

Project Background

This document presents an exploratory analysis of product sales performance using synthetic FMCG sales data from 2022 to 2024. The objective of this project is to uncover patterns in sales behaviour, promotions, stockouts, and seasonality that could inform the company's sales, finance and operational teams on future business decisions.

Insights and recommendations are provided on the following key areas:

- Sales Trends: Evaluation of historical sales patterns by units sold generated across 2022-2024
- Seasonality Patterns: An analysis of demand patterns across all product categories over time
- Promotions and Holiday Period Analysis: Examine the impact of promotions and holiday seasons on purchasing behaviour and product sales
- Stockout Analysis: Evaluation of stockout patterns based on product and channel-region

An interactive PowerBI dashboard that tracks sales performance can be found in the repository under "FMCG Project Dashboard".

The Pandas queries utilized to clean, inspect and analyse the data can be found in the repository under "FMCG Project.ipynb"

Data Structure and Initial Checks

Prior to the beginning of analysis, a variety of checks were conducted for data quality and familiarisation with the dataset.

There are a total of 190757 records and 14 columns with no duplicate and NULL entries.

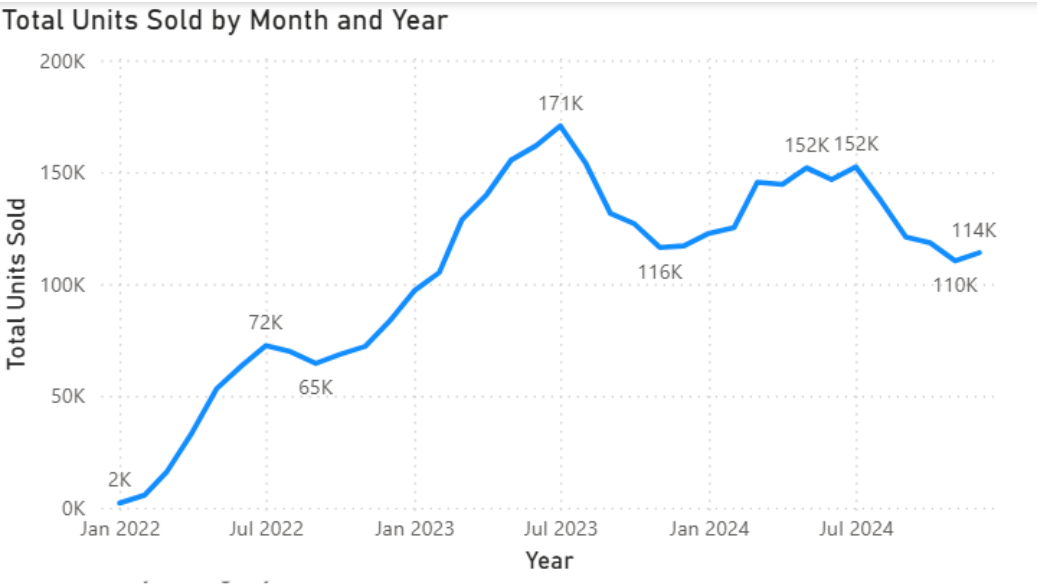
date	sku	brand	segment	category	channel	region	pack_type	price_unit	promotion_flag	delivery_days	stock_available	delivered_qty	units_sold
2023-07-26	SN-028	SnBrand2	SnackBar-Seg1	SnackBar	Discount	PL-South	Single	2.91	0	5	-2	-3	-3
2023-09-21	SN-010	SnBrand2	SnackBar-Seg2	SnackBar	Retail	PL-Central	Carton	8.60	1	4	-12	-11	-25
2024-03-14	RE-007	ReBrand4	ReadyMeal-Seg1	ReadyMeal	Discount	PL-Central	Carton	2.38	0	4	-6	-7	-8

3 rows of records showed units sold, delivered quantity and stock available as negative values were removed as they were deemed as erroneous entries as these variables cannot be negative.

Hence, after data cleaning, there are a total of 190754 records remaining in the dataset.

