Optimal Resource Allocation across Advertising Budgets

ICMS Modelling Camp
March 2016

- **Objective:**
  Maximize Skyscanner total revenues based on optimal allocation of spending on various channels of advertising.

- **Constraints**:
  - Max decrease per channel **50%**
  - Max increase per channel **10%**
  - Constant budget

- Revenues, spends for 50 channels over 6 months.

Skyscanner model

For jth channel

$$y_j = a_j x_j$$

$$\text{s.t.} \quad x_L \leq x_j \leq x_U \quad \text{and} \quad \sum_{j=1}^{N} x_j = I$$

We aim to maximize the total revenue Y

$$Y = \sum_j y_j$$

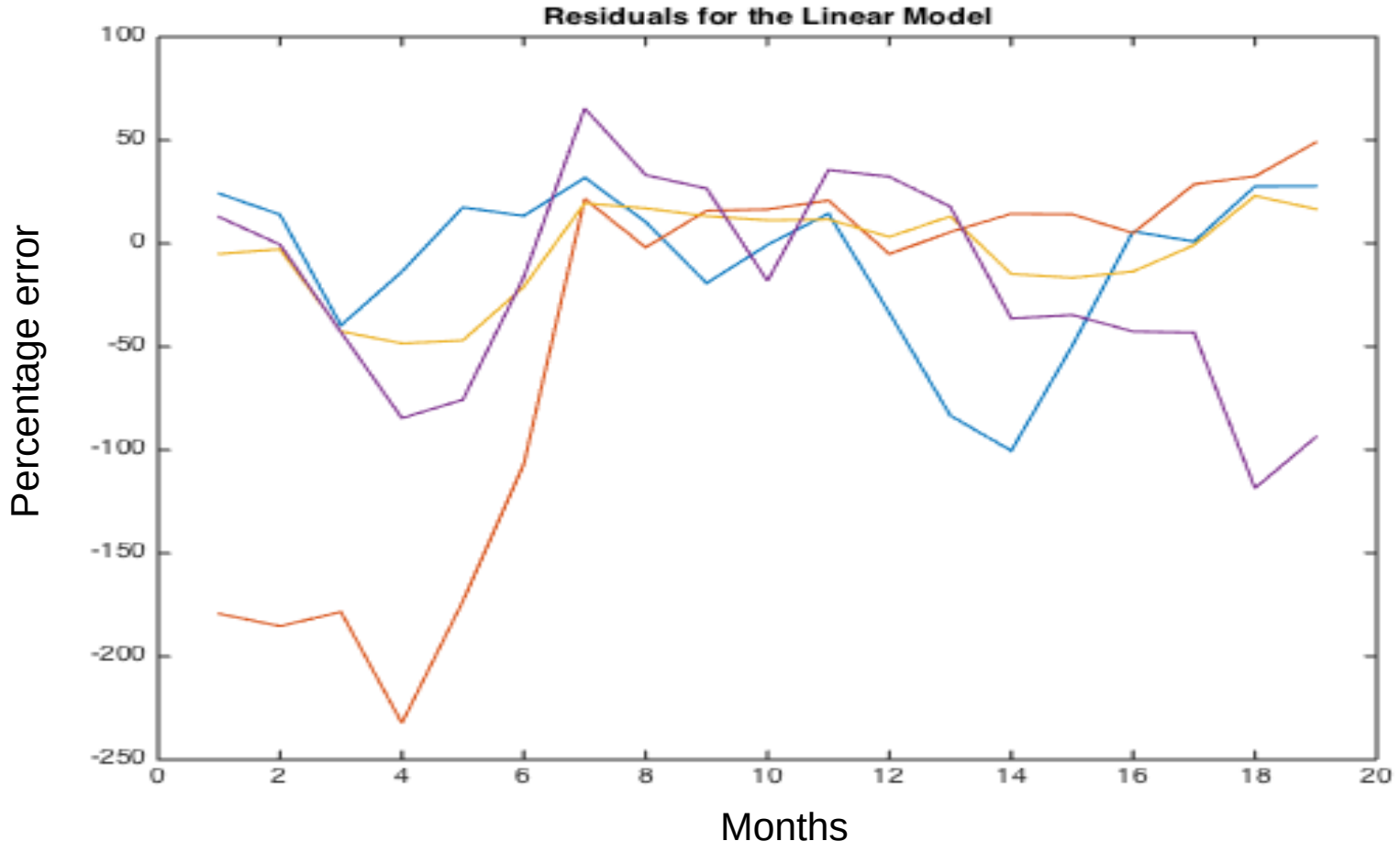
Linear model

$$y_j = a_j x_j + b_j$$

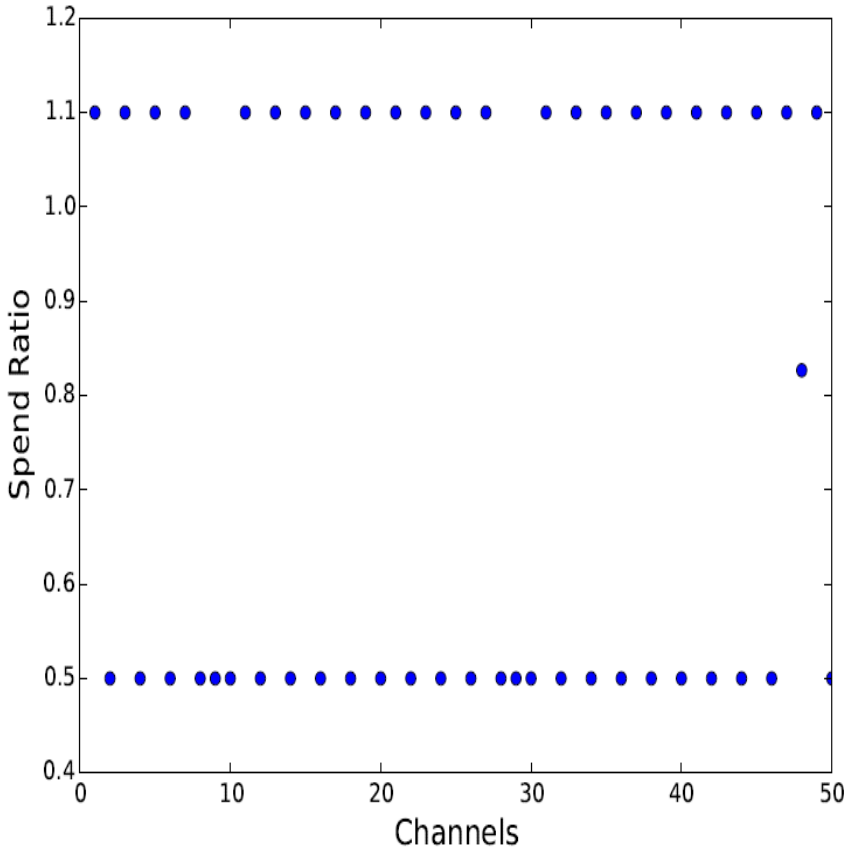
$$\text{s.t.} \quad x_L \leq x_j \leq x_U \quad \text{and} \quad \sum_{j=1}^{N} x_j = I$$

