

Optimizing Student Learning Outcomes as Data Analysts through Capstone Project at RevoU Tech Academy

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ABSTRACT

Study Independen Bersertifikat Program Batch 6 at RevoU Tech Academy presents learning programs that focus on software engineering and data analysis. These two positions are considered important in today's digital world. Apart from that, in order to improve the quality of human resources in the face of the complexity of the Industrial Revolution 4.0. This program will equip students to be ready to face the world of work with adequate knowledge and experience. The capstone project is one of the learning methods applied to evaluate student's knowledge and hone their practical skills regarding software engineering and data analyst material. The Capstone Project in the Data Analyst module at this partner uses dataset from vending machine sales in Central New Jersey. In vending machine sales, it is known that in the 12 months in the 2022 period, the highest sales figure was owned by Gutten Plans at \$6904 and the lowest was owned by Earle Asphalt at \$1809. The methods of descriptive analysis, exploratory data analysis, and root cause analysis (RCA) are used in data analysis. As a component of the RevoU Tech Academy's learning methodology, the Capstone Project demonstrates the critical role in developing human resources prepared to handle shifting industrial dynamics. In addition, students will receive pertinent knowledge and abilities to help them deal with the difficulties of the contemporary technological world.

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1. Introduction

The digital era in general, is characterized by rapid technological progress and the easy availability of diverse information. The period in which these two aspects of human activity undergo fundamental transformations is usually referred to as the Industrial Revolution (Oktaviandi & Ardiansyah, 2023). Today, society is in an era known as the "Industrial Revolution 4.0," which is characterized by the rapid development of science and technology. Those who recognize the potential in this environment can facilitate new breakthroughs (Bradud et al., 2022; Fatoni & Mastari, 2023; Lim, 2019). However, Otherwise, accompanied by the right skills and knowledge, various advances that occur can cause difficulties for society. This can ultimately increase unemployment and poverty rates (Oktaviandi & Ardiansyah, 2023). Improving the quality of human resources, research and development, and innovation are essential to address these issues (Mahriv et al., 2024).

An approach to achieving progress in a particular domain, particularly the caliber of human resources, involves improving the educational curriculum and promoting the development of HR competencies in preparation for the fourth industrial revolution (Mahriv et al., 2024). The policy known as "Merdeka Belajar - Kampus Merdeka," implemented by the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek), gives students the privilege to engage in extracurricular activities for one semester and one semester outside the curriculum. This program serves the interests and needs of students (Kampus Merdeka, 2023). Preparing students with adequate knowledge and experience before entering the workforce is the goal. Regulation of the Minister of Education and Culture No. 3 of 2020, which relates to National Higher Education Standards, has also regulated this policy (Permendikbud, 2020). One of the nine activities available at Kampus Merdeka that meets students' interests is Internship and Certified Independent Study (MSIB).

The purpose of the collaborative program RevoU Tech Academy Independent Study, run by PT Revolusi Cita Edukasi and the Ministry of Education, Culture, Research, and Technology is to equip students with the technological knowledge and skills needed to compete in the digital era. The learning program in batch 6 of the period February 16 to June 30, 2024 addresses two important positions today: data analyst and software engineer. Software engineering is the application of engineering principles and techniques to software development. On the other hand, the profession known as Data Analyst, requires processing large amounts of data to produce accurate and practical information. Big Data consists of information collected from sensor, satellite, social media, photo, video, and mobile phone data (Wamba et al., 2017). Proficiency in data analysis is currently one of the most sought-after skills. Proficiency in data analysis allows one to evaluate information effectively, so that it can be a reference for wise decision making, especially in the business field (Acharya et al., 2018; Fajriyani et al., 2023; Kuz'mina et al., 2020).

