

НАУЧНО ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ ИТМО  
ФАКУЛЬТЕТ СИСТЕМ УПРАВЛЕНИЯ И РОБОТОТЕХНИКИ

**Отчет по практическому заданию №2  
Нейронные сети**

Выполнил студент группы R3380  
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# Практическое задание № 2. Нейронные сети

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## Прогнозирование цены на жилье с помощью нейросетевой регрессионной модели

Необходимо по имеющимся данным о ценах на жильё предсказать окончательную цену каждого дома с учетом характеристик домов с использованием нейронной сети. Описание набора данных содержит 80 классов (набор переменных) классификации оценки типа жилья, и находится в файле `data_description.txt`.

В работе требуется дополнить раздел «Моделирование» в подразделе «Построение и обучение модели» создать и инициализировать последовательную модель нейронной сети с помощью фреймворков тренировки нейронных сетей как: Torch или Tensorflow. Скомпилировать нейронную сеть выбрав функцию потерь и оптимизатор соответственно. Оценить точность полученных результатов. Вывести предсказанные данные о продаже.

### Импорт библиотек

Импортируем необходимые библиотеки:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
```

### Считываем набор данных

Загрузим набор данных и присвоим следующими переменные:

- `train_data`: данные, используемые для обучения модели
- `test_data`: данные, используемые для проверки модели

```
train_data = pd.read_csv('./train.csv')
test_data = pd.read_csv('./test.csv')
```

### Подготовка данных

Отобразим обучающие и проверочные данные:

```
train_data.head()
```

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape
0	1	60	RL	65.0	8450	Pave	NaN	Reg
1	2	20	RL	80.0	9600	Pave	NaN	Reg
2	3	60	RL	68.0	11250	Pave	NaN	IR1
3	4	70	RL	60.0	9550	Pave	NaN	IR1
4	5	60	RL	84.0	14260	Pave	NaN	IR1
MoSold	LandContour	Utilities	...	PoolArea	PoolQC	Fence	MiscFeature	MiscVal
0	Lvl	AllPub	...	0	NaN	NaN	NaN	0
1	Lvl	AllPub	...	0	NaN	NaN	NaN	0
2	Lvl	AllPub	...	0	NaN	NaN	NaN	0
3	Lvl	AllPub	...	0	NaN	NaN	NaN	0
4	Lvl	AllPub	...	0	NaN	NaN	NaN	0
5								
YrSold	SaleType	SaleCondition	SalePrice					
0	2008	WD	Normal	208500				
1	2007	WD	Normal	181500				
2	2008	WD	Normal	223500				
3	2006	WD	Abnrmrl	140000				
4	2008	WD	Normal	250000				
[5 rows x 81 columns]								
test_data.head()								
LotShape	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	
Reg	0	1461	20	RH	80.0	11622	Pave	NaN
IR1	1	1462	20	RL	81.0	14267	Pave	NaN
IR1	2	1463	60	RL	74.0	13830	Pave	NaN
IR1	3	1464	60	RL	78.0	9978	Pave	NaN
IR1	4	1465	120	RL	43.0	5005	Pave	NaN
LandContour	Utilities	...	ScreenPorch	PoolArea	PoolQC	Fence		

```

MiscFeature \
0      Lvl    AllPub ...      120      0    NaN  MnPrv
NaN
1      Lvl    AllPub ...       0      0    NaN  NaN
Gar2
2      Lvl    AllPub ...       0      0    NaN  MnPrv
NaN
3      Lvl    AllPub ...       0      0    NaN  NaN
NaN
4      HLS    AllPub ...     144      0    NaN  NaN
NaN

   MiscVal MoSold YrSold SaleType SaleCondition
0      0        6    2010      WD      Normal
1  12500        6    2010      WD      Normal
2      0        3    2010      WD      Normal
3      0        6    2010      WD      Normal
4      0        1    2010      WD      Normal

[5 rows x 80 columns]

```

Как можно видеть, `train_data` имеет на один столбец больше, чем `test_data`, это столбец `SalePrice`, для обучения модели перед применением ее для предсказания меток в `test_data`.

Проверяем нет ли тестовые данные пустых значений значений (NaN)

Построим функцию `def missing_value_checker` для проверки и подсчёта пропущенных значений в `test_data`. А также выведем тип данных этих значений.

```

def missing_value_checker(data):
    list = []
    for feature in data.columns:
        if data[feature].isnull().values.any():

            sum = data[feature].isna().sum()

            type = data[feature].dtype

            print (f'{feature}: {sum}, type: {type}')

            list.append(feature)
    print(list)

    print(len(list))

missing_value_checker(test_data)

```

```
MSZoning: 4, type: object
LotFrontage: 227, type: float64
Alley: 1352, type: object
Utilities: 2, type: object
Exterior1st: 1, type: object
Exterior2nd: 1, type: object
MasVnrType: 894, type: object
MasVnrArea: 15, type: float64
BsmtQual: 44, type: object
BsmtCond: 45, type: object
BsmtExposure: 44, type: object
BsmtFinType1: 42, type: object
BsmtFinSF1: 1, type: float64
BsmtFinType2: 42, type: object
BsmtFinSF2: 1, type: float64
BsmtUnfSF: 1, type: float64
TotalBsmtSF: 1, type: float64
BsmtFullBath: 2, type: float64
BsmtHalfBath: 2, type: float64
KitchenQual: 1, type: object
Functional: 2, type: object
FireplaceQu: 730, type: object
GarageType: 76, type: object
GarageYrBlt: 78, type: float64
GarageFinish: 78, type: object
GarageCars: 1, type: float64
GarageArea: 1, type: float64
GarageQual: 78, type: object
GarageCond: 78, type: object
PoolQC: 1456, type: object
Fence: 1169, type: object
MiscFeature: 1408, type: object
SaleType: 1, type: object
['MSZoning', 'LotFrontage', 'Alley', 'Utilities', 'Exterior1st',
'Exterior2nd', 'MasVnrType', 'MasVnrArea', 'BsmtQual', 'BsmtCond',
'BsmtExposure', 'BsmtFinType1', 'BsmtFinSF1', 'BsmtFinType2',
'BsmtFinSF2', 'BsmtUnfSF', 'TotalBsmtSF', 'BsmtFullBath',
'BsmtHalfBath', 'KitchenQual', 'Functional', 'FireplaceQu',
'GarageType', 'GarageYrBlt', 'GarageFinish', 'GarageCars',
'GarageArea', 'GarageQual', 'GarageCond', 'PoolQC', 'Fence',
'MiscFeature', 'SaleType']
```

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Проверяем какие признаки в таблице можно оставить, а какие удалить. Если пропущенных значений слишком много, то удалим признак. Если их небольшое количество, то заполним `mean` или `median` для чисел, новая категория `missing` для строковых объектов.

В соответствии с этим:

– удалим ['Alley', 'FireplaceQu', 'PoolQC', 'Fence', 'MiscFeature'];

- заполним числовое отсутствующее значение значением `mean`;
- заполним строковое отсутствующее значение значением `missing`.

Также нормализуем наши данные для получения более лучших результатов:

```

to_drop = ['Id', 'Alley', 'FireplaceQu', 'PoolQC', 'Fence',
'MiscFeature']
test_edited = test_data.drop(to_drop, axis=1)
train_edited = train_data.drop(to_drop, axis=1)

def nan.filler(data):
    for label, content in data.items():
        if pd.api.types.is_numeric_dtype(content):
            data[label] = content.fillna(content.median())
            if label != "SalePrice":
                data[label] = (data[label] -
data[label].min())/(data[label].max() - data[label].min())
        else:
            data[label] = content.astype("category").cat.as_ordered()
            data[label] = pd.Categorical(content).codes+1

nan.filler(test_edited)
nan.filler(train_edited)
test_edited["MSZoning"]

0      3
1      4
2      4
3      4
4      4
...
1454     5
1455     5
1456     4
1457     4
1458     4
Name: MSZoning, Length: 1459, dtype: int8

```

Перепроверим наши данные:

```
missing_value_checker(test_edited)
```

```
[]
0
```

```
missing_value_checker(train_edited)
```

```
[]
0
```

```
train_edited.shape, test_edited.shape  
((1460, 75), (1459, 74))  
  
test_edited.info()  
  
