Final Listing Price Prediction for Private Used Car Sellers

Group 2 - Ji-Soo Kim, Tae-Yoon Kim, Jun-Beom Lee, Jin-Joo Yang, Sung-Hyun Kim

Table of Contents

1. Introduction

2. Data Preprocessing

3. Modeling Preview

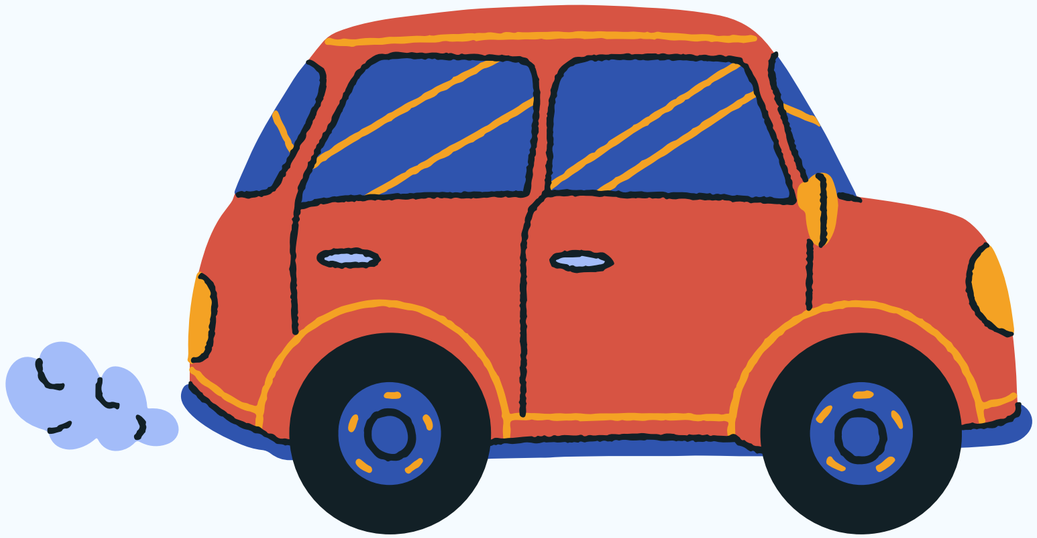
4. Model - Linear Regression

5. Model - Decision Tree

6. Model - Random Forest

1. Inroduction

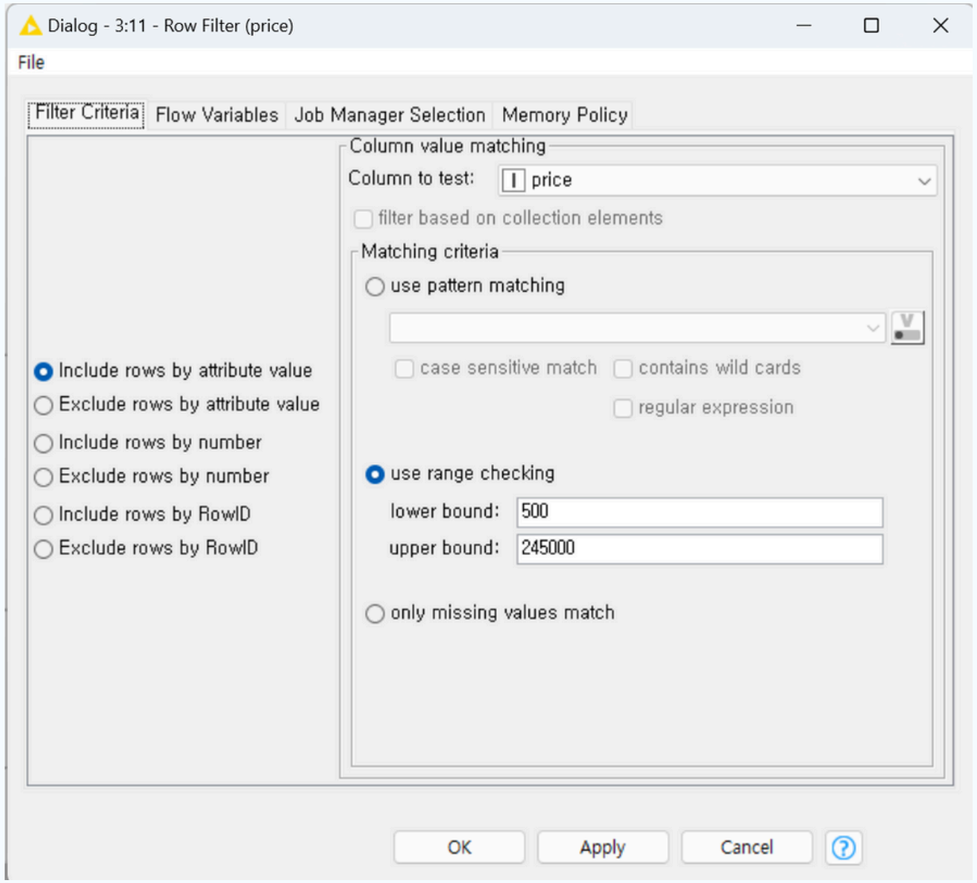
Target: **Used car owners**
Goal: **Final Listing Price Prediction**
➡️ using crawled private sale car record data from various sites



