



# BUDGET ALLOCATION THROUGH MARKETING ATTRIBUTION

## a.k.a. BATMAN

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### Company

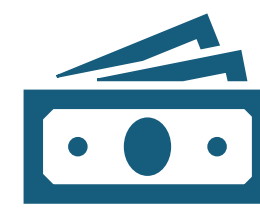
Leading Provider of Tools for Remote Collaboration, Information Technology and Customer Engagement

### Business Need

1. Understand how click and impressions affect sales
2. Analyze sales sensitivity to marketing spending
3. Recommend optimal budget allocation to different marketing channels to maximize return on marketing spending

### The Data

We studied GoTo Meeting e-commerce sales  
The training and testing data was obtained from:



**Marketing spend**

From different channels



**Marketing exposure**

Clicks & Impressions on Ads



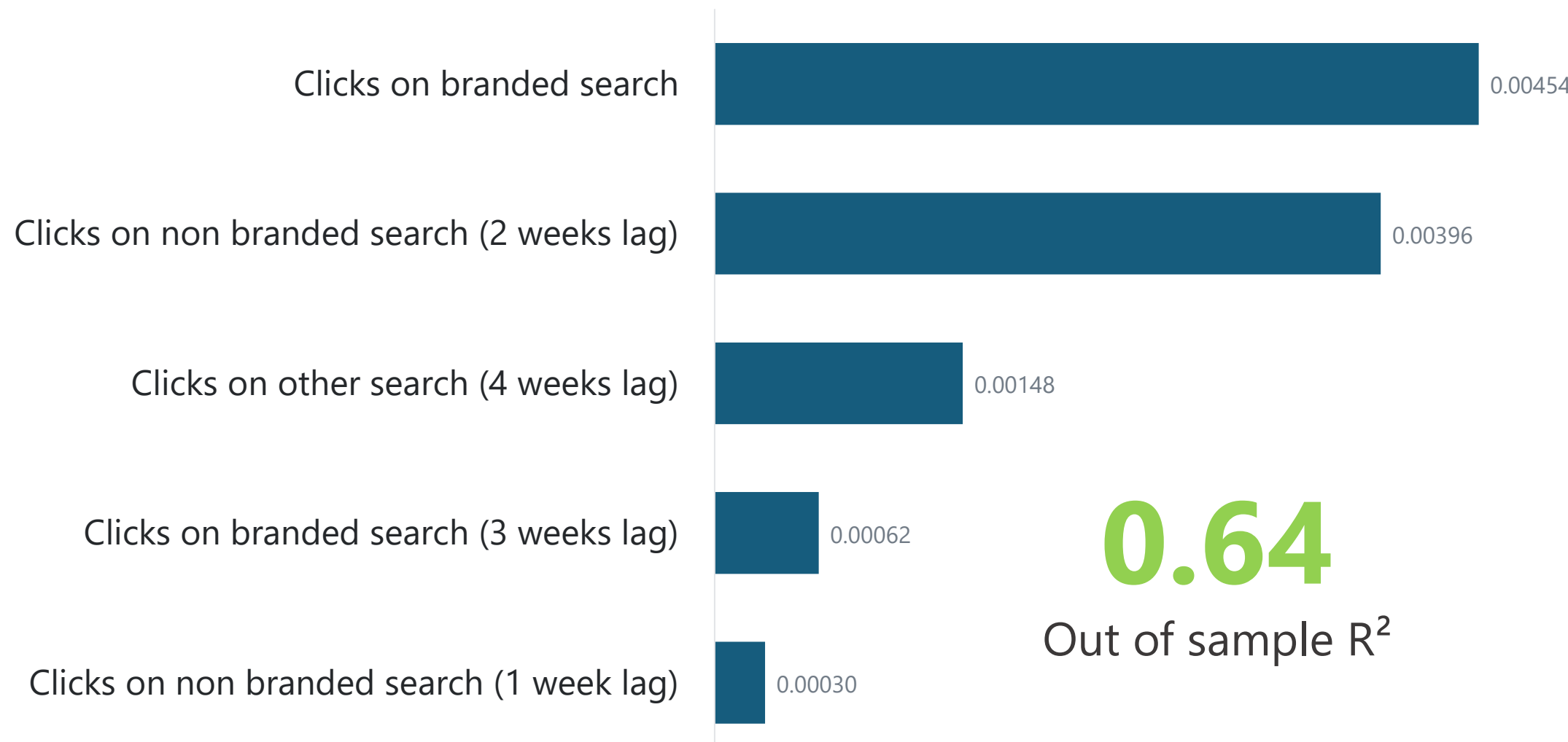
**Sales**

Direct purchases or coming from trials

### 1. How do clicks and impressions affect sales?

1. We aimed to predict **weekly sales** using **21** features related to marketing clicks and impressions in different channels
2. We trained Lasso regression model with cross validation which gave us **10** non-zero coefficients.