Insights Deep Dive

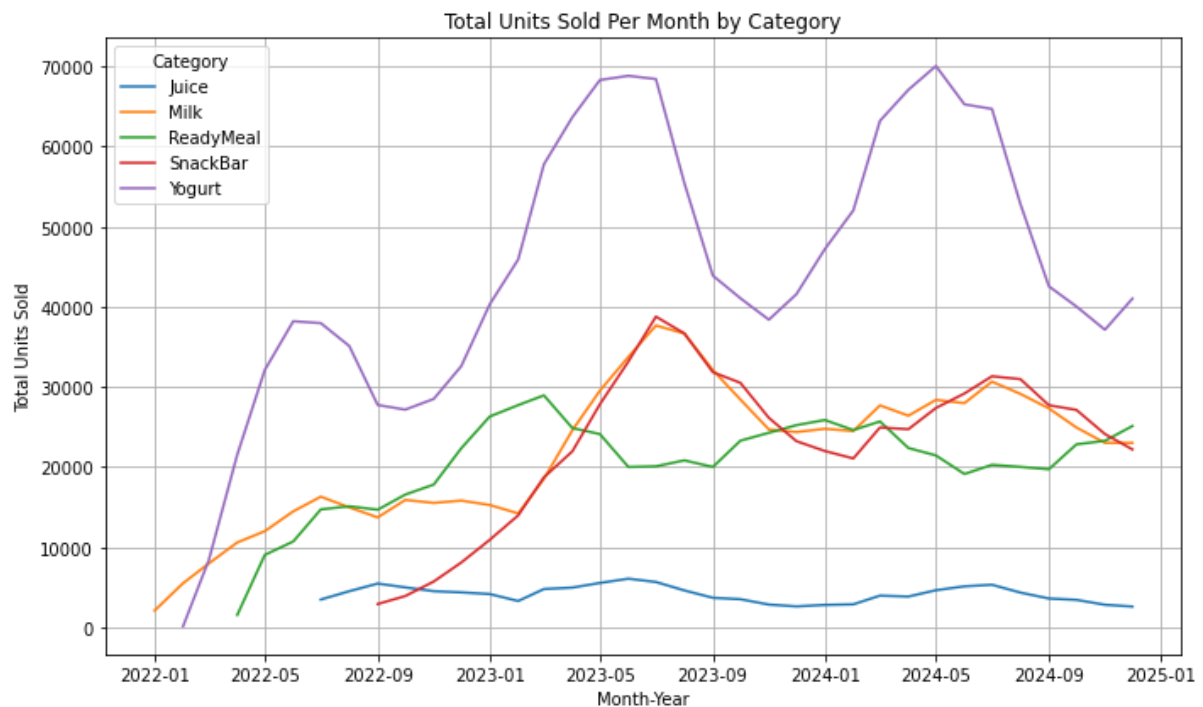
Sales Trends



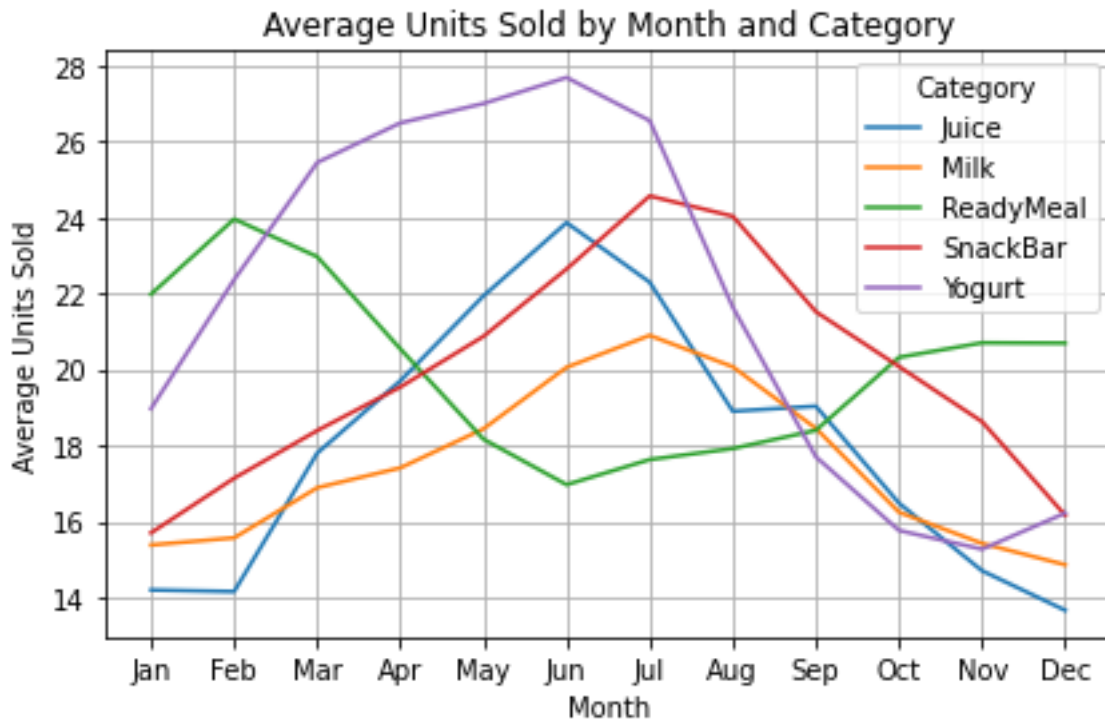
The company sales saw a steady increasing trend of units sold from Jan 2022 till its peak in July 2023, where a total of 171K units were sold in the month. This strong growth

could be due to new product launches, promotions and aggressive marketing. However, sales began to decline in the second half of 2023 and then faced plateauing, despite minor rebounds in 2024. This could be a signal that most of the products are entering into the decline phase of their product cycles and could also be driven by external factors such as decrease in consumer demand or market saturation.

Seasonality Trends



Based on this line graph that depicts total units sold across time for each category, yogurt is consistently the most popular product across all