‘What options would you like in your BMW i8?’

Option take-rate forecasting for BMW Group


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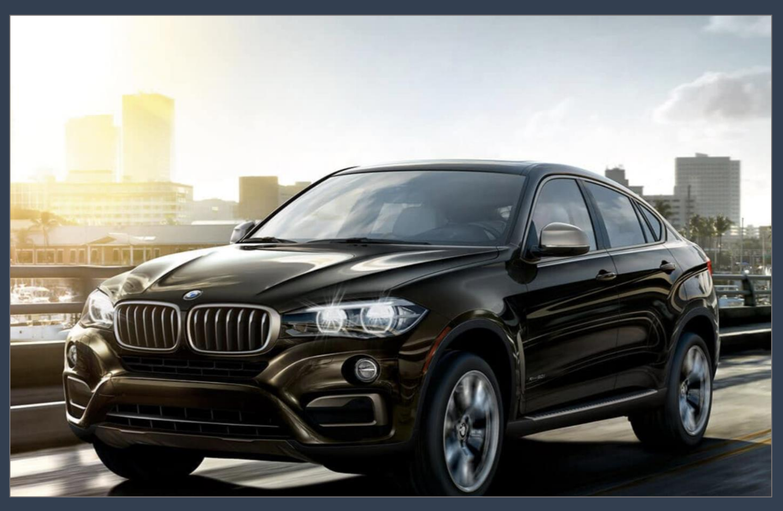
Model



BMW X6 XDRIVE 50I

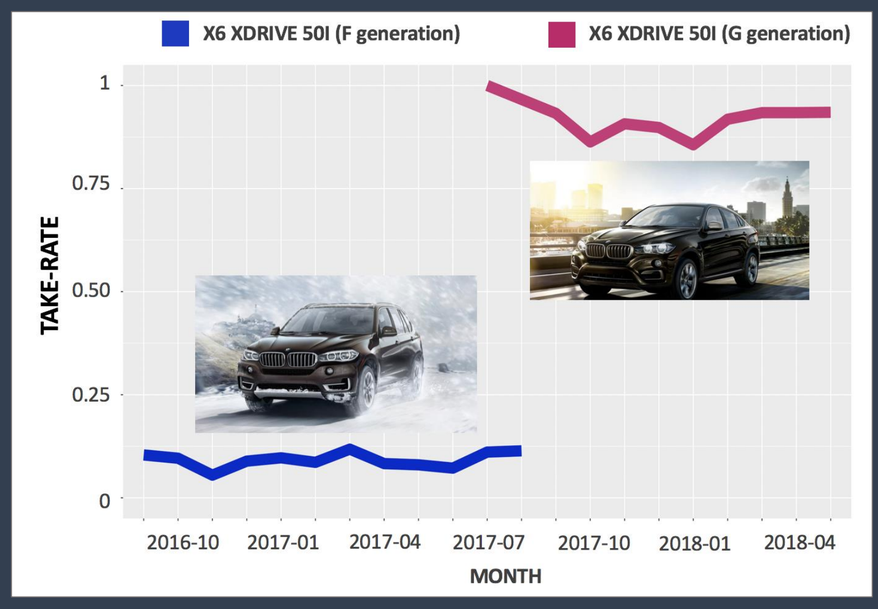
Options

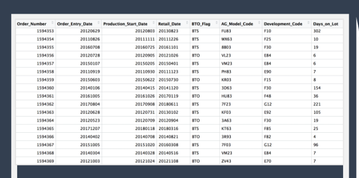
Back seat entertainment

Display key

Bi-LED lights

Take-rates
(illustrative)





Data source: VDWH
- Individual sales data
- Row is a sale containing all features and options
- Data serves as basis for full project scope

1 Feb. 2018 — 1 Jun. 2018 — 17 Aug. 2018

US Build-to-stock optimization
First part of project
- Goal: Perform alternative to current BMW approach
- Define and test choice modeling approach
- Compare results to ML-approach from BMW