<class 'pandas.core.frame.DataFrame'>  
RangeIndex: 1459 entries, 0 to 1458  
Data columns (total 74 columns):  
 #   Column           Non-Null Count  Dtype     
---  --    
 0   MSSubClass        1459 non-null   float64  
 1   MSZoning          1459 non-null   int8      
 2   LotFrontage       1459 non-null   float64  
 3   LotArea            1459 non-null   float64  
 4   Street             1459 non-null   int8      
 5   LotShape           1459 non-null   int8      
 6   LandContour        1459 non-null   int8      
 7   Utilities          1459 non-null   int8      
 8   LotConfig          1459 non-null   int8      
 9   LandSlope          1459 non-null   int8      
 10  Neighborhood        1459 non-null   int8      
 11  Condition1         1459 non-null   int8      
 12  Condition2         1459 non-null   int8      
 13  BldgType           1459 non-null   int8      
 14  HouseStyle         1459 non-null   int8      
 15  OverallQual        1459 non-null   float64  
 16  OverallCond        1459 non-null   float64  
 17  YearBuilt          1459 non-null   float64  
 18  YearRemodAdd       1459 non-null   float64  
 19  RoofStyle           1459 non-null   int8      
 20  RoofMatl            1459 non-null   int8      
 21  Exterior1st         1459 non-null   int8      
 22  Exterior2nd         1459 non-null   int8      
 23  MasVnrType          1459 non-null   int8      
 24  MasVnrArea          1459 non-null   float64  
 25  ExterQual           1459 non-null   int8      
 26  ExterCond           1459 non-null   int8      
 27  Foundation          1459 non-null   int8      
 28  BsmtQual            1459 non-null   int8      
 29  BsmtCond            1459 non-null   int8      
 30  BsmtExposure        1459 non-null   int8      
 31  BsmtFinType1        1459 non-null   int8      
 32  BsmtFinSF1          1459 non-null   float64  
 33  BsmtFinType2        1459 non-null   int8      
 34  BsmtFinSF2          1459 non-null   float64  
 35  BsmtUnfSF           1459 non-null   float64  
 36  TotalBsmtSF         1459 non-null   float64  
 37  Heating              1459 non-null   int8      
 38  HeatingQC            1459 non-null   int8
```

```

39 CentralAir      1459 non-null   int8
40 Electrical     1459 non-null   int8
41 1stFlrSF       1459 non-null   float64
42 2ndFlrSF       1459 non-null   float64
43 LowQualFinSF  1459 non-null   float64
44 GrLivArea      1459 non-null   float64
45 BsmtFullBath  1459 non-null   float64
46 BsmtHalfBath  1459 non-null   float64
47 FullBath       1459 non-null   float64
48 HalfBath        1459 non-null   float64
49 BedroomAbvGr   1459 non-null   float64
50 KitchenAbvGr   1459 non-null   float64
51 KitchenQual     1459 non-null   int8
52 TotRmsAbvGrd  1459 non-null   float64
53 Functional      1459 non-null   int8
54 Fireplaces      1459 non-null   float64
55 GarageType      1459 non-null   int8
56 GarageYrBlt    1459 non-null   float64
57 GarageFinish    1459 non-null   int8
58 GarageCars      1459 non-null   float64
59 GarageArea       1459 non-null   float64
60 GarageQual      1459 non-null   int8
61 GarageCond      1459 non-null   int8
62 PavedDrive      1459 non-null   int8
63 WoodDeckSF      1459 non-null   float64
64 OpenPorchSF    1459 non-null   float64
65 EnclosedPorch   1459 non-null   float64
66 3SsnPorch       1459 non-null   float64
67 ScreenPorch     1459 non-null   float64
68 PoolArea        1459 non-null   float64
69 MiscVal         1459 non-null   float64
70 MoSold          1459 non-null   float64
71 YrSold          1459 non-null   float64
72 SaleType        1459 non-null   int8
73 SaleCondition   1459 non-null   int8
dtypes: float64(36), int8(38)
memory usage: 464.6 KB

```

```
train_edited.info()
```

```

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1460 entries, 0 to 1459
Data columns (total 75 columns):
 #   Column            Non-Null Count  Dtype  
 ---  --  
 0   MSSubClass        1460 non-null   float64
 1   MSZoning          1460 non-null   int8  
 2   LotFrontage       1460 non-null   float64
 3   LotArea           1460 non-null   float64
 4   Street            1460 non-null   int8  

```

5	LotShape	1460	non-null	int8
6	LandContour	1460	non-null	int8
7	Utilities	1460	non-null	int8
8	LotConfig	1460	non-null	int8
9	LandSlope	1460	non-null	int8
10	Neighborhood	1460	non-null	int8
11	Condition1	1460	non-null	int8
12	Condition2	1460	non-null	int8
13	BldgType	1460	non-null	int8
14	HouseStyle	1460	non-null	int8
15	OverallQual	1460	non-null	float64
16	OverallCond	1460	non-null	float64
17	YearBuilt	1460	non-null	float64
18	YearRemodAdd	1460	non-null	float64
19	RoofStyle	1460	non-null	int8
20	RoofMatl	1460	non-null	int8
21	Exterior1st	1460	non-null	int8
22	Exterior2nd	1460	non-null	int8
23	MasVnrType	1460	non-null	int8
24	MasVnrArea	1460	non-null	float64
25	ExterQual	1460	non-null	int8
26	ExterCond	1460	non-null	int8
27	Foundation	1460	non-null	int8
28	BsmtQual	1460	non-null	int8
29	BsmtCond	1460	non-null	int8
30	BsmtExposure	1460	non-null	int8
31	BsmtFinType1	1460	non-null	int8
32	BsmtFinSF1	1460	non-null	float64
33	BsmtFinType2	1460	non-null	int8
34	BsmtFinSF2	1460	non-null	float64
35	BsmtUnfSF	1460	non-null	float64
36	TotalBsmtSF	1460	non-null	float64
37	Heating	1460	non-null	int8
38	HeatingQC	1460	non-null	int8
39	CentralAir	1460	non-null	int8
40	Electrical	1460	non-null	int8
41	1stFlrSF	1460	non-null	float64
42	2ndFlrSF	1460	non-null	float64
43	LowQualFinSF	1460	non-null	float64
44	GrLivArea	1460	non-null	float64
45	BsmtFullBath	1460	non-null	float64
46	BsmtHalfBath	1460	non-null	float64
47	FullBath	1460	non-null	float64
48	HalfBath	1460	non-null	float64
49	BedroomAbvGr	1460	non-null	float64
50	KitchenAbvGr	1460	non-null	float64
51	KitchenQual	1460	non-null	int8
52	TotRmsAbvGrd	1460	non-null	float64
53	Functional	1460	non-null	int8

```
54 Fireplaces      1460 non-null   float64
55 GarageType      1460 non-null   int8
56 GarageYrBlt     1460 non-null   float64
57 GarageFinish     1460 non-null   int8
58 GarageCars       1460 non-null   float64
59 GarageArea       1460 non-null   float64
60 GarageQual       1460 non-null   int8
61 GarageCond       1460 non-null   int8
62 PavedDrive       1460 non-null   int8
63 WoodDeckSF      1460 non-null   float64
64 OpenPorchSF     1460 non-null   float64
65 EnclosedPorch    1460 non-null   float64
66 3SsnPorch        1460 non-null   float64
67 ScreenPorch      1460 non-null   float64
68 PoolArea         1460 non-null   float64
69 MiscVal          1460 non-null   float64
70 MoSold           1460 non-null   float64
71 YrSold           1460 non-null   float64
72 SaleType          1460 non-null   int8
73 SaleCondition    1460 non-null   int8
74 SalePrice         1460 non-null   int64
dtypes: float64(36), int64(1), int8(38)
memory usage: 476.3 KB
```

## Разделим данные

Поскольку мы не знаем метку (Цена) тестовых данных, для оценки модели, чтобы получить лучшую модель перед прогнозированием тестовых данных, разделим данные в файле train.csv на обучающие и проверочные данные, соотношение составляет 20%.

```
X = train_edited.drop('SalePrice', axis=1)
y = train_edited['SalePrice']

X_train, X_val, y_train, y_val = train_test_split(X, y, test_size =
0.2)
```

Размерности получившихся разделений:

```
y_train.shape, X_train.shape, X_val.shape, y_val.shape
((1168,), (1168, 74), (292, 74), (292,))

X_train.shape, test_edited.shape
((1168, 74), (1459, 74))
```

# Моделирование

## Построение и обучение модели

Создадим последовательную модель нейронной сети с помощью фреймворка тренировки нейронных сетей Tensorflow. На начальном слое будет 64 нейрона, активация - линейная.

```
from tensorflow import random
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.optimizers import Adam

model = Sequential([
    Dense(16, input_dim=X_train.shape[1], activation='linear'),
    Dense(1, activation='linear')
])
random.set_seed(40)
```

Скомпилируем нейронную сеть, выбрав в качестве функции потерь, которую необходимо минимизировать, выберем `mae`, а в качестве оптимизатора - `Adam` с `learning_rate=0.001`, метрики стандартные для задачи регрессии (`mse/mae`).

