Fancy a BMW?
Optimizing Customer Discounts for the UK Market

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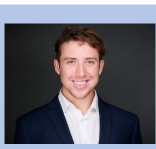
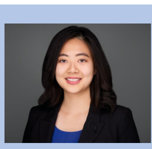
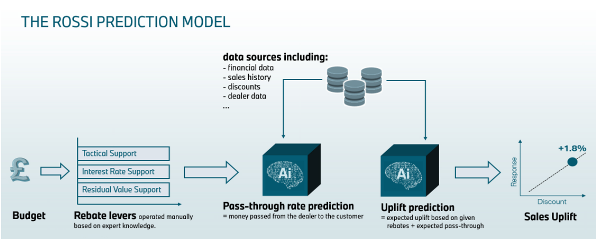

Luis Costa Laveron


Jingyuan "Donna" Gan

Project Overview

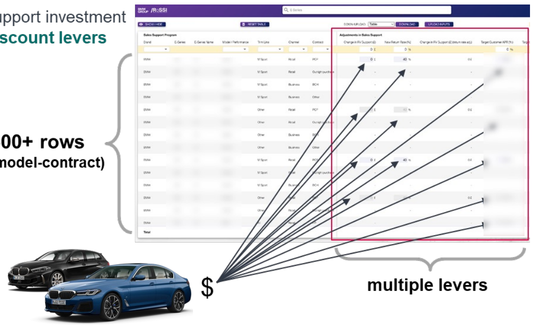


Task: optimal allocation of sales support investment across multiple vehicle series and discount levers

Vehicle Series:

- X5
- 2 series Active Tourer
- 5 series Saloon
- etc.

600+ rows (model-contract)



SALES SUPPORT LEVERS

- Tactical Cash Levers
  - → Residual Value Support (Retail-PCP Contract only)
  - → Chassis Support
  - → Deposit Contribution
  - → Motability Support (Motability Contract only)
- Percentage Rate Levers
  - → APR Support
  - → Retrospective Bonus Rate (Business Contract only)

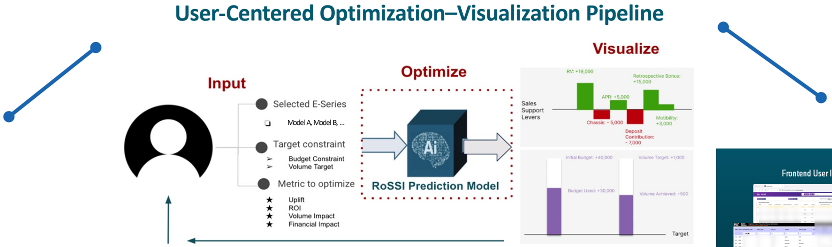
> HOW CAN BMW **INCREASE** SALES **VOLUME**?

> HOW CAN BMW **REDUCE** SALES SUPPORT **COST**?

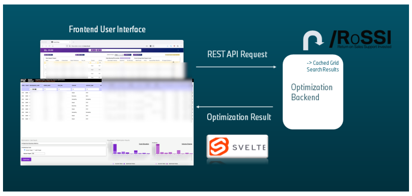
Analytical Approach

User-Centered Optimization–Visualization Pipeline

OPTIMIZATION



VISUALIZATION



Exhaustive Grid Search of Solution Space + **Integer Optimization** (find best solutions under constraints)

Tactical Cash Support	Non-Cash Percentage Rates
(Chassis Support, RV Support, Deposition Contribution, Motability)	(APR Support, Retrospective Bonus)
Increments of £100:	**Increments of 1% for Retrospective Bonus Target:**
..., -£200, -£100, £0, £100, £200, ...	0%, 1%, 2%, ...
	Set of Target APR Interest Rates:
	0.9%, 1.9%, 2.9%, 3.9%, 4.9%, 5.9%

Two Optimization Use Cases

- Maximizing business metrics under budget constraint
- Minimizing costs subject to meeting business targets

Business metrics:
- ❑ ROI
- ❑ Financial Impact
- ❑ Sales Uplift
- ❑ Volume Impact

Business targets:
- ❑ Volume Target
- ❑ Uplift Target

Minimization Problem

$$\min_{x} \sum_{i}\sum_{c} s_{ic}x_{ic}$$
$$\text{s.t.} \sum_{c} x_{ic} = 1 \quad \forall i \text{ (choose exactly one lever combination per vehicle–contract granularity)}$$
$$\sum_{i\in I_k}\sum_{c} x_{ic}v_{ic} \geq T_k \quad \forall k \text{ (hit volume targets for subset of RoSSI rows (e.g. e-series level targets))}$$
$$x_{ic} \in \{0,1\} \text{ (binary variable)}$$

