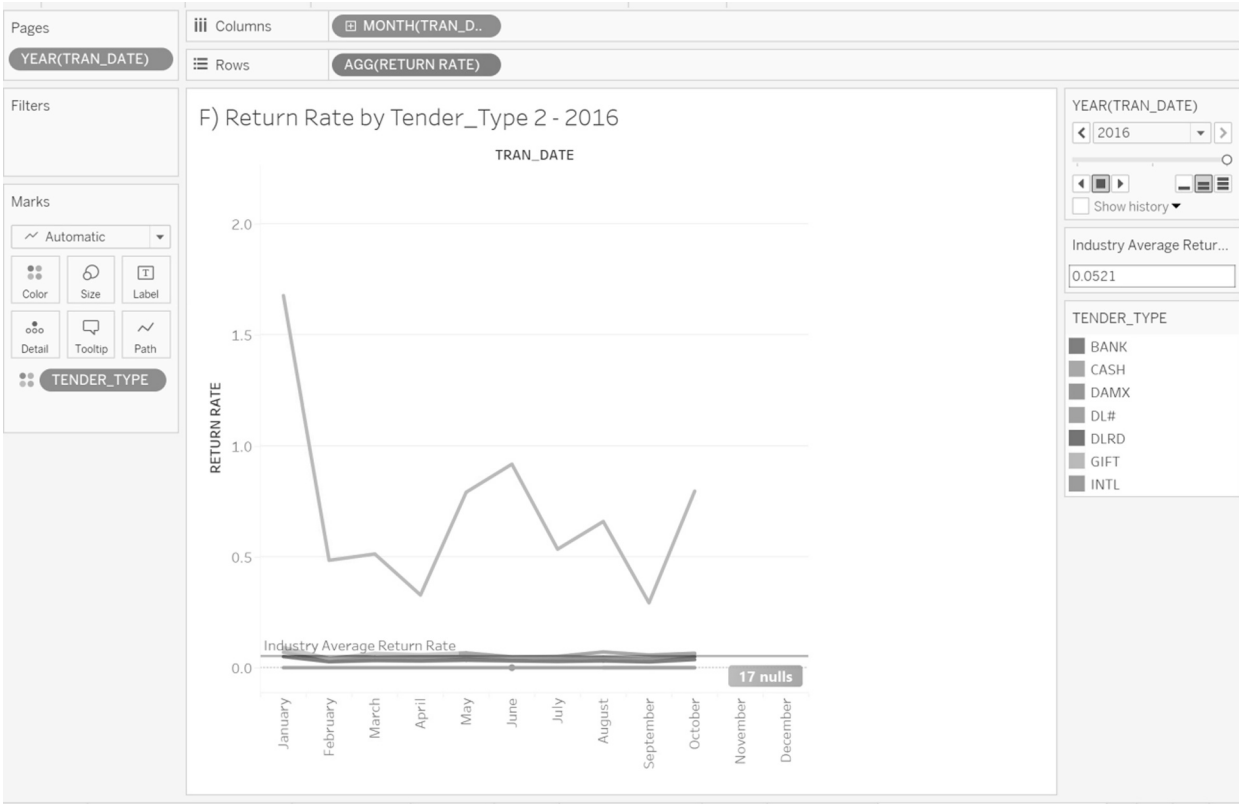

Fig. C11. Return rate by tender types.

f) Dashboard.