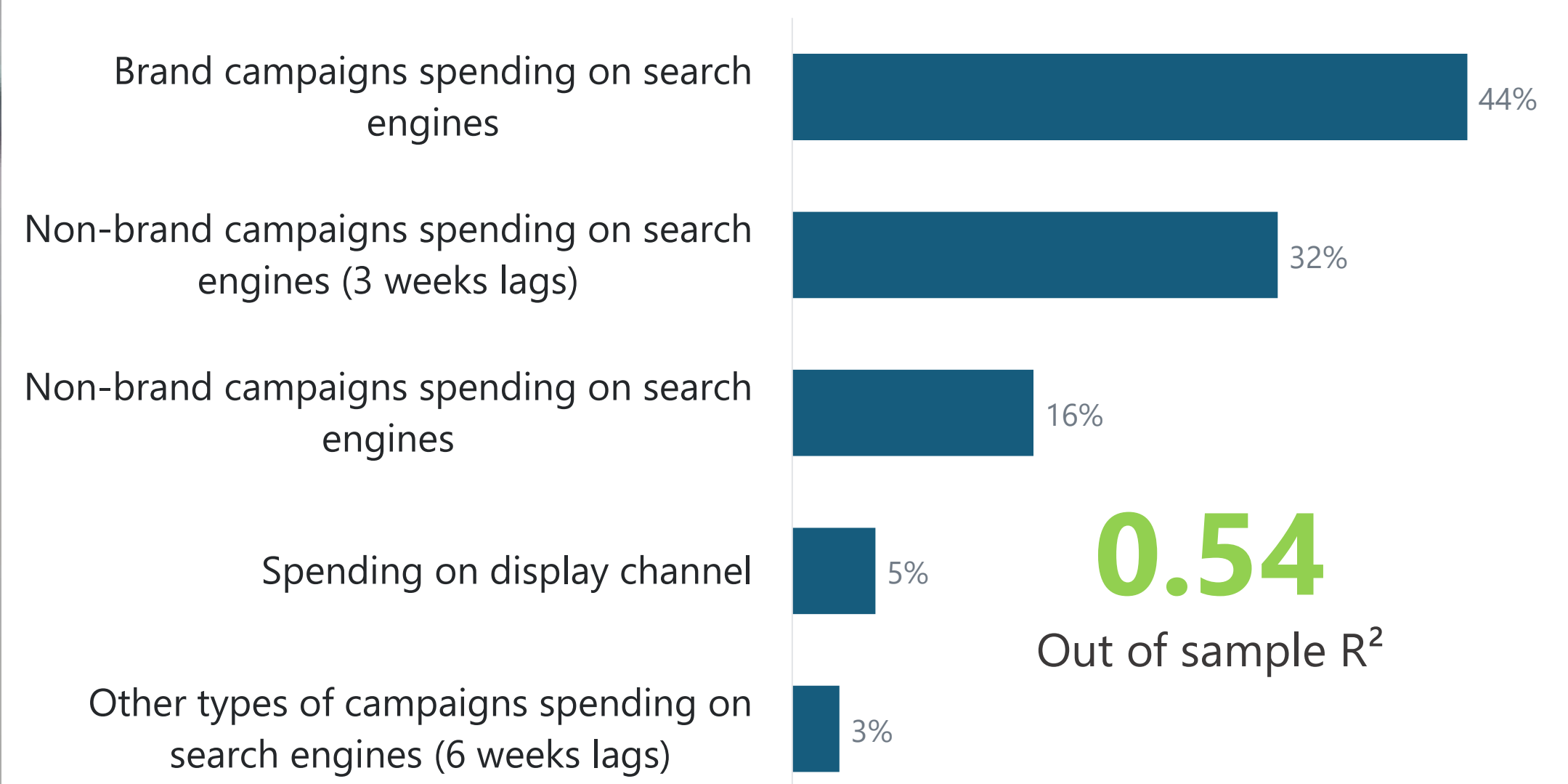
Coefficients of top 5 predictive features



