

TARUMT

BUSINESS INTELLIGENCE

YEE CHOOI LI

TEO SHI HAN

NATHAN TING

KHOO CHONG EE

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Group Assignment (mini-project) for BAIT3013 Business Intelligence (semester 202101)

1.	Name:	Yee Chooi Li
2.	Student ID:	20WMR12498
3.	Task Involved:	<ul style="list-style-type: none">- Contribution to Senheng sales dataset- Major Contribution to Senheng sales dataset ERD- Contribution to abstract- Contribution in data requirement- Major contribution in unit of business and decisions problem in background- Major contribution in Sales Performance Dashboard- Major contribution in Company Profit Ranking over Area Dashboard- Major contribution in descriptive analytics of Sales Performance Dashboard and Company Profit Ranking over Area Dashboard- Major contribution of diagnostic analysis Profit over State- Major contribution of predictive analysis of monthly revenue- Major contribution of prescriptive analysis of increase monthly revenue part- Contribution in conclusion

BAIT 3013 Business Intelligence

1.	Name:	Khoo Chong Ee
2.	Student ID:	20WMR12982
3.	Task Involved:	<ul style="list-style-type: none">- Major contribution to Senheng background introduction- Sole contributor of Company Sales & Profit analysis on Product Category Dashboard- Sole contributor of Top N Profit Analysis Dashboard- Contribution to 'Descriptive Analytics'- Minor contribution to data requirement

1.	Name:	Nathan Ting Chow Yew
2.	Student ID:	20WMR12222
3.	Task Involved:	<ul style="list-style-type: none">- Minor contribution to Senheng sales dataset used in the project- Sole contributor of Market Basket Analysis Dashboard- Minor contribution to 'Abstract' section- Minor contribution to 'Introduction' section- Major contribution to 'Market Basket Analysis Dashboard' in 'Descriptive Analytics' section- Major contribution to 'Diagnostic Analytics' in 'Advanced Analytics' section- Minor contribution to 'Prescriptive Analytics' in 'Advanced Analytics' section- Sole contributor of 'Market Basket Analysis Dashboard' in 'Conclusion' section

BAIT 3013 Business Intelligence

1.	Name:	Teo Shi Han
2.	Student ID:	20WMR12044
3.	Task Involved:	<ul style="list-style-type: none">- Producing inventory dataset for senheng company.- Major contribution to “Components of Business Intelligence” section- Major Contribution in inventory management dashboard.- Major contribution to ‘ABC-XYZ Analytics’ in the “Descriptive Analytics” section.- Major contribution to ‘Prescriptive Analytics’ in the ‘Advance Analytics’ section.

Assessment Rubric for BAIT3013 Business Intelligence

Part 1: 80 %

Criterion	Missing or Unacceptable (0-7 marks)	Satisfactory (8-10 marks)	Good (11-12 marks)	Excellent (13-16 marks)
Background	Background/introduction are omitted or inappropriate.	Background/introduction lacks relevance or fails to offer appropriate details about business intelligence components.	Background/introduction are relevant, offering details about the business intelligence components.	Background/introduction are informative, succinct, and offer sufficiently specific details about the business intelligence components.
Data Requirements	The data requirements are missing. No description on metadata. Irrelevant, inaccurate, or inappropriate information.	The data requirements are not listed and described clearly.	The data requirements are listed and described clearly.	The data requirements are listed and described very clearly.
Descriptive Analytics	Analytical methods and results are not properly explained. The explanations are not aligned with the business performance management and intelligence.	Analytical methods and results are explained. However, the explanations are confusing, incomplete or lacked relevance to the business performance management and intelligence.	Analytical methods and results are explained. The explanations are appropriate and related to the business performance management and intelligence.	Analytical methods and results are explained well. The explanations are clear, structured, appropriate and related to the business performance management and intelligence.
Advanced Analytics and Discussion	Discussions are omitted or confusing. No or very little advanced analytics.	Little discussions are presented. Advanced analytics on the results are unclear or confusing.	Discussions of the results are presented. Advanced analytics on the results are presented	The significance of the results of the work is discussed, sufficiently inclusive of the advanced analytics. Limitations and future improvements of the studies are identified.
Organization and Structure	The structure of the paper is incomprehensible, irrelevant, or confusing. Transition from one to another is awkward.	The structure of the paper is weak. Transition from one to another is weak and sometimes difficult to understand.	The structure of the paper is good. Transition from one to another is smooth.	The structure of the paper is excellent. Transition from one to another is smooth and organized.

Part 2: 20 %

Criterion	Missing or Unacceptable (0-9 mark)	Satisfactory (10-13 marks)	Good (14-15 marks)	Excellent (16-20 marks)
Interactive Dashboard	Dashboard is inappropriate.	Dashboard lacks descriptive and advanced analytics and bring little improvement for better business performance management and intelligence.	Dashboard presents both descriptive and advanced analytics, and create better business performance management and intelligence.	The dashboard can present both descriptive and advanced analytics precisely, in real-time, and create better business performance management and intelligence.

Senheng Sales Data Analysis & Visualization: A Data Analytics Project Powered by Tableau

Yee Chooi Li^{1,2}, Khoo Chong Ee^{1,3}, Nathan Ting Chow Yew^{1,4} and Teo Shi Han^{1,5}

¹*Faculty of Computing and Information Technology, Tunku Abdul Rahman University College,*

Jalan Genting Kelang, 53300 Kuala Lumpur, Malaysia

²*yeecl-wm20@student.tarc.edu.my*

³*khooce-wm20@student.tarc.edu.my*

⁴*nathancty-wm20@student.tarc.edu.my*

⁵*teosh-wp19@student.tarc.edu.my*

Abstract: This report details the analysis and visualization of Senheng® sales from 2020 to 2021. Inventory Management, Customer Analysis, Company Profit, and Market Basket Analysis are aspects explored in this project to analyze the situation of the business management of Senheng. The dataset consists of snippets of data taken from various datasets found on Kaggle and data.world. Tableau Software is used to visualize the data to create interactive dashboards which can provide information to ease the process of making sales decisions.

1.0 Background

1.1 Introduction

Our business client sells a wide range of electronic products including refrigerators, washing machines, televisions, and smartphones, from brands including Samsung, Sharp, Canon, KDK, Olympus, Sharp, Philips and Panasonic. The business clients we stated are Senheng® ELECTRIC (KL) SDN. BHD.



Figure 1: Senheng (Senheng, 2022)

Senheng® ELECTRIC (KL) SDN. BHD. is considered as one of the largest consumer electronics retailers in Malaysia. It also has a retail brand called senQ Digital Station.

Senheng® was founded in 1989 by the Lim brothers, K.H. Lim, K.C. Lim, and K.Y. Lim, on a half-shop lot in Pandan Jaya. It has grown from a small consumer electronics half-shop lot with stocks worth less than RM30,000 to the largest electronics chain store in Malaysia today. The goal was to provide clients with a wide choice of electronics relevant to their life, as well as educated and friendly services.

Senheng® is now a major employer and a well-known brand in Peninsular Malaysia, thanks to its extensive footprint. The Lim brothers then took key steps to grow the brand, participating in thorough marketing operations, perfecting the in-store shopping experience, and formulating plans to supercharge their expansion in order to consolidate their progress.

With over 100 locations across Malaysia, we have cemented our position as the country's biggest consumer electronics retailer. Organizations such as the SOBA Awards, the Putra Brand Awards, Reader's Digest, the BrandLaureate, the Malaysia Retail Chain Association, and the Chinese Chamber of Commerce and Industry of KL & Selangor have repeatedly recognised our brand building efforts.

1.2 Components of Business Intelligence

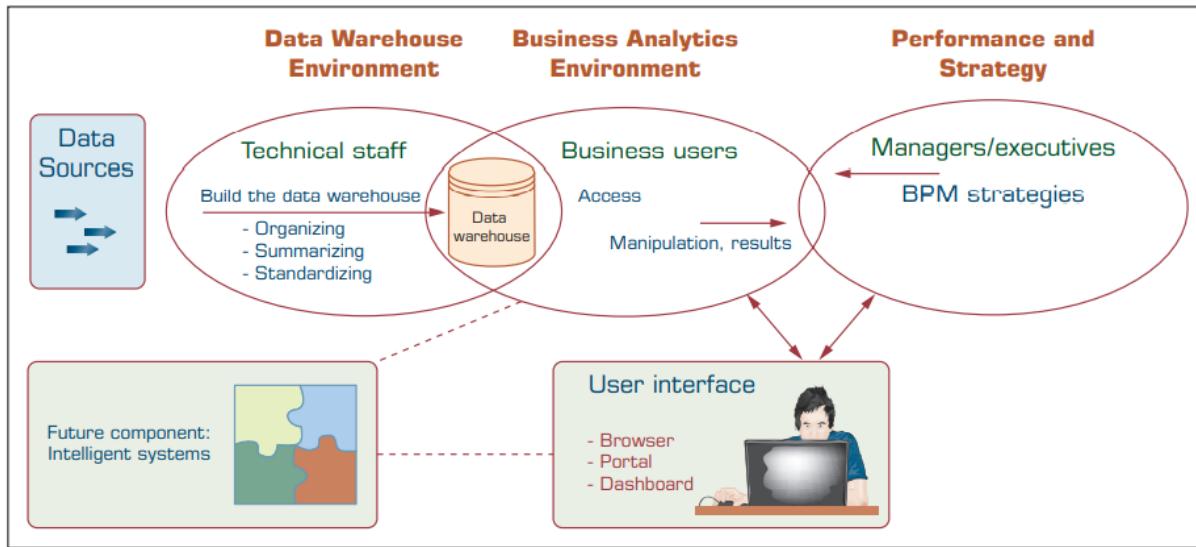


Figure 2: The Architecture of Business Intelligence

Business Intelligence consists of 4 major components: Data Warehouse, Business Analytics, Performance and Strategy, as well as User Interface. Data warehouse is used to store cleaned and readily analyzed data. Business Analytics consists of analytics tools such as data manipulation tools, data mining tools and analyzing tools. Coming to the next level, there is the BPM(Business Performance Manager) whose main responsibility is analyzing and monitoring how the business is going including process performance etc. Lastly, the user interface, commonly referred to as the dashboard, is responsible for visualization.

1.2.1 Data Source and Data Warehouse

The data source for this business intelligence project is retrieved from Senheng data warehouse. Senheng Company has implemented an enterprise data warehouse under its subsidiary BI company - Black Box Consultancy Sdn Bhd (established since 2021) that collaborated with MicroStrategy.Inc to store transaction data collected from all outlets and transform it into information such as sales, inventory, customer, and finance.

For this BI project, we use the dataset regarding the daily sales of electronic product senheng retail shops that reflect the daily OLTP process. These transactional data was stored in a detailed

manner so that every point in the selling timeline is recorded nicely in a data warehouse and possible to understand sell conditions in a specific timeline.

1.2.2 Business Analytics

Business analytics basically means analysis of business data is statistical methods and developing new insights from it to solve business problems and make decisions.

This required not only application of statistical methods but also technological methods to analyze the data so that it can be done in an efficient and fast way.

In terms of technology, we use the tableau application as well as some python libraries such as pandas, numpy and scikit learn for machine learning purposes. In terms of statistical analytics, we use data aggregation techniques as well as creating some statistical models such as regression models to analyze the data. We will afford to create a machine learning model as well.

1.2.3 Performance and Strategy

After Senheng company implemented the data warehouse, a BPM system was also developed.