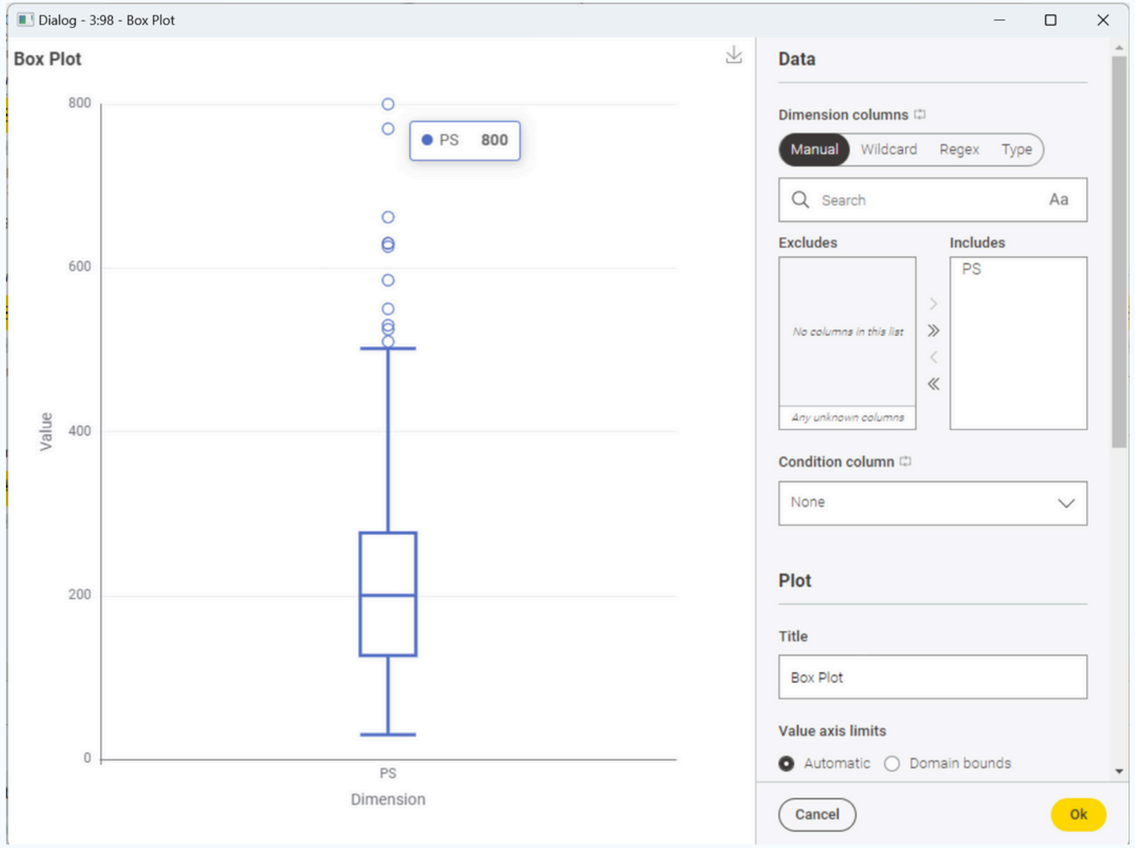
2. Data Preprocessing

RowID	dateCrawled String	name String	price ↓ Number (intege...
1299...	2016-03-11 08:...	Kaufe_AUTOS_...	2147483647
56973	2016-03-18 18:...	tausche_ford_...	99999999
69747	2016-03-20 10:...	Suche_Merced...	99999999
77520	2016-03-22 14:...	Tausch_gegen...	99999999
1089...	2016-03-29 00:...	Biete_Hier_zu...	99999999
1278...	2016-03-14 17:...	audi_a6_c5_av...	99999999
1390...	2016-03-14 12:...	Mercedes_Ben...	99999999
1509...	2016-04-02 22:...	Suche_Autos_...	99999999
1605...	2016-03-29 12:...	Golf_4_schrott	99999999
1897...	2016-04-03 12:...	Oldtimer_Gogg...	99999999
2466...	2016-03-25 11:...	Suche_Vw_Pas...	99999999
2681...	2016-04-01 09:...	Schlachte_e36...	99999999
2800...	2016-03-05 20:...	Kaufe_VW_Gol...	99999999
3255...	2016-03-27 21:...	Tausche/_verk...	99999999
3627...	2016-03-06 10:...	Passat_35i_1.8...	99999999
3666...	2016-03-20 10:...	BMW_E36_Cab...	99999999
2519...	2016-03-21 22:...	Audi_A6_2.7_T...	99000000
1209...	2016-03-25 12:...	???_?_???____?...	74185296
1833...	2016-03-26 11:...	BMW_e60_nur...	32545461
87799	2016-03-08 20:...	Leasinguebern...	27322222
2799...	2016-04-03 11:...	Mercedes_Ben...	14000500

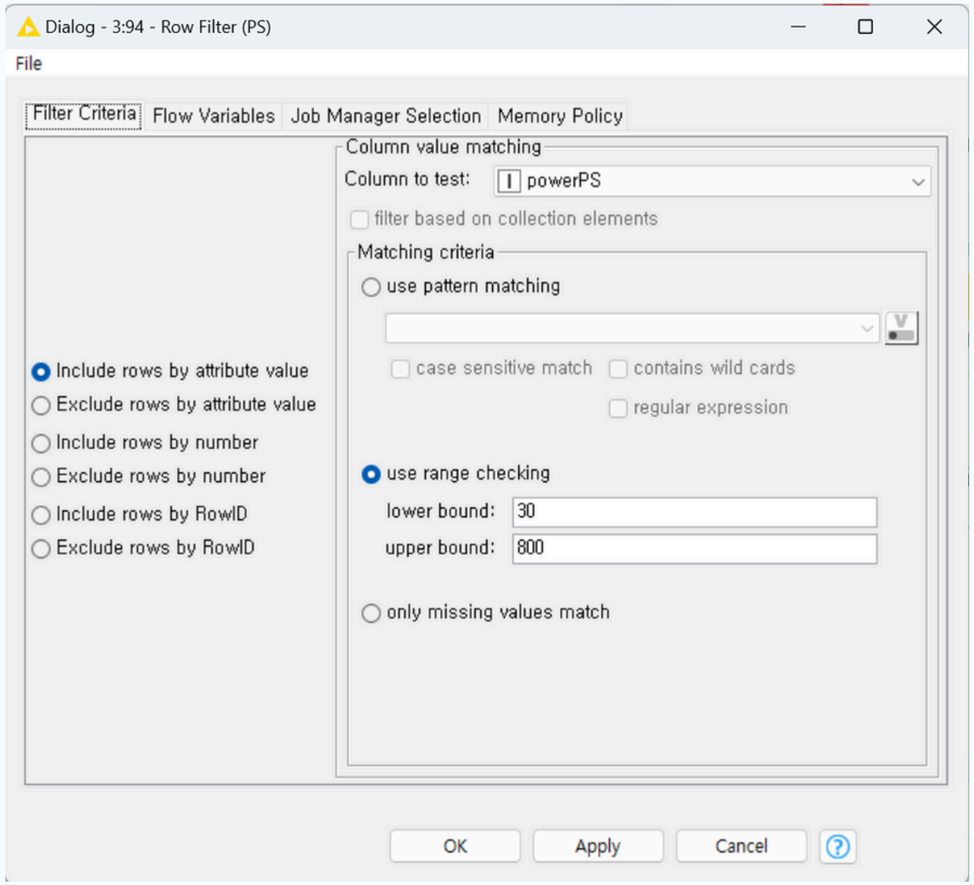
Setting a range for handling outliers in the **Price** column