There are five learning methods used in the RevoU Tech Academy learning program, namely *peer-to-peer discussions*, mentor simulations, mentor sections, live online classes, individual assignments for learning evaluation, and capstone projects (RevoU, 2023). The *capstone* project is a final academic project that aims to demonstrate mastery of subjects that have been researched using actual issues (Ridi, 2019). In the Data Analyst module and Software Engineering module, the capstone project given is to carry out the data analysis process and also the creation of a website that will display a dashboard of the data that has been processed. The analysis process was carried out from start to finish using data from one of the vending machine sales spread across several areas of Central New Jersey, including Gutten Plans, EB Public Library, Earle Asphalt, and Brunswick Sq Mall. This Vending Machine sells a variety of food, water, carbonated drinks and non-carbonated drinks at affordable prices.

In the 12 months of 2022, the highest sales figure was owned by Gutten Plans at \$6904 and the lowest was owned by Earle Asphalt at \$1809. Revenue (sales figures) of all vending machines in Central New Jersey decreased from July (\$2126.3) to December (\$1366.8) by 35.7%. This data analysis was conducted to find information or strategies that can increase total revenue (revenue figures) from all locations, namely Gutten Plans, EB Public Library, Earle Asphalt, and Brunswick Sq Mall with a decrease in total revenue of \$1366.8 increased to \$1776.8 in a period of 6 months (from January 2023 to June 2023).

2. Research Methods

The datasets obtained by partners are obtained from Kaggle.com. A dataset is a structured set of data typically presented in a tabular format (Testbooks, 2023). The dataset consists of data related to the current state of the sales industry in vending machine sales. The dataset provided consists of one table consisting of eighteen columns. Status, Device ID, Location, Machine, Product, Category, Transaction, TransDate, Type, RCoil, RPrice, RQty, Mcoil, MPrice, MQty, LineTotal, TransTotal, and Prcd Date are the names of these columns. This whole series of analyses uses a wide variety of tools. Google Docs or Microsoft Word, spreadsheet or Excel, SQL, Google BigQuery, Python, Google Colab, Looker Studio, Chat GPT, Canvas, Visual Studio Code, GitHub, and Figma are the applications used. The next section provides a detailed description of the stages of data analysis performed to process the vending machine sales dataset:

1. *Business Understanding & Problem Definition*, at this stage, Root Cause Analysis (RCA) is used to understand the business and its problems, as well as existing data structures. Root Cause Analysis (RCA) is a methodical scientific procedure used to identify components that contributed to one or more events in the past with the aim of utilizing that knowledge to improve future performance (Hasan, 2021).
2. *Data Cleaning and Analysis*, at this stage what is done is to clean the dataset by identifying missing values, removing duplicate values, and adding columns to facilitate data analysis later.
3. *Finalise Data Analysis and Insight Gathering*, at this stage what is done is to start analyzing using SQL to answer business problems, then after analyzing begin to find the main findings based on research questions obtained through data analysis. Then based on the findings of the research questions that have been made previously and recommendations are compiled. The recommendations offered focus on each *key insight* obtained so that cumulatively it will be a strategy that can increase vending machine sales in Central New Jersey. Key Insight is the main understanding or finding obtained through data analysis.
4. *Data Visualization Mockup*, at this stage what is done is to make data visualization. Data visualization is a process that converts numerical data into graphical or visual forms such as diagrams, graphs, or maps, so that they are easily understood and interpreted by users. The tool used to create data visualizations is by using Looker Studio.

3. Results and Discussion

This project starts by doing a *Root Cause Analysis* first. *Root cause analysis* (RCA) is a tool used to help identify and explain an event, how it happened, and why it happened. Here are the results of the *root cause analysis*:



Figure 1 Root Cause Analysis

The decrease in revenue (sales figures) can be caused by two factors, namely the category and products sold & vending machine sales services. Some other factors are factors that can occur but cannot be proven through existing data. Therefore, from the four sub-factors above, the following research questions were born:

1. Does the decrease in revenue occur due to products sold less attractive?
2. Is the category of products sold not in accordance with consumer wishes?
3. Is the price of the product not in accordance with the product sold?
4. Are the payment types provided less varied?