The reason why Senheng company implemented the BPM system is because they want to monitor how their business is going so that they can manage their business performance. The BPM software is provided by various providers. Objects that are related with BPM include business processes, methodologies, metrics and technologies. These objects are then applied to measure, monitor and manage business performance.

Theoretically the BPM consists of 3 major components. First component is the analytic process which is integrated and closed-loop. It is supported by technology. The second component is the tools that are used to let us know “goal” and at the same time, know “how good we are working towards the goal” by measuring the performance. Last component is the core process. These processes include financial and operational planning, consolidation and reporting, key performance indicators etc.

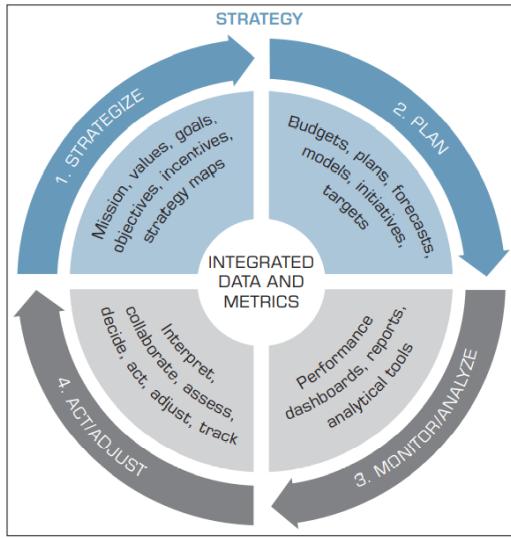


Figure 3: Strategy to integrate data and metrics

1.2.4 User Interface

After all the necessary analytical process is done, it is time to create the user interface also known as dashboard. It is related to data visualization that involves many charts such as pie charts, Bullet Chart, Waterfall Chart etc.

The dashboard can provide approximate real-time insight based on the transactional data that changes rapidly, meaning it has the magic to transform those “unmeaningful console log” into interactive charts that are understandable at one glance.

It is also user friendly, summarized and simple in that it aggregates those critical performance metrics in a very clear way hence the whole picture could be obtained.

The most important point is that it can generate actionable intelligence in an efficient way. Since all the complex data become meaningful, it is not surprising that there is a chance to discover the underlying trends and patterns. Whenever there is a problem, the dashboard will be great support to help make decisions.

1.3 Unit of Business

A strong sales department will drive the success of the company to a higher level. Sales department is responsible for making sales, maintaining the relationships with the customer and growing the business. Our project is targeted to work with the sales department of Senheng, employing the various analytics techniques to help the sales department make good decisions or gain a competitive edge. The objectives of the sales department include converting sales, customer retention and business growth while all this objective can be achieved by using the Business Intelligence (BI) system.

The conversion rate refers to the percentage of customers who finished processing an order. For example, the sales team approaches 100 potential customers per day and results in 30 customers completing the sale, then the sales team has a 30% conversion rate. A higher conversion will make Senheng companies spend less money to approach more customers and succeed in making higher profits and let the company operate more smoothly. BI systems can help the sales departments to gain new customer insights which can recognise the current customers buying trends and knowing where to improve to meet with the customers' expectations.

Customer retention is another key element that sales departments work on to increase the customers' satisfaction and directly influence the company's profit. The sales department is responsible to build relationships with customers and make sure the customers are happy with the product or service provided and willing to continue to shop in Senheng. BI can be used to handle Customer Relationship Management (CRM) and keep track of all interactions with customers like identifying new or existing customers and interpret humongous data to generate strategic initiatives.

If the customers are satisfied, they will probably recommend Senheng's products and services to their friends or relatives, bringing in new customers. By providing quality service to the customers, the sales team can grow the business. Customers' satisfaction (Satisfied customers) will leave positive reviews and these reviews are very important [nowadays] in differentiating Senheng from other competitors and convince customers to stay with Senheng. Real-time data

which is implied by using BI will help the sales department view real-time business information in a glance and identify areas of improvement. BI can also be used to gain competitors' insights.

Our project will use BI to combine data from multiple sources and analyze the valuable information into a visualization format. This allows Senheng to have a big picture and execute smart business decisions to cope with any challenges that arise.

1.4 Decision Problems

1.4.1 Customer Insight

Customer insight is another key element that Senheng requires in order to come up with customer segmentation. An example of customer insight is purchase trends of different age groups, gender, living state and product category. The sales department can use the insight to provide personalized offers that can better serve the customer and enhance customer experience.

1.4.2 Company Profit

Senheng sells many products from categories like digital gadgets, home entertainment and kitchen appliances of different brands. It is important to manage the net margin (net profit divided by overall revenue) for each product and identify the discount that can be given to the product when Senheng wants to do promotion on certain categories or products. BI can help Senheng to increase their price elasticity since they sell various kinds and brands of products.

1.4.3 Market Basket Analysis

There are times when businesses want to check what goes into their customers' baskets to see if there are common purchasing patterns from one shopper to another. This process of looking for relationships between products which appear together frequently is known as Market Basket Analysis. Market Basket Analysis goes beyond just checking what items often go together into a customer's cart; it can help Senheng with actions such as product placement and customer retention by revealing associations between products and how they relate to customers. This analysis is based on association mining rules and uses Apriori algorithm to find the most frequent itemsets. Using the data generated from this analysis, Senheng can carry out initiatives such as cross-selling or up-selling by creating bundle deals, changing store layout and product

placement, and planning radical marketing strategies to further push the sales of frequent product groupings, or to boost the sales of comparatively poorer-performing products by pairing them with more popular products, or even new product groupings which seem to have potential to perform.

1.4.4 Inventory Management

In the era of Industry 4.0, businesses have come up and grown faster than ever with the aid of analytics. Senheng will need to practice inventory optimization to meet consumers' demands, act as a buffer against unexpected disruption and avoid wasteful surplus. Senheng company has multiple distribution centers and multiple inventory management locations and it is crucial to use advanced analytics to deal with volumes of disparate and unstructured data gathered from different branches. The analytics need to identify the fast-moving and slow-moving products to ensure sufficient inventory for the fast-moving products and apply sales tactics to the slow-moving products to increase their sales.

2.0 Data Requirement

The dataset we used in this project is collected from GitHub and is related to the sales data from Senheng for 2020-2021. We get to know about Senheng's sales method that drives the company to become listed in the Top 10 retail chain stores in Malaysia. The sales data was recorded between Jan 2020 and Sep 2021. A detailed data dictionary of the dataset is described below:

Product Data

Data Name	Data Description	Data Type
product_id	Identification number of a specific product	String
title	Product name	String
unit_price	Product unit price	Number
cost	Product unit cost	Number
category	Categories of products sold include Phone Accessories, Laptops, Computer Accessories, Earphones, Headphones and Headsets, Phone Accessories, Home Appliance, Batteries, Mobile & Tablets, Computer Accessories.	String

Sales Data

Data Name	Data Description	Data Type
sales_id	Identification number of a specific sales records	String
sales_date	Date of sales records made by the customer	Date
qty_ordered	Quantity of specific product that bought by customer	Number
payment_method	Payment method that is used by customers. Type of payment method include cash, debit, credit, touch n go, boost, shopee pay, grab pay, MAE	String

product_id	Identification number of a specific product	String
cust_id	Identification number of a specific customer	String
branch_id	Identification number of a specific branch	String
team_id	Identification number of a specific team	String

PastOrder Data

Data Name	Data Description	Data Type
order_date	Date that a specific branch order a specific stock	Date
branch_id	Identification number of a specific branch	String
sku_id	Identification number of sku (store-keeping unit)	String
order_qty	Quantity of stock ordered by branch	Number

Stock Data

Data Name	Data Description	Data Type
sku_id	Identification number of sku (store-keeping unit)	String
current_stock_qty	Quantity of specific stock in the inventory	Number
avg_lead_time	the average time between the initiation and completion of a loading process.	Number
max_lead_time	The maximum time between the initiation and completion of a loading process.	Number
unit_price	Stock unit price	Number

Branch Data

Data Name	Data Description	Data Type
branch_id	Identification number of a specific branch	String
branch_name	Name of a specific branch	String
branch_state	State of the branch located	String
branch_address	Simple address of the branch located	String

SalesTeam Data

Data Name	Data Description	Data Type
team_id	Identification number of a specific team	String
leader_name	Leader of a sales team	String
member_count	Number of team member	Number
branch_id	Identification number of a specific branch	String

Customer Data

Data Name	Data Description	Data Type
cust_id	Identification number of a specific customer	String
cust_type	Type of customer (Member or Non-member)	String
name_prefix	Last name of the customer	String
full_name	Full name of the customer	String
gender	Gender of customer (M or F)	Char

age	Age of customer	Number
cust_since	Date of the customer register as Member	Date
email	Email of customer	String
phone_no	Contact number of customer	String
state	State of the customer lived	String
postal_code	Postal Code of the customer lived	String
username	Username of the customer for account login	String

Promotion Data

Data Name	Data Description	Data Type
promotion_id	Identification number of specific promotion	String
start_date	The date of specific promotion start	Date
end_date	The date of specific promotion end	Date
promotion_type	Type of promotion conducted include Email Marketing, Sponsorship, Offer Discount, Blog, Online Ads, KOL Marketing, Newspaper	String
discount_percent	The percent of discount set for specific product	Number