product categories. Conversely, Juice has the lowest sales among all product categories, likely due to the limited variety of Juice offerings, where only one option (JU021) has been available across the three years.



This line plot shows the average monthly sales (in units) by product category, which can help uncover seasonality trends across product types. Juice and Yogurt products show strong summer seasonality, peaking between June and August, likely driven by warmer weather and increased consumption of refreshing products.

ReadyMeals show an inverse trend, with higher demand in winter months, possibly linked to convenience-seeking behaviour during colder seasons.

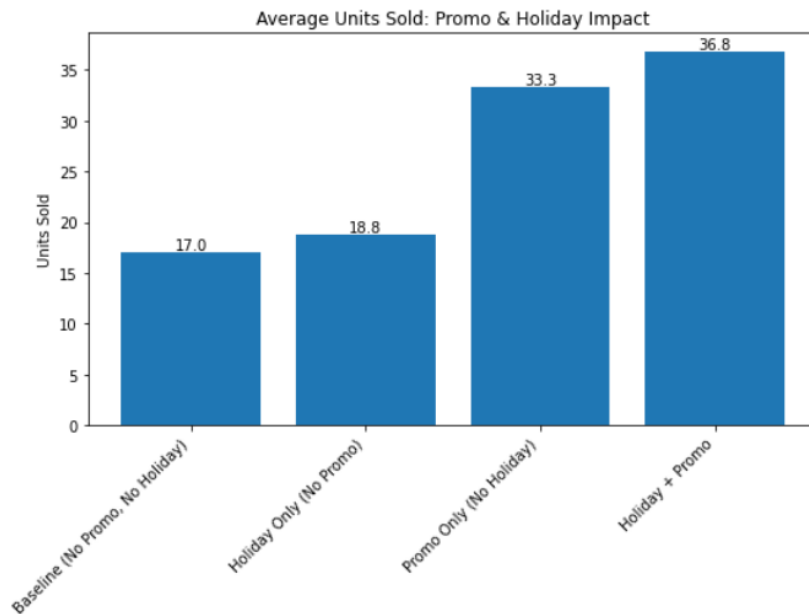
Milk has a more stable pattern with mild seasonality. This suggests that milk is a habitual purchase, driven by regular consumer consumption.