We aim to maximize the total revenue Y

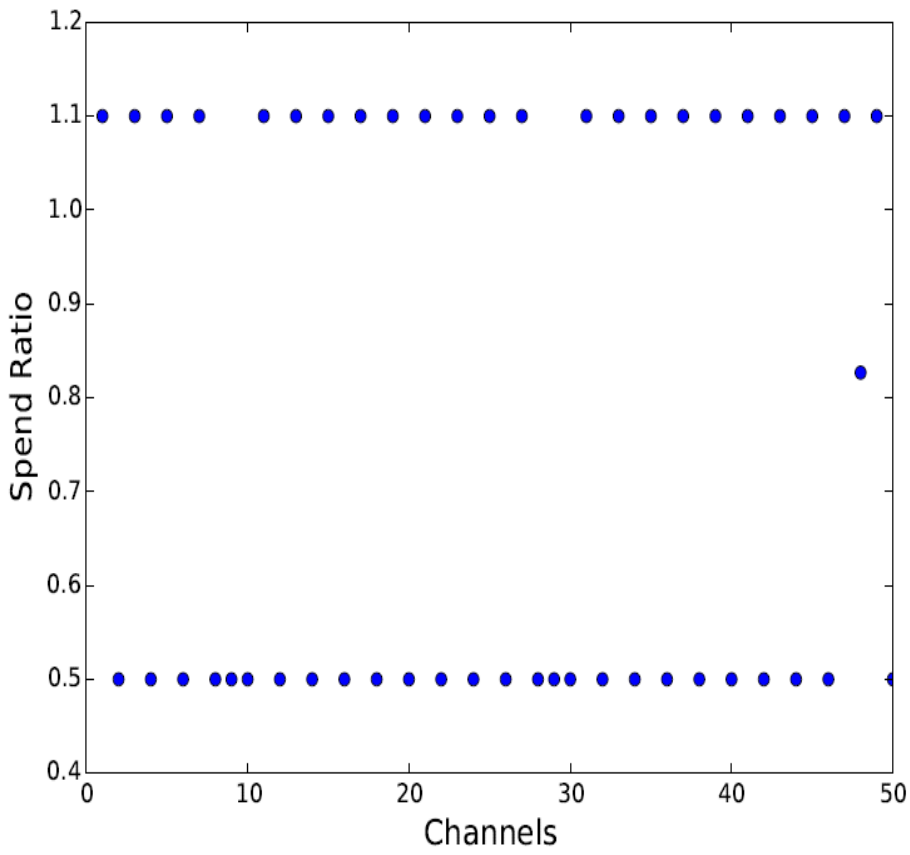
$$Y = \sum_j y_j$$


Residuals for the Linear Model
Percentage error
Months
100
50
0
-50
-100
-150
-200
-250
0
2
4
6
8
10
12
14
16
18
20