ERD Diagram with Entities Found in Dataset


Figure 4: ERD of Senheng Dataset

3.0 Descriptive Analytics (Dashboard)

3.1 Sales Performance Dashboard

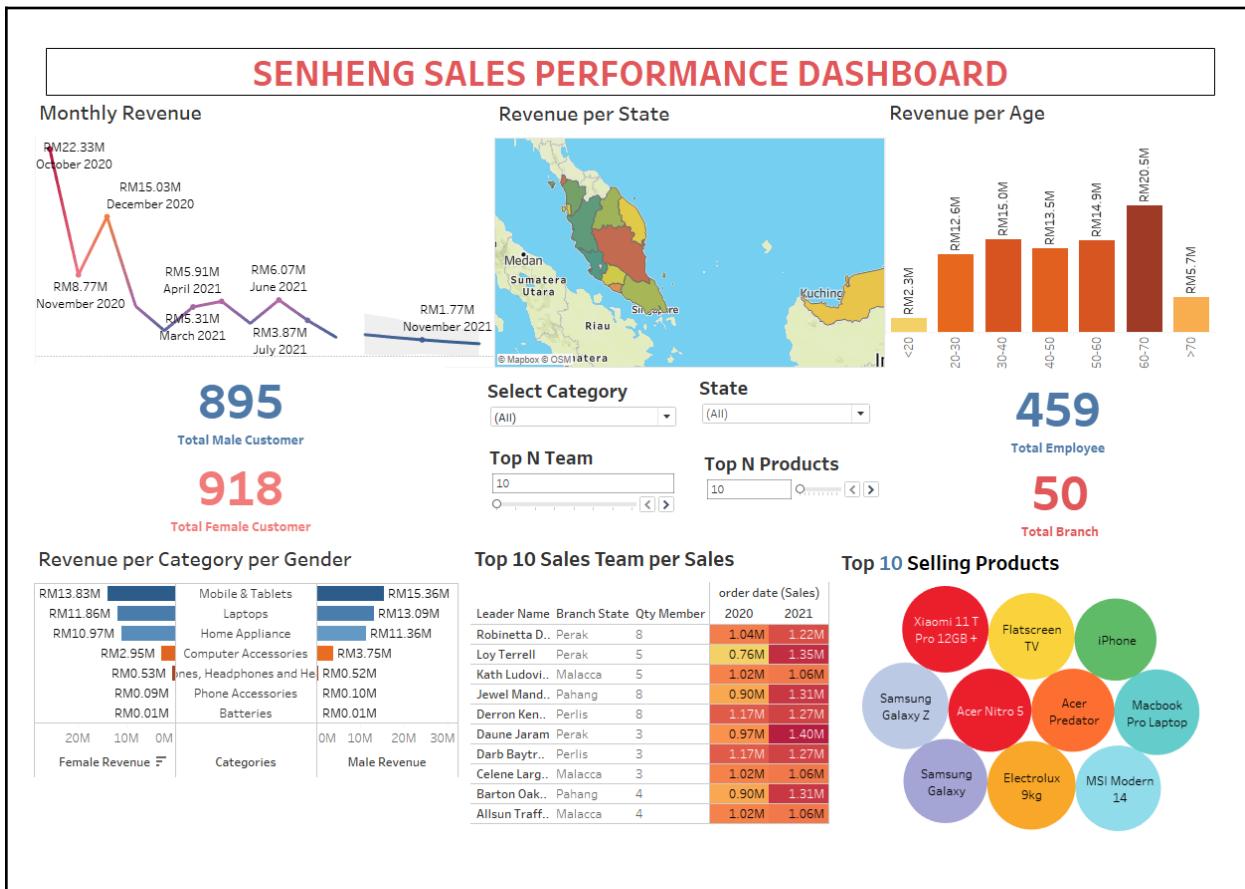


Figure 5: Sales Performance Dashboard

Figure 5 shows the sales performance dashboard of Senheng. The dashboard consists of six sheets, namely “Monthly Revenue”, “Revenue per State, Revenue per Age”, “Revenue per Category over Gender”, “Top N Sales Team per Sales” and “Top N Selling Products”, where N can be altered by the filter.

From Monthly Revenue, the sales team of Senheng can see a big picture of the revenue trend archive. Moreover, the line chart shows that the revenue produced is a downward trend from October 2020 to September 2021. The revenue plunged from 22.33 million in October 2020 to 8.77 million in November 2020 and then escalated to 15.03 million in December 2020. Furthermore, the revenue trend dropped to 5.38 million in January 2021 and kept rising and

declined until 2.33 million in September 2021. The lowest revenue is made in August 2020 which is 2.04 million.

The Map graph shows the total revenue archive by each state. Pahang, which is indicated by darker brown, is the highest revenue state, with a total revenue reaching RM9.0 million. Furthermore, Selangor, indicated by darker green, is the lowest revenue state which is RM3.8 million. Distribution of revenue over category for each state is shown in the tooltip.

From the revenue per age, customers in the range of 60-70 years old produce the highest revenue (20.5million). Second is the customer in 30-40 years old which produces revenue about 15 million and third goes to 50-60years old that produce 14.9 million. The least purchase group is the customer who is below 20 years old.

In the butterfly chart, the revenue over gender in category is shown. From the chart, the sales team can notice that the most selling product category between male and female is the same which is mobile & tablet, laptops and followed by home appliances. Since Senheng has more female customers than males, the purchasing amount from female customers is higher than male.

Furthermore, the table shows the top N sales team which archive higher company revenue. The ‘N’ can be altered by the sales team flexibly in step of 10. Sales team led by Robinetta Dan from branch Perak S02 that made up of 8 employees produced the highest company revenue and followed by the sales team led by Loy Terrell and third goes to Kath Ludovici’s team. The biggest improvement goes to the second team led by Loy Terrell which produced more than 5900k in 2021 compared to 2020.

Top N selling product of Senheng is shown in the bubble chart. From the chart, the sales team can see that the quantity sold of the top products is likely the same due to the size of the bubble being quite similar. This shows that the most selling product has quite similar popularity among the customers.

3.2 Company Profit Ranking over Month Dashboard

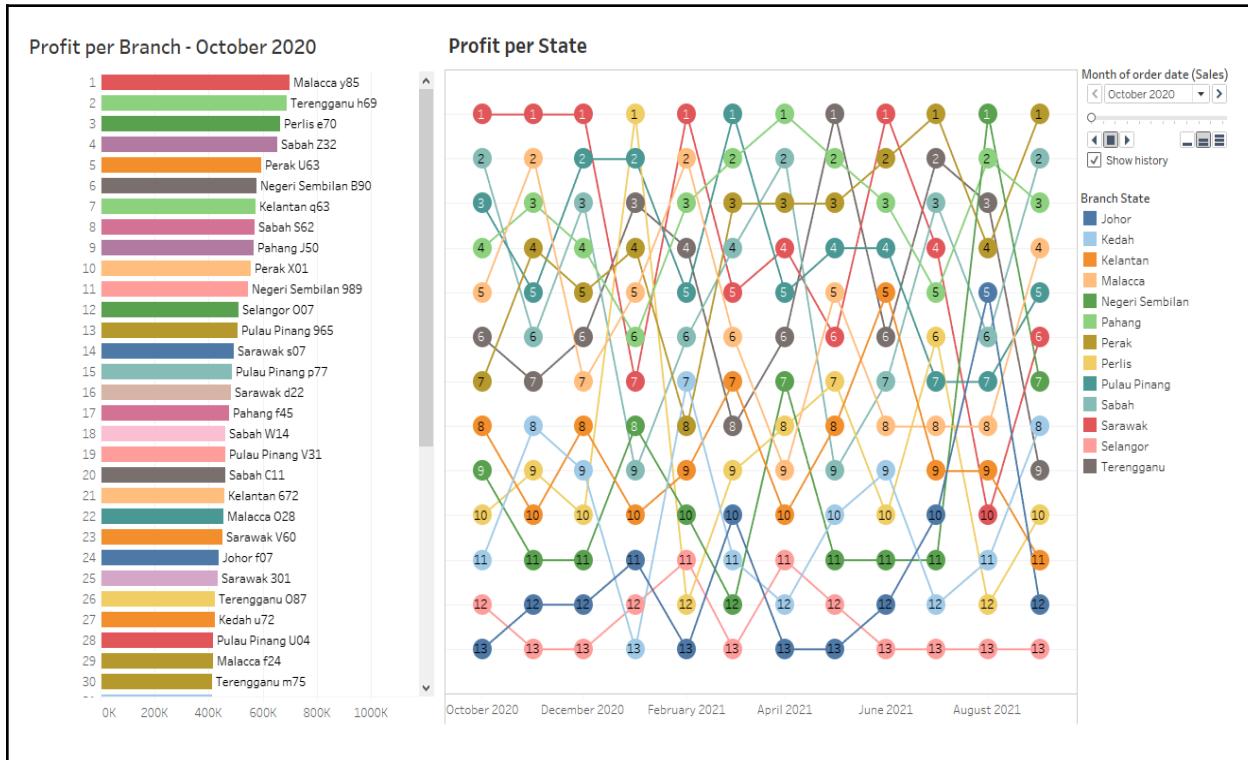


Figure 6: Company Profit Ranking over Month Dashboard

Figure 6 is a dashboard consisting of 2 sheets which are “ profit per branch” and “profit per state”. These dashboards enable the Sales team of Senheng to have an overview of branch ranking each month and indirectly encourage the sales teams of each branch to improve themselves to increase the sales. Moreover, for profit per state, the ranking needs the strength combination of each branch in the state to reach a higher rank.

From profit per branch. We can see the ranking of all branches each month. The filter of month of order date (sales) enables to show the ranking motion of branches. In addition, profit per state shows the ranking of states each month and clicking the specific state in legend can highlight the ranking of specific states. If taking a closer look, the Selangor which is indicated by pink, always stays at the bottom level may need to come up with new sales strategies or investigate the reason for low revenue to avoid loss of the Selangor market.

3.3 Top N Profit Analysis

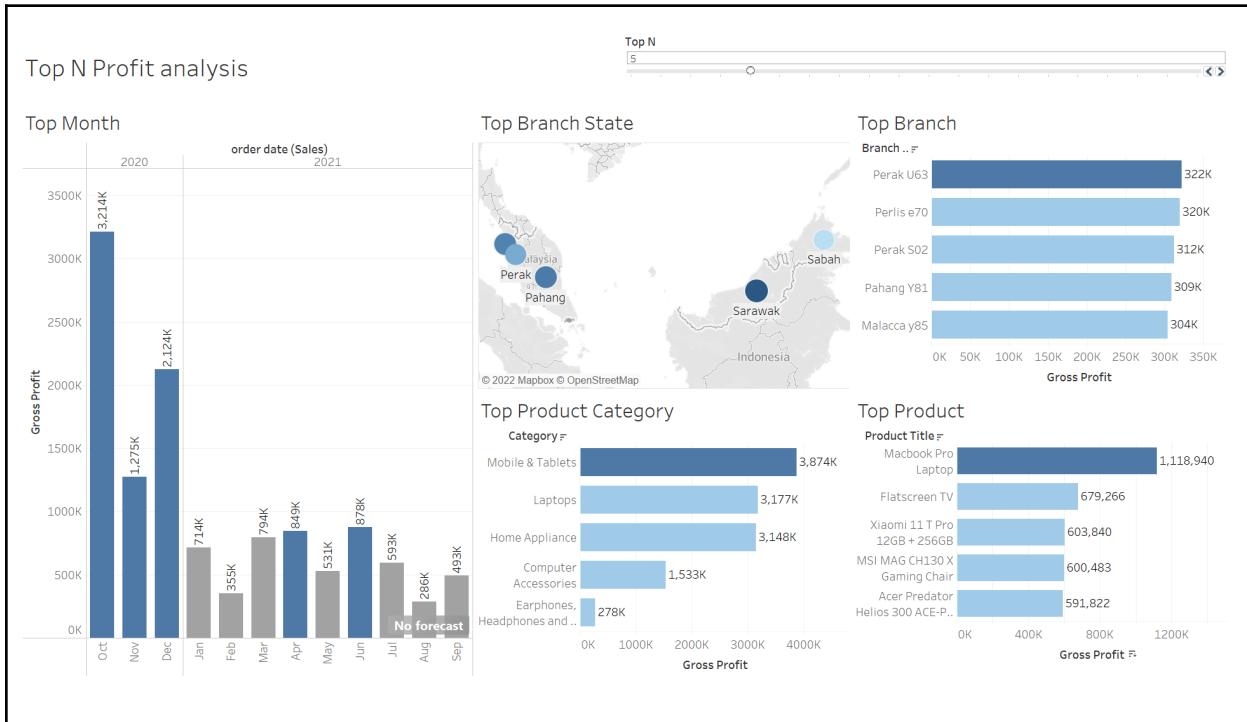


Figure 7: Top N Profit analysis Dashboard

Figure 7 shows the produced Top N Profit analysis Dashboard for Senheng. The dashboard consists of five sheets, namely “Top Month”, “Top Branch State”, “Top Branch”, “Top Product Category” and “Top Product”.

“Top Month” sheet shows the top N profit of the month. It will highlight the N month with blue color with the highest profit over the past months based on the “Top N” filters on top right of the dashboard.

“Top Branch State” displays the branch state with top N state with highest profit. It can filter out the state by editing the “Top N” filter.

“Top Branch” shows the branch with top N profit. It will highlight the N branch with blue color while one of the darkest blue colors shows the highest among the branches.