```
model.compile(optimizer=Adam(learning_rate=0.05),
              loss='mae',
              metrics=['mae'])
```

Обучим модель на обучающих данных `X_train` и `y_train`, задав гиперпараметры гиперпараметры:

- `epochs=100`
- `batch_size=32`

```
history = model.fit(X_train, y_train, epochs=100, batch_size=32,
validation_data=(X_val, y_val))

Epoch 1/100
37/37 [=====] - 1s 8ms/step - loss:
174415.9062 - mae: 174415.9062 - val_loss: 179418.8281 - val_mae:
179418.8281
Epoch 2/100
37/37 [=====] - 0s 5ms/step - loss:
145687.9688 - mae: 145687.9688 - val_loss: 130183.3828 - val_mae:
130183.3828
Epoch 3/100
37/37 [=====] - 0s 6ms/step - loss:
80829.6250 - mae: 80829.6250 - val_loss: 63973.0078 - val_mae:
63973.0078
Epoch 4/100
37/37 [=====] - 0s 5ms/step - loss:
```

```
51378.9297 - mae: 51378.9297 - val_loss: 60809.9570 - val_mae:  
60809.9570  
Epoch 5/100  
37/37 [=====] - 0s 6ms/step - loss:  
50700.9023 - mae: 50700.9023 - val_loss: 60291.1797 - val_mae:  
60291.1797  
Epoch 6/100  
37/37 [=====] - 0s 5ms/step - loss:  
49972.2383 - mae: 49972.2383 - val_loss: 59639.6016 - val_mae:  
59639.6016  
Epoch 7/100  
37/37 [=====] - 0s 5ms/step - loss:  
49193.4297 - mae: 49193.4297 - val_loss: 58858.2070 - val_mae:  
58858.2070  
Epoch 8/100  
37/37 [=====] - 0s 6ms/step - loss:  
48479.7930 - mae: 48479.7930 - val_loss: 58013.4297 - val_mae:  
58013.4297  
Epoch 9/100  
37/37 [=====] - 0s 5ms/step - loss:  
47704.6094 - mae: 47704.6094 - val_loss: 57292.0156 - val_mae:  
57292.0156  
Epoch 10/100  
37/37 [=====] - 0s 5ms/step - loss:  
46879.5352 - mae: 46879.5352 - val_loss: 56053.1523 - val_mae:  
56053.1523  
Epoch 11/100  
37/37 [=====] - 0s 5ms/step - loss:  
46118.6250 - mae: 46118.6250 - val_loss: 55714.4453 - val_mae:  
55714.4453  
Epoch 12/100  
37/37 [=====] - 0s 4ms/step - loss:  
45141.1211 - mae: 45141.1211 - val_loss: 54056.0625 - val_mae:  
54056.0625  
Epoch 13/100  
37/37 [=====] - 0s 5ms/step - loss:  
44309.6719 - mae: 44309.6719 - val_loss: 53802.5820 - val_mae:  
53802.5820  
Epoch 14/100  
37/37 [=====] - 0s 4ms/step - loss:  
43537.5156 - mae: 43537.5156 - val_loss: 52694.7930 - val_mae:  
52694.7930  
Epoch 15/100  
37/37 [=====] - 0s 4ms/step - loss:  
42430.9844 - mae: 42430.9844 - val_loss: 51624.0742 - val_mae:  
51624.0742  
Epoch 16/100  
37/37 [=====] - 0s 4ms/step - loss:  
41441.7852 - mae: 41441.7852 - val_loss: 50029.4766 - val_mae:
```

```
50029.4766
Epoch 17/100
37/37 [=====] - 0s 4ms/step - loss:
40531.1992 - mae: 40531.1992 - val_loss: 49058.8477 - val_mae:
49058.8477
Epoch 18/100
37/37 [=====] - 0s 4ms/step - loss:
39504.8789 - mae: 39504.8789 - val_loss: 48353.7422 - val_mae:
48353.7422
Epoch 19/100
37/37 [=====] - 0s 5ms/step - loss:
38398.0547 - mae: 38398.0547 - val_loss: 47669.9570 - val_mae:
47669.9570
Epoch 20/100
37/37 [=====] - 0s 4ms/step - loss:
37601.4297 - mae: 37601.4297 - val_loss: 46181.1797 - val_mae:
46181.1797
Epoch 21/100
37/37 [=====] - 0s 5ms/step - loss:
36484.5781 - mae: 36484.5781 - val_loss: 44864.9570 - val_mae:
44864.9570
Epoch 22/100
37/37 [=====] - 0s 5ms/step - loss:
35488.9805 - mae: 35488.9805 - val_loss: 43691.8594 - val_mae:
43691.8594
Epoch 23/100
37/37 [=====] - 0s 4ms/step - loss:
34564.1758 - mae: 34564.1758 - val_loss: 42903.4023 - val_mae:
42903.4023
Epoch 24/100
37/37 [=====] - 0s 4ms/step - loss:
33666.3945 - mae: 33666.3945 - val_loss: 41757.8945 - val_mae:
41757.8945
Epoch 25/100
37/37 [=====] - 0s 4ms/step - loss:
32878.3750 - mae: 32878.3750 - val_loss: 41338.5820 - val_mae:
41338.5820
Epoch 26/100
37/37 [=====] - 0s 4ms/step - loss:
32302.7461 - mae: 32302.7461 - val_loss: 40444.0703 - val_mae:
40444.0703
Epoch 27/100
37/37 [=====] - 0s 4ms/step - loss:
31665.5586 - mae: 31665.5586 - val_loss: 39813.0977 - val_mae:
39813.0977
Epoch 28/100
37/37 [=====] - 0s 4ms/step - loss:
31086.2324 - mae: 31086.2324 - val_loss: 38746.8008 - val_mae:
38746.8008
```

```
Epoch 29/100
37/37 [=====] - 0s 4ms/step - loss:
30649.7148 - mae: 30649.7148 - val_loss: 38065.0664 - val_mae:
38065.0664
Epoch 30/100
37/37 [=====] - 0s 4ms/step - loss:
30100.8730 - mae: 30100.8730 - val_loss: 37979.2188 - val_mae:
37979.2188
Epoch 31/100
37/37 [=====] - 0s 4ms/step - loss:
29705.1309 - mae: 29705.1309 - val_loss: 37183.0312 - val_mae:
37183.0312
Epoch 32/100
37/37 [=====] - 0s 4ms/step - loss:
29387.7285 - mae: 29387.7285 - val_loss: 37194.2031 - val_mae:
37194.2031
Epoch 33/100
37/37 [=====] - 0s 4ms/step - loss:
29174.7188 - mae: 29174.7188 - val_loss: 36391.8516 - val_mae:
36391.8516
Epoch 34/100
37/37 [=====] - 0s 5ms/step - loss:
28744.4238 - mae: 28744.4238 - val_loss: 36275.5156 - val_mae:
36275.5156
Epoch 35/100
37/37 [=====] - 0s 6ms/step - loss:
28404.1914 - mae: 28404.1914 - val_loss: 35861.1562 - val_mae:
35861.1562
Epoch 36/100
37/37 [=====] - 0s 5ms/step - loss:
28124.1719 - mae: 28124.1719 - val_loss: 35175.1719 - val_mae:
35175.1719
Epoch 37/100
37/37 [=====] - 0s 5ms/step - loss:
27907.0352 - mae: 27907.0352 - val_loss: 35452.1133 - val_mae:
35452.1133
Epoch 38/100
37/37 [=====] - 0s 7ms/step - loss:
27740.5312 - mae: 27740.5312 - val_loss: 34295.6914 - val_mae:
34295.6914
Epoch 39/100
37/37 [=====] - 0s 5ms/step - loss:
27461.0059 - mae: 27461.0059 - val_loss: 33760.7070 - val_mae:
33760.7070
Epoch 40/100
37/37 [=====] - 0s 5ms/step - loss:
27252.3633 - mae: 27252.3633 - val_loss: 34396.6133 - val_mae:
34396.6133
Epoch 41/100
```