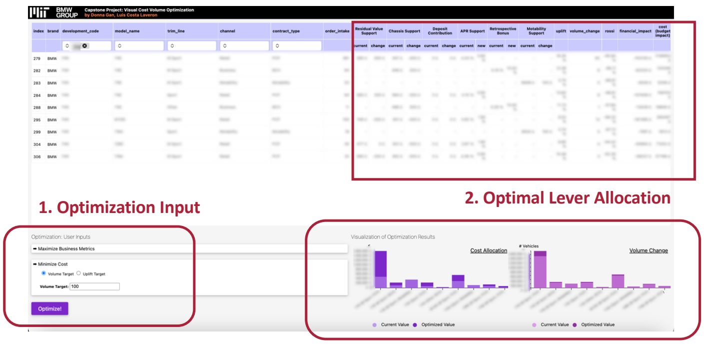
Robustified against RoSSI prediction error →

$$\sum_{i\in I_k}\sum_{c} x_{ic}\hat{v}_{ic} + \sum_{i\in I_k}\sum_{c} x_{ic}\delta_{ic}z_{ic} \geq T_k \quad \forall k \quad \forall \mathbf{z} \in \mathcal{Z}$$
$$\mathcal{Z} = \{\mathbf{z} : ||\mathbf{z}||_\infty \leq \rho, ||\mathbf{z}||_1 \leq \Gamma\}$$

Maximization Problem

$$\max_{x} \sum_{i}\sum_{c} x_{ic}r_{ic}$$
$$\text{s.t.} \sum_{c} x_{ic} = 1 \quad \forall i \text{ (choose exactly one lever combination per vehicle–contract granularity)}$$
$$\sum_{i\in I_k}\sum_{c} x_{ic}s_{ic} \leq B_k \quad \forall k \text{ (meet budget constraints)}$$
$$x_{ic} \in \{0,1\} \text{ (binary variable)}$$

User Interface



3. Visualize Cost –Volume Tradeoff

Result & Further Consideration

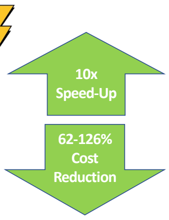
1: Real-Time Optimization + Significant Cost Savings

An Example Use Case with Electric Vehicles:

5 vehicle–contract granularities
- → Chassis Support Lever
- → Retrospective Bonus Rate Lever
- → Residual Value Support Lever
- → Deposit Contribution Lever
- → APR Support Lever
- → Motability Support Lever

5 vehicle–contract granularities
- → Chassis Support Lever
- → Retrospective Bonus Rate Lever
- → Residual Value Support Lever
- → Deposit Contribution Lever
- → APR Support Lever

3 vehicle–contract granularities
- → Chassis Support Lever
- → Retrospective Bonus Rate Lever
- → Residual Value Support Lever
- → Deposit Contribution Lever
- → APR Support Lever



Random Search

Minimize Costs Subject to Meeting Business Targets

	Total Financial Impact	Average ROI	Total Volume Impact	Average Uplift	Total Cost (Budget Impact)	Runtime
Volume-Constrained	-£3,296,868.51	-0.3869957929	100.00	4.15%	£4,174,972.36	20.3s
Uplift-Constrained	-£2,800,784.00	-32.74%	98.87	4.00%	£3,674,768.63	20.5s

Optimization (Example Numbers)

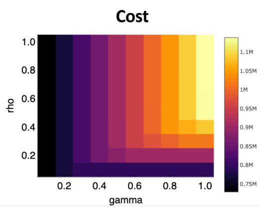
Minimize Costs Subject to Meeting Business Targets

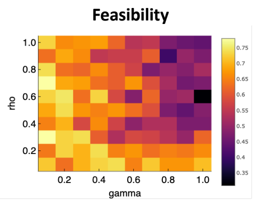
	Total Financial Impact	Average ROI	Total Volume Impact	Average Uplift	Total Cost (Budget Impact)	Runtime
Volume-Constrained	-£1,939,525.89	-20.78%	100.02	1.91%	£1,570,450.64	2.78s
Uplift-Constrained	£1,587,635.17	-14.47%	-60.08	4.00%	-£984,870.71	2.28s

2: Mitigating Price Cannibalization Effect

(no cannibalization constraints)			
Average Uplift	7.81%	0.91%	5.90%
Relative Price Difference	4.52%	5.19%	0.67%
(with cannibalization constraints)			
Average Uplift	7.81%	0.90%	5.90%
Relative Price Difference	4.52%	4.96%	0.67%

3: Trading Off Cost vs Robustness





$$\mathcal{Z} = \{\mathbf{z} : ||\mathbf{z}||_\infty \leq \rho, ||\mathbf{z}||_1 \leq \Gamma\}$$