The above research questions will be investigated through descriptive analysis. Vending Machine Sales are spread across several areas of Central New Jersey, including Gutten Plans, EB Public Library, Earle Asphalt, and Brunswick Sq Mall. This Vending Machine sells a variety of food, water, carbonated drinks and non-carbonated drinks at affordable prices. In the 12 months of 2022, the highest sales figure was owned by Gutten Plans at \$6904 and the lowest was owned by Earle Asphalt at \$1809. Revenue (sales figures) of all vending machines in Central New Jersey decreased from July (\$2126.3) to December (\$1366.8) by 35.7%.

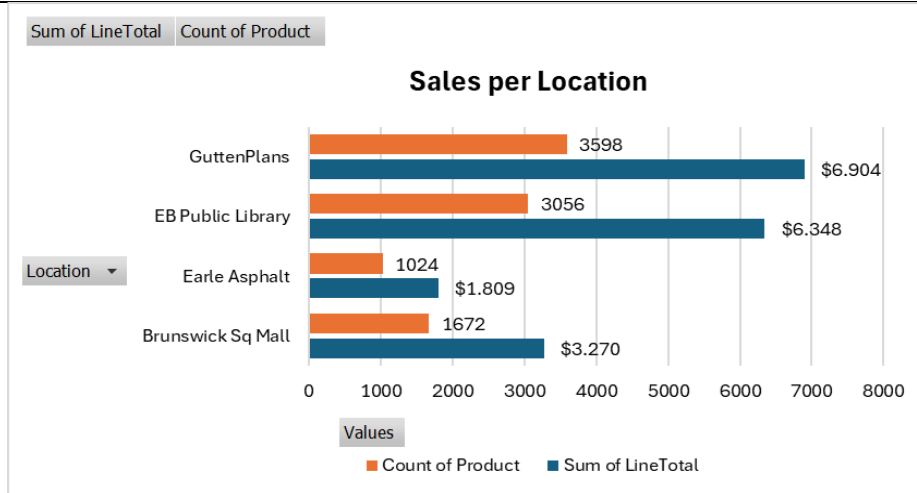


Figure 2 Grafik Sales Per Location

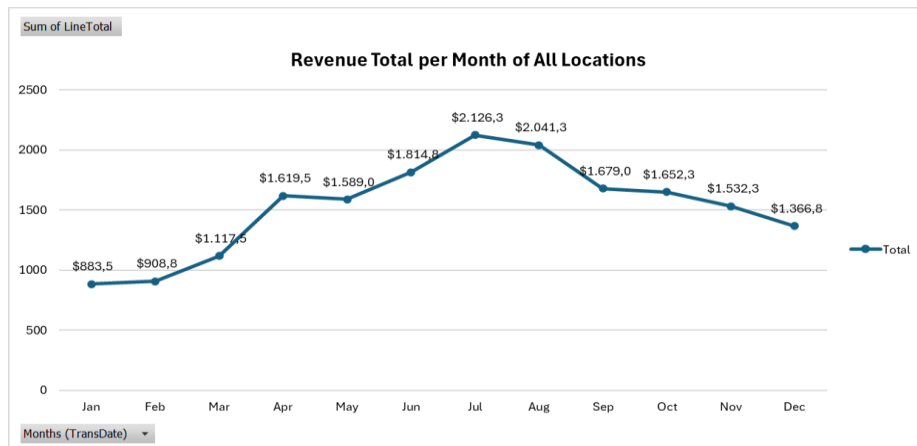


Figure 3 Grafik Revenue Total per Month of All Locations

This indicates a significant difference in sales performance between the locations recorded. This can provide valuable insights for evaluating sales strategies, identifying factors that affect sales performance at each location, and taking appropriate actions to improve sales results in locations that may require special attention.

Here are the *key insights* found from the results of previous data analysis:

1. Products Sold Less Attractive

From the picture below, it can be seen that the most popular product or most in demand by consumers in vending machine sales in Central New Jersey is Coca Cola – Zero Sugar.