“Top Product Category” shows the product category with top N profit. It will highlight the N product category with blue color while one of the darkest blue colors shows the highest among the product categories.

“Top Product” shows the product with top N profit. It will highlight the N product with blue color while one of the darkest blue colors shows the highest among the products.

The “Top N” highlighter on the top right allows the viewer to drag the slider to get the N and filter out all the graphs based on top N.

3.4 Company Sales & Profit analysis on Product Category

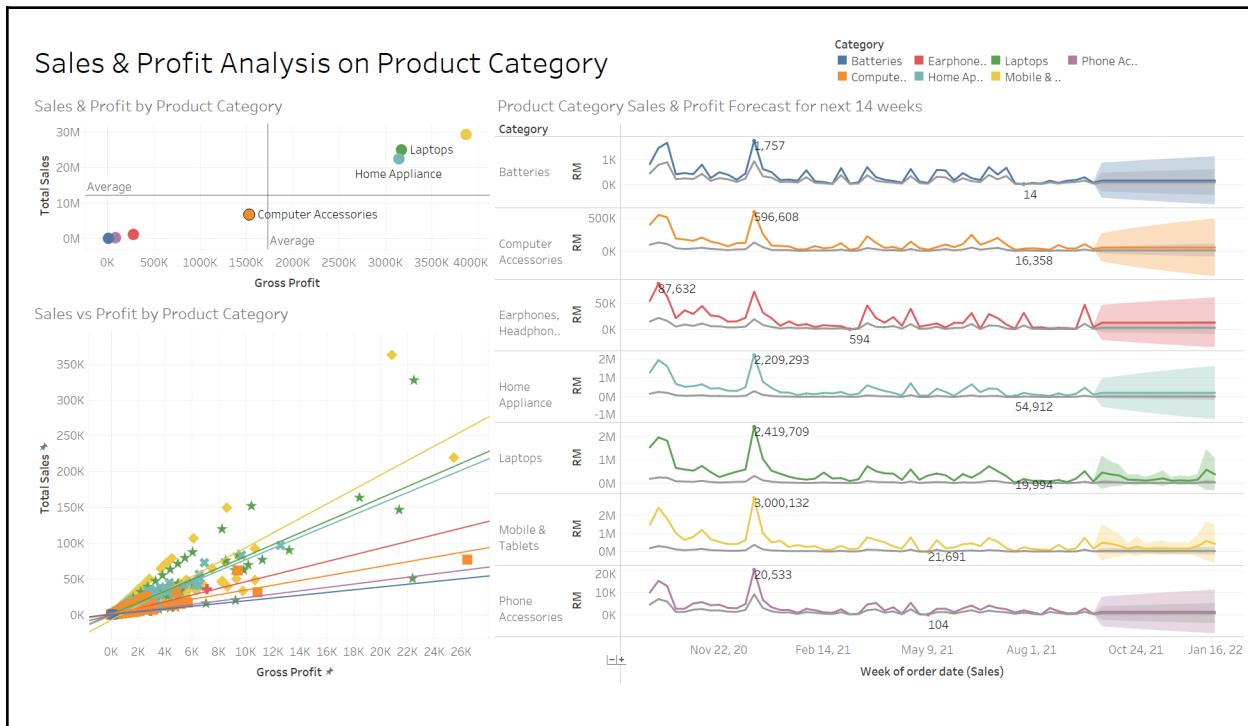


Figure 8: Company Sales & Profit analysis on each Product Category Dashboard

Figure 8 shows the produced Company Sales & Profit analysis on each Product Category Dashboard for Senheng. The dashboard consists of three sheets, namely “Sales & Profit by Product Category”, “Sales & Profit Regression on each Product Category”, and “Product Category Sales & Profit Forecast for next 14 weeks”.

“Sales & Profit by Product Category” is the core of this dashboard as it shows the total sales and total profit of each product category. It separates the profit of each product category into 4 sections which are High Sales Low Profit, High Sales High Profit, Low Sales Low Profit and Low Sales High Profit which are located at left upper, right upper, left lower and right lower respectively based on the average line. Each product category is labeled with different colors to easily distinguish.

“Sales vs Profit by Product Category” displays the scatter plot for two variables which are sales and profit. The main function of this sheet is to determine whether or not two variables have a relationship or correlation by product category. As the higher sales don't always indicate higher

profit, viewers can see the relationship between these two variables on every category product. Clicking a product category from the last sheet which is “Sales & Profit by Product Category” will filter out the others and will bring a more understandable view for the viewer due to viewing all product categories together is complex.

“Product Category Sales & Profit Forecast for next 14 weeks” performs prediction function. This sheet focuses on showing the sales and profit of all product categories weekly from September 2020 to September 2021. Besides, it also shows the prediction of sales and profit for the next 14 weeks from September 2021.

The “Category” highlighter on the top right allows the viewer to select the product category they wish to highlight, in which all the sheets will highlight the product category. This allows the viewer to check the sales and profit of a specific product category, as they might look into the prediction of sales and profit of the product category for the next 14 weeks or looking for the relationship between the sales and profit for the product category.

3.5 Market Basket Analysis Dashboard

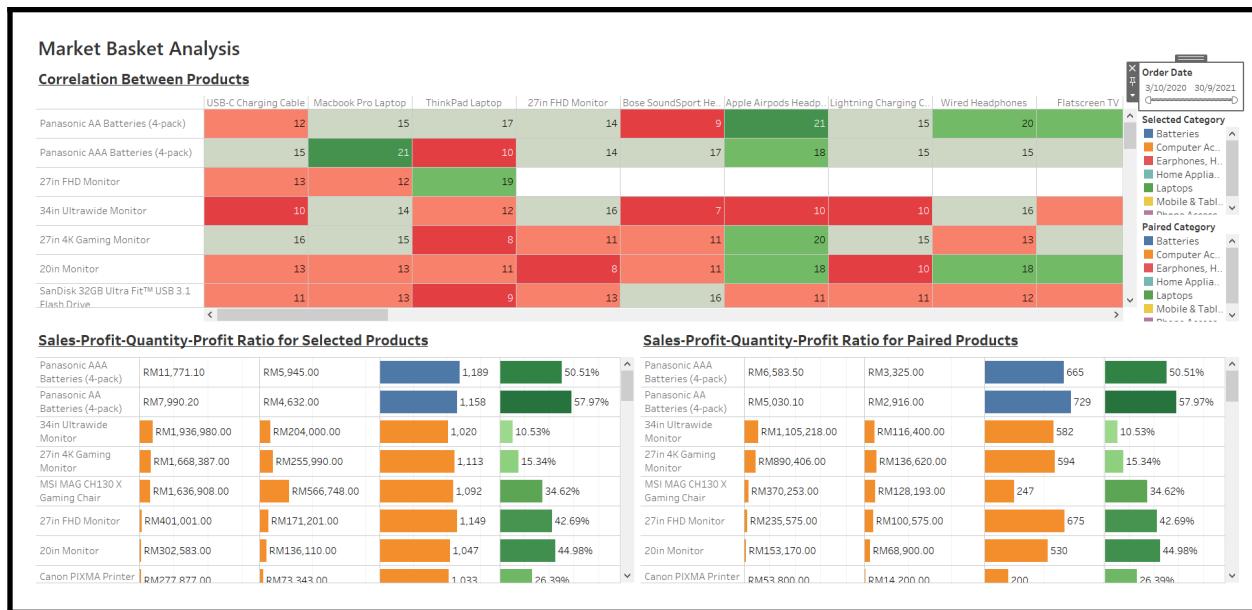


Figure 9: Market Basket Analysis Dashboard

Figure 9 shows the produced Market Basket Analysis Dashboard for Senheng. The dashboard consists of three sheets, namely “Correlation Between Products”, “Sales-Profit-Quantity-Profit Ratio for Selected Products”, and “Sales-Profit-Quantity-Profit Ratio for Paired Products”.

“Correlation Between Products” is the core of this dashboard as it shows what products were paired together in a single order. Each cell indicates the number of orders containing a selected product (indicated on the rows) and a paired product (indicated on the columns). The cells have a colour range from red to green, red indicating the worst product grouping (identified by the least amount of orders) and green indicating the best product grouping (identified by the most amount of orders). These product groupings are with respect to the selected products (indicated on the rows) as the primary purchase for an order, and the paired products (indicated on the columns) as the secondary purchase for that order.

“Sales-Profit-Quantity-Profit Ratio for Selected Products” displays the main performance metrics of the selected products (indicated on the rows), namely the amount of sales generated, the amount of profit generated, the quantity sold, and its profit ratio (profit ratio = profit generated / sales generated). When a cell is selected in the “Correlation Between Products” sheet,

the corresponding selected product is highlighted in this sheet, with the products in the same category as the selected product being greyed out, but still in view. This gives focus to the performance of the selected product, but still allows for comparison to be made with the remaining products in the category in terms of the given performance metrics. Selecting a product in this sheet will also cause it to be filtered and displayed in the “Correlation Between Products” sheet as well.

“Sales-Profit-Quantity-Profit Ratio for Paired Products” performs a similar function as “Sales-Profit-Quantity-Profit Ratio for Selected Products”, but for the paired products (indicated on the columns). When a cell is selected in the “Correlation Between Products” sheet, the corresponding paired product is highlighted in this sheet, with the products in the same category as the paired product being greyed out, but still in view. This sheet focuses on the performance of the paired product as the secondary purchase in an order, so it will be slightly different when compared to the performance metrics when it is the main product or the primary purchase in an order.

The “Order Date” filter allows the viewer to change the range of dates for the Market Basket Analysis, in which all the sheets will reflect the change as the results will only be from the range of dates as determined by the filter. This allows the viewer to check the performance of product groupings during specific periods of time, as they might look into the impact of seasonal factors on what customers put into their basket.

The “Selected Category” and “Paired Category” filters function similarly, filtering out selected categories in “Correlation Between Products”, “Sales-Profit-Quantity-Profit Ratio for Selected Products”, and “Sales-Profit-Quantity-Profit Ratio for Paired Products” sheets. However, they can only be used one at a time, hence the justification for applying filters which take actions straight from the sheets.

