Project Title: Profit Performance Analysis

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Executive Summary

This project analyzes the profit performance of a company over a two-year period (January 2013 – December 2014) using sales data sourced from Kaggle. The dataset comprises 700 records and 16 variables related to sales, pricing, discounts, and cost of goods sold (COGS) across various countries and product segments. The primary objective is to identify the key factors influencing profit margins and determine the optimal conditions required to achieve or exceed the company's average profit target of $24,133.86.

Through systematic data cleaning, transformation, and exploratory analysis in Excel and Power BI, the report calculates the relationships between selling price, discounts, COGS, and unit sales. It establishes that, under conservative accounting assumptions (minimum price, maximum discount), the company must sell at least 13,436 units at an optimal COGS of 85.03% to meet its profit target. Visualizations support these findings, and recommendations are provided to guide strategic decision-making for improved profitability.

Objective

To understand the factors affecting profit margins.

Dataset Overview

Attribute	Description
Source	Kaggle
Format	Excel
Number of Records	700 rows
Number of Variables	16 features
Period Covered	Jan 2013 – Dec 2014

Key Variables

Variable	Description
Country	Sale country
Segment	Sale segment
Product	Type of product
Discount Band	Range of discount
Units Sold	Number of items sold
Manufacturing Price	Manufacturing price per unit
Sale Price	Sale Price per unit
Gross Sales	Total amount sold per date
Discounts	Relief amount on gross sales
Sales	Gross sales less discount
COGS	Cost of Goods Sold
Profit	Sales less COGS
Date	Transaction timestamp
Month Number	Month of transaction
Month Name	Month of transaction
Year	Year of transaction

Actions Taken

Cleaning

First, we need to create a copy of the original dataset on a new sheet in the same workbook to retain the authenticity of the datasets.

Removing the dollar sign from amount columns:

The method of changing the format of the columns with a dollar sign to a number does not work here. When applied, some rows are not affected by the change in format. The dollar sign still appears at the beginning of some numbers.

I	J	K	L
unts	Sales	COGS	Profit
	$32,370.00	16,185.00	$16,185.00
	$26,420.00	13,210.00	$13,210.00
	$32,670.00	21,780.00	$10,890.00
	$13,320.00	8,880.00	$4,440.00
	$37,050.00	24,700.00	$12,350.00
	$5,29,550.00	$3,93,380.00	$1,36,170.00
	$13,815.00	9,210.00	$4,605.00
	$30,216.00	7,554.00	$22,662.00
	$37,980.00	18,990.00	$18,990.00
	$18,540.00	4,635.00	$13,905.00
	$37,050.00	24,700.00	$12,350.00
	$3,33,187.50	$3,19,860.00	$13,327.50
	$2,87,400.00	$2,39,500.00	$47,900.00
	$15,022.00	10,730.00	$4,292.00
	$43,125.00	41,400.00	$1,725.00
	$9,225.00	6,150.00	$3,075.00
	$5,840.00	2,920.00	$2,920.00
	$14,610.00	9,740.00	$4,870.00
	$30,216.00	7,554.00	$22,662.00
	$3,52,100.00	$2,61,560.00	$90,540.00
	$4,404.00	1,101.00	$3,303.00

Alternatively, we can use the SPLIT formula to separate the dollar sign from the numbers.

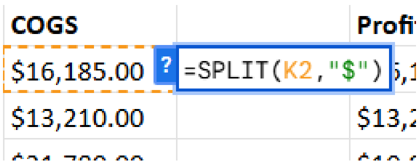


Fig 2. Formula for removing dollar sign

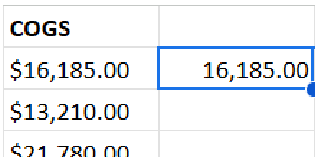


Fig 3. Dollar sign removed

We apply this method to all columns with the dollar sign.

To make the dataset suitable for EDA, we have to copy/cut the new column with the non-dollar figure and paste as a **value** at the original column which we referenced in the SPLIT formula.

Special case: Discount column

We can see some values of discount represented as ***"-"***. First, we filter the discount column to view only rows with values ***"-"***. The corresponding discount band for this value is "none". With this we know that the actual value is ***"0"*** and not ***"-"***.

Fixing the date columns

We now consolidate all the four columns representing date into one column. First, we delete the “Month Name” column since it is already represented in the “Month Number” column.