2. Data Preprocessing



Setting a range for handling outliers in the **PowerPS** column

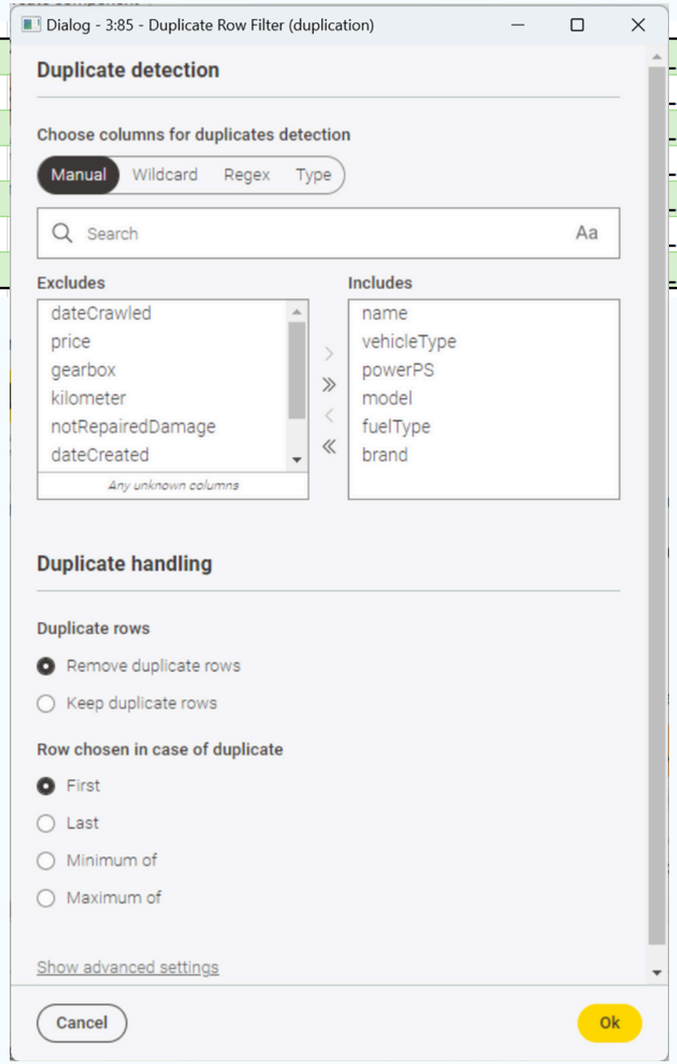


collect the horsepower of the models in the dataset

➡ identify the min & max

2. Data Preprocessing

2016-03-06 0:00	2016-03-06 9:47	2016-03-09 22:18	*_Mercedes_Benz_W220_S_400_CDI_Langvers._<>_162_TKM_>_1	9999			_benz
2016-03-10 0:00	2016-03-10 7:55	2016-03-11 8:44	*_Mercedes_Benz_W220_S_400_CDI_Langvers._<>_162_TKM_>_1	9999			_benz
2016-03-11 0:00	2016-03-11 9:53	2016-03-13 4:46	*_Mercedes_Benz_W220_S_400_CDI_Langvers._<>_162_TKM_>_1	9999			_benz
2016-03-20 0:00	2016-03-20 8:54	2016-03-25 7:51	*_Mercedes_Benz_W220_S_400_CDI_Langvers._<>_162_TKM_>_1	9999			_benz
2016-03-25 0:00	2016-03-25 9:38	2016-03-28 7:45	*_Mercedes_Benz_W220_S_400_CDI_Langvers._<>_162_TKM_>_1	9999			_benz
2016-03-28 0:00	2016-03-28 19:54	2016-04-01 5:17	*_Mercedes_Benz_W220_S_400_CDI_Langvers._<>_162_TKM_>_1	9999			_benz
2016-04-02 0:00	2016-04-02 7:55	2016-04-02 9:41	*_Mercedes_Benz_W220_S_400_CDI_Langvers._<>_162_TKM_>_1	9999			_benz



Handle duplicate rows
(Some of the features are exactly the same)

Our Project's Goal: **Final Listing Price**

➡️ Sort by 'createdAt', leaving the most recent row.

3. Modeling preview - model & performance

Linear Regression

represent linear relationship
(ft. input, output)
fast # easy to interpret

good for non-linear relationship
good at handling outlier

Decision Tree

Random Forest

combine several decision trees
better generalization (ft. decision tree)

3. Modeling preview - model & performance

R^2

indicate how well explain real value

MAPE
(Mean Absolute Percentage Error)

| actual value - predict value | (%)

=> used in all price range
(regardless size of price)

adjusted R^2

MAD
(Mean signed difference)

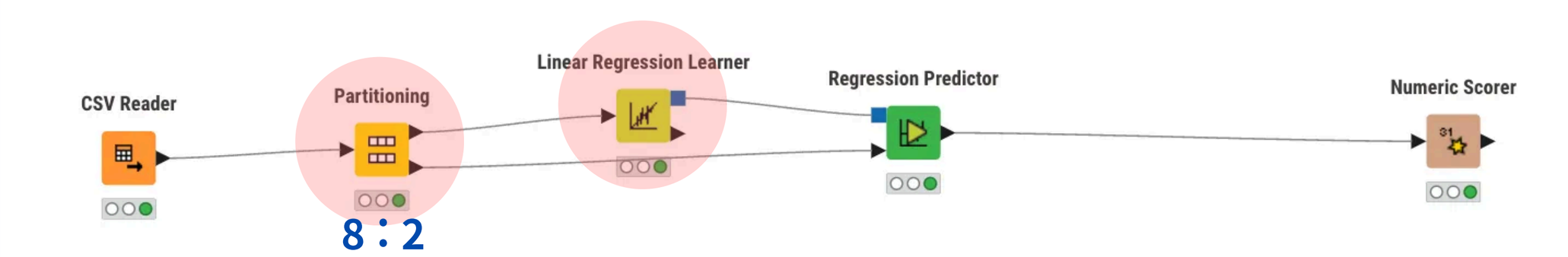
MAE
(Mean absolute error)

MSE
(Mean squared error)

calculate the average error for all price
=> relatively high error at low price

3. Model - Linear Regression

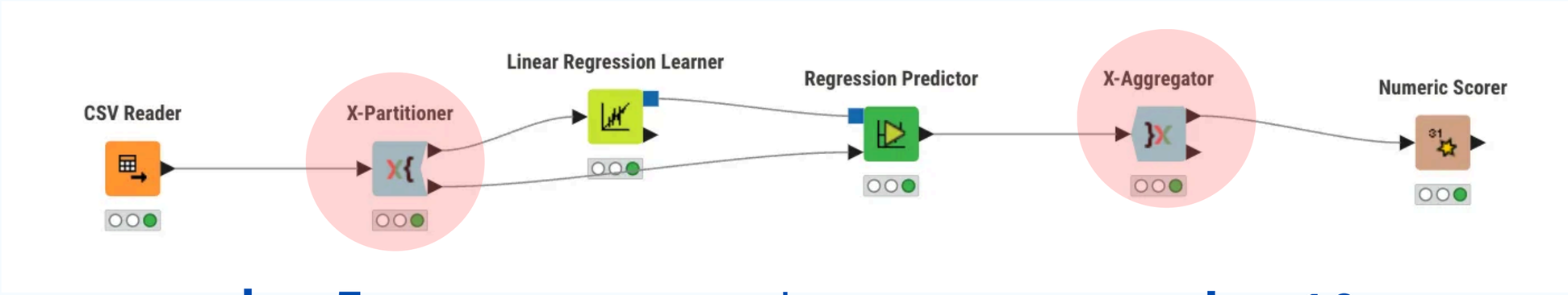
Base Line → K-fold validation → Normalization



performance	prediction (price)
R^2	0.551
MAPE (Mean Absolute Percentage Error)	1.029