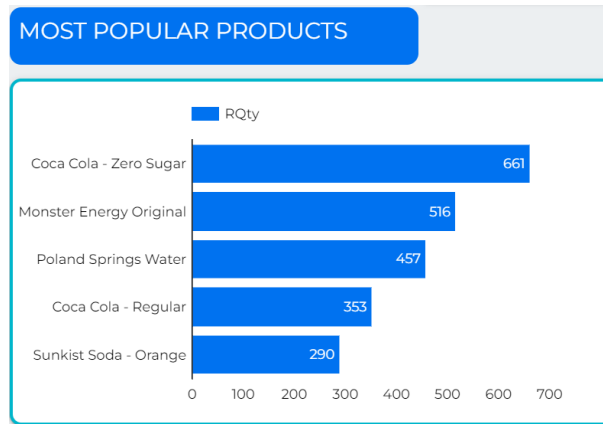


Figure 4 Grafik Most Popular Products of All Locations

As for the less attractive products in every vending machine in Central New Jersey, namely:

a. Vending Machine Sales Locations in Gutten Plans

In vending machines located at Gutten Plans for less attractive products, namely Quaker Cheddar Rice Crisps and Pop Corners – White Cheddar.

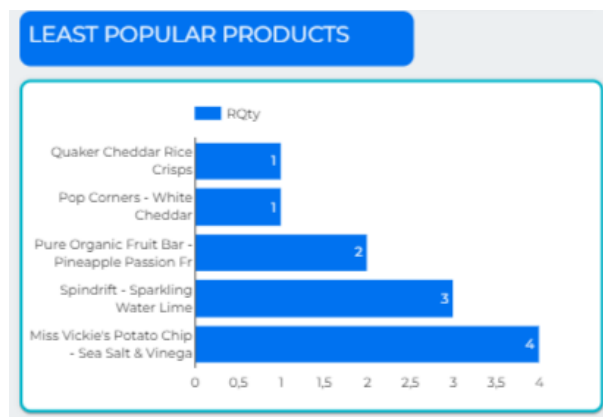


Figure 5 Grafik Least Popular Products on Gutten Plans

b. Vending Machine Sales Location at EB Public Library

Pada vending machine yang berlokasi di EB Public Library untuk produk yang kurang menarik yaitu pada produk Nature's Bakery Fig Bar – Raspberry, Orchard Bar – Cranberry Orange & Walnut, dan Orchard Bar – Pineapple Coconut & Macadamia.

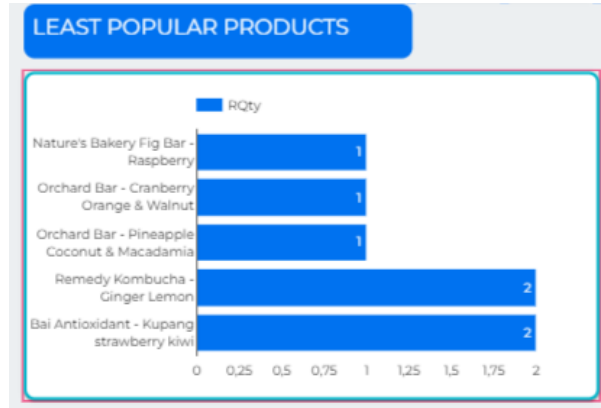


Figure 6 Grafik Least Popular Products on EB Public Library

c. Vending Machine Sales Location at Brunswick Sq Mall.

At the vending machine located in Brunswick Sq Mall for less interesting products, namely Larabar products - Peanut Butter chocolate Chip, Snyder's of Hanover Pretzel Pieces - Hot Buff, Keto Krisp - Almond / Chocolate, Nature's Valley Crunchy Granola Bar - Oats, and Nature's Valley Chewy Granola Bar - Fruits.

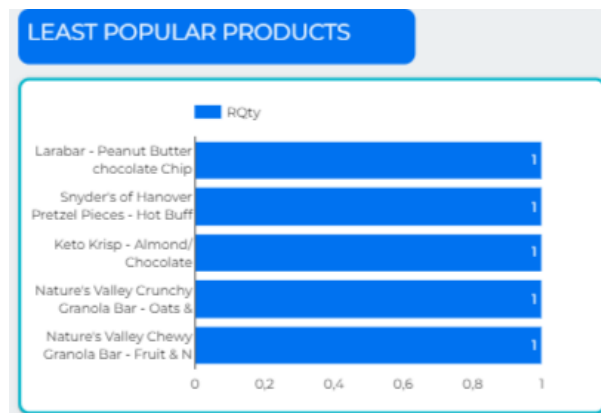


Figure 7 Grafik Least Popular Products on Brunswick Sq Mall

d. Vending Machine Sales Location at Earle Asphalt.