```
37/37 [=====] - 0s 5ms/step - loss:  
27070.0332 - mae: 27070.0332 - val_loss: 34232.2227 - val_mae:  
34232.2227  
Epoch 42/100  
37/37 [=====] - 0s 5ms/step - loss:  
26918.3906 - mae: 26918.3906 - val_loss: 33023.5039 - val_mae:  
33023.5039  
Epoch 43/100  
37/37 [=====] - 0s 5ms/step - loss:  
26542.8516 - mae: 26542.8516 - val_loss: 33259.3203 - val_mae:  
33259.3203  
Epoch 44/100  
37/37 [=====] - 0s 5ms/step - loss:  
26352.8203 - mae: 26352.8203 - val_loss: 33363.7773 - val_mae:  
33363.7773  
Epoch 45/100  
37/37 [=====] - 0s 4ms/step - loss:  
26200.6211 - mae: 26200.6211 - val_loss: 32723.4004 - val_mae:  
32723.4004  
Epoch 46/100  
37/37 [=====] - 0s 5ms/step - loss:  
25960.1055 - mae: 25960.1055 - val_loss: 32484.6504 - val_mae:  
32484.6504  
Epoch 47/100  
37/37 [=====] - 0s 6ms/step - loss:  
25796.8262 - mae: 25796.8262 - val_loss: 32131.0371 - val_mae:  
32131.0371  
Epoch 48/100  
37/37 [=====] - 0s 5ms/step - loss:  
25877.8203 - mae: 25877.8203 - val_loss: 31695.7734 - val_mae:  
31695.7734  
Epoch 49/100  
37/37 [=====] - 0s 6ms/step - loss:  
25400.0469 - mae: 25400.0469 - val_loss: 31496.8828 - val_mae:  
31496.8828  
Epoch 50/100  
37/37 [=====] - 0s 6ms/step - loss:  
25323.5605 - mae: 25323.5605 - val_loss: 31664.9043 - val_mae:  
31664.9043  
Epoch 51/100  
37/37 [=====] - 0s 6ms/step - loss:  
25027.7012 - mae: 25027.7012 - val_loss: 30935.9414 - val_mae:  
30935.9414  
Epoch 52/100  
37/37 [=====] - 0s 5ms/step - loss:  
25101.9395 - mae: 25101.9395 - val_loss: 30929.4824 - val_mae:  
30929.4824  
Epoch 53/100  
37/37 [=====] - 0s 4ms/step - loss:
```

```
24745.5762 - mae: 24745.5762 - val_loss: 30964.1738 - val_mae:  
30964.1738  
Epoch 54/100  
37/37 [=====] - 0s 4ms/step - loss:  
24564.8809 - mae: 24564.8809 - val_loss: 30173.0449 - val_mae:  
30173.0449  
Epoch 55/100  
37/37 [=====] - 0s 4ms/step - loss:  
24449.0117 - mae: 24449.0117 - val_loss: 30027.0898 - val_mae:  
30027.0898  
Epoch 56/100  
37/37 [=====] - 0s 4ms/step - loss:  
24246.8359 - mae: 24246.8359 - val_loss: 29733.6914 - val_mae:  
29733.6914  
Epoch 57/100  
37/37 [=====] - 0s 5ms/step - loss:  
24227.1230 - mae: 24227.1230 - val_loss: 29884.1816 - val_mae:  
29884.1816  
Epoch 58/100  
37/37 [=====] - 0s 4ms/step - loss:  
24012.1797 - mae: 24012.1797 - val_loss: 29346.8320 - val_mae:  
29346.8320  
Epoch 59/100  
37/37 [=====] - 0s 4ms/step - loss:  
23806.4395 - mae: 23806.4395 - val_loss: 29107.8398 - val_mae:  
29107.8398  
Epoch 60/100  
37/37 [=====] - 0s 5ms/step - loss:  
23627.9297 - mae: 23627.9297 - val_loss: 29409.9824 - val_mae:  
29409.9824  
Epoch 61/100  
37/37 [=====] - 0s 5ms/step - loss:  
23661.9531 - mae: 23661.9531 - val_loss: 28772.6602 - val_mae:  
28772.6602  
Epoch 62/100  
37/37 [=====] - 0s 5ms/step - loss:  
23608.8867 - mae: 23608.8867 - val_loss: 28694.4785 - val_mae:  
28694.4785  
Epoch 63/100  
37/37 [=====] - 0s 4ms/step - loss:  
23308.5156 - mae: 23308.5156 - val_loss: 28354.2480 - val_mae:  
28354.2480  
Epoch 64/100  
37/37 [=====] - 0s 5ms/step - loss:  
23062.9746 - mae: 23062.9746 - val_loss: 28221.8555 - val_mae:  
28221.8555  
Epoch 65/100  
37/37 [=====] - 0s 4ms/step - loss:  
23096.3828 - mae: 23096.3828 - val_loss: 28003.6035 - val_mae:
```

```
28003.6035
Epoch 66/100
37/37 [=====] - 0s 5ms/step - loss:
22813.7129 - mae: 22813.7129 - val_loss: 27680.8086 - val_mae:
27680.8086
Epoch 67/100
37/37 [=====] - 0s 4ms/step - loss:
22782.2285 - mae: 22782.2285 - val_loss: 27540.9043 - val_mae:
27540.9043
Epoch 68/100
37/37 [=====] - 0s 4ms/step - loss:
22681.0781 - mae: 22681.0781 - val_loss: 27408.9375 - val_mae:
27408.9375
Epoch 69/100
37/37 [=====] - 0s 5ms/step - loss:
22443.3730 - mae: 22443.3730 - val_loss: 27173.9453 - val_mae:
27173.9453
Epoch 70/100
37/37 [=====] - 0s 4ms/step - loss:
22390.3398 - mae: 22390.3398 - val_loss: 27049.0879 - val_mae:
27049.0879
Epoch 71/100
37/37 [=====] - 0s 4ms/step - loss:
22242.2617 - mae: 22242.2617 - val_loss: 26945.1855 - val_mae:
26945.1855
Epoch 72/100
37/37 [=====] - 0s 5ms/step - loss:
22345.6719 - mae: 22345.6719 - val_loss: 26991.2969 - val_mae:
26991.2969
Epoch 73/100
37/37 [=====] - 0s 5ms/step - loss:
22048.2598 - mae: 22048.2598 - val_loss: 26586.2070 - val_mae:
26586.2070
Epoch 74/100
37/37 [=====] - 0s 5ms/step - loss:
22072.5156 - mae: 22072.5156 - val_loss: 26472.7129 - val_mae:
26472.7129
Epoch 75/100
37/37 [=====] - 0s 4ms/step - loss:
21884.2383 - mae: 21884.2383 - val_loss: 26285.0723 - val_mae:
26285.0723
Epoch 76/100
37/37 [=====] - 0s 4ms/step - loss:
21802.0527 - mae: 21802.0527 - val_loss: 26155.7852 - val_mae:
26155.7852
Epoch 77/100
37/37 [=====] - 0s 4ms/step - loss:
21676.2285 - mae: 21676.2285 - val_loss: 26012.0078 - val_mae:
26012.0078
```

```
Epoch 78/100
37/37 [=====] - 0s 4ms/step - loss:
21703.6406 - mae: 21703.6406 - val_loss: 26526.6836 - val_mae:
26526.6836
Epoch 79/100
37/37 [=====] - 0s 4ms/step - loss:
21548.7832 - mae: 21548.7832 - val_loss: 25760.3496 - val_mae:
25760.3496
Epoch 80/100
37/37 [=====] - 0s 4ms/step - loss:
21561.7383 - mae: 21561.7383 - val_loss: 25596.7324 - val_mae:
25596.7324
Epoch 81/100
37/37 [=====] - 0s 4ms/step - loss:
21482.8809 - mae: 21482.8809 - val_loss: 26035.6699 - val_mae:
26035.6699
Epoch 82/100
37/37 [=====] - 0s 5ms/step - loss:
21356.3027 - mae: 21356.3027 - val_loss: 25432.9375 - val_mae:
25432.9375
Epoch 83/100
37/37 [=====] - 0s 4ms/step - loss:
21202.8789 - mae: 21202.8789 - val_loss: 25348.8359 - val_mae:
25348.8359
Epoch 84/100
37/37 [=====] - 0s 4ms/step - loss:
21168.8359 - mae: 21168.8359 - val_loss: 26275.3984 - val_mae:
26275.3984
Epoch 85/100
37/37 [=====] - 0s 4ms/step - loss:
21411.5840 - mae: 21411.5840 - val_loss: 25158.3125 - val_mae:
25158.3125
Epoch 86/100
37/37 [=====] - 0s 4ms/step - loss:
21073.5488 - mae: 21073.5488 - val_loss: 25422.3848 - val_mae:
25422.3848
Epoch 87/100
37/37 [=====] - 0s 4ms/step - loss:
20969.6113 - mae: 20969.6113 - val_loss: 24990.7910 - val_mae:
24990.7910
Epoch 88/100
37/37 [=====] - 0s 4ms/step - loss:
20965.3672 - mae: 20965.3672 - val_loss: 24945.0059 - val_mae:
24945.0059
Epoch 89/100
37/37 [=====] - 0s 4ms/step - loss:
20883.4609 - mae: 20883.4609 - val_loss: 24949.2949 - val_mae:
24949.2949
Epoch 90/100
```