Lastly, SnackBars show some fluctuation, with higher activity around mid-year but without a strong seasonal peak.

Promotions and Holiday Trends

To analyse the effects of promotions and holiday seasons on sales performance, a bar graph is used to visualise the average units sold daily across 4 segments:

- No promotions and holidays
- No promotions but holiday period
- Promotions but no holidays
- Promotions and holidays

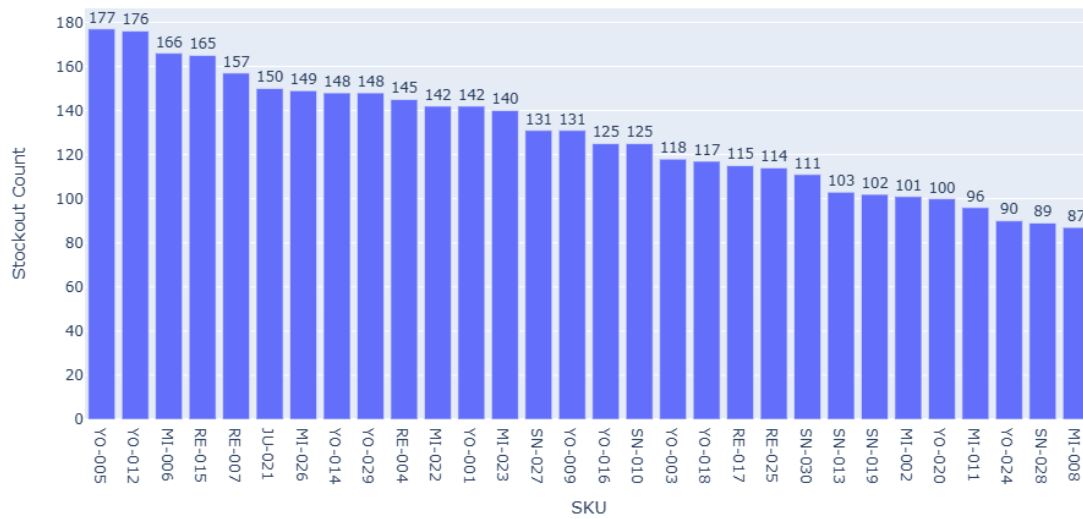


During holiday periods, the combination of a promotion leads to the highest sales uplift of an average of 36.8 units sold. Products on promotion show higher average sales than those not on promotion. The base level (no promotion, no holiday) shows the lowest average sales of just 17.0 units. Promotion outside holidays performs better than holiday-only sales, suggesting that promotion is the stronger driver.

Hence, promotions can significantly increase sales, especially when aligned with holiday periods. Promotions also perform strongly even outside seasonal peaks.