3. Model - Linear Regression

Base Line ⟶ **K-fold validation** ⟶ Normalization



k = 5

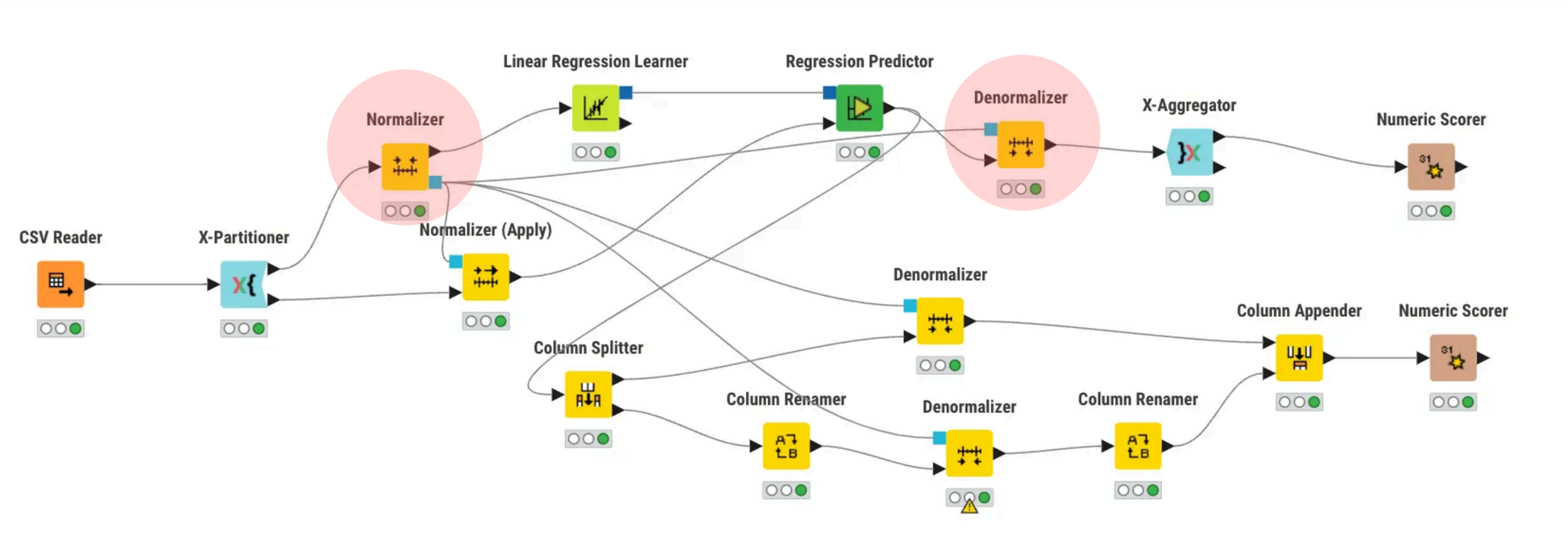
performance	prediction (price)
R^2	0.551
MAPE (Mean Absolute Percentage Error)	1.029

k = 10

performance	prediction (price)
R^2	0.551
MAPE (Mean Absolute Percentage Error)	1.029