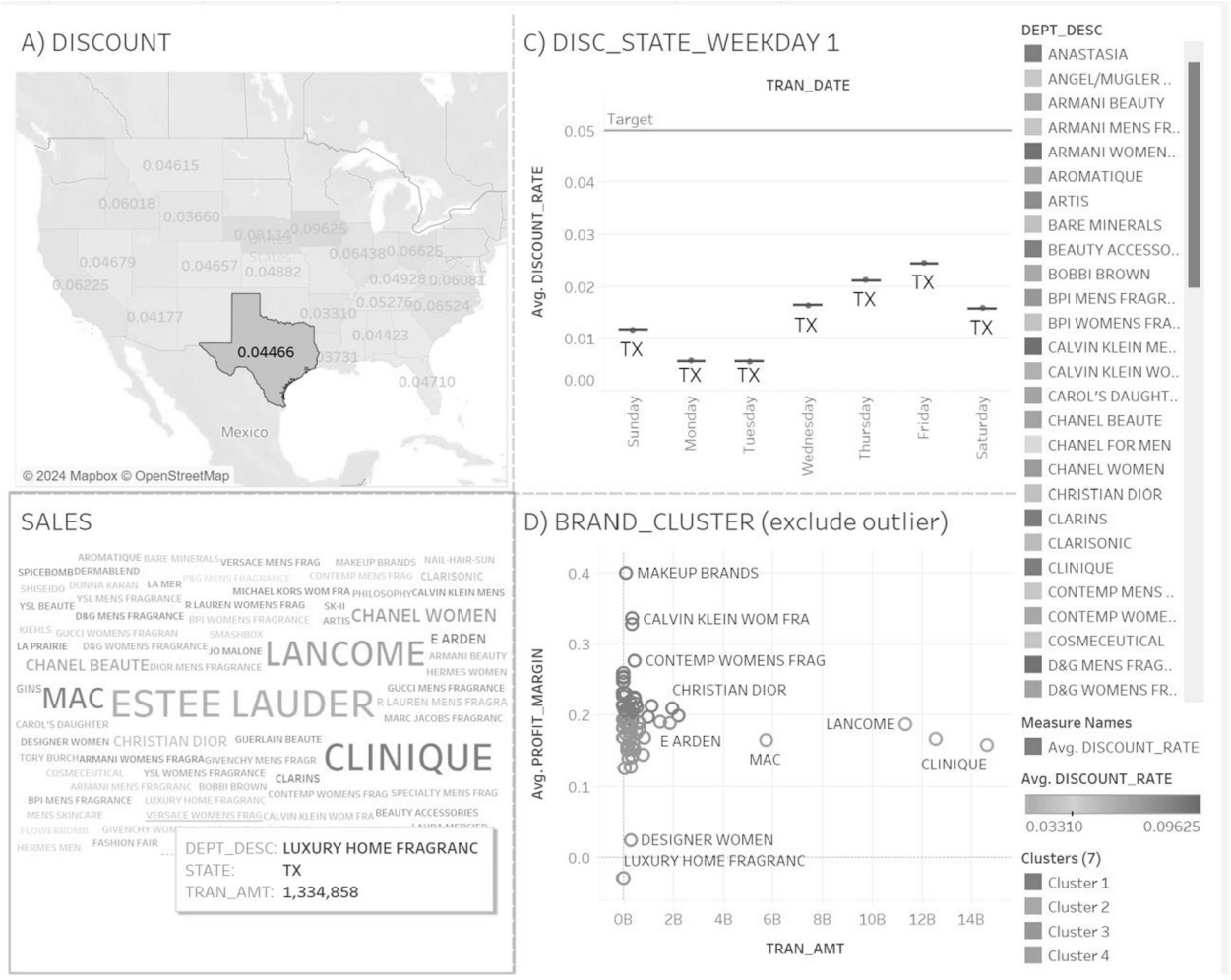

Fig. C12. Dashboard.

Fig. C.12 presents the dashboard analysis for Texas, utilizing the geographic map as a filter. The most popular cosmetic brands in Texas are Clinique, Estee Lauder, Lancome, Mac, and Chanel for Women. Notably, Chanel for Women boasts a higher profit margin compared to other popular brands, and Estee Lauder is particularly favored in Texas. Texas stores often offer substantial discounts on Fridays, with rates about three times higher than the average discount rate. Previous analysis indicates that sales are likely to stay at a similar level on Fridays, despite the stores offering greater discounts on that day. This implies that providing larger discounts may not significantly boost sales but could potentially impact customers' perception of product pricing.

As a result, our company may want to consider implementing other promotional strategies instead of relying solely on low discount offers. By exploring alternative approaches, we can maintain customers' confidence in product pricing while finding effective ways to drive sales and enhance overall customer satisfaction.

g) Story.

Example of the story created in Tableau.

Fig. C13. Example of the story.

Data availability

Data will be made available on request.

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