ASSESSING MARKETING ROI WITH MATLAB REGRESSION AND INTERACTION EFFECTS

1. Overview

Client:

A mid-sized e-commerce brand headquartered in the United Kingdom, selling sustainable lifestyle products

Objective:

To evaluate the return on investment (ROI) of marketing spend across digital and offline channels using multiple linear regression in MATLAB. The goal was to understand individual and combined effects of channels and optimize budget allocation.

2. Background

The marketing team distributed budgets across paid search, social media, email campaigns, and influencer collaborations. However, there was no quantitative model in place to understand how these channels worked individually or together, nor how external factors such as seasonality influenced results.

3. Data Summary

Dataset:

Weekly marketing and sales data across 104 weeks (2 years)

Key Variables:

Variable	Type	Description
Weekly_Revenue	Continuous	Revenue generated (USD, dependent var)
Paid_Search_Spend	Continuous	Weekly spend on Google Ads
Social_Media_Spend	Continuous	Spend on Meta, Twitter ads
Email_Campaigns	Integer	Count of emails sent that week
Influencer_Spend	Continuous	Paid influencer budget
Holiday_Week	Binary	1 = Major sales week (e.g., Black Friday)

Week_Number	Integer	Sequential index (used for trend control)
Paid_Search x Social	Interaction	Product term (added manually in MATLAB)

4. Methodology

Software Used:

MATLAB R2023b

Workflow:

1. **Data Preparation:**

   o Imported data using readtable()

   o Created interaction term: Paid_Search_Spend .* Social_Media_Spend

   o Normalized continuous variables for comparability

2. **Model Construction:**

   o Used fitlm() with interaction terms

   o Regression formula:
   Revenue ~ Paid_Search + Social + Email + Influencer + Holiday + Paid_Search * Social

3. **Diagnostics:**

   o Validated assumptions (linearity, independence, normality of residuals)

   o Checked VIF for multicollinearity

   o Used adjusted R^2 and RMSE for performance comparison

4. **Interpretation & Reporting:**

   o Coefficient estimates with 95% confidence intervals

   o Scenario-based ROI simulations using predict()

   o Plotted marginal effects of interaction terms

5. Key Results

Metric	Value

Adjusted R²	0.889
RMSE (Test Set)	$4,200
Highest ROI Channel	Email Campaigns
Significant Interaction	Paid Search x Social Media
Revenue Lift in Holidays	+23% (holding spend constant)

Notable Findings:

- Each email sent correlated with a **$19.4 increase in revenue**

- The **interaction effect** between Paid Search and Social Media was **positive and significant ($p < 0.01$)**, indicating synergy when both channels were active

- Influencer spend showed diminishing returns after the 3rd quartile

6. Visual Outputs (MATLAB):

- Coefficient plot with 95% CI using coefCI()

- Interaction surface plot: Paid Search vs. Social Media

- Predicted vs. Actual revenue scatter plot

- Partial regression plots for each predictor

7. Deliverables

- MATLAB scripts for data import, regression modeling, and plotting

- Interactive dashboard (MATLAB App Designer prototype) for internal use

- 14-page analytical report:

  o ROI by channel

  o Visual impact summaries

  o Forecasting table with what-if scenarios

- One-page summary memo for stakeholders

8. Application & Outcome

- Client shifted 12% of budget from influencer marketing to email and search

- Weekly revenue volatility reduced by 9% due to targeted allocation

- Leadership gained clear visibility into channel synergy effects

- A/B testing of spend strategy now aligned with regression insights

9. Strategic Value Delivered

- Delivered **channel-specific ROI measurement**

- Enabled **data-backed budget reallocation**

- Highlighted **cross-channel effects** previously missed by siloed analysis

- Provided **reusable, script-driven model** for future forecasting