3. Model - Linear Regression

Base Line ⟶ K-fold validation ⟶ **Normalization**



prediction (price)
0.549

Normalizer

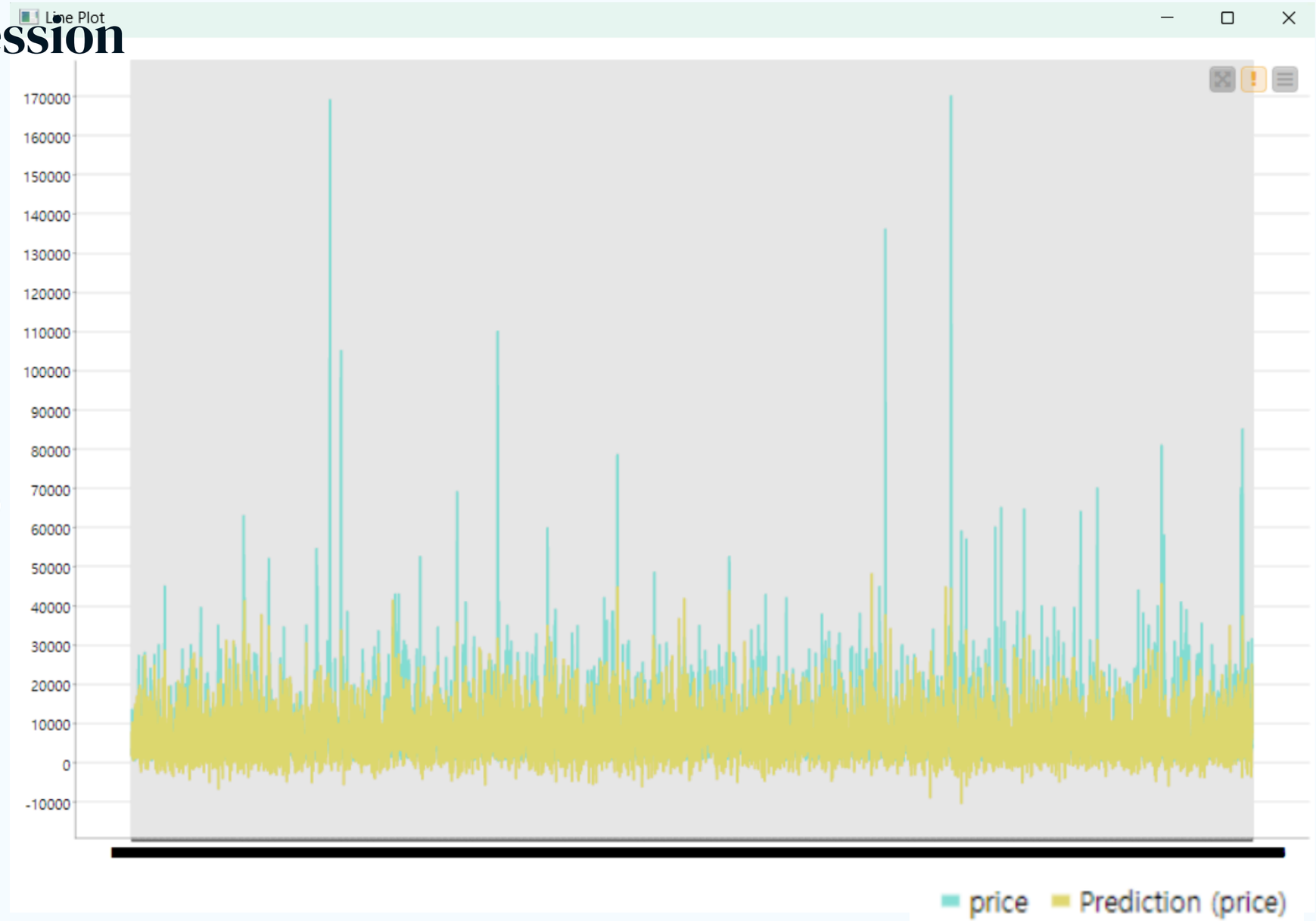
powerPS
kilometer
vehicleType
how old

<- continuous variable

3. Model - Linear Regression

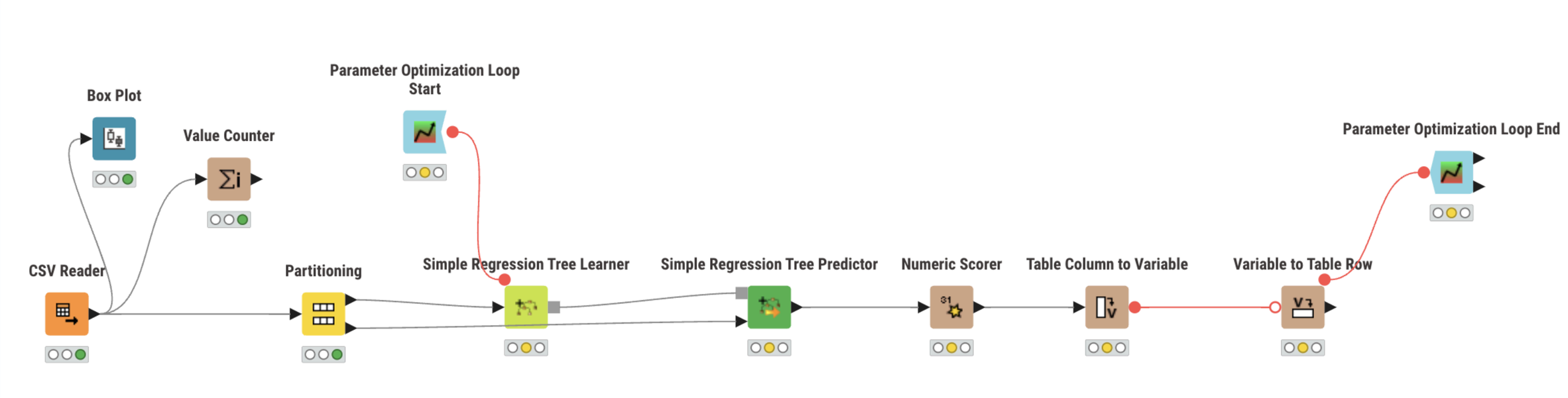
linear regression

Used car prices are likely not to change linearly...
=> Let's consider nonlinear models
such as Random Forest etc.



4. Model - Decision Tree

Optimal Parameters → Base Line → K-fold validation → Normalization



4. Model - Decision Tree

Optimal Parameters → Base Line → K-fold validation → Normalization

Max Tree Depth

Start Value	Stop Value	Step Size	Best Param
1	300	5	**11**
1	30	1	**12**

Minimize Split Node Size

Start Value	Stop Value	Step Size	Best Param
1	300	5	21
1	30	1	**18**

Minimize Node Size

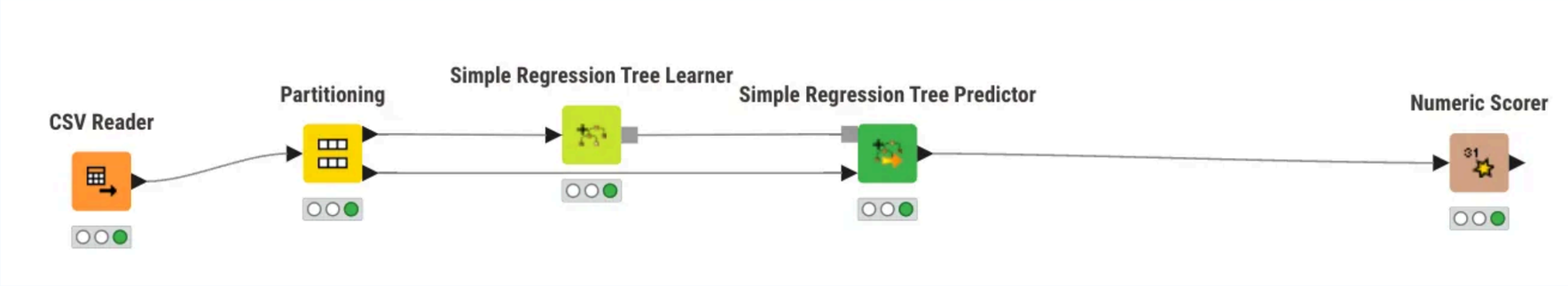
Start Value	Stop Value	Step Size	Best Param
1	9	1	**8**

➡️ The Optimal Combination

Max Tree Depth : 12, Minimize Split Node Size: 18, Minimize Node Size: 8

4. Model - Decision Tree

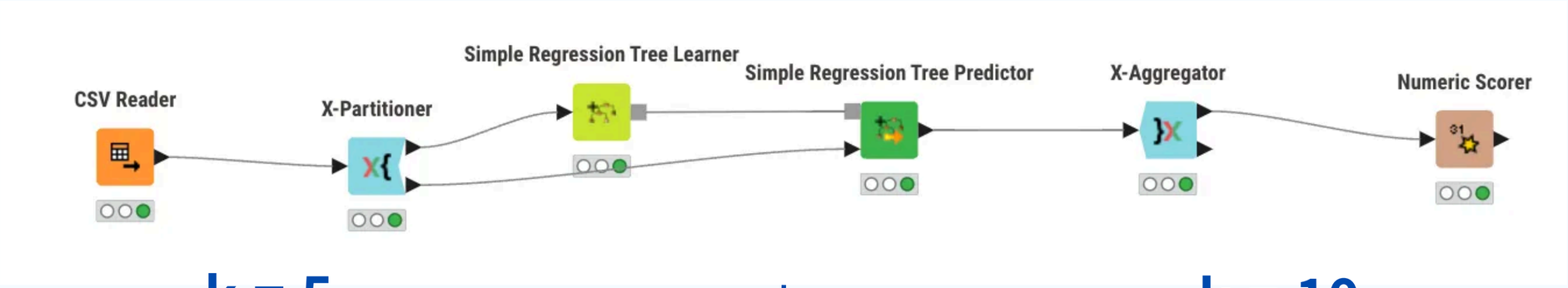
Optimal Parameters → **Base Line** → K-fold validation → Normalization



performance	prediction (price)
R^2	0.841
MAPE (Mean Absolute Percentage Error)	0.365