Skyscanner model



Linear model



Log-linear model

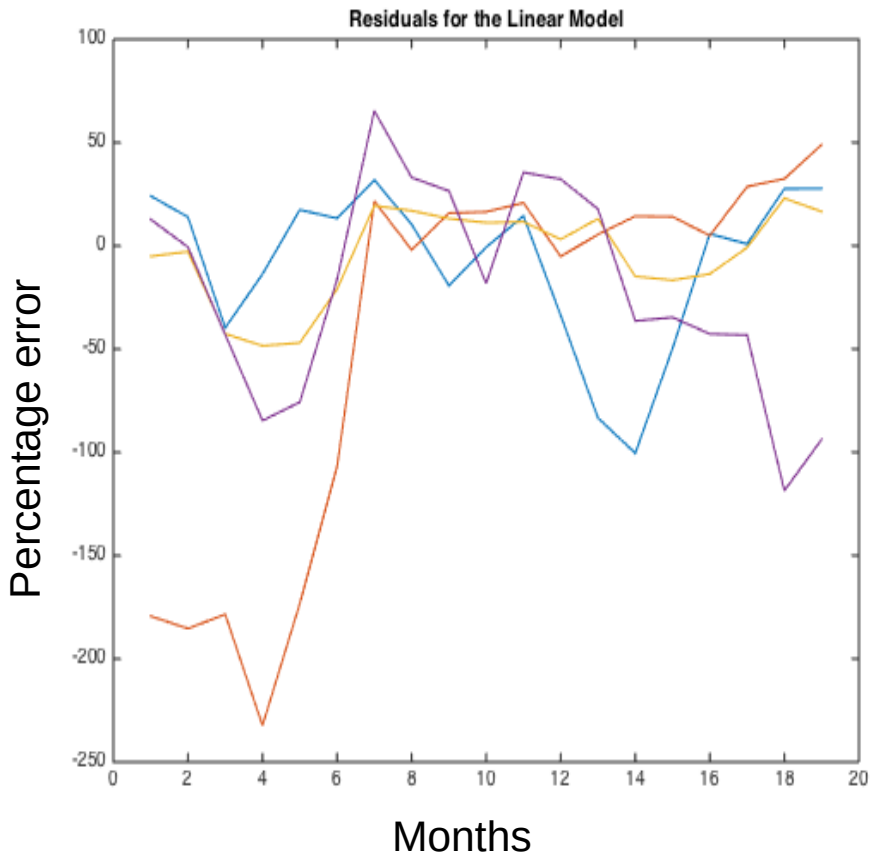
$$y_j = a_j x_j + b_j$$

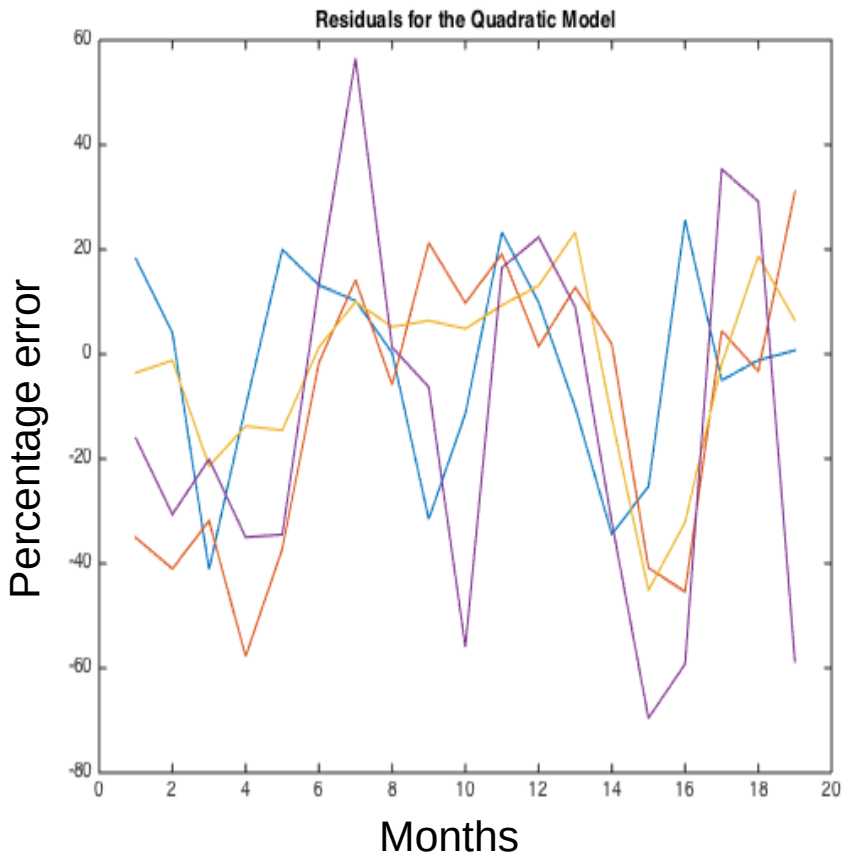