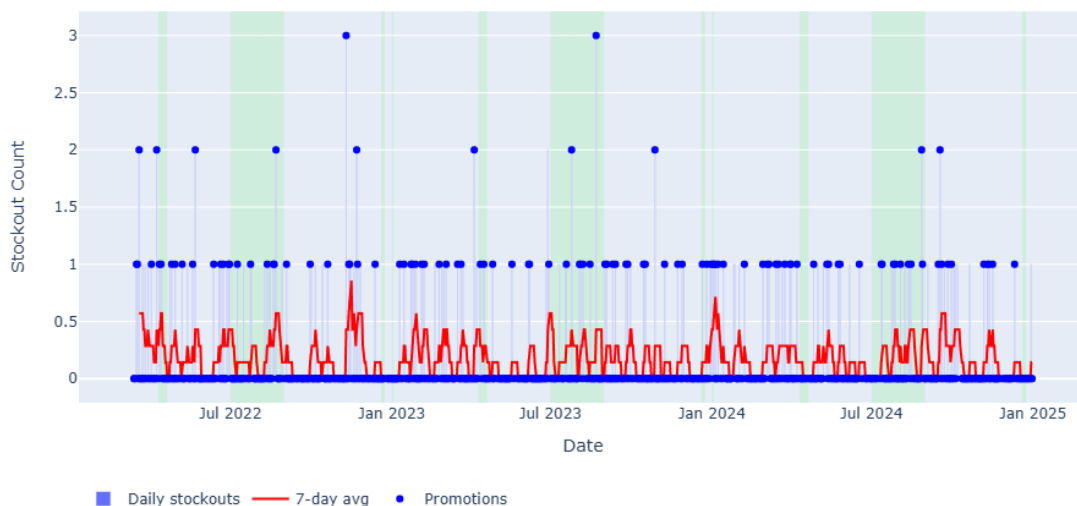
Stockout Analysis

Total Stockouts by SKU



Based on the bar chart, SKU YO-005 has the highest stock out count across all SKUs with 177 stockout instances across 2022 to 2024, followed closely by YO-012 with 176 instances. Since Yogurt products have the highest demand and share of unit sales, it is integral to conduct an in-depth stockout analysis to uncover the factors for the high stockout counts and prevent further lost sales opportunities. To do this, SKU YO-005 will be analysed.

YO-005 Stockouts with Promotions & Holiday Ranges

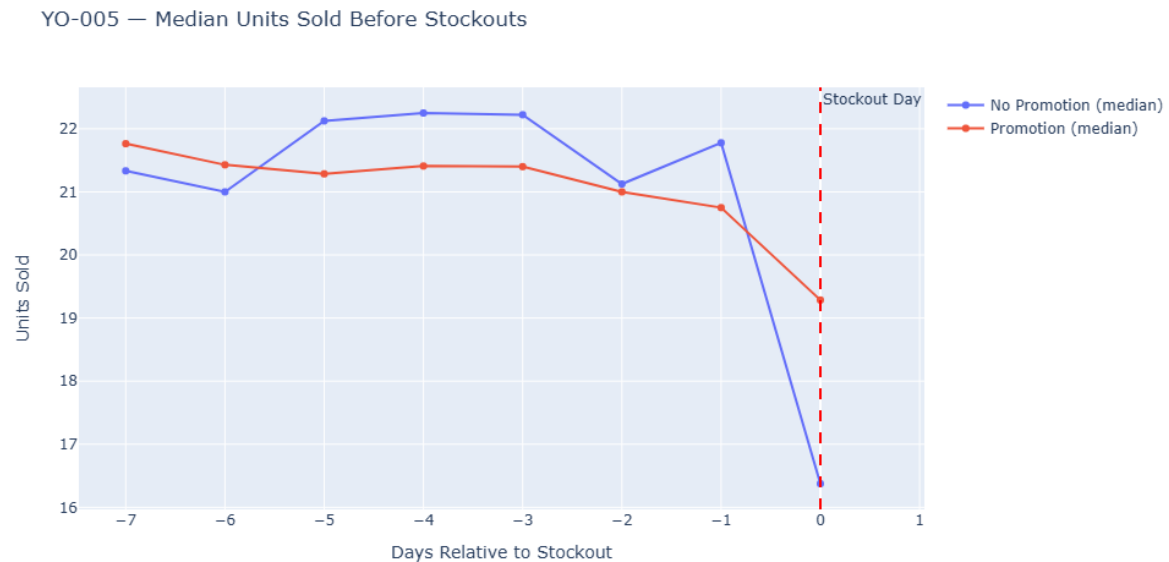


The stockouts are not continuous but are intermittent across the 2022-2024 period, with some seasonal spikes occurring.