3.6 Inventory Monitoring and Management Dashboard

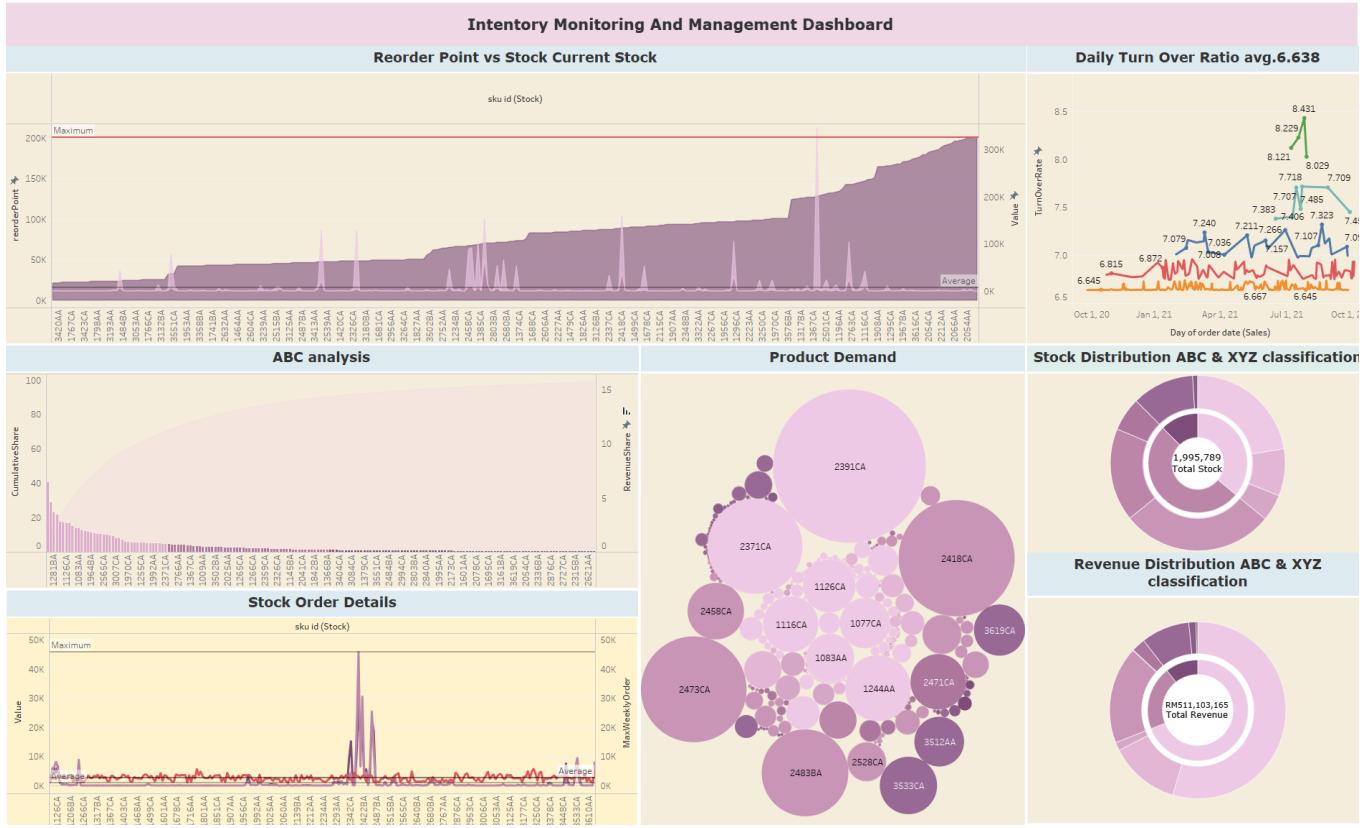


Figure 10 : Inventory Monitoring and management dashboard

The above dashboard consists of 7 major sheets “ABC_analysis_pareto_chart”, “InventoryTurnover”, “Stock Distribution ABC & XYZ classification”, “ProductDemandBubble”, “Revenue Distribution ABC & XYZ classification” and “Reorder Point vs Stock Current Stock” and “StockOrder”.

3.6.1 ABC_analysis_pareto_chart

Classification	% of Items	% of Sales
A	5%	70%
B	10%	10%
C	65%	20%
beyond C	20%	0%

Figure 11 : ABC classification range

The purpose of this analysis is to divide the inventories into three categories which are A, B and C. Class A inventories are the inventory with *highest value*, such top end or flagship mobile phones which have higher prices. Class B inventories have *moderate value* while class C inventories would have *least value*.

This analysis can give “*sense of priority*” to business management so that they know which inventories they are focusing on are more valuable. Class A would be the most valuable to focus on.

The reason why the pareto chart is chosen is it can visualize what is most significant. In this case, the line indicates cumulative revenue. Notice that the gradient for a category is high meaning the increase is a lot while when it reaches in class C, the increment becomes insignificant.

3.6.2 Inventory Turnover

The purpose of this analysis is showing the “*cycle*” of the inventory. The cycle is about product sold → Product buy for replacing purpose.

Formula:

$$\text{Inventory Turnover} = \frac{\text{Net Sales}}{\text{Average Inventory at Selling Price}}$$

Figure 12: Inventory Turnover

Higher turnover rate means the sale is fast while lower rate means the sales is not active.

3.6.3 Stock Distribution ABC & XYZ classification

This chart is a sunburst chart. The inner ring is A,B,C category while the outer ring is cross multiplied with X, Y, Z.

XYZ classification

XYZ classification is the same as A,B,C as they are both classification methods. However instead of “value” it classifies the inventories into X, Y, Z categories of uniform demand, moderate demand and variable demand. It involves two variables in calculation, average demand as well as standard deviation of the weekly demand. After the average demand and coefficient for each product is done calculated, we can rank order the coefficient and rank them accordingly.

$$\text{Average Demand} = \bar{x} = \frac{\sum_{i=1}^n (\text{Demand}_i)}{n}$$

Figure13: Formula of average demand

$$\text{Standard Deviation} = s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{(n - 1)}}$$

Figure 14a :Formula of standard deviation




$$\text{Coefficient of Variation Formula} = \frac{\text{Standard Deviation}}{\text{Mean}}$$


Figure 14.b : Formula of coefficient variation

X would be the most stable stock and the revenue would most likely be consistent and guaranteed. This type of insight is also important as if a stock is valuable but the demand is uncertain, the risk is quite high to invest.

ABC-XYZ principle

If we combine the ABC and XYZ together, the result would be very insightful. We know the value of the stock and its stability in terms of demand. The matrix below shows the possible categories of product fall under it.

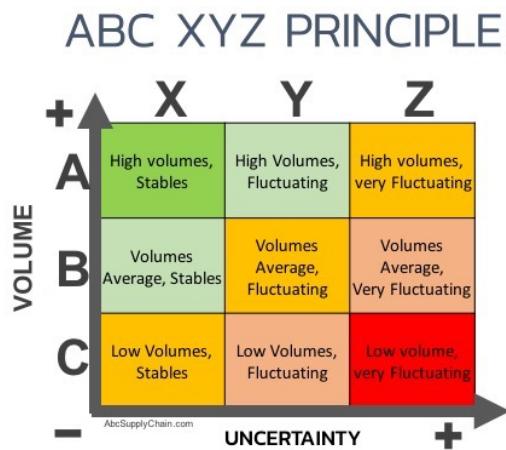


Figure 15 :ABC XYZ Principle

The outer ring of the sunburst chart uses the above ABC-XYZ concept to classify the chart. This sunburst chart can let the business management know the quantity of their stock according to their ABC-XYZ category.

3.6.4 Revenue Distribution ABC & XYZ classification

The purpose of this sunburst chart is to show the contribution of inventories to revenue based on ABC_XYZ categories. Usually the A class inventory product would yield a huge portion of revenue since it has the highest value.

3.6.5 ProductDemandBubble

The bubble chart shows each product in the form of a bubble. Larger bubble means the product has high demand. The brighter color means it is worth investing and focusing more. It is useful to know which product has the highest demand by just looking at the largest bubble on the chart.

3.6.6 StockOrder

This line graph is to show the relationship between average weekly sales, maximum weekly sales and standard deviation of weekly order.

3.6.7 Reorder Point vs Stock Current Stock

This is the second most important chart other than the ABC pareto and was used in prescriptive analytics.

4.0 Advanced Analytics

4.1 Diagnostic Analytics

Diagnostic Analytics is used to explain the reason or reasons behind trends found in a dataset. Usually, there is more than one contributing factor behind any given trend (Alvarado, 2021). By understanding the full spectrum of contributing reasons behind these trends, our Business Intelligence can become more actionable, since the actions that can be taken based on the results of Diagnostic Analytics are more focused on significant factors behind those trends, thus making them more effective. This is especially important when the identified trend is a problem within the company. Making uninformed or misinformed guesses about the reasons behind said problem results in time and resources wasted on ineffective solutions, while the problem possibly escalates over that period of time. By using Diagnostic Analytics to reveal the reasons behind this problem, it will be a better use of time and resources developing solutions that can get to the root of the problem, making the overall process more effective.

4.1.1 Diagnostic Analytics on Market Basket Analysis

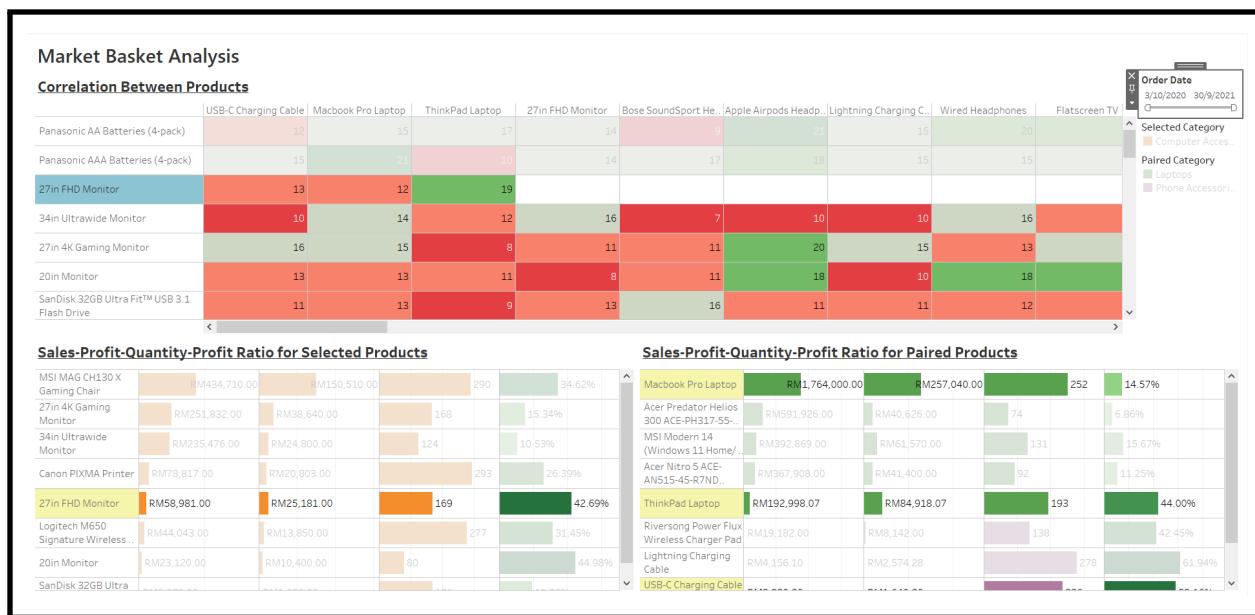


Figure 16: Correlation between 27 inch FHD Monitor and USB-C Charging Cable, Macbook Pro Laptop or ThinkPad Laptop

Let us take Figure 16 as an example. The 27 inch FHD Monitor is the primary purchase with USB-C Charging Cable, Macbook Pro Laptop, or ThinkPad Laptop as secondary purchases. The

pairing of 27 inch FHD Monitor and ThinkPad Laptop is the best performing pairing with 19 orders, whereas the pairing of 27 inch FHD Monitor and Macbook Pro Laptop is the worst performing pairing with 12 orders. This could be due to the drastic difference in price between the Macbook Pro Laptop and the ThinkPad Laptop. With most work-related or study-related activities still being carried out remotely, it would make sense for a customer of said demographic to purchase a monitor with their laptop to increase productivity since there will be more screen to work with. However, with the Macbook Pro Laptop (RM 7,000.00) being 7 times more expensive than the ThinkPad Laptop(RM 999.99), it would make sense why more customers opted for the latter than the former. Furthermore, it could be that customers who purchase Apple products are more likely to stick to Apple accessories to fully experience the Apple ecosystem, which would be disrupted if a non-Apple accessory was to be used. Customers who go for the cheaper ThinkPad Laptop might just care about function, and the 27 inch FHD Monitor might be good enough for them.