We now join “Month Name” and “Month Number” into one column using the formula =CONCAT

N	O	P
Month Number	Year	
1	201	=CONCAT(N2,O2)
1	2014	
6	2014	

Month Number	Year	
1	2014	12014
1	2014	62014
6	2014	62014
6	2014	62014
6	2014	122014
12	2014	32014
3	2014	62014
6	2014	62014

After joining both columns, we now have to include “**/**” after the first number of the concatenated value. This can be achieved by using a nested formula. Note: The reference cell for the formula is P2, which contains the value “**12014**”

12014	=LEFT(P2,1) & "/" & MID(P2,2, LEN(P2)-1)
12014	1/2014
12014	1/2014
62014	6/2014
62014	6/2014
62014	6/2014
122014	1/22014
32014	3/2014
62014	6/2014

We now copy the values resulting from the nested formula into the date column since it is currently filled with a placeholder. The “Month Number” and “Year” columns can now be deleted.

The date column must now be formatted into date with format “mm/yyyy”

Dealing with blanks

Fortunately, there are no blanks in this dataset

Inconsistent place values

It can be observed that some of the numbers have wrong place value resulting in wrong comma placement. This can be resolved with a nested formula of “Value” and “Substitute”

After running the formula, the resulting values are without commas. That can be resolved by changing the data format into a number. This can be done by selecting the column and changing the data type into a number from the format menu.

Profit
16,185.00
13,210.00
10,890.00
4,440.00
12,350.00
1,36,170.00

fig 1.

Profit	
16,185.0	=VALUE(SUBSTITUTE(T2,",",""))

fig 2.

16,185.00	16185
13,210.00	13210
10,890.00	10890
4,440.00	4440
12,350.00	12350
1,36,170.00	136170
4,605.00	4605

fig 3.

16,185.00	16,185.00
13,210.00	13,210.00
10,890.00	10,890.00
4,440.00	4,440.00
12,350.00	12,350.00
1,36,170.00	136,170.00

fig 4

The process is iterated in all other columns containing numbers.

Data Analysis

The company's focus is to make a profit greater or equal to its average for the years under review.

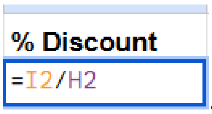
Finding the average profit

We use the =AVERAGE formula on the profit column. The formula returns a value of ***$24,133.86***

Finding Percentage Discount

For a simpler analysis, let's change the discount values to percentages. We create a new column, "***% Discount***". We know the discount is calculated on the Gross Sales and cannot exceed its value.

$$\% \, Discount = \frac{Discount}{Gross \, Sales} \, x \, 100$$

In excel, this formula can be replicated as 

. Since it is the percent value we are interested in, we format the whole column into percentage.

Finding COGS%

COGS is a function of Sales. As a result, we can find the its percentage by comparing it to sales.

$$\% \, COGS = \frac{COGS}{Sales} \, x \, 100$$

In excel, the formula can be replicated by dividing using the “/”. We format the column into percentage afterwards.

With both new columns completed, we sort both in descending order. It can be observed that % Discount has a maximum value of ***15%*** whereas %COGS has a maximum value of ***112.94%***

We do the same for the Sale Price column but in ascending order. It is observed that ***$12*** is the minimum selling price (regardless of product type).

Following the ***Prudence Concept*** of accounting, we will use the maximum discount, minimum selling price, and an optimal value for COGS% which will be calculated later.

Finding the number of units to be sold to meet the average profit

Selling Price (SP) per unit = $12
Quantity sold = y
Revenue = 12y
COGS = c·12y
Profit = Revenue − COGS = 12y(1−c)
Target Profit = ***$24,133.86***

Where c is COGS%

$$Profit = Revenue \; - \; COGS \; = \; 12y(1-c)$$

Step 1: Solving for c

We want:

$$12y(1-c) = 24{,}133.86 \qquad (1)$$

Solve for c:

$$1 - c = \frac{24{,}133.86}{12y} \Rightarrow \mathrm{c} = 1 - \frac{24{,}133.86}{12y} \qquad (2)$$

Step 2: Choose a practical value for y

Assuming that y is minimum integer that results in the average profit

So, from equation (1):

$$y = \frac{24{,}133.86}{12(1-c)} \qquad (3)$$

Now we find the minimum value of c (maximum COGS %) such that y is a positive whole number. We know when COGS % $\geq$ 100% there will be no profit.