```
37/37 [=====] - 0s 5ms/step - loss:  
20917.6348 - mae: 20917.6348 - val_loss: 24757.7227 - val_mae:  
24757.7227  
Epoch 91/100  
37/37 [=====] - 0s 4ms/step - loss:  
20790.7891 - mae: 20790.7891 - val_loss: 24658.4844 - val_mae:  
24658.4844  
Epoch 92/100  
37/37 [=====] - 0s 4ms/step - loss:  
20741.3848 - mae: 20741.3848 - val_loss: 24984.5957 - val_mae:  
24984.5957  
Epoch 93/100  
37/37 [=====] - 0s 4ms/step - loss:  
20637.1680 - mae: 20637.1680 - val_loss: 24829.8340 - val_mae:  
24829.8340  
Epoch 94/100  
37/37 [=====] - 0s 4ms/step - loss:  
20748.6406 - mae: 20748.6406 - val_loss: 24673.3574 - val_mae:  
24673.3574  
Epoch 95/100  
37/37 [=====] - 0s 4ms/step - loss:  
20849.7578 - mae: 20849.7578 - val_loss: 24367.6172 - val_mae:  
24367.6172  
Epoch 96/100  
37/37 [=====] - 0s 4ms/step - loss:  
20913.7617 - mae: 20913.7617 - val_loss: 24458.2207 - val_mae:  
24458.2207  
Epoch 97/100  
37/37 [=====] - 0s 4ms/step - loss:  
20583.1875 - mae: 20583.1875 - val_loss: 24368.9883 - val_mae:  
24368.9883  
Epoch 98/100  
37/37 [=====] - 0s 4ms/step - loss:  
20521.9180 - mae: 20521.9180 - val_loss: 24756.5430 - val_mae:  
24756.5430  
Epoch 99/100  
37/37 [=====] - 0s 4ms/step - loss:  
20837.1211 - mae: 20837.1211 - val_loss: 24073.3125 - val_mae:  
24073.3125  
Epoch 100/100  
37/37 [=====] - 0s 4ms/step - loss:  
20346.0488 - mae: 20346.0488 - val_loss: 23994.0859 - val_mae:  
23994.0859
```

### Оценка полученных результатов

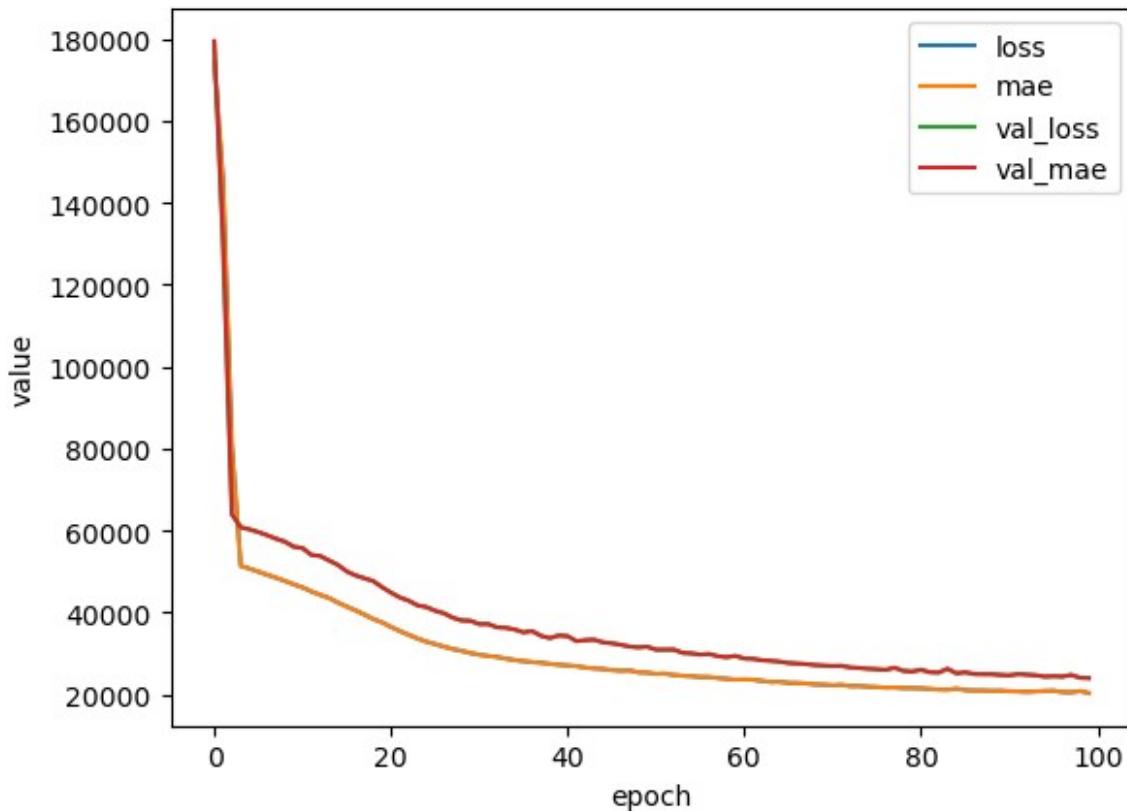
```
pd.DataFrame(history.history).plot()  
plt.ylabel('value')
```

```
plt.xlabel('epoch')
print(history.history)

{'loss': [174415.90625, 145687.96875, 80829.625, 51378.9296875,
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35175.171875, 35452.11328125, 34295.69140625, 33760.70703125,  
34396.61328125, 34232.22265625, 33023.50390625, 33259.3203125,  
33363.77734375, 32723.400390625, 32484.650390625, 32131.037109375,  
31695.7734375, 31496.8828125, 31664.904296875, 30935.94140625,  
30929.482421875, 30964.173828125, 30173.044921875, 30027.08984375,  
29733.69140625, 29884.181640625, 29346.83203125, 29107.83984375,  
29409.982421875, 28772.66015625, 28694.478515625, 28354.248046875,  
28221.85546875, 28003.603515625, 27680.80859375, 27540.904296875,  
27408.9375, 27173.9453125, 27049.087890625, 26945.185546875,  
26991.296875, 26586.20703125, 26472.712890625, 26285.072265625,  
26155.78515625, 26012.0078125, 26526.68359375, 25760.349609375,  
25596.732421875, 26035.669921875, 25432.9375, 25348.8359375,  
26275.3984375, 25158.3125, 25422.384765625, 24990.791015625,

```
24945.005859375, 24949.294921875, 24757.72265625, 24658.484375,  
24984.595703125, 24829.833984375, 24673.357421875, 24367.6171875,  
24458.220703125, 24368.98828125, 24756.54296875, 24073.3125,  
23994.0859375]}}
```



Видим, что модель начала переобучаться. Параметр `epochs` как раз помогает контролировать этот момент.

## Изменения

Изменение параметров `batch_size` и `epochs` напрямую влияет на обучение (`epochs` делает обучение более длительные, помогая с переобучение; меньшие значения `batch_size` увеличивают точность градиента, но требуют больше времени на обучение), покажет это:

Итка, зададим всю ту же модель:

```
model = Sequential([  
    Dense(16, input_dim=X_train.shape[1], activation='linear'),  
    Dense(1, activation='linear')  
])  
random.set_seed(40)
```

```
model.compile(optimizer=Adam(learning_rate=0.05),
              loss='mae',
              metrics=['mae'])
```