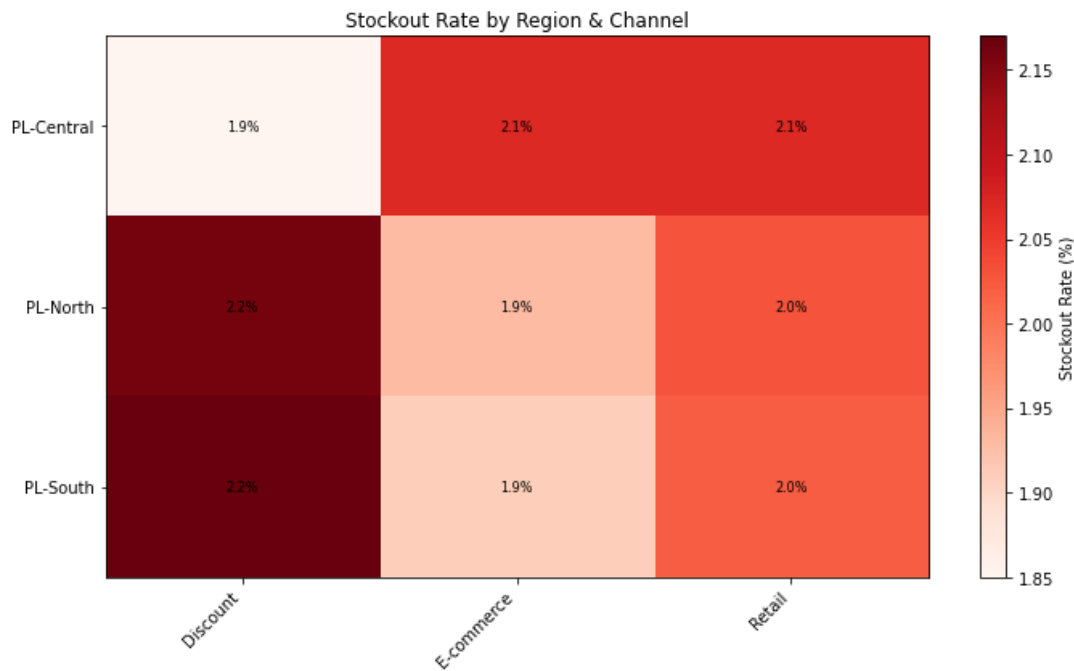
The 7-day rolling average plot shows that stockouts peak around mid-2022, mid-2023, and early 2024, which suggests potential demand surges or production delays.

Stockouts for YO-005 are low severity, as the average number of stockouts per day does

not exceed 1, even during peak periods. However, the persistence of stockouts indicates a need for better replenishment planning. The company could consider increasing buffer stock or demand forecasting accuracy during periods with expected high sales, such as holidays or promotions.



The median units sold before stockouts remains stable at 21-22 units per day, which implies consistent demand leading up to the stockout period. The sharp dip in sales on stockout day highlights the lost revenue due to stock unavailability, showing unmet demand due to stockouts. Thus, YO-005 has stable demand, but stockouts are causing lost sales. Promotions don't meaningfully change pre-stockout sales trends, so replenishment planning is more critical than promotions here.



Stockout rates represent the proportion of instances where products are out of stock, relative to the total number of sales records within a given region-channel combination.

From the heatmap, while stockout rates are generally low across all regions and channels, stockouts are still occurring in every channel and region, suggesting that availability issues are persistent.

Stockout rates are more pronounced in the Retail and Discount channels whereas Ecommerce channel exhibits a lower stockout rate likely attributed to a centralised inventory management.

Recommendations

Based on the uncovered insights, the following recommendations have been provided:

- Expand and diversify product portfolio. Considering the plateauing and declining sales trends, it is essential to diversify and expand the product portfolio to boost sales by attracting new customer segments and creating new revenue streams. Especially the Juice product line which only has one product option.
- Enhance inventory replenishment management. Given persistent stockout issues especially for products in high demand, re-evaluate and optimize inventory replenishment processes. This includes better forecasting models and ensuring that stock levels are in line with actual demand, especially during promotional or holiday periods. Consider implementing buffer stock to mitigate the risk of stockouts and improve replenishment frequency.

- Given the higher stockout rates in Retail and Discount channels, focus on improving supply chain efficiencies in these regions. Consider increasing warehouse capacities or replenishment cycles to meet demand fluctuations, particularly for high-demand products during promotional periods.
- Leverage promotions during key holiday and seasonal periods, as this has proven effective in driving sales.
- Capitalise on growing consumer preference for healthier and organic options. Consumer demand for Yogurt and Juice can extend beyond seasonality and remain strong throughout the year. Introduce a range of organic or healthier products and alternatives and promote their long-term health benefits to appeal to this growing segment.