4. Model - Decision Tree

Optimal Parameters ⟶ Base Line ⟶ **K-fold validation** ⟶ Normalization



k = 5

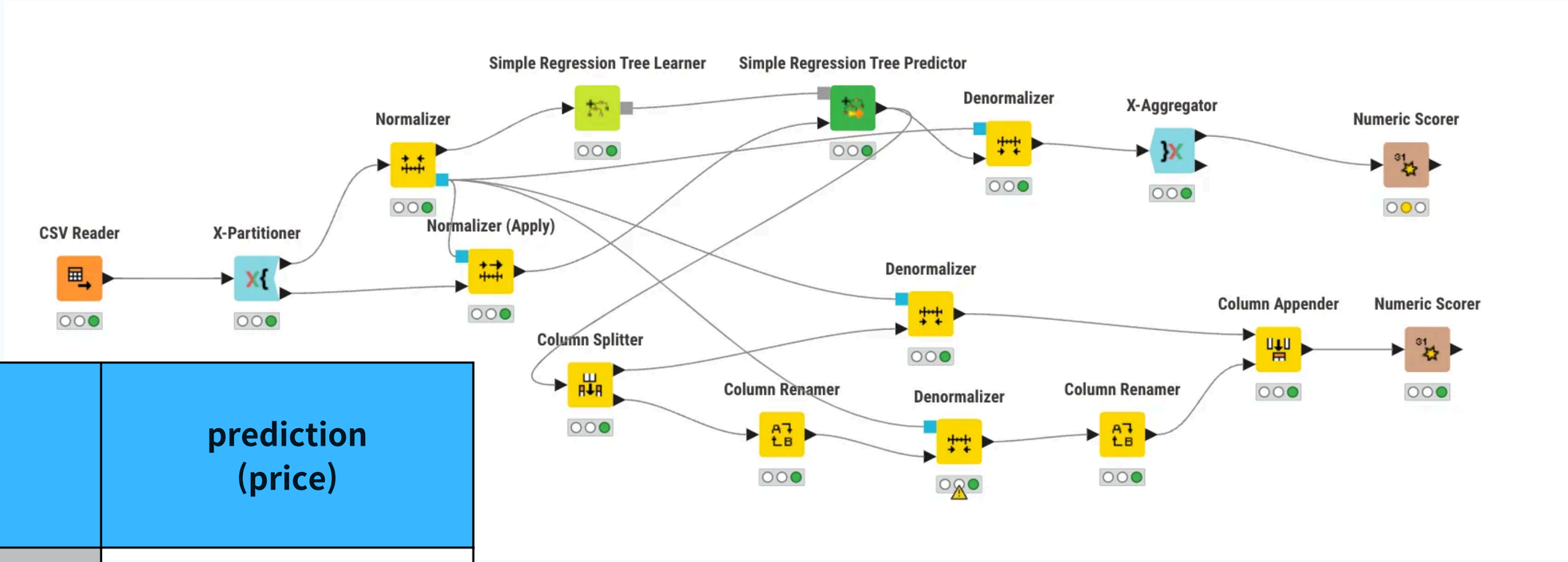
performance	prediction (price)
R^2	0.854
MAPE (Mean Absolute Percentage Error)	0.368

k = 10

performance	prediction (price)
R^2	0.854
MAPE (Mean Absolute Percentage Error)	0.369

4. Model - Decision Tree

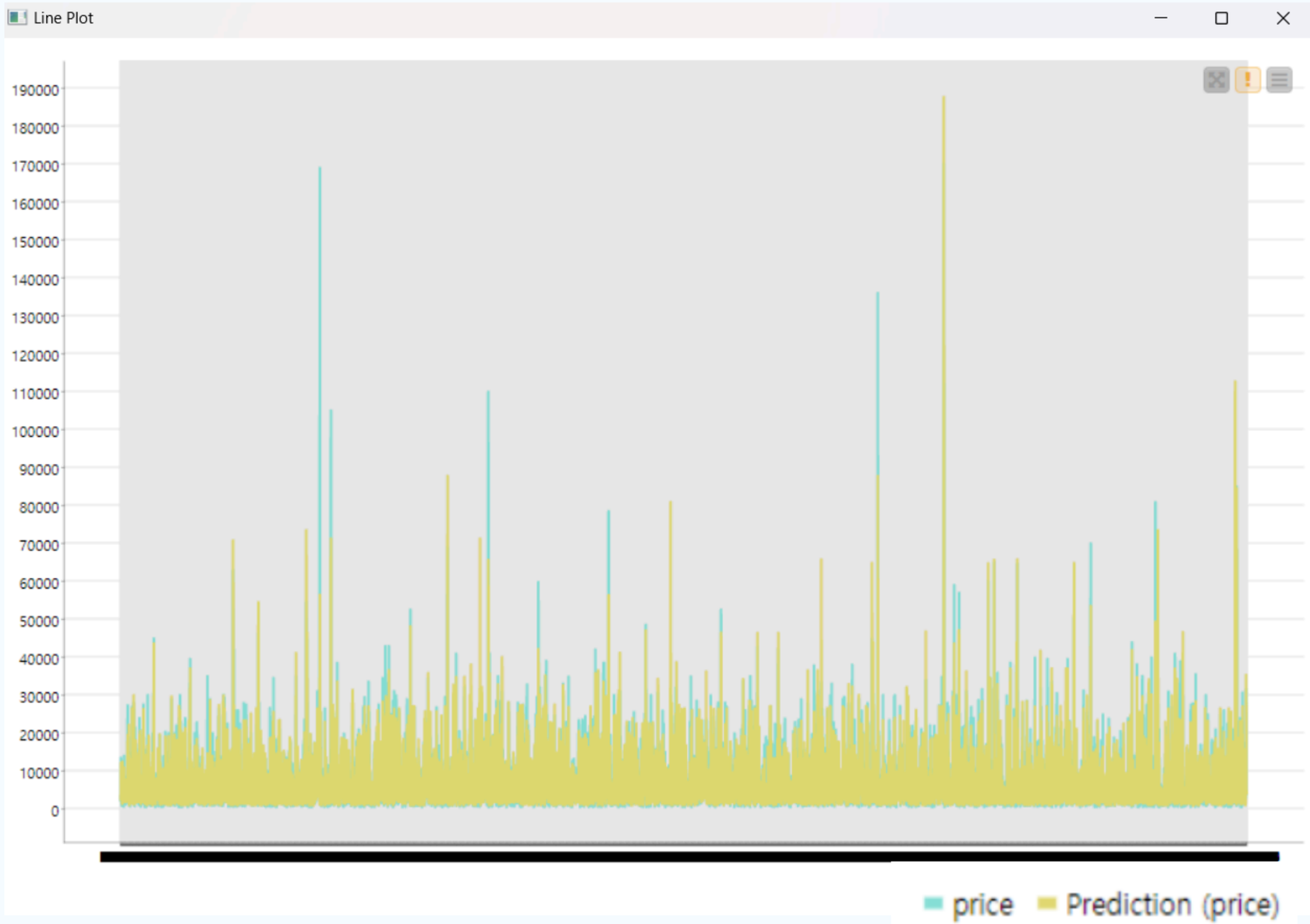
Optimal Parameters ⟶ Base Line ⟶ K-fold validation ⟶ **Normalization**



performance	prediction (price)
R^2	0.858
MAPE (Mean Absolute Percentage Error)	0.378