### 2. How do sales vary by marketing spend?

1. We aimed to predict **weekly sales** using **29** features related to marketing spending in different channels
2. We kept **5** features with non-zero coefficients based on Lasso regression with cross validation

Importance of predictive features

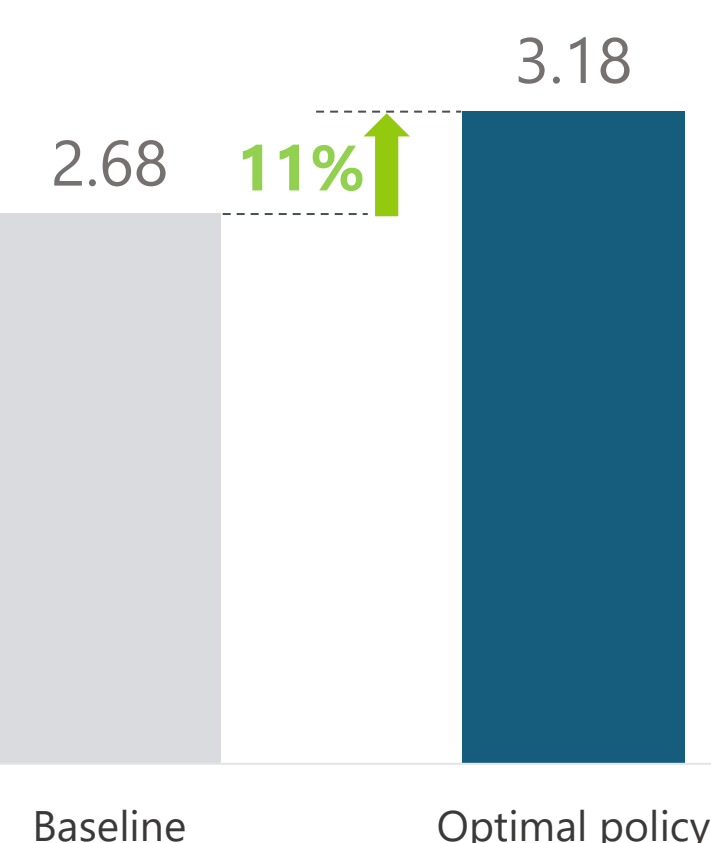


### 3. How to optimize budget allocation?

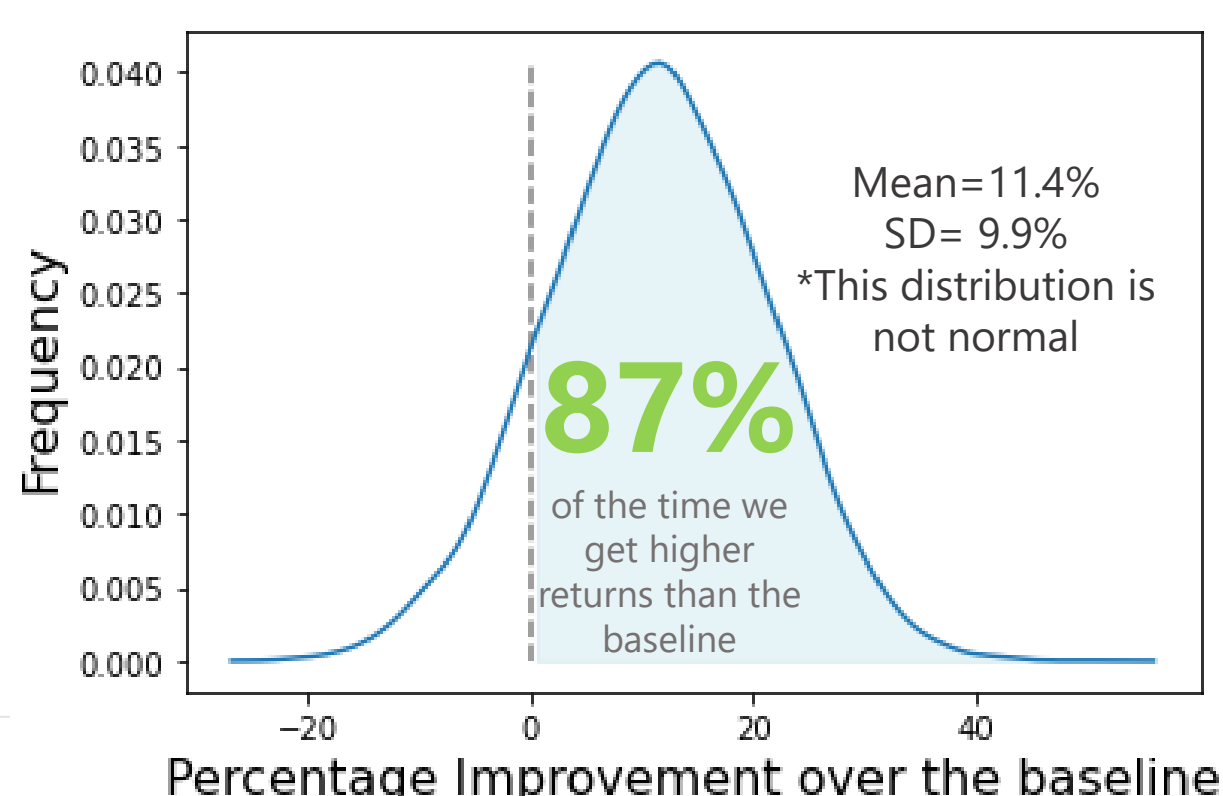
We solved an optimization problem to recommend optimal marketing budget allocation

$$\begin{aligned}
 & \text{Max}_{R_t, s_{t,j}} \sum_{t=1}^T R_t \quad \text{Total return on marketing spend} \\
 & \text{s.t.} \quad \text{Customer life time value} \\
 & R_t \leq r(\beta_0 + \sum_{j \in J} \sum_{l \in L} \beta_{t-l,j} \ln(s_{t-l,j})) - \sum_{j \in J} s_{t,j} \quad \forall t \quad \text{Demand prediction model} \\
 & |s_{t,j} - s_{t-1,j}| \leq \alpha s_{t-1,j} \quad \forall t, \forall j \quad \text{Upper bound on weekly change in marketing spend} \\
 & \sum_{j \in J} \sum_{t \in T} s_{t,j} \leq B \quad \text{Budget} \\
 & \gamma \sum_{j \in \text{Search}} s_{t,j} \leq s_{t,j=\text{display}} \quad \forall t \quad \text{Relation between spend in search and display} \\
 & R_t \geq 0 \quad s_{t,j} \geq 0
 \end{aligned}$$