Try COGS% = 0.89:

$$y = \frac{24{,}133.86}{12(1-0.89)} = \frac{24{,}133.86}{12 \cdot 0.11} = \frac{24{,}133.86}{1.32} \approx 18{,}279.44$$

Still not a whole number.

Now we use equation (2) to solve for c directly assuming y must be a whole number. Let's find the minimum y such that c is optimal.

Try:

$$y = 2000 \Rightarrow c = 1 - \frac{24{,}133.86}{12 \cdot 2000} = 1 - \frac{24{,}133.86}{24{,}000} \approx 1 - 1.0056 = -0.0056$$

Negative COGS! Too small.

Try:

$$y = 2{,}200 \Rightarrow c = 1 - \frac{24{,}133.86}{26{,}400} \approx 1 - \frac{24{,}133.86}{24{,}000} \approx 1 - 0.9142 = 0.0858 = 8.58\%$$

Try:

$$y = 8{,}000 \Rightarrow c = 1 - \frac{24{,}133.86}{96{,}000} = 1 - \ 0.2514 = 0.7486 = 74.86\%$$

Getting close.

Now try:

$$y = 10{,}000 \Rightarrow c = 1 - \frac{24{,}133.86}{120{,}000} = 1 - \ 0.2011 = 1 - 0.7989 = 79.89\%$$

Try:

$$y = 12{,}000 \Rightarrow c = 1 - \frac{24{,}133.86}{144{,}000} = 1 - \ 0.1676 = 0.8324 = 83.24\%$$

Try:

$$y = 13{,}000 \Rightarrow c = 1 - \frac{24{,}133.86}{156{,}000} = 1 - 0.1546 = 0.8454 = 84.54\%$$

Try:

$$y = 13{,}436 \Rightarrow c = 1 - \frac{24{,}133.86}{161{,}232} \approx 1 - 0.1497 = 0.8503 = 85.03\%$$

Therefore, when we sell 13,436 units and at a max COGS of 85.03% at a selling price of $12 and a discount of 15%, we are capable to make the average profit.

Alternatively, we can use limits to solve for the optimal COGS to meet the average profit

We define:

$$P(c) = 12y(1 - c)$$

We want:

$$\lim_{c \to c^*} 12y(1 - c) = 24133.86$$

Where c^* is the optimal COGS%

$$12y(1 - c^*) = 24133.86$$

$$1 - c^* = \frac{24133.86}{12y} \Rightarrow c^* = 1 - \frac{24133.86}{12y}$$

This is our formula for optimal COGS%

Thus, the limit of COGS% as profit approaches $24,133.36 is

$$\lim_{P \to 24133.86} c^* = 1 - \frac{24133.86}{12y}$$

So, COGS% depends on quantity y, and this limit gives us the exact maximum value for COGS% to hit the profit target.

Let's evaluate this limit for a few values of y

For $y = 10000$:

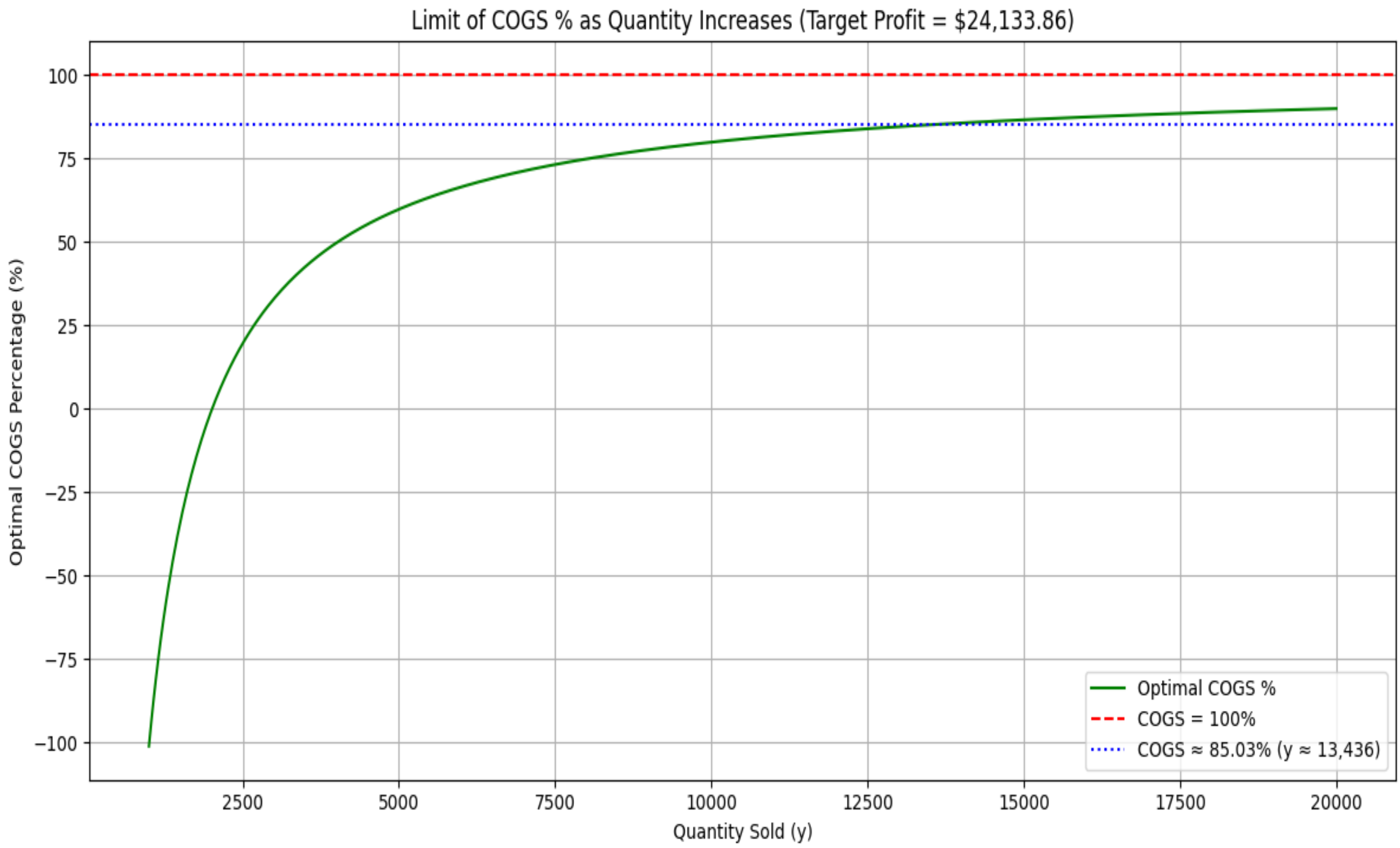
$$c^* = 1 - \frac{24133.86}{12 \cdot 10000} = 1 - \frac{24133.86}{120000} = 1 - 0.2011155 = 0.7988845 = 79.89\%$$

For $y = 13436$:

$$c^* = 1 - \frac{24133.86}{12 \cdot 13436} = 1 - \frac{24133.86}{161232} = 1 - 0.1497 = 85.03\%$$

With both methods, we arrive at the same answer of COGS% being ***85.03%,*** translating to ***$137,098.14*** at a quantity of ***13,436 units*** to sell to reach the average profit of ***$24,133.86***