$$y_j = a_j \log x_j + b_j$$

Quadratic model

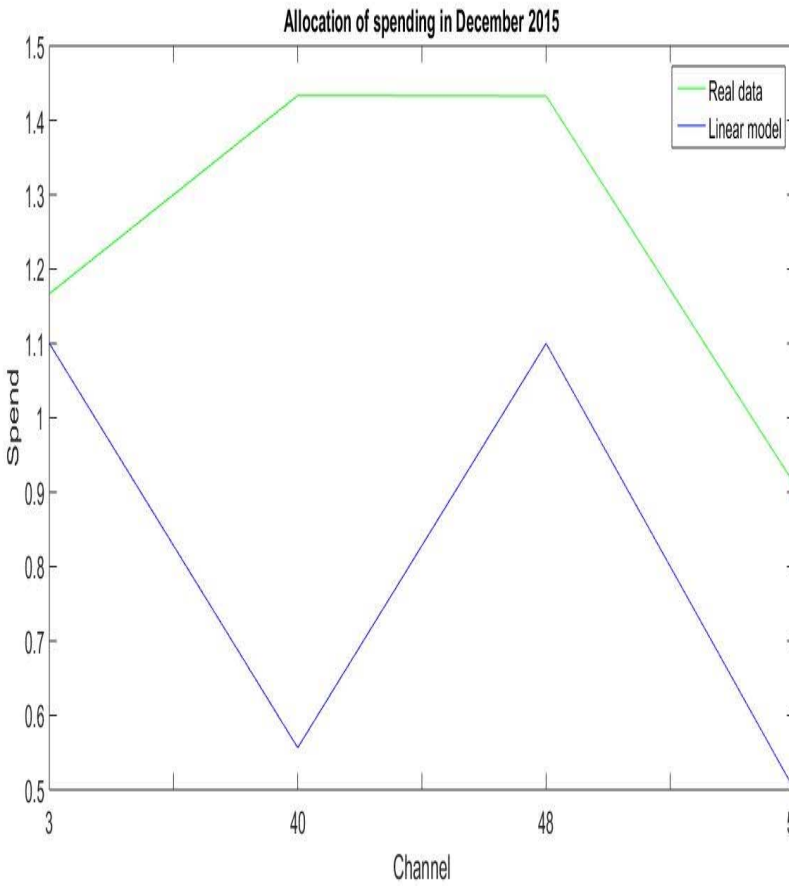
$$y_j = a_j x_j + b_j \quad + \sum_i q_{ij} x_i x_j$$