In vending machines located at Earle Asphalt for less attractive products, namely Good Health Veggie Stix – Zesty Ranch, Belvita Snack Packs – Cinnamon, Spindrift – Sparkling Water Lime, and Cheetos Baked – Flaming Hot.

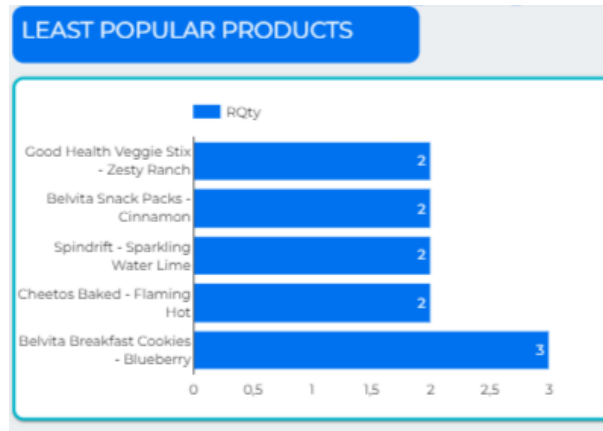


Figure 8 Grafik Least Popular Products on Earle Asphalt

From the graphs described above, it is clear that there are still many products that are not in demand by consumers in vending machine sales in each location, this allows for a decrease in revenue obtained from July to December.

2. Product Categories Sold Not in accordance with Consumer Desires.

Overall, the average sales value of the product category in all vending machine locations with the highest range of values is in the Food category.

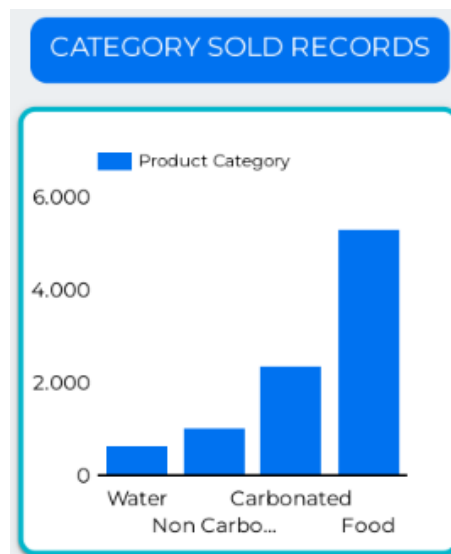


Figure 9 Grafik Category Sold Records of All Locations

As for product categories that are not by consumer desires in every vending machine in Central New Jersey, namely:

a. Location of Vending Machine in Gutten Plans.

In vending machines located at Gutten Plans for product categories that are not in accordance with consumer desires, namely in the Non-Carbonated product category as many as 351 products.



Figure 10 Grafik Category Sold Records on Gutten Plans

b. Location of Vending Machine Sales di EB Public Library.

There are 389 products in the water product category in vending machines located at EB Public Library that are not in accordance with consumer wishes.



Figure 11 Grafik Category Sold Records on EB Public Library

c. Location of Vending Machine Sales di Brunswick Sq Mall.

In vending machines located in Brunswick Sq Mall for product categories that are not in accordance with consumer wishes, namely in the Non-Carbonated product category as many as 242 products.



Figure 12 Grafik Category Sold Records on Brunswick Sq Mall

d. Location of Vending Machine Sales di Earle Asphalt.

In vending machines located in Brunswick Sq Mall for product categories that are not in accordance with consumer wishes, namely in the Water product category as many as 18 products.