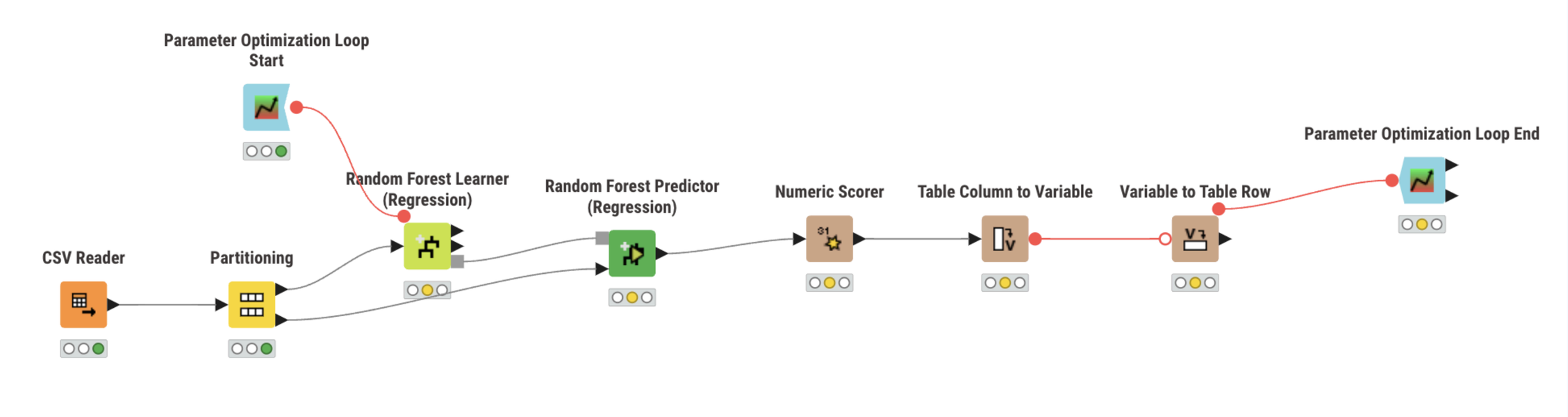
4. Model - Decision Tree

Decision tree



5. Model - Random Forest

Optimal Parameters → Base Line → K-fold validation → Normalization



5. Model - Random Forest

Optimal Parameters → Base Line → K-fold validation → Normalization

Max Tree Depth

Start Value	Stop Value	Step Size	Best Param
1	300	10	31
1	50	1	24
1	25	1	24

Minimize Node Size

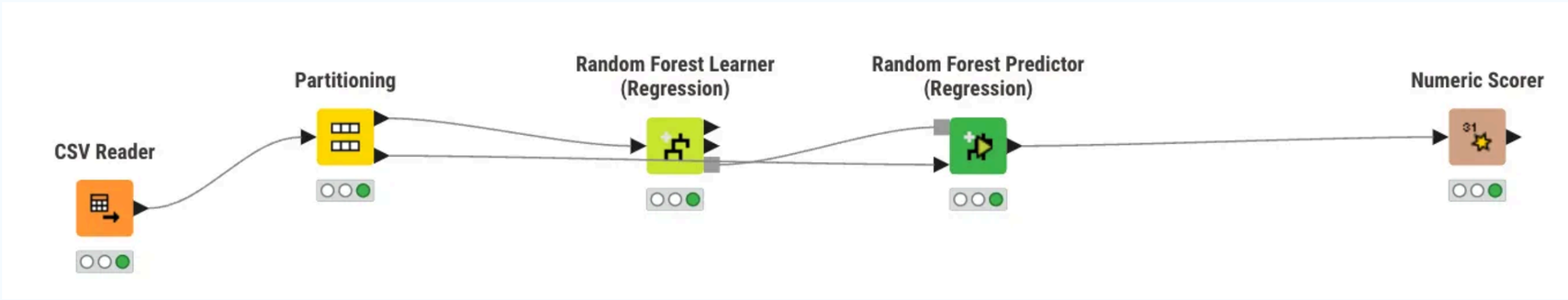
Start Value	Stop Value	Step Size	Best Param
1	50	1	1

➡️ The Optimal Combination

max_tree_Depth : 24, minimize_node_size : 1, 5

5. Model - Random Forest

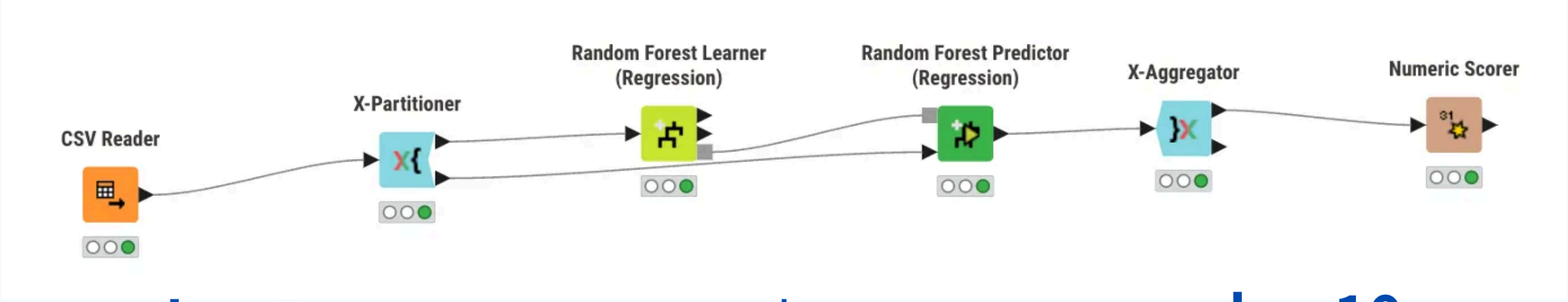
Optimal Parameters → **Base Line** → K-fold validation → Normalization



performance	prediction (price)
R^2	0.858
MAPE (Mean Absolute Percentage Error)	0.399