Изменим `batch_size` с 32 до 8, `epochs` со 100 до 50, сделав вычисление градиента более точным, а обучение менее длительным:

```
history = model.fit(X_train, y_train, epochs=50, batch_size=8,
                     validation_data=(X_val, y_val))

Epoch 1/50
146/146 [=====] - 1s 4ms/step - loss:
114296.4609 - mae: 114296.4609 - val_loss: 60866.4844 - val_mae:
60866.4844
Epoch 2/50
146/146 [=====] - 0s 3ms/step - loss:
50089.6094 - mae: 50089.6094 - val_loss: 58515.8555 - val_mae:
58515.8555
Epoch 3/50
146/146 [=====] - 0s 3ms/step - loss:
47785.5195 - mae: 47785.5195 - val_loss: 56255.6484 - val_mae:
56255.6484
Epoch 4/50
146/146 [=====] - 0s 3ms/step - loss:
45476.5430 - mae: 45476.5430 - val_loss: 53586.8750 - val_mae:
53586.8750
Epoch 5/50
146/146 [=====] - 0s 3ms/step - loss:
42671.9023 - mae: 42671.9023 - val_loss: 50327.0352 - val_mae:
50327.0352
Epoch 6/50
146/146 [=====] - 0s 3ms/step - loss:
40119.5703 - mae: 40119.5703 - val_loss: 47603.3359 - val_mae:
47603.3359
Epoch 7/50
146/146 [=====] - 0s 3ms/step - loss:
37495.4727 - mae: 37495.4727 - val_loss: 45100.3398 - val_mae:
45100.3398
Epoch 8/50
146/146 [=====] - 0s 3ms/step - loss:
35086.0820 - mae: 35086.0820 - val_loss: 42506.9219 - val_mae:
42506.9219
Epoch 9/50
146/146 [=====] - 0s 3ms/step - loss:
33103.0469 - mae: 33103.0469 - val_loss: 40225.5156 - val_mae:
40225.5156
Epoch 10/50
146/146 [=====] - 0s 3ms/step - loss:
31705.4102 - mae: 31705.4102 - val_loss: 39987.6719 - val_mae:
```

```
39987.6719
Epoch 11/50
146/146 [=====] - 0s 3ms/step - loss: 30647.0410 - mae: 30647.0410 - val_loss: 38051.0430 - val_mae: 38051.0430
Epoch 12/50
146/146 [=====] - 0s 3ms/step - loss: 29629.0820 - mae: 29629.0820 - val_loss: 35885.1172 - val_mae: 35885.1172
Epoch 13/50
146/146 [=====] - 0s 3ms/step - loss: 28846.0215 - mae: 28846.0215 - val_loss: 35684.7266 - val_mae: 35684.7266
Epoch 14/50
146/146 [=====] - 0s 3ms/step - loss: 28126.8184 - mae: 28126.8184 - val_loss: 34568.7695 - val_mae: 34568.7695
Epoch 15/50
146/146 [=====] - 0s 3ms/step - loss: 27772.9453 - mae: 27772.9453 - val_loss: 33956.0898 - val_mae: 33956.0898
Epoch 16/50
146/146 [=====] - 0s 3ms/step - loss: 27273.8301 - mae: 27273.8301 - val_loss: 33655.1250 - val_mae: 33655.1250
Epoch 17/50
146/146 [=====] - 0s 3ms/step - loss: 26795.6719 - mae: 26795.6719 - val_loss: 32649.4766 - val_mae: 32649.4766
Epoch 18/50
146/146 [=====] - 0s 3ms/step - loss: 26294.5625 - mae: 26294.5625 - val_loss: 32300.7012 - val_mae: 32300.7012
Epoch 19/50
146/146 [=====] - 0s 3ms/step - loss: 25951.8730 - mae: 25951.8730 - val_loss: 31560.6641 - val_mae: 31560.6641
Epoch 20/50
146/146 [=====] - 0s 3ms/step - loss: 25557.1895 - mae: 25557.1895 - val_loss: 31041.0820 - val_mae: 31041.0820
Epoch 21/50
146/146 [=====] - 0s 3ms/step - loss: 25231.4531 - mae: 25231.4531 - val_loss: 32683.7285 - val_mae: 32683.7285
Epoch 22/50
146/146 [=====] - 0s 3ms/step - loss: 24881.0742 - mae: 24881.0742 - val_loss: 31520.4102 - val_mae: 31520.4102
```

```
Epoch 23/50
146/146 [=====] - 0s 3ms/step - loss: 24485.7207 - mae: 24485.7207 - val_loss: 30123.8672 - val_mae: 30123.8672
Epoch 24/50
146/146 [=====] - 0s 3ms/step - loss: 24124.7617 - mae: 24124.7617 - val_loss: 29235.8320 - val_mae: 29235.8320
Epoch 25/50
146/146 [=====] - 0s 3ms/step - loss: 23800.7910 - mae: 23800.7910 - val_loss: 28760.4453 - val_mae: 28760.4453
Epoch 26/50
146/146 [=====] - 0s 3ms/step - loss: 23520.7695 - mae: 23520.7695 - val_loss: 28383.5938 - val_mae: 28383.5938
Epoch 27/50
146/146 [=====] - 0s 3ms/step - loss: 23259.6641 - mae: 23259.6641 - val_loss: 27928.8223 - val_mae: 27928.8223
Epoch 28/50
146/146 [=====] - 0s 3ms/step - loss: 22946.3320 - mae: 22946.3320 - val_loss: 27563.2988 - val_mae: 27563.2988
Epoch 29/50
146/146 [=====] - 0s 3ms/step - loss: 22839.8320 - mae: 22839.8320 - val_loss: 27210.8555 - val_mae: 27210.8555
Epoch 30/50
146/146 [=====] - 0s 3ms/step - loss: 22487.0078 - mae: 22487.0078 - val_loss: 26873.6035 - val_mae: 26873.6035
Epoch 31/50
146/146 [=====] - 0s 3ms/step - loss: 22225.3301 - mae: 22225.3301 - val_loss: 26565.0859 - val_mae: 26565.0859
Epoch 32/50
146/146 [=====] - 0s 3ms/step - loss: 22028.9199 - mae: 22028.9199 - val_loss: 26542.2617 - val_mae: 26542.2617
Epoch 33/50
146/146 [=====] - 0s 3ms/step - loss: 21859.1250 - mae: 21859.1250 - val_loss: 26003.2715 - val_mae: 26003.2715
Epoch 34/50
146/146 [=====] - 0s 3ms/step - loss: 21680.8262 - mae: 21680.8262 - val_loss: 25835.8145 - val_mae: 25835.8145
Epoch 35/50
```

```
146/146 [=====] - 0s 3ms/step - loss:  
21519.7715 - mae: 21519.7715 - val_loss: 25798.4844 - val_mae:  
25798.4844  
Epoch 36/50  
146/146 [=====] - 0s 3ms/step - loss:  
21396.5703 - mae: 21396.5703 - val_loss: 25312.1934 - val_mae:  
25312.1934  
Epoch 37/50  
146/146 [=====] - 0s 3ms/step - loss:  
21290.8828 - mae: 21290.8828 - val_loss: 25060.9844 - val_mae:  
25060.9844  
Epoch 38/50  
146/146 [=====] - 0s 3ms/step - loss:  
21287.3633 - mae: 21287.3633 - val_loss: 25212.8633 - val_mae:  
25212.8633  
Epoch 39/50  
146/146 [=====] - 0s 3ms/step - loss:  
21072.4785 - mae: 21072.4785 - val_loss: 24735.6875 - val_mae:  
24735.6875  
Epoch 40/50  
146/146 [=====] - 0s 3ms/step - loss:  
20917.2207 - mae: 20917.2207 - val_loss: 24935.4473 - val_mae:  
24935.4473  
Epoch 41/50  
146/146 [=====] - 0s 3ms/step - loss:  
20636.5078 - mae: 20636.5078 - val_loss: 24568.6738 - val_mae:  
24568.6738  
Epoch 42/50  
146/146 [=====] - 0s 3ms/step - loss:  
20936.3262 - mae: 20936.3262 - val_loss: 24328.7734 - val_mae:  
24328.7734  
Epoch 43/50  
146/146 [=====] - 0s 3ms/step - loss:  
20711.3047 - mae: 20711.3047 - val_loss: 24081.8379 - val_mae:  
24081.8379  
Epoch 44/50  
146/146 [=====] - 0s 3ms/step - loss:  
20465.1504 - mae: 20465.1504 - val_loss: 24342.2246 - val_mae:  
24342.2246  
Epoch 45/50  
146/146 [=====] - 1s 3ms/step - loss:  
20558.5410 - mae: 20558.5410 - val_loss: 24102.9688 - val_mae:  
24102.9688  
Epoch 46/50  
146/146 [=====] - 0s 3ms/step - loss:  
20472.2676 - mae: 20472.2676 - val_loss: 23692.9512 - val_mae:  
23692.9512  
Epoch 47/50  
146/146 [=====] - 0s 3ms/step - loss:
```

```
20281.2227 - mae: 20281.2227 - val_loss: 23531.6543 - val_mae:  
23531.6543  
Epoch 48/50  
146/146 [=====] - 0s 3ms/step - loss:  
20207.7988 - mae: 20207.7988 - val_loss: 23566.3457 - val_mae:  
23566.3457  
Epoch 49/50  
146/146 [=====] - 0s 3ms/step - loss:  
20226.1602 - mae: 20226.1602 - val_loss: 23457.6270 - val_mae:  
23457.6270  
Epoch 50/50  
146/146 [=====] - 0s 3ms/step - loss:  
20127.2578 - mae: 20127.2578 - val_loss: 23337.7422 - val_mae:  
23337.7422
```

Значения остались на прежнем уровне!

