Market Mix Modelling – An Insight

One of the largest CPG companies across the globe was interested in quantifying the impact of their marketing efforts on sales in the ELN product category. They wanted to in turn leverage this knowledge to optimize their marketing budget and maximize the ROI.

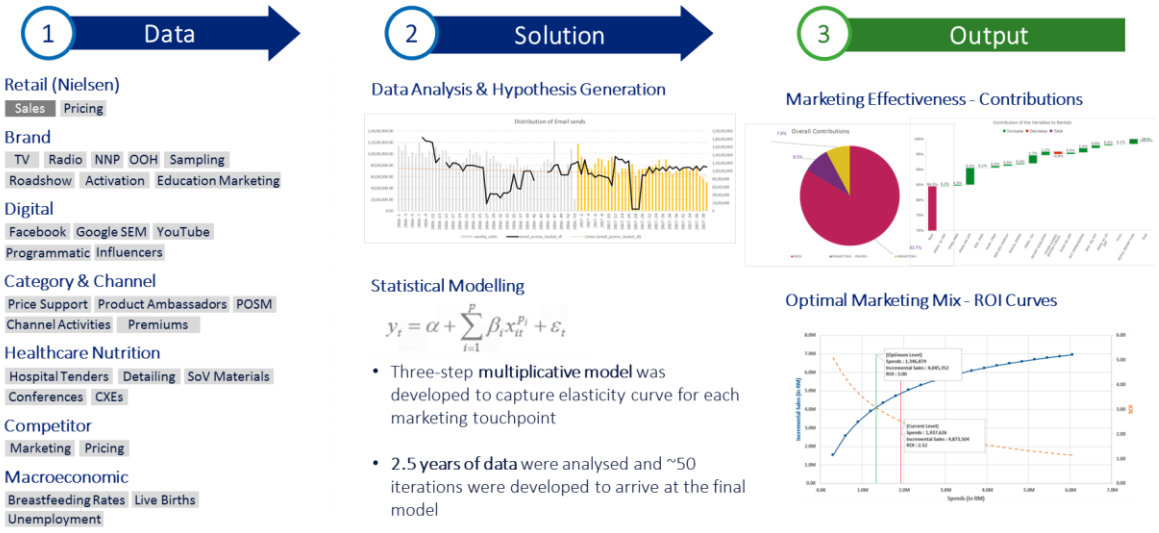
Solution Summary

TheMathCompany partnered with the CPG giant to perform an exhaustive & robust **Market Mix Modelling** (MMM) exercise to quantify the direct impact of marketing activities and the indirect effects such as halo effect, inter-channel interactions, long-term/brand equity impact, the impact of market movement, macroeconomic factors, etc.

With this understanding of the impact of all marketing channels and campaigns (and their interactions and indirect effects), an **optimizer** was developed to get the best marketing mix/spends allocation to drive the best ROI across the product portfolio.

A **simulator** was built and delivered to the business stakeholders, enabling them to perform dynamic what-if analysis with insights and deep-dives. This helped them plan their next year's marketing budget & execution.

Approach Details



1. Data

Total of 26 different marketing channels across:

- ATL – TV, Radio, Billboards, Newspapers, Roadshows, etc.
- BTL – Sampling, Sales Promo, Activations, Point-of-sale marketing, etc.
- Digital – Paid Social, Paid Display and Paid Search
- Pharmaceutical – HCP Detailing, Sampling, etc.
- Trade Promotions – Price Support, Premiums, etc.

The channels, along with competitor price & spends, and macroeconomic factors, were considered for the analysis. The analysis considered marketing spends and sales for the last ~3 years.

An extensive and thorough **data processing** and **wrangling** exercise was done to create the Analytical Data Sets (ADS) at a weekly level from all the relevant data sources.

Time-series **interpolation** techniques were applied for a few data sources where the required time granularity (weekly) was not available.

2. Solution

Measure Impact – Understand & decompose the impact of marketing, promotions, brand equity, and market changes on sales

Study Interplay – Study the interplay of channels, halo effect, long & short-term impact of marketing on sales

Optimize – Identify & recommend the opportunity to tune marketing budget allocation to maximize return on investments

1. Exploratory Data Analysis & Business Hypotheses Generation

A series of workshops were conducted with business, marketing & channel stakeholders to understand the existing strategy, pain-points, and expectations.

