MARKETING MIX MODELING

Marketing Mix Modeling is one of the most popular analyses under marketing analysis which helps organization in estimating the effects of spend on different advertising channels like Tv, Radio, Print, Online Ads etc. As well as other factors like price, competition, weather, inflation, unemployment on sales. In simple words it helps companies in optimizing their marketing investment which they spend in different marketing mediums. (Both online and offline).

Uses of Marketing Mix Modeling

1. Which marketing medium (Tv, radio, print, online ads) returns maximum return (ROI)?
2. How much to spend on marketing activities to increase sales by some percent (10%)?
3. Predict sales in future from investment spend on marketing activities?
4. Identifying key drivers of sales (include marketing mediums, price, competition, weather and macro-economic factors).
5. How to optimize marketing spend?
6. Is online marketing medium better than offline?

Types of Marketing Mediums

Offline Marketing	Online Marketing
Print Media: Newspaper, Magazine	Search Engine marketing like content marketing, backlink building etc.
TV	Pay per click, pay per impression
Radio	Email Marketing
Out-of-home advertising like billboards, ads in public places.	Social Media marketing.
Telemarketing	Affiliate Marketing
Below the line promotions like free product sample or vouchers	
Sponsorship	

Data Required for Marketing Mix Modeling

1. Product Data.
2. Promotion Data.
3. Advertising Data
4. Seasonality.

5. Geographical Data.
6. Macroeconomic Data.
7. Sales: It is not possible to build MMM without sales variable. Sales can be in volume in units as well as revenue.

Data Source

We need to extract data from multiple sources and the merge them to prepare analytics DataMart for modeling.

1. Sales, product and promotion data are generally stored internally within company relational database management system.
2. Advertising data is either managed by internal marketing term or through external marketing agency.
3. Macroeconomic data can be extracted through websites like world bank, IMF and Economagic.

Data Preparation: Data Granularity

First, we need to check how granular data we have. At which level we have sales and advertising data in our database. Is at hourly/daily or weekly level. Some data points can be at monthly level, while other are measured every week. We need to be very careful while merging data from multiple sources. Data aggregation comes into picture here.

The level of data can be decided depending on the implementation of promotion campaign. Ideally data should NOT be prepared at daily level as daily sales data generally has to much variation which leads to poor accuracy. We generally use weekly time period and aggregate data a weekly level as promotion is live from Monday to Sunday.

Dependent Variable

Sales (dollar value) is generally considered as a dependent variable in MMM. Sales into two components: baseline sales (sales when no promotions or offers are active) and incremental sales (due to marketing activities). In eCommerce industry, sales are also called as gross merchandise volume (GMV). Sometime companies consider sales volume (in units) as a target variable.

Data Exploration and Transformation

Before building a model, we as analysts need to perform various quality checks. It's a crucial stage of building a model. If your data is not prepared and handed correctly, model development would be of less use. Accuracy and robustness of model can also be deteriorated badly if you compromise data cleaning and transformation.

1. Importing Data.
2. Missing Value.
3. Outliner values.
4. Univariate and Bivariate Analysis.

AdStock

The concept behind Adstock is that advertising has been show to have an effect extending several periods after you see it first time. In Other words, an advertisement from a previous period may have some effect of an advertisement in the current period. It is also called advertising carryover. It's a very old concept, when TV was the main medium of advertisement. It is not restricted to TV only and can be applied to online, radio and print media as well.

Let understand with example.

Suppose you are watching your favorite Tv show. During a commercial break, you see an ad of perfume brand 'X'. You would not buy this perfume immediately after the commercial break. Let's say you see the ad of the same brand 'X' a couple of times in next few days. It would increase awareness to a new level and there is a highly change that you would purchase perfume of this brand (if you need it). If you would not has seen the advertisement again after first time, you would not be able to recall the brand easily. This is the decay effect of Adstock. This decay is reduced by new advertising exposure.

$$A_t = T_t + \lambda A_{t-1} + \lambda A_{t-2} \text{ Here } t = 1,\ldots,n$$

Where At is the adstock at t. Tt is the value of the advertising variable at time t and λ is the 'retention' or lag weight parameter and can be interpreted as percentage of effectively remembered ad contact from previous week plus contacts from current week. Λ (lamda) lies between 0 and 1.

Adstock rate = 0.5
TV GRP in week 1 = 115
TV GRP in week 2 = 120
Adstock in week 2 = 120 + 0.5*115 = 177.5

Techniques Used in Marketing Mix Modeling

The common statistics techniques used in MMM are linear and non-linear regression techniques.

Multiple Linear Regression

Sales = β0 + β1*X1 + β2*X2 + ... + βn*Xn
Xi are independent variables (or predictors), βi can be interpreted as change in sales corresponding to unit change in predictor.

Log-Linear Regression

LN(Sales) = β0 + β1*X1 + β2*X2 + ... + βn*Xn
LN is natural log. Xi are independent variables (or predictors), βi can be interpreted as % change in sales corresponding to unit change in predictor.

Elasticity

What marketing activities to pull or push and the corresponding impact on sales? For example, a price elasticity of -1.9 means that when price is increased by 1% sales will be reduced by 1.9 percent keeping all the other factors being constant. Similarly, we can calculate elasticity of TV, radio and online advertisement.

When you have simple linear regression model, you can calculate elasticity using the formula below -

$$\epsilon = \frac{\Delta y/y}{\Delta x/x} = \frac{\Delta y}{\Delta x} \cdot \frac{x}{y} = \beta_1 \cdot \frac{x}{y}$$

In the case of non-linear regression models, the above defined elasticity formula needs to be tweaked according to the equation. Refer the table below.

TRANSFORMATION	FUNCTION	ELASTICITY
Level-Level	$Y = a + bX$	$\epsilon = b * \frac{X}{Y}$
Log-Level	$log(Y) = a + bX$	$\epsilon = b * X$
Level-Log	$Y = a + b * log(X)$	$\epsilon = \frac{b}{Y}$
Log-Log	$log(Y) = a + b * log(X)$	$\epsilon = b$

Model Performance

R-squared, Adjusted R-Squared, Mean Absolute Percentage Error (MAPE)