Graphical representation of COGS% as Quantity increases



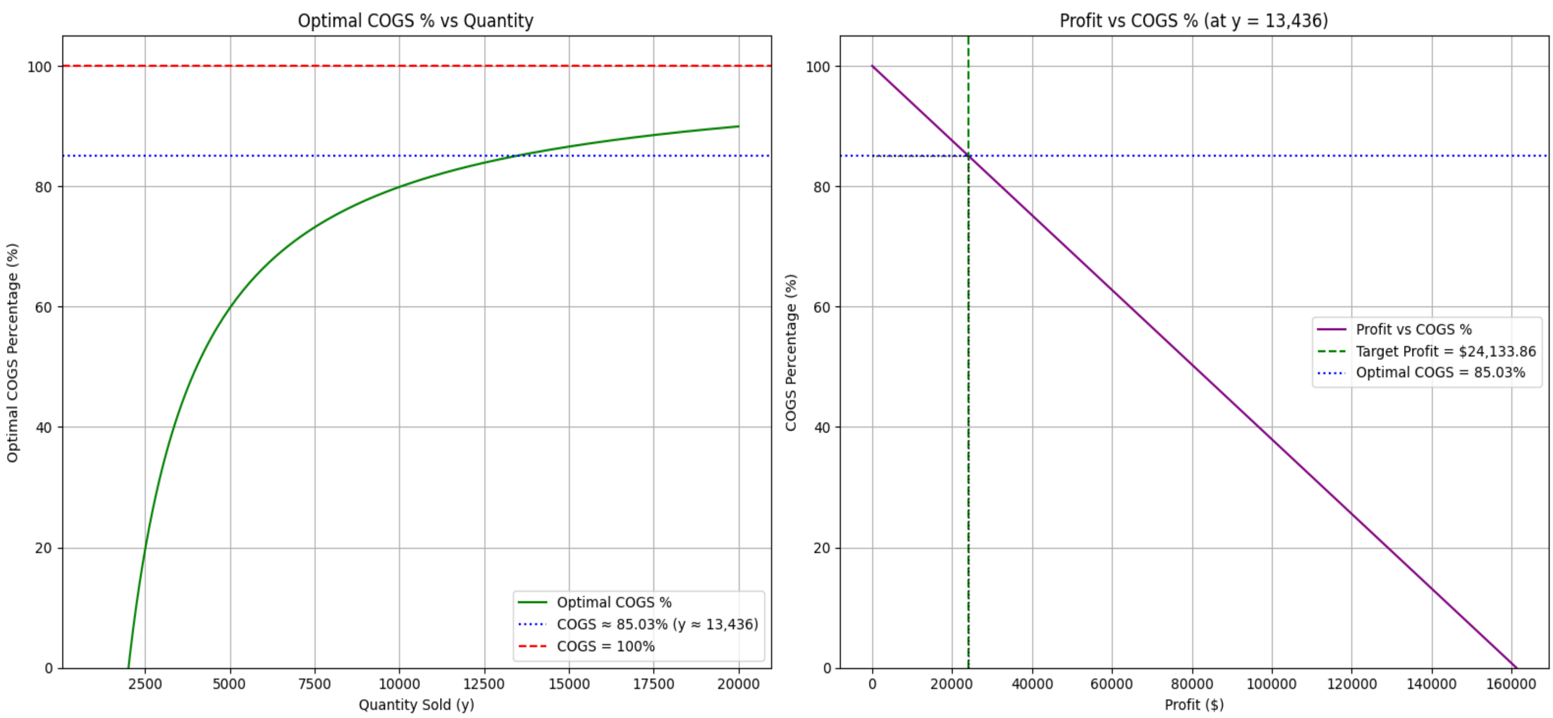
Description of the Graph:

The graph shows the **limit behavior of the Cost of Goods Sold (COGS) percentage** required to achieve a **fixed profit of $24,133.86** as the **quantity sold (y)** increases.

- The **green curve** represents the optimal COGS percentage needed to meet the profit target for each level of quantity sold.
- As the quantity sold increases, the required COGS % also increases, approaching an upper limit.
- A **dotted blue line** marks the point where COGS ≈ **85.03%**, which corresponds to a quantity of **y ≈ 13,436** — this is the minimum quantity needed to exactly meet the profit target without exceeding a COGS of 85.03%.
- The **dashed red line** at 100% indicates the theoretical maximum COGS threshold, beyond which profit becomes negative.

This visualization highlights how **higher quantities allow for higher COGS percentages** while still achieving the same fixed profit, illustrating the trade-off between production cost efficiency and sales volume.

Graphical representation of the consequential effect of the movement of COGS% on profit

