Lab 2 - Media Mix Modelling

Digital and Social Media Strategies

Fall 2024

Assignment Information

This formative assignment is designed to help you build and revise your knowledge of Media Mix Modelling. This material was discussed in Lecture 2. There are two components:

1. Revision Questions: Short answer questions relating to the lecture content.
2. Hands On: Use R to write short code snippets to do some simple media mix modelling.

This question document, the dataset for this assignment, any additional information about the data and an R script for you to write your code are available on Canvas as a zip file "lab-02-mmm.zip." Download this repository and unzip on your computer in a location where you are keeping files for this class.

We will provide solutions to the coding parts of the assignment via Canvas on Friday after the final Lab Section of the week has concluded.

You **do not need to submit this assignment for grading.**

Learning Goals

By the end of this assignment, you will be able to:

- Provide definitions of alternative media mix modelling strategies
- Explain the rationale behind what variables to include in a media mix model
- Implement media mix models in R and explain their output

Revision Questions

1. Provide a one sentence definition of Media Mix Modelling.

2. How is Media Mix Modelling different from marketing mix modelling?

3. What are the similarities and differences between the following models:
    a. Simple Linear Regression MMM
    b. Mixed Model MMM
    c. State Space Model MMM

4. Provide an intuitive explanation as to why an analyst might include variables to control for seasonality in a MMM.

5. When working for a company that performs MMM, an colleague suggests:
   We should add control variables for the advertising spending of our cloest competitors.
    a. Do you agree with your colleague? Explain your answer.
    b. Write down an MMM regression model that includes the companies own spending and that of it closest competitor. Assume that they both spend on the same two advertising channels: TV and Google Ads.
    c. Many companies do not include competitor advertising variables in their MMM. Why might that be the case?

6. What are the differences between linear, concave and S-shaped advertising response curves? Explain your answers in terms of the marginal effectiveness of an extra EUR 1,000 of spending at different base levels of spending.

7. Consider an MMM model with TV Ad Spending and Facebook Ad Spending. Should the temporal effects of advertising spend differ between the two channels? Justify your answer.

8. Explain the Media Mix Optimization problem that a company with two advertising spending channels should solve to allocate spending optimally.

Hands On: Doing Media Mix Modelling

We will work with a dataset that contains sales data and data on one (1) marketing inputs, TV spending. All the data are measured at the weekly level and contain national sales and national spending data for the time period from April 2020 to July 2024.

Your task is to put some of the theory learned in the “Media Mix Modelling” lecture to work and estimate some models using the R programming language.

Data & Variables

The data provided has been artificially generated, but closely reflects what a real dataset a marketer tasked with doing media mix modelling would receive.
The variables included in the data are:

- **date:** the date of the start of the week (i.e. Monday)
- **year:** the year the data was recorded
- **month:** The calendar month that the data was recorded
- **sales:** sales of a product in a given week (100,000s of EUR)
- **tv_spend:** spending on TV advertising in a given week (10,000s of EUR)

Now let's get started:

Task 1: Setting Up Your R Session

A. Open R.
B. Start a new RStudio project in the folder "lab-02-mmm" that you have already downloaded unzipped (see page 1).
C. Open the script file "media_mix.R".

Task 2: Loading Data into R & Developing an Understanding of the Data

A. Load the data into R.
B. How many rows are there in the data?
C. What are the mean, median, standard deviation, 25th and 75th percentiles of sales, tv spending?
D. Produce a plot of sales over time. Repeat for advertising spending. Summarise what you can see from the plots in at most three sentences.

Task 3: Your first Media Mix Model

The first media mix model we want to estimate is:

$$sales_t = \beta_0 + \beta_1 TV\ Spending_t + \varepsilon_t$$

A. Explain the meaning of the terms β_0, β_1 and ε_t.
B. Estimate the model and print the summary output.
C. Interpret the coefficients $\hat{\beta}_1$.
D. Write the code that extends this model to include seasonality at the calendar month level.
   We write the model as:

$$sales_t = \beta_0 + \beta_1 TV\ Spending_t + \tau_t + \varepsilon_t$$

   Where τ_t denotes monthly seasonality in sales.

   How do your results change? Can you explain why?

Task 4: Ad Spending Stocks

The first extension to this model is to use a "stock" variable for each of the ad spending categories rather than levels.

A. What is an advertising stock variable? Explain intuitively in no more than 3 sentences.
B. In the exercise, we will assume the following about the ad stock variables:
    - Decay Rate = 0.5, and
    - Effect lasts for a maximum of 4 weeks.

   Provide an explanation of why the decay rates and how long an advertising medium has an effect of sales differs between the TV and Facebook.
C. Create the ad stock variables using the code provided.
D. Estimate the updated media mix model:

$$sales_t = \beta_0 + \beta_1 TV\ Spending\ Stock_t + \tau_t + \varepsilon_t$$

E. Report and interpret the estimates. How do they compare to Task 3?

Task 5: Saturation of Advertising Spending

The next extension we will add to our media mix model is to allow the effects of advertising to decrease in effectiveness as spending increases. This means that an extra 1000 Euros spent on advertising is more effective for low levels of advertising than for high levels of advertising.

A. Provide an intuitive explanation for why advertising spending's effectiveness could decrease as the level of advertising stock rises.
B. Run the code that estimates the media mix model with decreasing effectiveness:

$$sales_t = \beta_0 + \beta_1 TV\ Spending\ Stock_t + \beta_2 TV\ Spending\ Stock_t^2 + \tau_t + \varepsilon_t$$

C. Report the estimates. From the estimates can you see evidence of decreasing effectiveness of spending on either channel? Explain.
D. Run the code to visualise how the effectiveness of the TV advertising changes across different levels of the advertising stock. Explain the pattern that you see
E. Is there a point where additional spending would decrease the sales? Would this make sense?