## Добавление нейронов на начальном слое

Увеличим количество нейронов на входном слое с 16 до 64

```
model = Sequential([  
    Dense(64, input_dim=X_train.shape[1], activation='linear'),  
    Dense(1, activation='linear')  
)  
random.set_seed(40)  
  
model.compile(optimizer=Adam(learning_rate=0.05),  
              loss='mae',  
              metrics=['mae'])  
  
history = model.fit(X_train, y_train, epochs=100, batch_size=32,  
validation_data=(X_val, y_val))  
  
Epoch 1/100  
37/37 [=====] - 1s 10ms/step - loss:  
164753.3750 - mae: 164753.3750 - val_loss: 145211.1094 - val_mae:  
145211.1094  
Epoch 2/100  
37/37 [=====] - 0s 6ms/step - loss:  
76682.5078 - mae: 76682.5078 - val_loss: 62082.5195 - val_mae:  
62082.5195  
Epoch 3/100  
37/37 [=====] - 0s 5ms/step - loss:  
51593.3789 - mae: 51593.3789 - val_loss: 60064.5820 - val_mae:  
60064.5820  
Epoch 4/100  
37/37 [=====] - 0s 5ms/step - loss:  
49396.2188 - mae: 49396.2188 - val_loss: 58494.5977 - val_mae:
```

```
58494.5977
Epoch 5/100
37/37 [=====] - 0s 5ms/step - loss:
47988.7969 - mae: 47988.7969 - val_loss: 56662.0234 - val_mae:
56662.0234
Epoch 6/100
37/37 [=====] - 0s 5ms/step - loss:
46708.2266 - mae: 46708.2266 - val_loss: 55122.7969 - val_mae:
55122.7969
Epoch 7/100
37/37 [=====] - 0s 5ms/step - loss:
44867.5234 - mae: 44867.5234 - val_loss: 53561.0781 - val_mae:
53561.0781
Epoch 8/100
37/37 [=====] - 0s 5ms/step - loss:
43078.0117 - mae: 43078.0117 - val_loss: 52313.4727 - val_mae:
52313.4727
Epoch 9/100
37/37 [=====] - 0s 5ms/step - loss:
41313.3281 - mae: 41313.3281 - val_loss: 50163.2578 - val_mae:
50163.2578
Epoch 10/100
37/37 [=====] - 0s 5ms/step - loss:
39232.8047 - mae: 39232.8047 - val_loss: 47379.5938 - val_mae:
47379.5938
Epoch 11/100
37/37 [=====] - 0s 5ms/step - loss:
37345.2617 - mae: 37345.2617 - val_loss: 44948.6953 - val_mae:
44948.6953
Epoch 12/100
37/37 [=====] - 0s 5ms/step - loss:
35388.4492 - mae: 35388.4492 - val_loss: 42884.8398 - val_mae:
42884.8398
Epoch 13/100
37/37 [=====] - 0s 5ms/step - loss:
33550.4961 - mae: 33550.4961 - val_loss: 41571.7383 - val_mae:
41571.7383
Epoch 14/100
37/37 [=====] - 0s 5ms/step - loss:
32253.3008 - mae: 32253.3008 - val_loss: 39490.1250 - val_mae:
39490.1250
Epoch 15/100
37/37 [=====] - 0s 5ms/step - loss:
31406.0625 - mae: 31406.0625 - val_loss: 39162.5977 - val_mae:
39162.5977
Epoch 16/100
37/37 [=====] - 0s 5ms/step - loss:
30586.8770 - mae: 30586.8770 - val_loss: 38988.3164 - val_mae:
38988.3164
```

```
Epoch 17/100
37/37 [=====] - 0s 5ms/step - loss:
29741.0273 - mae: 29741.0273 - val_loss: 36018.9688 - val_mae:
36018.9688
Epoch 18/100
37/37 [=====] - 0s 5ms/step - loss:
28898.6367 - mae: 28898.6367 - val_loss: 35222.6914 - val_mae:
35222.6914
Epoch 19/100
37/37 [=====] - 0s 5ms/step - loss:
28368.0723 - mae: 28368.0723 - val_loss: 34747.3047 - val_mae:
34747.3047
Epoch 20/100
37/37 [=====] - 0s 5ms/step - loss:
27849.9336 - mae: 27849.9336 - val_loss: 33951.5664 - val_mae:
33951.5664
Epoch 21/100
37/37 [=====] - 0s 5ms/step - loss:
27589.7988 - mae: 27589.7988 - val_loss: 33935.3242 - val_mae:
33935.3242
Epoch 22/100
37/37 [=====] - 0s 5ms/step - loss:
27216.4434 - mae: 27216.4434 - val_loss: 33715.2070 - val_mae:
33715.2070
Epoch 23/100
37/37 [=====] - 0s 5ms/step - loss:
26594.7578 - mae: 26594.7578 - val_loss: 33855.6758 - val_mae:
33855.6758
Epoch 24/100
37/37 [=====] - 0s 5ms/step - loss:
26349.0762 - mae: 26349.0762 - val_loss: 32622.9141 - val_mae:
32622.9141
Epoch 25/100
37/37 [=====] - 0s 5ms/step - loss:
26034.4590 - mae: 26034.4590 - val_loss: 31951.5723 - val_mae:
31951.5723
Epoch 26/100
37/37 [=====] - 0s 5ms/step - loss:
25488.7598 - mae: 25488.7598 - val_loss: 31749.5859 - val_mae:
31749.5859
Epoch 27/100
37/37 [=====] - 0s 5ms/step - loss:
25415.4902 - mae: 25415.4902 - val_loss: 31063.4082 - val_mae:
31063.4082
Epoch 28/100
37/37 [=====] - 0s 6ms/step - loss:
25002.8008 - mae: 25002.8008 - val_loss: 30554.2988 - val_mae:
30554.2988
Epoch 29/100
```

```
37/37 [=====] - 0s 5ms/step - loss:  
24499.7109 - mae: 24499.7109 - val_loss: 29984.4082 - val_mae:  
29984.4082  
Epoch 30/100  
37/37 [=====] - 0s 5ms/step - loss:  
24332.9102 - mae: 24332.9102 - val_loss: 29513.8359 - val_mae:  
29513.8359  
Epoch 31/100  
37/37 [=====] - 0s 5ms/step - loss:  
23984.5098 - mae: 23984.5098 - val_loss: 29090.6816 - val_mae:  
29090.6816  
Epoch 32/100  
37/37 [=====] - 0s 5ms/step - loss:  
23977.9238 - mae: 23977.9238 - val_loss: 28899.0215 - val_mae:  
28899.0215  
Epoch 33/100  
37/37 [=====] - 0s 5ms/step - loss:  
23446.8125 - mae: 23446.8125 - val_loss: 28648.2129 - val_mae:  
28648.2129  
Epoch 34/100  
37/37 [=====] - 0s 5ms/step - loss:  
23222.7188 - mae: 23222.7188 - val_loss: 28060.6621 - val_mae:  
28060.6621  
Epoch 35/100  
37/37 [=====] - 0s 5ms/step - loss:  
22961.6328 - mae: 22961.6328 - val_loss: 28070.8066 - val_mae:  
28070.8066  
Epoch 36/100  
37/37 [=====] - 0s 5ms/step - loss:  
22789.6758 - mae: 22789.6758 - val_loss: 27345.8984 - val_mae:  
27345.8984  
Epoch 37/100  
37/37 [=====] - 0s 5ms/step - loss:  
22608.3027 - mae: 22608.3027 - val_loss: 26935.2969 - val_mae:  
26935.2969  
Epoch 38/100  
37/37 [=====] - 0s 5ms/step - loss:  
22379.1211 - mae: 22379.1211 - val_loss: 27496.7988 - val_mae:  
27496.7988  
Epoch 39/100  
37/37 [=====] - 0s 5ms/step - loss:  
22075.8828 - mae: 22075.8828 - val_loss: 26727.0762 - val_mae:  
26727.0762  
Epoch 40/100  
37/37 [=====] - 0s 5ms/step - loss:  
21969.4531 - mae: 21969.4531 - val_loss: 26331.8281 - val_mae:  
26331.8281  
Epoch 41/100  
37/37 [=====] - 0s 5ms/step - loss:
```

```
21935.7734 - mae: 21935.7734 - val_loss: 26341.3730 - val_mae:  
26341.3730  
Epoch 42/100  
37/37 [=====] - 0s 5ms/step - loss:  
22501.4590 - mae: 22501.4590 - val_loss: 25900.4980 - val_mae:  
25900.4980  
Epoch 43/100  
37/37 [=====] - 0s 5ms/step - loss:  
21399.0723 - mae: 21399.0723 - val_loss: 26201.0020 - val_mae:  
26201.0020  
Epoch 44/100  
37/37 [=====] - 0s 5ms/step - loss:  
21199.1582 - mae: 21199.1582 - val_loss: 25364.3652 - val_mae:  
25364.3652  
Epoch 45/100  
37/37 [=====] - 0s 5ms/step - loss:  
21361.7012 - mae: 21361.7012 - val_loss: 25149.0254 - val_mae:  