4.1.2 Diagnostic Analytics on Profit over State

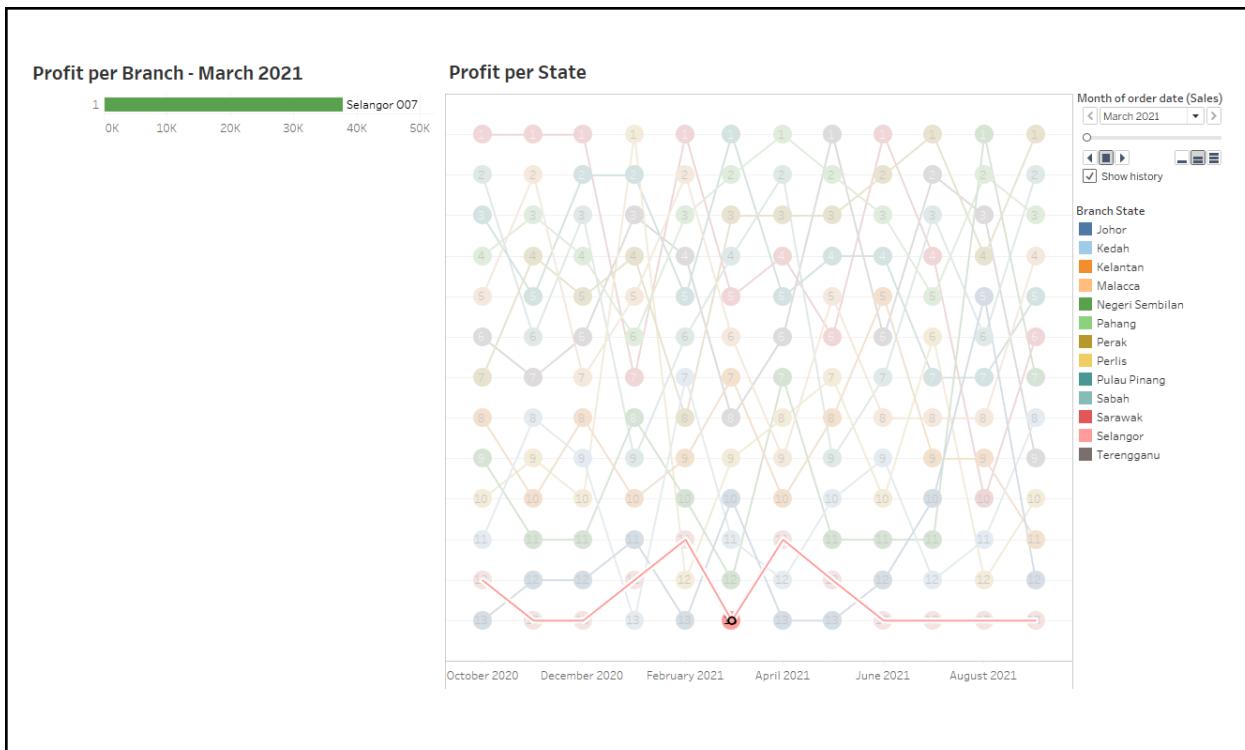


Figure 17: Ranking of Selangor in Company Profit Ranking over Month Dashboard

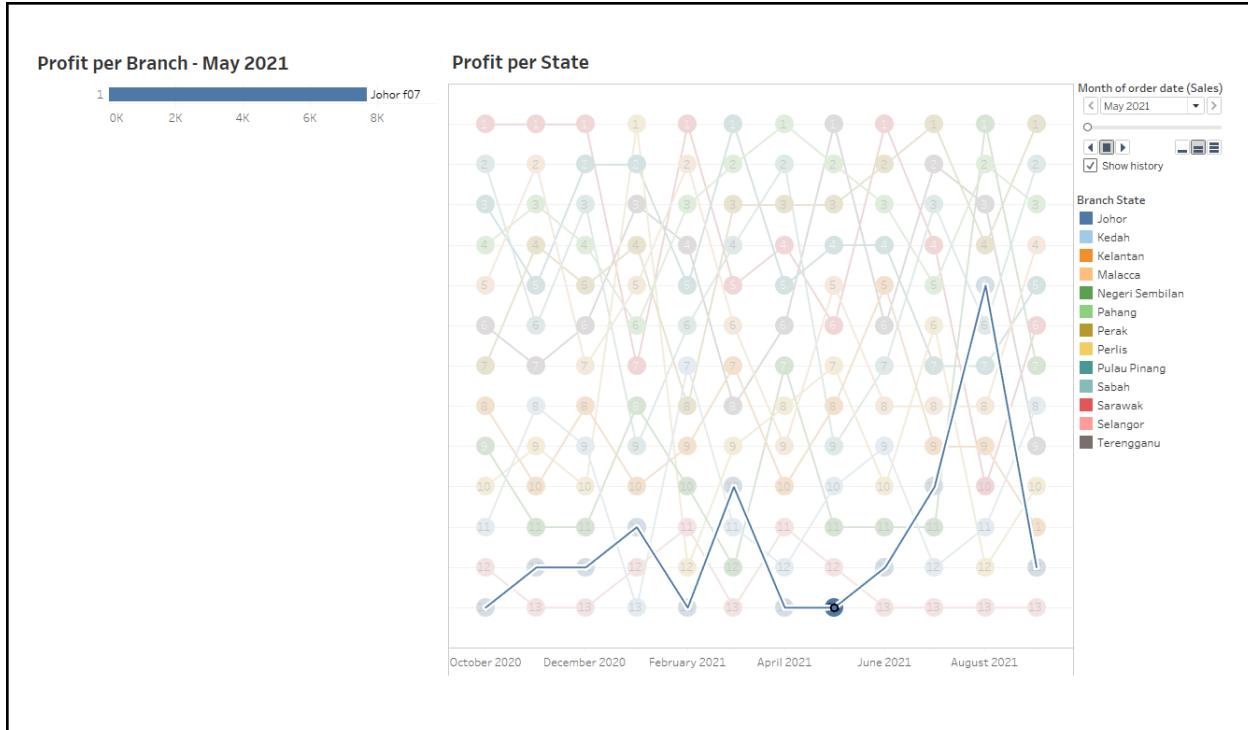


Figure 18: Ranking of Johor in Company Profit Ranking over Month Dashboard

From figures 17 and 18, the profit ranking of Selangor and Johor always stays at bottom level may be due to the branch establishment in the state being too less compared to other states that have at least 2 branches. Since Selangor and Johor are the top 2 states that have the most populations, Senheng may establish more branches in these two states to capture more customers and increase company profit. And for Johor branch, the profit ranking escalated from top 10 in July 2021 to top 5 in August 2021. The increased profit may be due to the national day promotions or marketing approach that have been made. The Johor sales team can implement the sales strategy used in August 2021 to keep hitting top ranking in subsequent months.

4.2 Predictive Analytics

4.2.1 Predictive Analytics of Monthly Revenue

Predictive analysis is using historical data to forecast the potential future trend which is useful in making strategic decisions in business. By using tableau, we use forecasting to perform predictive analysis. Forecasting in tableau works on a technique known as exponential smoothing. It analyses the regular pattern in measures that can be continued into the future. The requirement of using forecasting is minimum one date field or one dimension with integer values with at least one measure. The sales team can forecast sales, detect risks and optimize sales operations by using predictive analytics. Benefits of using forecasting in predictive analysis include accuracy level of sales forecast increase, more efficient, shorter sales cycles because the team members do not need to spend time on the sales process but focus on how to close deals.

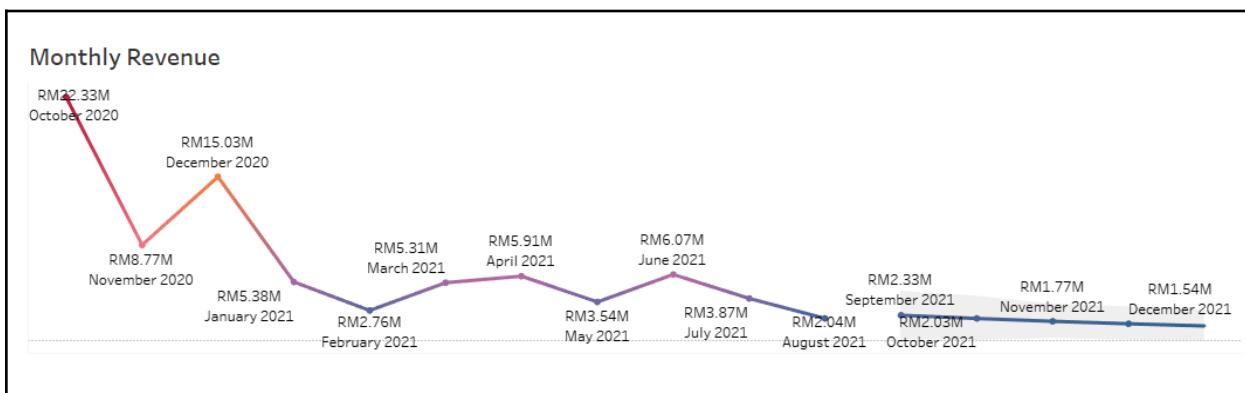


Figure 19: Senheng Monthly Revenue

In figure 5.1, the forecasting shows that the revenue will be a decline trend which will lead to lowest revenue (RM1.54 million) in december 2021. The company may not overcome the operating cost with the revenue obtained and face the problem of bankruptcy. Since the overall revenue trend goes downhill, it indicates that Senheng loses its customers gradually from month to month. The purchasing of existing customers decreases and less of new customers.

4.2.2 Predictive Analytics of Sales and Profit on each Product Category for next 14 weeks

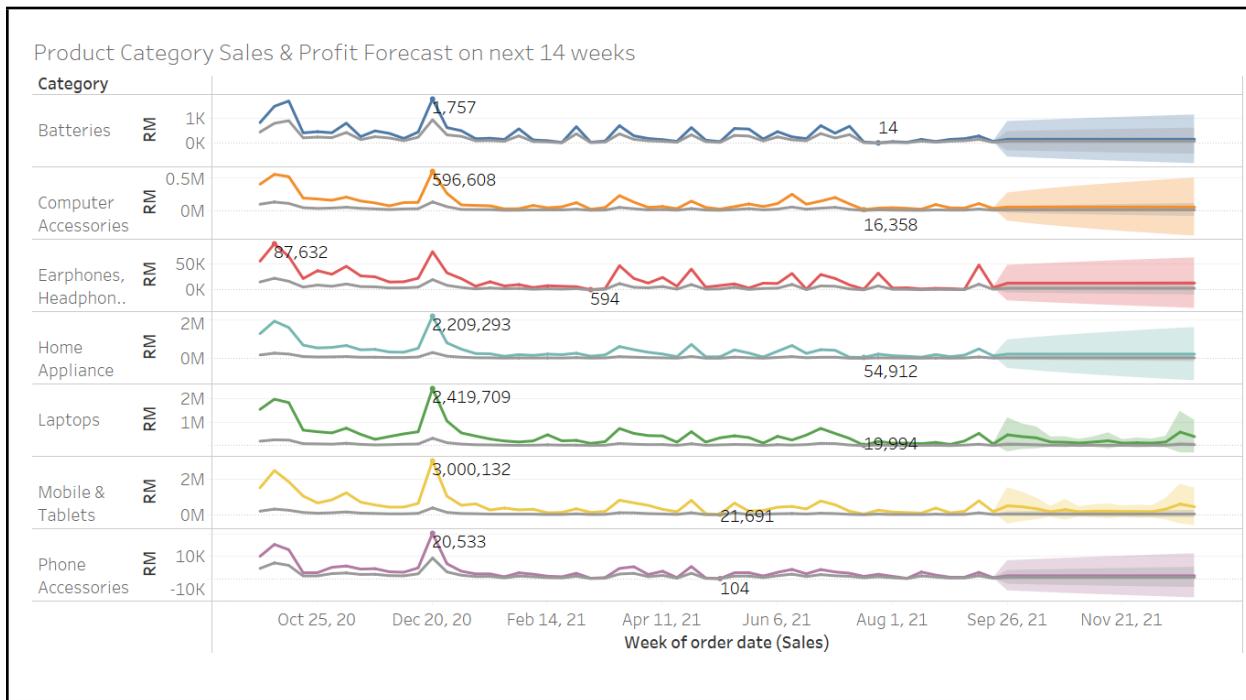


Figure 20: Forecasting Senheng Sales and Profit on each Product Category for next 14 weeks

In figure 8.1, each color and row represented a product category, and the colored line was showing the sales of the product category while the gray line under the colored line indicated the profit of it. At the back of each product category has 2 areas which indicates the forecasting of the sales and profit for next 14 weeks. The forecast shows the sales and profit of most of the product category a slightly downward and flat trend compared with the past few weeks from 26 September 2021.