5. Model - Random Forest

Optimal Parameters ⟶ Base Line ⟶ **K-fold validation** ⟶ Normalization



k = 5

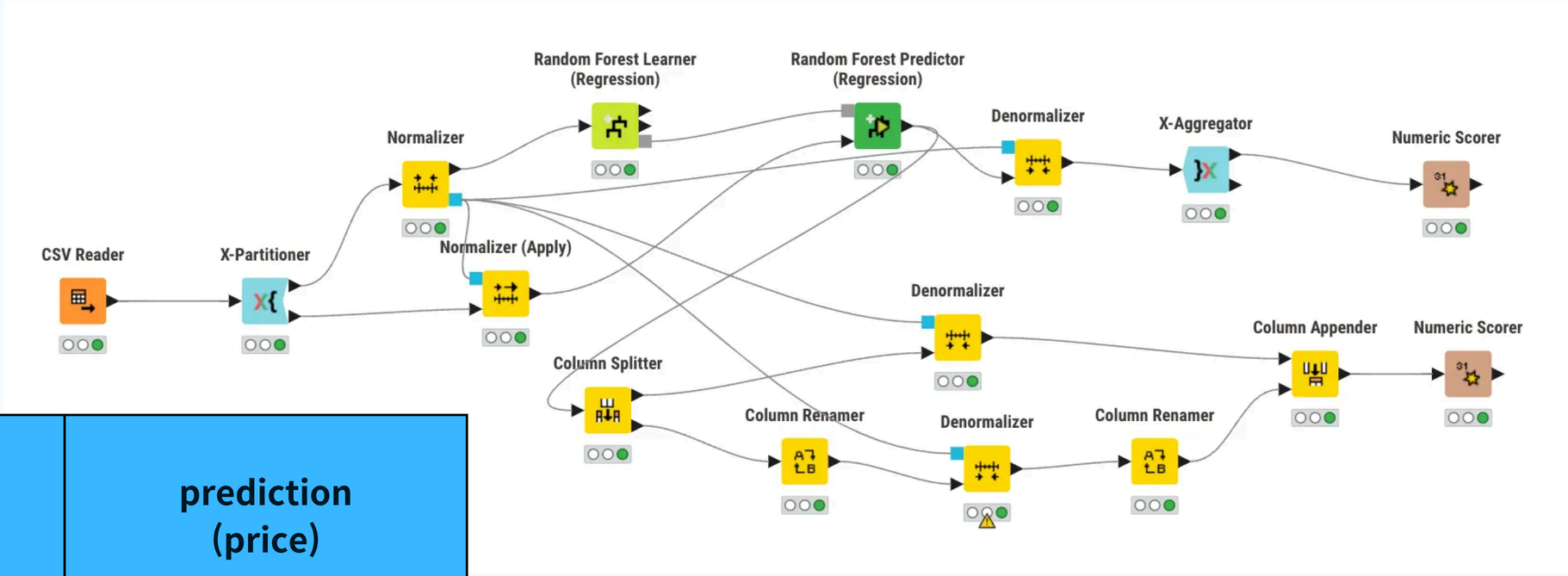
performance	prediction (price)
R^2	0.857
MAPE (Mean Absolute Percentage Error)	0.394

k = 10

performance	prediction (price)
R^2	0.855
MAPE (Mean Absolute Percentage Error)	0.402

5. Model - Random Forest

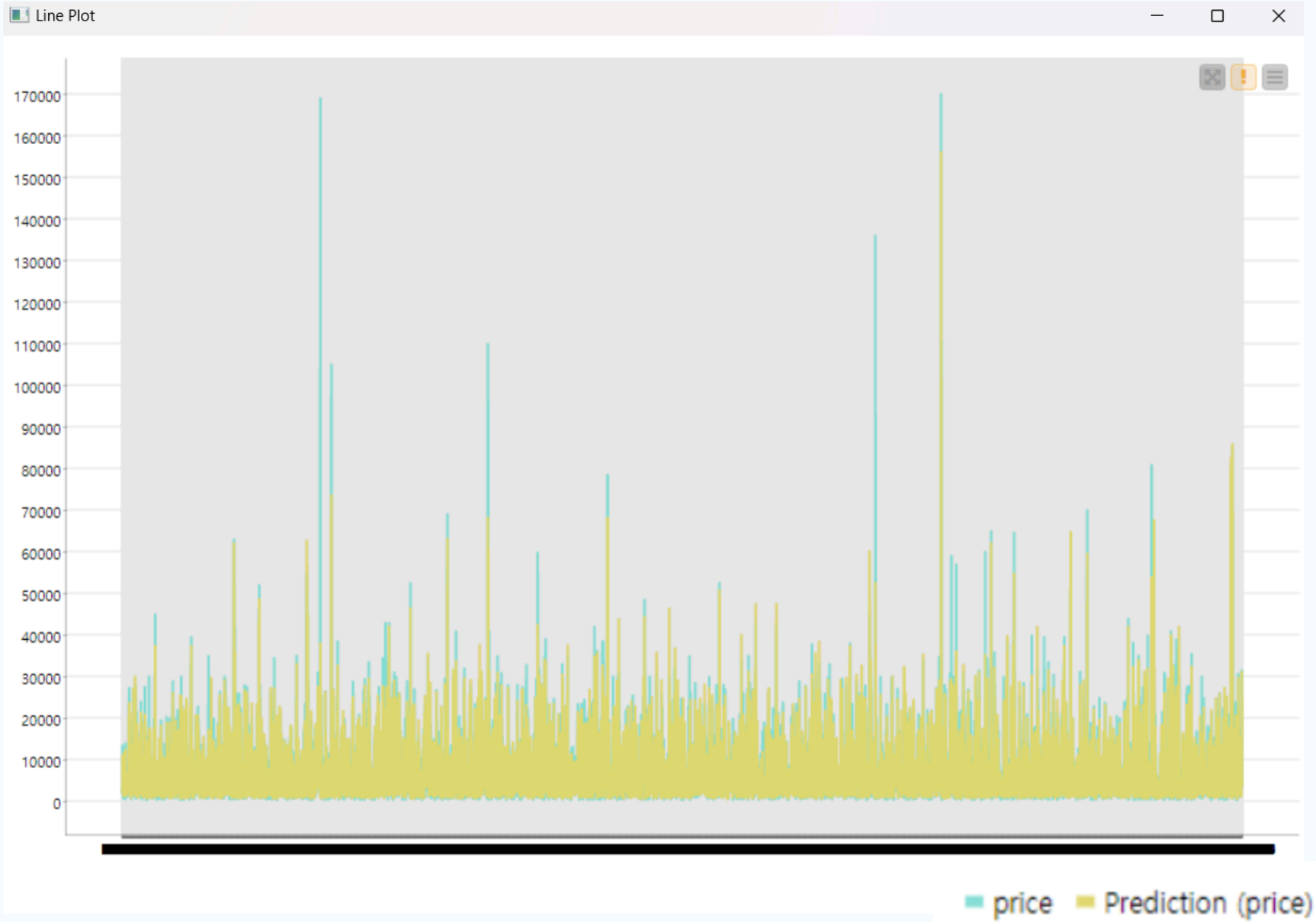
Optimal Parameters ⟶ Base Line ⟶ K-fold validation ⟶ **Normalization**



performance	prediction (price)
R^2	0.865
MAPE (Mean Absolute Percentage Error)	0.393

5. Model - Outcomes

Random Forest



Q & A

Thank you for listening!