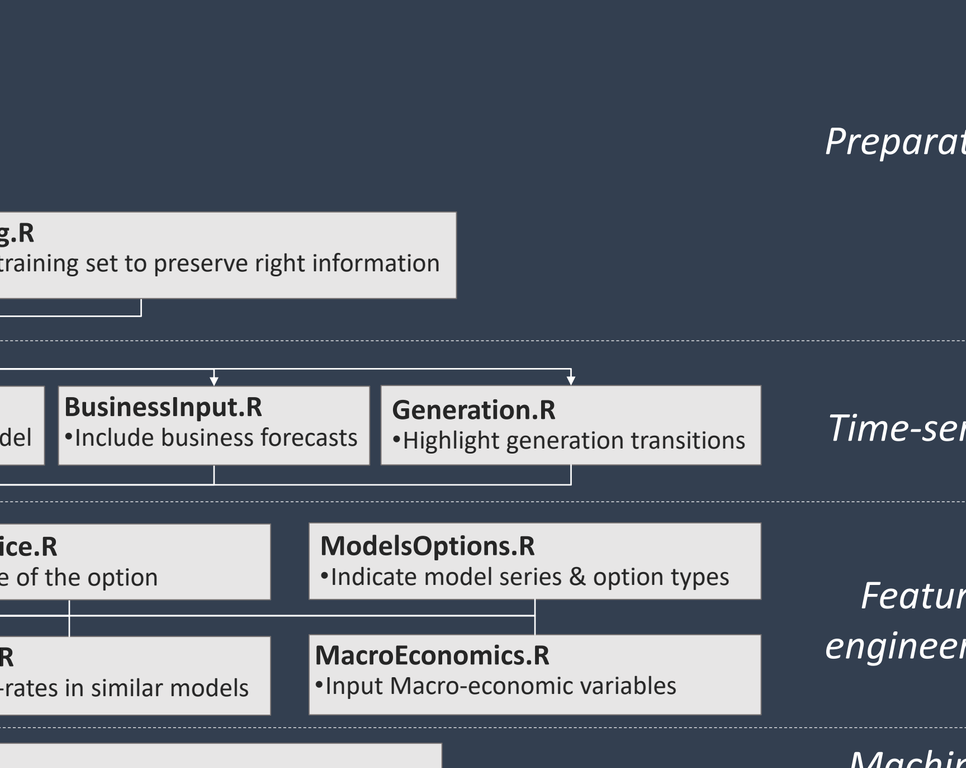
Option take-rate forecasting
Part two and content of this poster
- Goal: Establish Option Take-rate forecasting model
- Define approach, features and model from scratch
- Hand-over to BMW/BCG Gamma for implementation

SOP + 6 months

MAE observed
(in % pt take-rate)

		MIT Model Informed by markets	MIT Model Uninformed	Baseline	BMW market forecasts
1 Existing models	Overall	NA	4.1% ↓	6.9%	NA
2 New Models	Overall	6.5% ↓	8.5% ↑	10.5%	7.8%
	G30 540I	5.2% ↓	7.0% ↑	9.6%	6.4%
	G30 540I XDRIVE	6.0% ↓	7.4% ↓	11.8%	8.3%
	G30 M550I XDRIVE	10.9% ↑	12.4% ↑	12.2%	10.1%
	G01 X3 XDRIVE 30I	4.9% ↓	8.0% ↑	8.5%	6.8%

SOP + 6 - 11 months



Pipeline steered by main document (R)

Data (.csv)

Raw data (VDWH or BV-15) → **Initial data frame.R**
- Produce monthly option take-rates per unique ID

Monthly take-rates per ID → **Smoothing.R**
- Perform LOESS on take-rates across full timespan

Regular and smoothed take-rates per ID → **Target.R**
- Create prediction target (at prediction horizon set)

→ **Re-smoothing.R**
- Re-smooth training set to preserve right information

Data including prediction and target variables → *Preparation*

Multiple data sets including time-related variables → **Historic.R** •Set historic take-rates; **Linear.R** •Fit linear trends; **Quadratic.R** •Assess TR convexity; **ARIMA.R** •Forecast ARIMA model; **BusinessInput.R** •Include business forecasts; **Generation.R** •Highlight generation transitions → *Time-series*

Option price.R
•Show price of the option

ModelsOptions.R
•Indicate model series & option types

Joining.R
- Joins the predictors into one data frame

Similarity.R
•Show take-rates in similar models

MacroEconomics.R
•Input Macro-economic variables

One data set including all prediction variables → *Feature engineering*

Grid Search.R
- Optimize hyperparameters using cross-validation

→ **XGB.R**
- XGBoost on input and prediction data

Values & importances of variables in prediction → *Machine Learning*

Rule-based Optimization.R
- Avoids rule violation: rules as constraints
- Outcome optimally close to ML output

Test set RMSE and MAE and predicted future take-rates → *Optimization*

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