With the business understanding, following MMM-focused Exploratory Data Analysis (EDA) was done to **generate business hypotheses**:

- **Univariate analysis** to find patterns that exist within each element of the data
- **Trend analysis** of every marketing channel to understand the spend pattern over the years
- **Bivariate analysis** to understand the relationship between two different variables among marketingmix elements to:
    - Identify the key variables that exhibit a good relationship with the dependent variable
    - Identify the type of relationship that the variable exhibits with the dependent variable, to help with variable transformations

2. Feature Engineering and Variable Transformation

Following transformations were applied on the ADS adhering to the business hypotheses:

- **Lag** – Marketing spends are lagged to capture the delayed effect of marketing on sales
- **Adstock** – Advertising adstock is the prolonged or carry-over effect of advertising on consumer purchase behaviour
- **Aggregation of Variables** – Similar marketing touchpoints which have a similar response on sales are aggregated and modelled together
- **Log Transformation** – Advertising activities will demonstrate a non-linear impact on sales & returns and exhibit a pattern of diminishing returns. This relationship can be captured in the form of log transformations. Independent variables are log-transformed along with the target variable

3. Modelling

To overcome the limitations inherent in linear models, **multi-step multiplicative (log-log) models** were built for each of the products in the category, to capture the elasticity for each marketing touchpoints, indirect effects & market movement. This offers a more realistic representation of the complex market response than the usual additive linear models do.

Model Equation:

> **Sales** = exp(Intercept) * exp(β1*(adstocked(lagged(Marketing Spends 1))) * exp(β2*adstocked(lagged(Marketing Spends 2))) * exp(β3*adstocked(lagged(Marketing Spends 3))) *…

A total of **3 models** were built for each product.

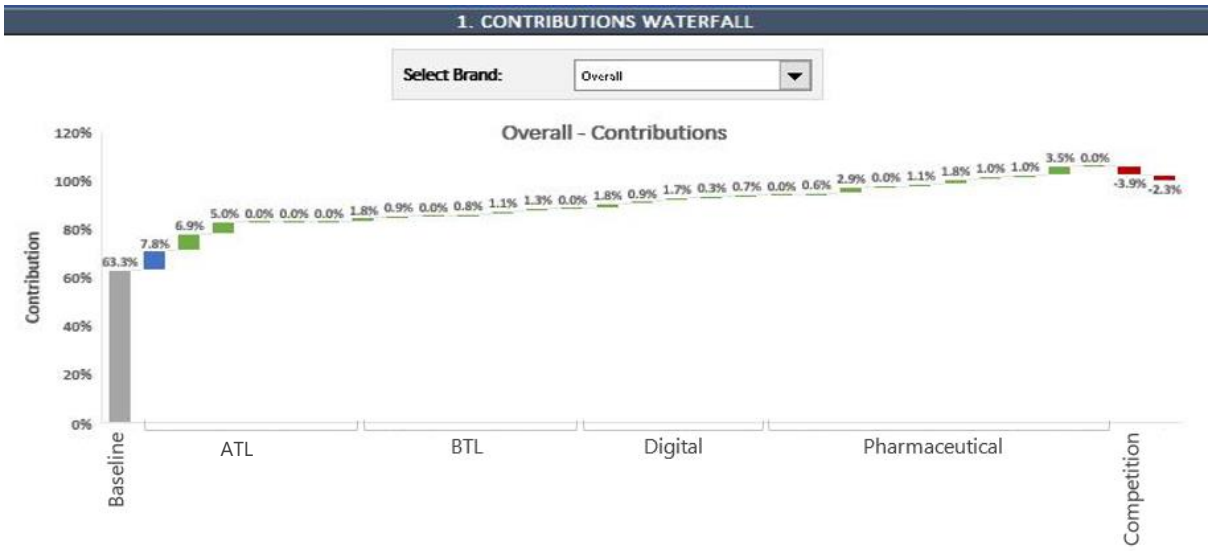
3 Step Modelling Approach

4. Output

Contributions:

In a multiplicative model, the output is interpreted as the result of the multiplication of all the independent variables. Hence, it is not possible to breakdown the output into the individual non-overlapping effects of the different independent variables.

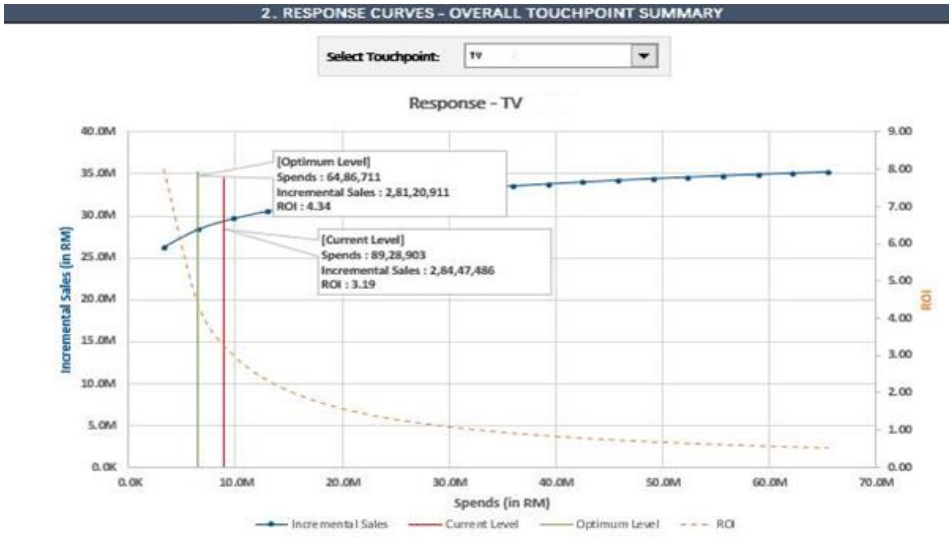
Hence, contribution of an independent variable is the difference in total sales and the sales when the effect of that independent variable is removed. This lets us infer the influence each independent variable has on sales. Contributions are visually reported using Waterfall charts.