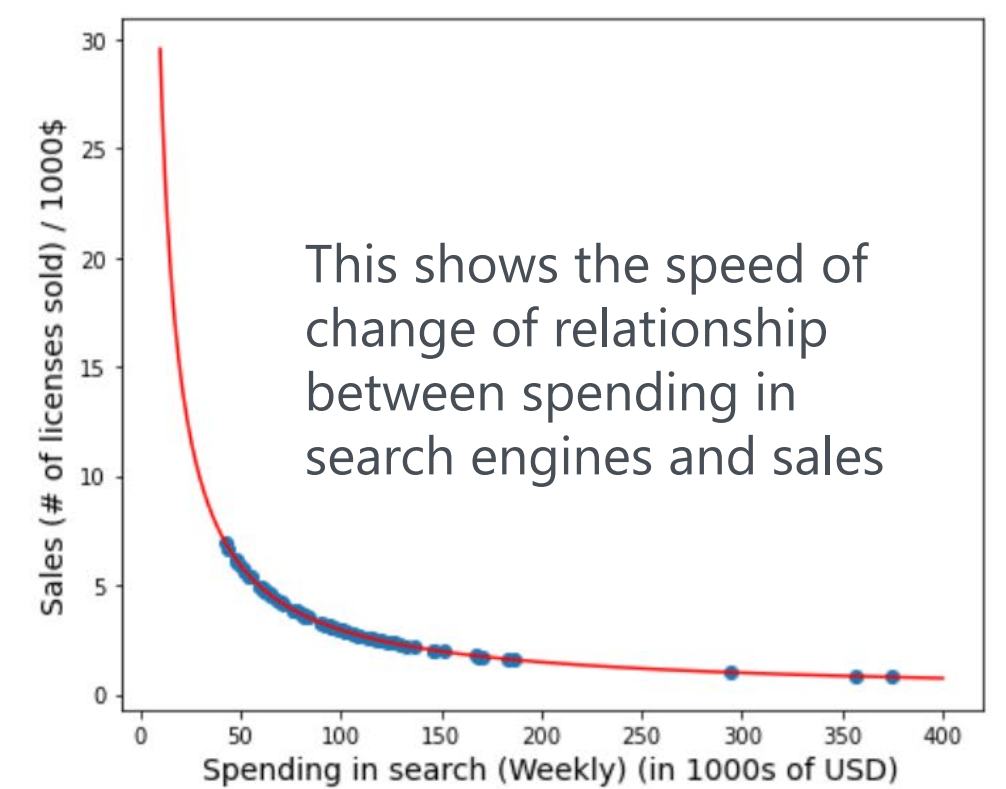
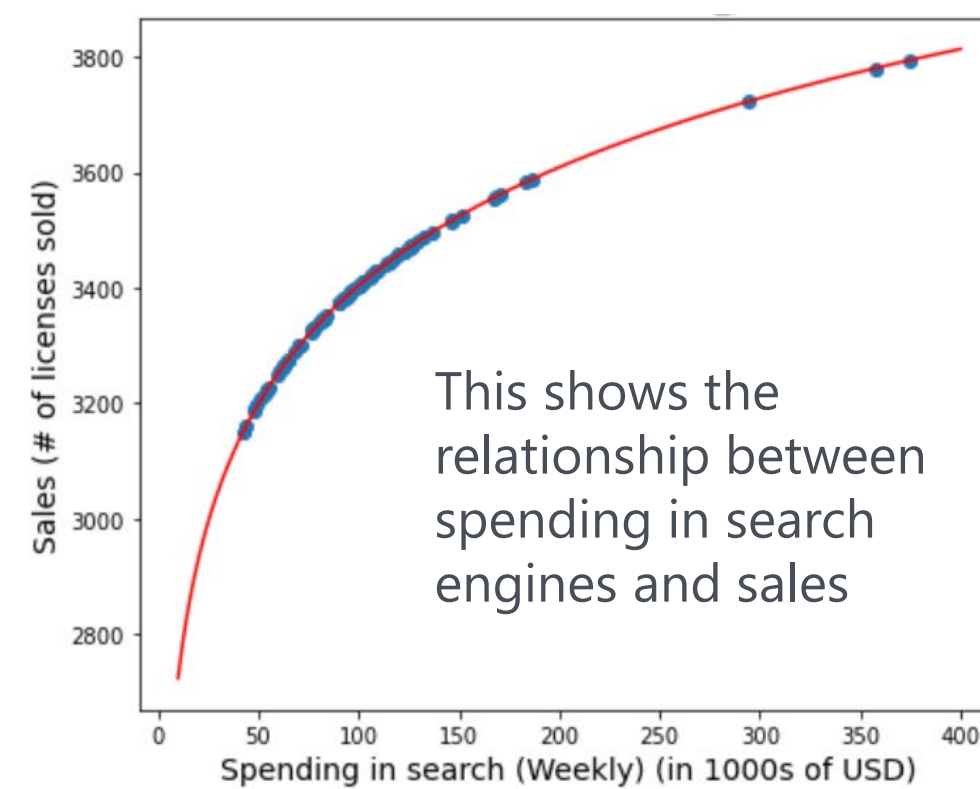
Return on Marketing Spend (Million USD)



We run simulations to evaluate the robustness of the solution against the noise in the predictions



We assumed a logarithmic relationship between marketing spending and sales



\*We repeated this analysis with all digital marketing channels

### Future work

1. Iterate the models on other products in LogMeIn portfolio
2. Expand the budget allocation formulation to include other products and channels to maximize the return on marketing spend at the company level
3. Improve the budget allocation formulation to include robustness against uncertainty in the model
4. Perform A/B testing to evaluate the impact of the optimal budget allocation model in our predictive model