Figure 13 Grafik Category Sold Records on Earle Asphalt

From the graphs described above, it is clear that there are still many product categories that are less attractive to consumers in vending machine sales in each location, this allows for a decrease in revenue obtained from July to December.

3. Product Prices Do Not Match the Products Sold.

From the vending machine sales dataset, it can be seen that the lowest product prices are in the Food product category where the price is around 1 to 2.5. While the food category is most in demand or in accordance with consumer needs and is sold the most. This makes the total revenue of vending machine sales decrease and it can be proven in the Average Order Value (Average Sales Figures). Where the AOV chart below shows the average AOV of all vending machine sales in Central New Jersey.

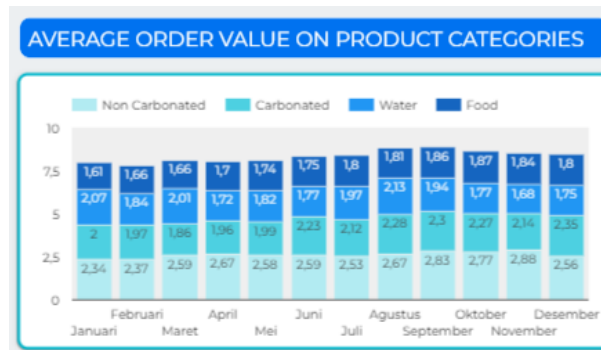


Figure 14 Grafik AOV on Product Categories of All Locations

From the AOV graphic image above, it shows that the non carbonated product category has the highest AOV compared to the Food product category. This is precisely inversely proportional to the data that shows that the Food product category is the most purchased product category by consumers. This can happen because the price of the Food category is the lowest price compared to the price of the Non Carbonated product category, so that if it is averaged (AOV value), then the results of the Food product category are at the lowest level. It is also possible that this caused a decrease in revenue obtained from July to December.

4. Payment Types Vary Less.

The data used comes from the Type column. It can be seen from the picture above that there are only 2 types of payment available at Vending Machine Sales, namely Cash and Credit. As many as 65.2% of consumers use the Credit payment type and as many as 34.8% of consumers use the Cash payment type. Most consumers use the Cash payment type because consumers just put cash into vending machine sales and then the purchased product will come out. Meanwhile, if you use the Credit payment type, consumers must enter the card and card pin first, then the credit card comes out and then the product purchased comes out. It can be concluded that the lack of variety of payment types in vending machine sales can affect the decrease in revenue.

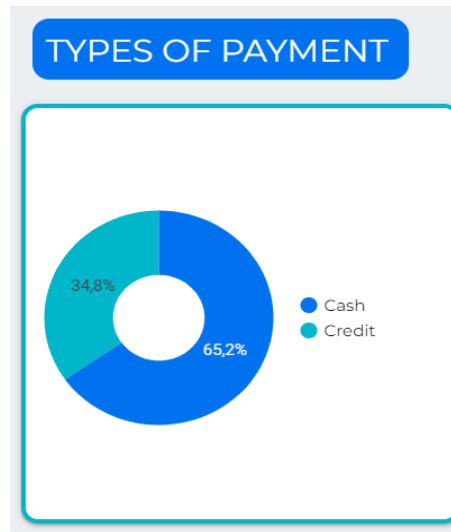


Figure 15 Grafik Types of Payment on All Locations

5. Conclusion

Categories and Products Sold. Of the 4 vending machine sales locations, Gutten Plans had the highest revenue, followed by EB Public Library, while Earle Asphalt had the lowest revenue. The Food category is the most popular product category for consumers. Coca-Cola Zero Sugar, Monster Energy Original, and Poland Springs Water are the 3 most popular products. Consumers tend to buy Non-Carbonated Drink products with the highest AOV (Average Order Value). The Food product category has the lowest AOV value but has the highest sales, and sales tend to increase every month. Gutten Plans has the highest revenue and total sales figures, followed by EB Public Library. Earle Asphalt has the lowest revenue figures as well as the second lowest total sales. Vending Machine Sales Service. In all vending machine sales locations, most consumers choose cash as their payment method.

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