$$\text{s.t.} \quad x_L \leq x_j \leq x_U \quad \text{and} \quad \sum_{j=1}^{N} x_j = I$$

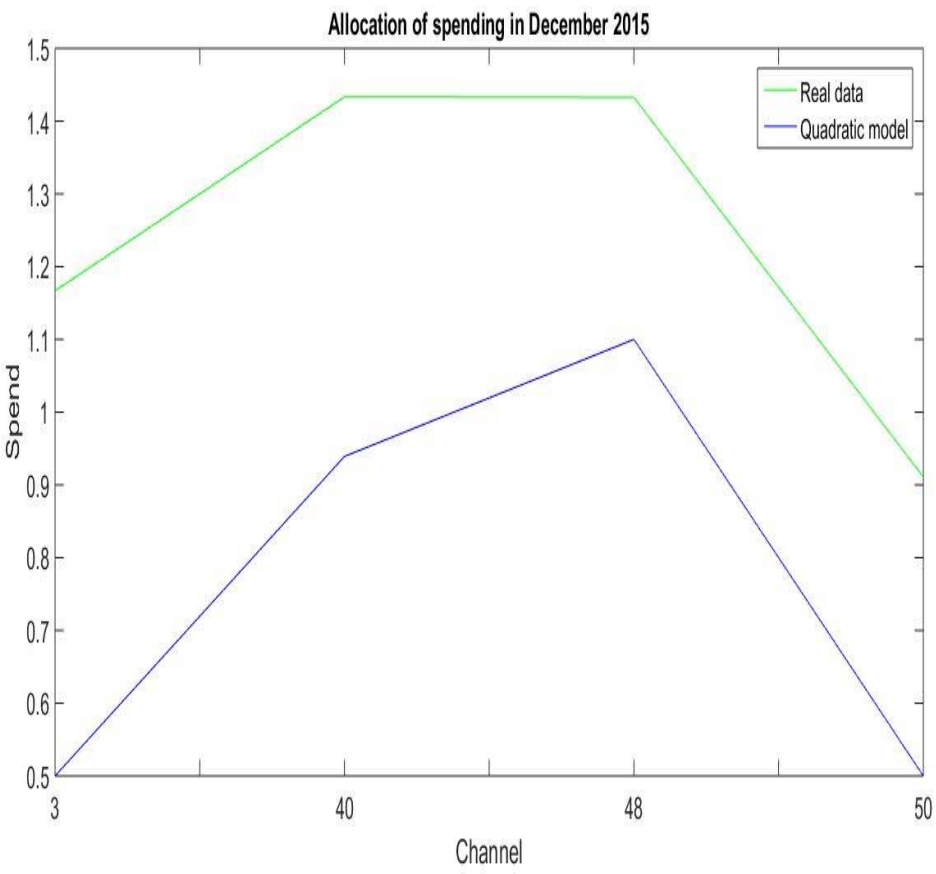

Residuals for the Linear Model
Percentage error
Months
100
50
0
-50
-100
-150
-200
-250
0
2
4
6
8
10
12
14
16
18
20


Residuals for the Quadratic Model
Percentage error
Months
60
40
20
0
-20
-40
-60
-80
0
2
4
6
8
10
12
14
16
18
20

Linear Model



Quadratic Model



Future work

- Change boundaries
- Add noise to the model?
- Allocated vs spent
- Risk
- More data
- Experiment – to validate model