4.3 Prescriptive Analytics

4.3.1 Increasing Monthly Revenue

The analytics will prescribe numbers of possible actions that can be taken by the sales team to address the problem or to meet the goal. It goes beyond descriptive and predictive analytics to find the ideal of action for particular situations. Initially, the sales team needs to be aware of the problem and prescriptive analytics work to find the right way to the solution based on the data.

Based on the insight gained from the above analysis, the prescriptive analysis of the Senheng sales team is to increase the monthly revenue so that the company can avoid business loss. The sales team needs to come up with solutions to escalate the sales. They may need to build relationships with existing customers with marketing automation and research the market to address the customers' needs. The sales teams need to work on upsell and cross-sell to increase the average order value in existing customers. Upsell happens when the salesgirl convinces customers to buy more than they originally planned while cross sell happens when the salesgirl approaches different kinds of products to a customer. The sales team can promote upsell and cross sell with guidance of market basket analysis. Normally when the customers spend more at a business, they are more likely to return visits.

4.3.2 Prescribe the purchase of new stock

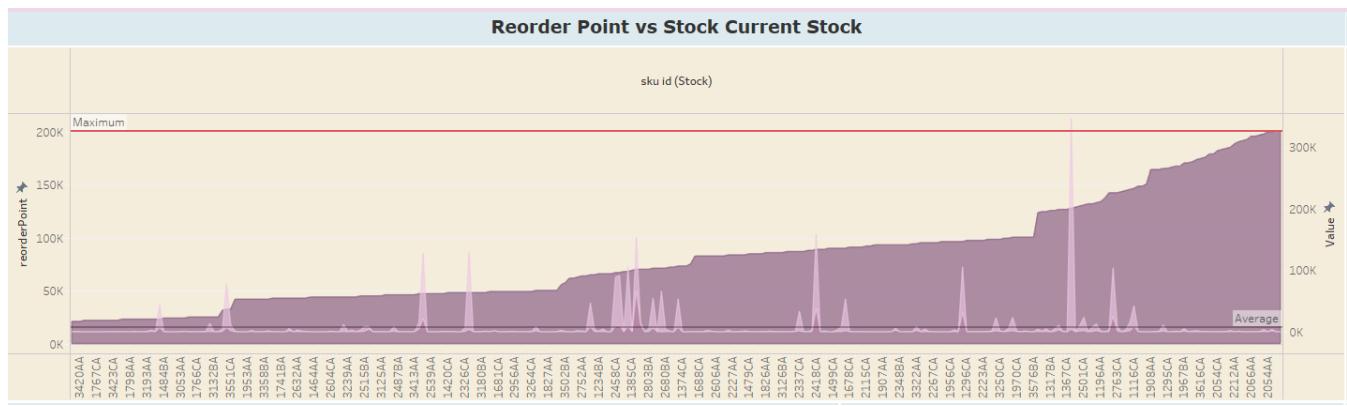


Figure21: Reorder Point vs Stock Current Stock

The analytics give the following consideration information for stock purchasing decisions.

1. Risk of purchase

2. Worthiness of purchase
3. Required purchase

The risk of purchase is based on the XYZ-analysis. The X category product is considered as having lowest risk to purchase while the class C on the contrary would result in higher risk of decrease of turn-over-lack as the stock might not have a smooth selling curve.

The worthiness of purchase is based on the ABC-analysis. The A category product is considered as the worthiest product to be purchased since it yields higher revenue.

The key part of the analysis is “required to be purchased”. It is based on the chart “Reorder Point vs Current Stock”. This graph shows the relationship between reorder point and the current stock quantity. If the current stock quantity is below the reorder point, then the product is considered as low stock. It involves the forecasting of product demand in future. The analysis involves the following calculations, safety stock and reorder point.

Safety stock


$$\left(\frac{\text{Maximum Daily Usage} \times \text{Maximum Lead Time}}{\text{Average Daily Usage} \times \text{Average Lead Time}} \right) - 1$$

Figure 22:Safety stock formula

Safety Stock is a measure to prevent a particular stock from becoming “out of stock”. By adding the safety stock amount to current stock, we assume that the stock will not become “out of stock” in future.

Reorder Point

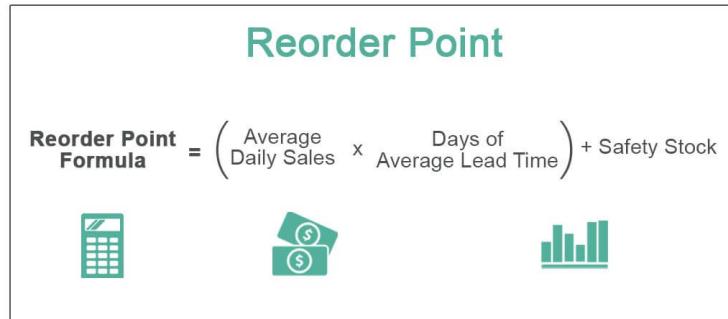


Figure 23:Reorder Point

Reorder point is a value that indicates the stock must be increased. If the current stock quantity is lower than the reorder point, it is considered low stock and should be ordered to prevent stock shortage. It is related to the safety stock mentioned above.

The totalup of the analytics is knowing which stock should be reorder and prioritizing them based on risk and worthiness.

4.3.3 Prescriptive Analytics on Market Basket Analysis

Let us go back to Figure 16 as an example. It was seen that the pairing of 27 inch FHD Monitor and ThinkPad Laptop was the best performing pairing with 19 orders, whereas the pairing of 27 inch FHD Monitor and Macbook Pro Laptop was the worst performing pairing with 12 orders. A few reasons behind this occurrence included the drastic difference in price between the Macbook Pro Laptop and the ThinkPad Laptop, and that customers who purchase Apple products are more likely to stick to Apple accessories to fully experience the Apple ecosystem. One possible prescription for boosting the sales of the pairing of 27 inch FHD Monitor and Macbook Pro Laptop is to bundle them up with another Apple-branded product. Customers who are more likely to purchase Apple products might be attracted by such a grouping and be willing to put up with the non-Apple monitor. Another possible prescription would be to just include a discount voucher that can be used for items of similar categories. If customers see that the given voucher is for an item that they are looking to invest in in the future, they might be more inclined to purchase said product pairing.

5.0 Conclusion

5.1 Sales Performance Dashboard

Advantages	The user can overview the distribution of revenue over many factors easily.
Disadvantages	The dashboard cannot provide insight on what action can be taken in decision making and predict the customers behaviors like what products they would like to buy, when they will visit and which brand they would like to visit

5.2 Company Profit Ranking over Area Dashboard

Advantages	The user can overview the ranking of branch and state easily. And, the sales team can refer to the sales strategy used by the top branch to enhance the company profit.
Disadvantages	The dashboard didn't go into detail to show the factor that might affect the ranking.

5.3 Top N Profit Analysis

Advantages	The user can overview the top n of month, branch state, branch, product category and product with highest profit. The viewer might want to limit the amount of information displayed to an important subset of records that helps to work with and answer questions about the data more effectively due to the large dataset.
Disadvantages	The dashboard does not have many filtering options based on category or product or others.

5.4 Company Sales & Profit analysis on each Product Category

Advantages	The user can overview the total sales and total profit by each product category and the correlation between sales and profit by product category. It also separates the profit of each product category into 4 sections which are High Sales Low Profit, High Sales High Profit, Low Sales Low Profit and Low Sales High Profit, so viewer can see easily which product category falls under which section.
Disadvantages	The dashboard couldn't filter out by product, and only can filter by the product category.

5.5 Market Basket Analysis Dashboard

Advantages	The viewer can easily select specific products to check itemsets which are associated with them. The performance of each product in a selected itemset can also be viewed clearly within the dashboard. Furthermore, similar products are still kept in view, but just greyed out, so the viewer can still make comparisons in sales performance, but still be able to keep his or her focus on the current selection. The date filter allows the viewer to adjust the range of dates for which the metrics are displayed on the dashboard, allowing for an approximate real-time experience.
Disadvantages	The dashboard cannot go into the full details of association rule mining that is Market Basket Analysis, such as measure of Lift, Confidence, and Support for a given itemset. This means that the viewer can see the frequency of a given itemset in the correlation matrix, but cannot fully know the likeliness of the itemset occurring or the strength of association between two given products.

5.6 Inventory Monitoring and management dashboard

Advantages	The viewer can easily visualize current stock status in terms of demand stability as well as value. The user can visualize the demand in just one glance at the bubble chart. It is easy to know the distribution of the stock based on the ABC-XYZ principle. Furthermore, the user can quickly know which product is labeled as low stock and decide whether it needs to be reordered based on risk and worthiness.
Disadvantages	The disadvantage is the dashboard has too much detail since there are so many products. The barchart width becomes too small and a large amount of product consumes a lot of graphic processing and might cause delay in interactivity.