Response Curves:

Response curves characterize the diminishing returns to scale as the marketing activity increases. This aligns well with the expectation that as the intensity of discounts, and displays & advertising increase, returns diminish.

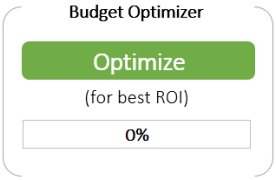
Response curves (incremental sales v/s spends) are generated for all marketing activities and studied to understand the current level and optimal level of spending.



Optimizer:

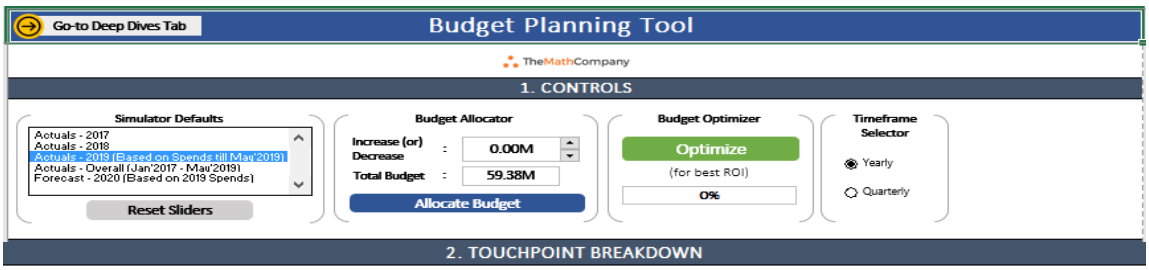
An optimization algorithm was developed to get the best marketing mix/spends allocation to drive the best ROI across the product portfolio, maintaining the current spending level.

The optimizer works across all the models simultaneously to arrive at the best overall ROI. The optimizer reallocates a portion of spends from the marketing channel with lowest ROI to the channel with highest ROI across the product portfolio. The optimizer iterates till the overall ROI is maxed out (saturation point)



Simulator:

An exhaustive front-end tool was designed encompassing all the outputs from the MMM models – contributions waterfall, response curves, and optimizer, along with a what-if analyser which lets the end user play out various spends scenarios and dynamically visualize the impact – incremental sales and ROI across various levels.



#	Touchpoint	Optimi	Spends	Incremental Sales	ROI
				Overall	Overall
1	TV		8.93M	2.02M	0.23
1.1	TV | Product 1	☑	3.63M	820.10K	0.23
1.2	TV | Product 2	☑	2.30M	519.11K	0.23
1.3	TV | Product 3	☑	0.00K	0.00K	NA
1.4	TV | Product 4	☑	3.00M	676.34K	0.23
2	Billboards		2.89M	653.23K	0.23
2.1	Billboards | Product 1	☑	1.36M	306.48K	0.23
2.2	Billboards | Product 2	☑	420.47K	94.91K	0.23
2.3	Billboards | Product 3	☑	0.00K	0.00K	NA
2.4	Billboards | Product 4	☑	1.12M	251.84K	0.23
3	Newspaper		0.00K	0.00K	NA
3.1	Newspaper | Brand	☑	0.00K	0.00K	NA
3.2	Newspaper | Product 1	☑	0.00K	0.00K	NA
3.3	Newspaper | Product 2		0.00K	0.00K	NA
3.4	Newspaper | Product 3		0.00K	0.00K	NA
3.5	Newspaper | Product 4		0.00K	0.00K	NA
4	Radio		0.00K	0.00K	NA
4.1	Radio | Product 1	☑	0.00K	0.00K	NA
5	Activations		1.76M	0.00K	0.00
5.1	Activations | Product 1	☑	0.00K	0.00K	NA
5.2	Activations | Product 4		1.76M	0.00K	0.00
6	Dry Sampling		1.96M	667.77K	0.34
6.1	Dry Sampling | Product 1	☑	796.24K	0.00K	0.00
6.2	Dry Sampling | Product 3	☑	428.00K	667.77K	1.56
6.3	Dry Sampling | Product 4		733.45K	0.00K	0.00

5. Impact:

- Business was able to understand their historical effectiveness of spends across various marketing channels.
- This helped business in planning and allocation of budget for different marketing channels for the upcoming year.
- Provided users an option to change spends of different marketing channels and know their impact on sales of all the products in the category using the simulator tool.

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