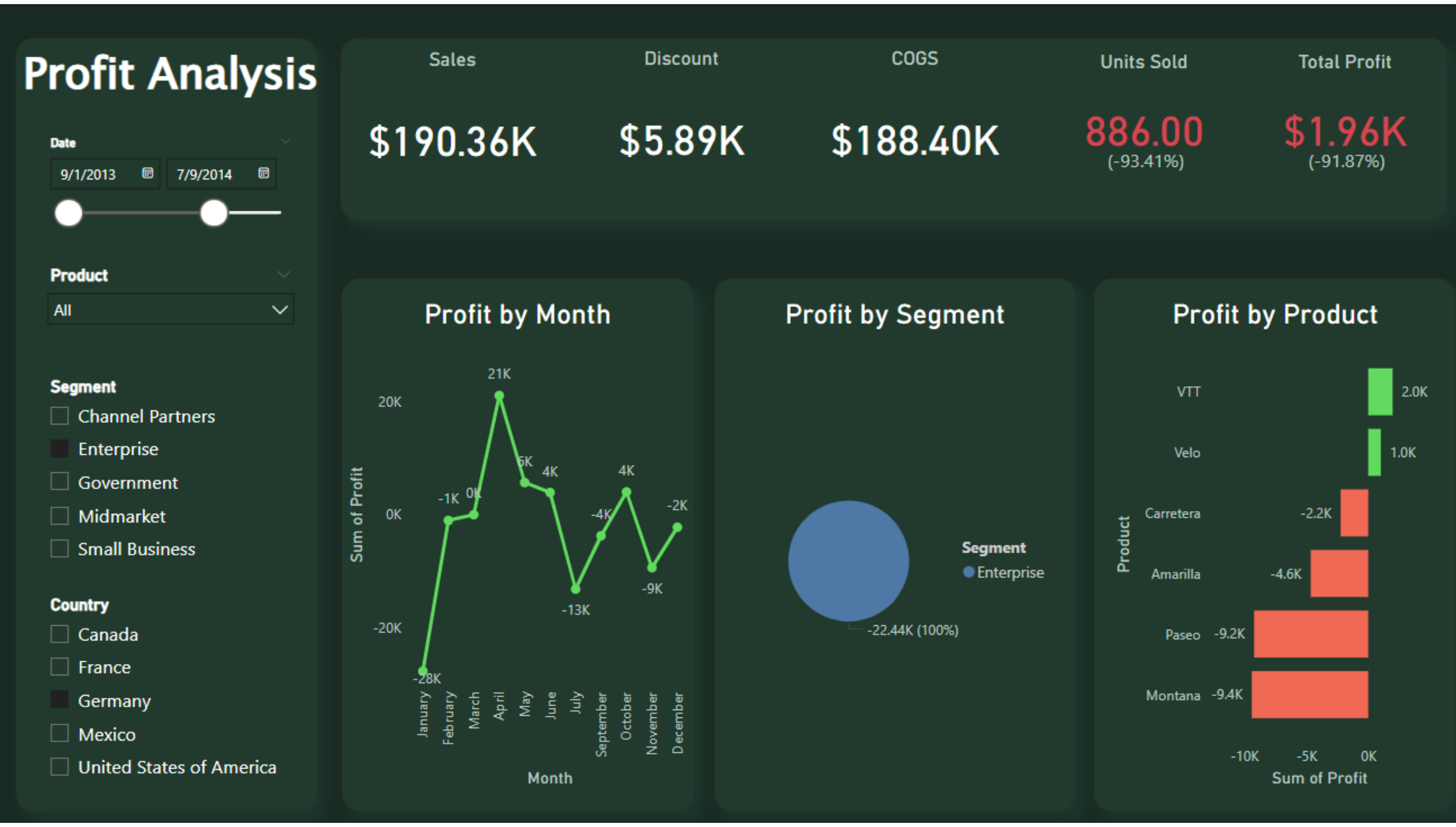


Right Plot: Profit vs COGS % (at y = 13,436)

- This graph illustrates the **inverse relationship between COGS % and Profit** at a fixed quantity (**y = 13,436**).
- The **purple line** represents how profit decreases as COGS % increases.
- The **dashed green line** represents the **target profit** of $24,133.86.

- The **dotted blue line** marks the optimal COGS % (85.03%) required to achieve that profit at this fixed quantity.
- Their intersection visually confirms that **at y = 13,436 and COGS = 85.03%**, the target profit is precisely met.

Visualization



In the above Power BI dashboard, I set target measures of 13,436 and 24,133.86 for the ***Units Sold*** and ***Total Profit*** slicers, respectively. This will flag all values lesser than the target as ***red*** and all values greater than the target as ***green***

Recommendation

For the company to make a profit greater than or equal to the target profit;

Following the principle of prudence in accounting thus, holding Selling Price at $12 and Discount at 15% and COGS% at its optimal level of 85.03% ($137,098.14), the company must sell 13,436 units of products to meet the target profit holding the above parameters constant.

Alternatively, the company can sell fewer units by selling at a higher price, offering lower discounts and reducing COGS.