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7.0 Appendix

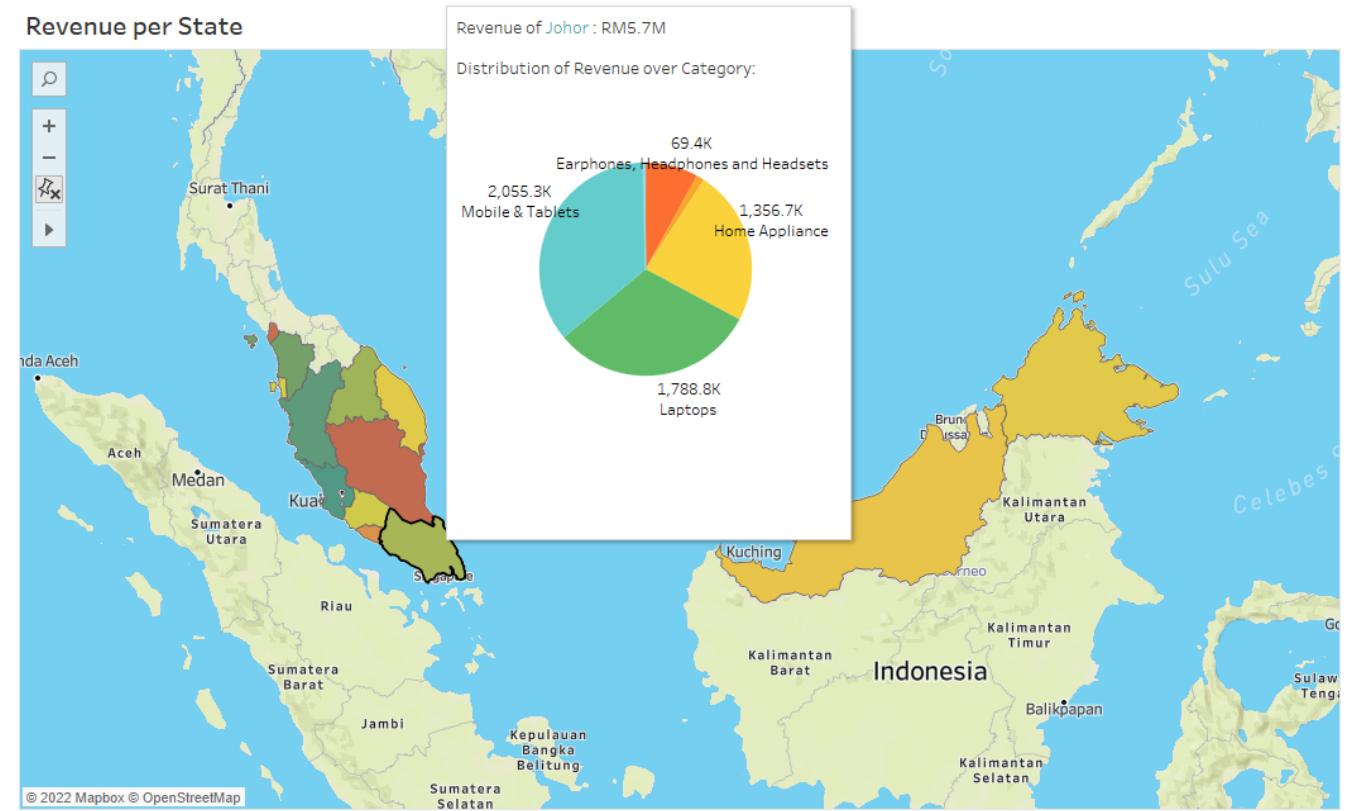


Figure 24: Revenue per State in Sales Performance Dashboard

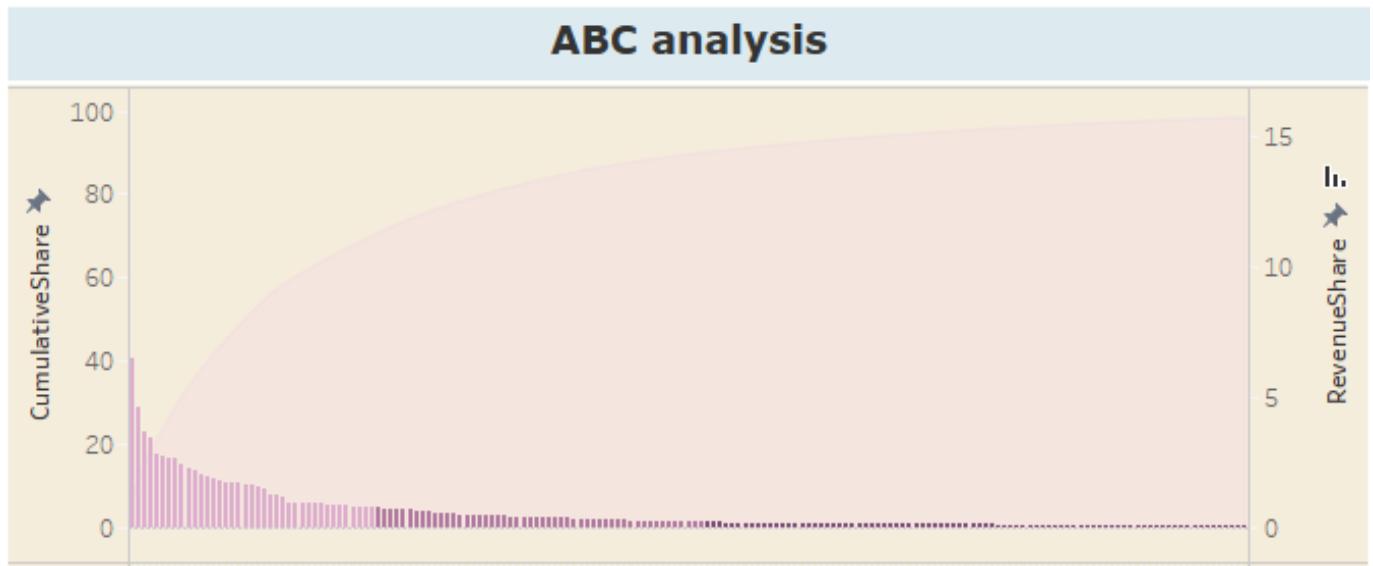


Figure 25:ABC analysis pareto chart

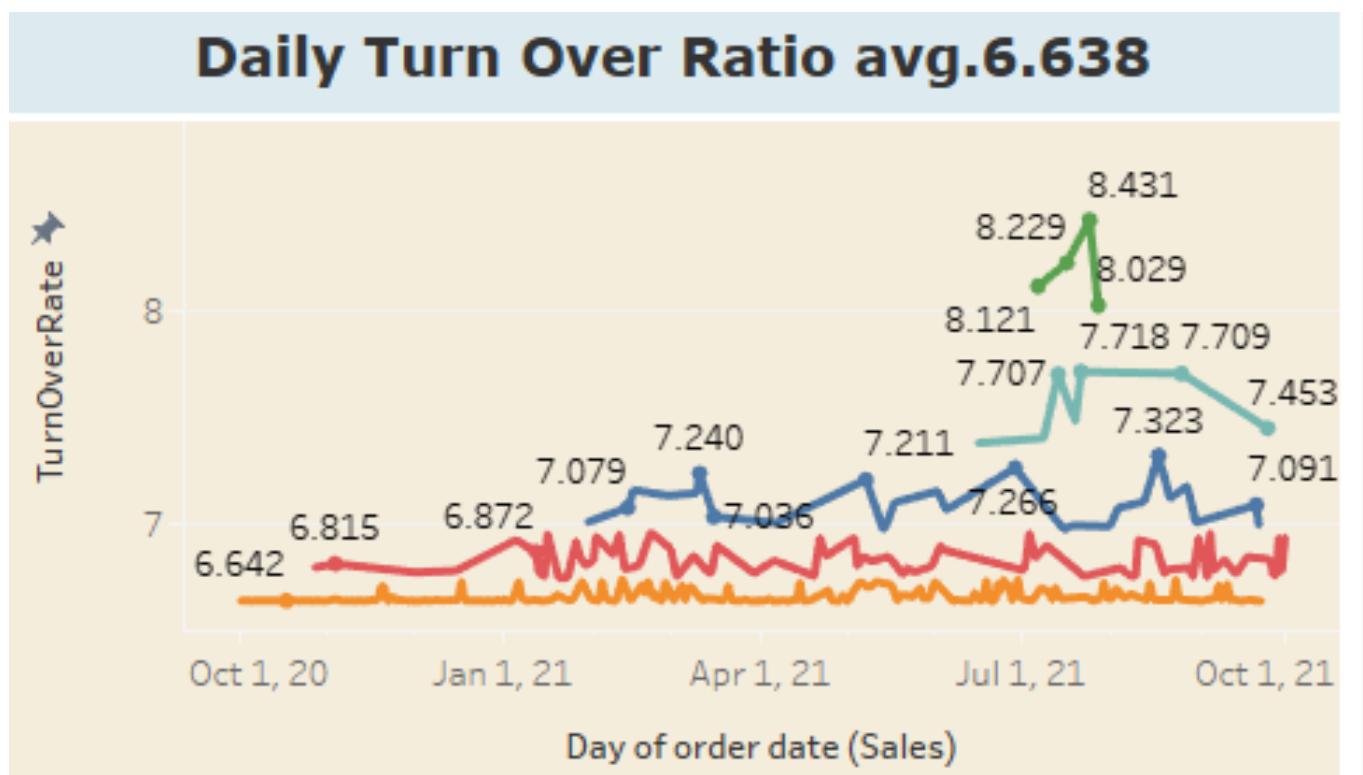


Figure 26: Daily Turnover Ratio

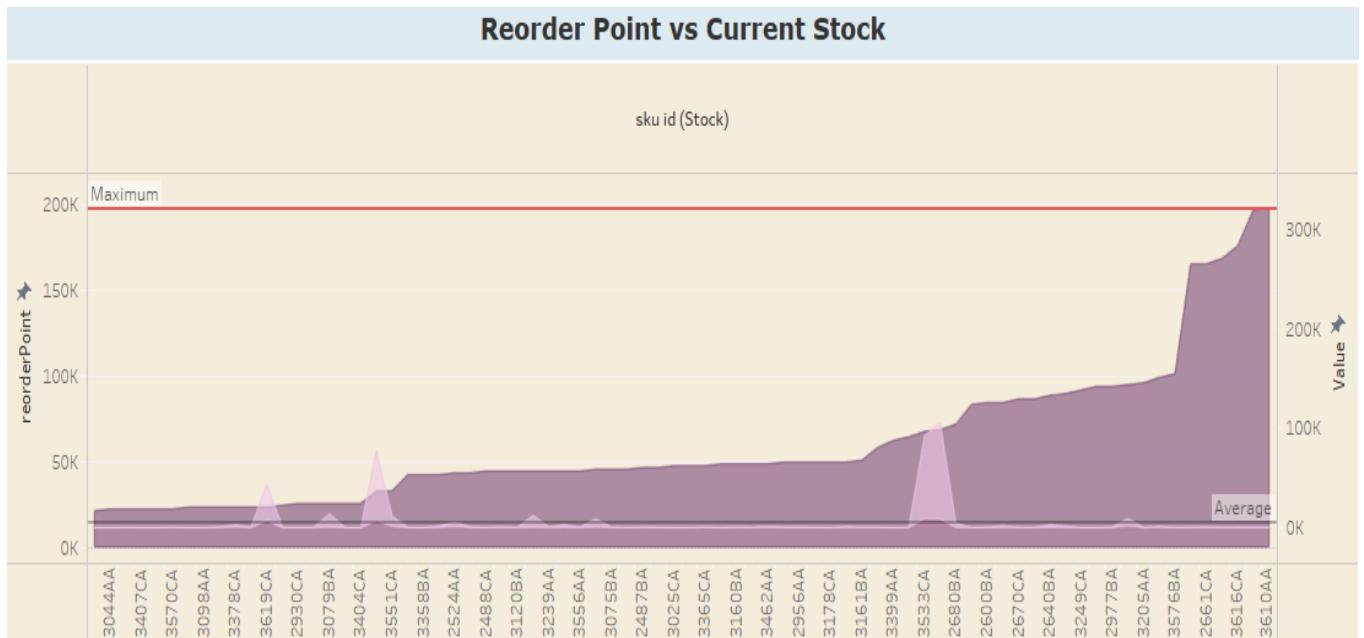


Figure 27: Daily Turnover Ratio