25149.0254  
Epoch 46/100  
37/37 [=====] - 0s 5ms/step - loss:  
21161.3613 - mae: 21161.3613 - val_loss: 24948.6484 - val_mae:  
24948.6484  
Epoch 47/100  
37/37 [=====] - 0s 5ms/step - loss:  
20911.5645 - mae: 20911.5645 - val_loss: 24881.5566 - val_mae:  
24881.5566  
Epoch 48/100  
37/37 [=====] - 0s 5ms/step - loss:  
21002.2207 - mae: 21002.2207 - val_loss: 24975.9121 - val_mae:  
24975.9121  
Epoch 49/100  
37/37 [=====] - 0s 5ms/step - loss:  
20728.5020 - mae: 20728.5020 - val_loss: 24453.1074 - val_mae:  
24453.1074  
Epoch 50/100  
37/37 [=====] - 0s 5ms/step - loss:  
20826.9648 - mae: 20826.9648 - val_loss: 24298.4648 - val_mae:  
24298.4648  
Epoch 51/100  
37/37 [=====] - 0s 5ms/step - loss:  
20523.2070 - mae: 20523.2070 - val_loss: 24394.0352 - val_mae:  
24394.0352  
Epoch 52/100  
37/37 [=====] - 0s 5ms/step - loss:  
20743.6289 - mae: 20743.6289 - val_loss: 24124.2656 - val_mae:  
24124.2656  
Epoch 53/100  
37/37 [=====] - 0s 5ms/step - loss:  
20478.5449 - mae: 20478.5449 - val_loss: 24183.6113 - val_mae:
```

```
24183.6113
Epoch 54/100
37/37 [=====] - 0s 5ms/step - loss:
20328.4316 - mae: 20328.4316 - val_loss: 23758.3574 - val_mae:
23758.3574
Epoch 55/100
37/37 [=====] - 0s 5ms/step - loss:
20502.6582 - mae: 20502.6582 - val_loss: 24087.2734 - val_mae:
24087.2734
Epoch 56/100
37/37 [=====] - 0s 6ms/step - loss:
20375.8555 - mae: 20375.8555 - val_loss: 23580.2637 - val_mae:
23580.2637
Epoch 57/100
37/37 [=====] - 0s 5ms/step - loss:
20306.2480 - mae: 20306.2480 - val_loss: 23517.5645 - val_mae:
23517.5645
Epoch 58/100
37/37 [=====] - 0s 5ms/step - loss:
20209.6035 - mae: 20209.6035 - val_loss: 23597.9551 - val_mae:
23597.9551
Epoch 59/100
37/37 [=====] - 0s 5ms/step - loss:
20165.9961 - mae: 20165.9961 - val_loss: 23433.9688 - val_mae:
23433.9688
Epoch 60/100
37/37 [=====] - 0s 5ms/step - loss:
19954.9590 - mae: 19954.9590 - val_loss: 23890.4961 - val_mae:
23890.4961
Epoch 61/100
37/37 [=====] - 0s 5ms/step - loss:
19953.6367 - mae: 19953.6367 - val_loss: 23237.7539 - val_mae:
23237.7539
Epoch 62/100
37/37 [=====] - 0s 5ms/step - loss:
20035.1465 - mae: 20035.1465 - val_loss: 23512.3066 - val_mae:
23512.3066
Epoch 63/100
37/37 [=====] - 0s 5ms/step - loss:
20416.9609 - mae: 20416.9609 - val_loss: 23056.5059 - val_mae:
23056.5059
Epoch 64/100
37/37 [=====] - 0s 5ms/step - loss:
19757.7773 - mae: 19757.7773 - val_loss: 23179.7988 - val_mae:
23179.7988
Epoch 65/100
37/37 [=====] - 0s 5ms/step - loss:
20179.0762 - mae: 20179.0762 - val_loss: 23294.2109 - val_mae:
23294.2109
```

```
Epoch 66/100
37/37 [=====] - 0s 5ms/step - loss:
19896.7969 - mae: 19896.7969 - val_loss: 23347.0762 - val_mae:
23347.0762
Epoch 67/100
37/37 [=====] - 0s 5ms/step - loss:
19722.7520 - mae: 19722.7520 - val_loss: 23765.0117 - val_mae:
23765.0117
Epoch 68/100
37/37 [=====] - 0s 5ms/step - loss:
19879.2754 - mae: 19879.2754 - val_loss: 22824.6758 - val_mae:
22824.6758
Epoch 69/100
37/37 [=====] - 0s 5ms/step - loss:
19774.9902 - mae: 19774.9902 - val_loss: 22739.2207 - val_mae:
22739.2207
Epoch 70/100
37/37 [=====] - 0s 5ms/step - loss:
19655.0117 - mae: 19655.0117 - val_loss: 22832.2637 - val_mae:
22832.2637
Epoch 71/100
37/37 [=====] - 0s 5ms/step - loss:
19601.8672 - mae: 19601.8672 - val_loss: 22779.9375 - val_mae:
22779.9375
Epoch 72/100
37/37 [=====] - 0s 5ms/step - loss:
19673.0098 - mae: 19673.0098 - val_loss: 22646.3574 - val_mae:
22646.3574
Epoch 73/100
37/37 [=====] - 0s 5ms/step - loss:
19513.2148 - mae: 19513.2148 - val_loss: 22706.7441 - val_mae:
22706.7441
Epoch 74/100
37/37 [=====] - 0s 5ms/step - loss:
19999.4102 - mae: 19999.4102 - val_loss: 22746.2949 - val_mae:
22746.2949
Epoch 75/100
37/37 [=====] - 0s 5ms/step - loss:
19493.8438 - mae: 19493.8438 - val_loss: 22521.8066 - val_mae:
22521.8066
Epoch 76/100
37/37 [=====] - 0s 5ms/step - loss:
19472.9688 - mae: 19472.9688 - val_loss: 22545.9766 - val_mae:
22545.9766
Epoch 77/100
37/37 [=====] - 0s 5ms/step - loss:
19471.6465 - mae: 19471.6465 - val_loss: 22424.1406 - val_mae:
22424.1406
Epoch 78/100
```

```
37/37 [=====] - 0s 5ms/step - loss:  
19515.8535 - mae: 19515.8535 - val_loss: 23694.4980 - val_mae:  
23694.4980  
Epoch 79/100  
37/37 [=====] - 0s 5ms/step - loss:  
19529.1270 - mae: 19529.1270 - val_loss: 22888.4160 - val_mae:  
22888.4160  
Epoch 80/100  
37/37 [=====] - 0s 5ms/step - loss:  
19747.1367 - mae: 19747.1367 - val_loss: 22351.2168 - val_mae:  
22351.2168  
Epoch 81/100  
37/37 [=====] - 0s 5ms/step - loss:  
19800.5469 - mae: 19800.5469 - val_loss: 22313.2891 - val_mae:  
22313.2891  
Epoch 82/100  
37/37 [=====] - 0s 6ms/step - loss:  
19352.7168 - mae: 19352.7168 - val_loss: 22266.6270 - val_mae:  
22266.6270  
Epoch 83/100  
37/37 [=====] - 0s 5ms/step - loss:  
19328.3906 - mae: 19328.3906 - val_loss: 22447.6797 - val_mae:  
22447.6797  
Epoch 84/100  
37/37 [=====] - 0s 5ms/step - loss:  
19455.7305 - mae: 19455.7305 - val_loss: 22476.0859 - val_mae:  
22476.0859  
Epoch 85/100  
37/37 [=====] - 0s 5ms/step - loss:  
19219.6348 - mae: 19219.6348 - val_loss: 22255.2109 - val_mae:  
22255.2109  
Epoch 86/100  
37/37 [=====] - 0s 5ms/step - loss:  
19222.2246 - mae: 19222.2246 - val_loss: 22401.2559 - val_mae:  
22401.2559  
Epoch 87/100  
37/37 [=====] - 0s 5ms/step - loss:  
19218.2988 - mae: 19218.2988 - val_loss: 22221.2129 - val_mae:  
22221.2129  
Epoch 88/100  
37/37 [=====] - 0s 5ms/step - loss:  
19193.6523 - mae: 19193.6523 - val_loss: 22366.2969 - val_mae:  
22366.2969  
Epoch 89/100  
37/37 [=====] - 0s 5ms/step - loss:  
19231.2656 - mae: 19231.2656 - val_loss: 22533.4180 - val_mae:  
22533.4180  
Epoch 90/100  
37/37 [=====] - 0s 5ms/step - loss:
```

```
19313.2051 - mae: 19313.2051 - val_loss: 22318.8535 - val_mae:  
22318.8535  
Epoch 91/100  
37/37 [=====] - 0s 5ms/step - loss:  
19152.1328 - mae: 19152.1328 - val_loss: 22576.5234 - val_mae:  
22576.5234  
Epoch 92/100  
37/37 [=====] - 0s 6ms/step - loss:  
19288.1602 - mae: 19288.1602 - val_loss: 22114.4297 - val_mae:  
22114.4297  
Epoch 93/100  
37/37 [=====] - 0s 5ms/step - loss:  
19006.1055 - mae: 19006.1055 - val_loss: 22222.9512 - val_mae:  
22222.9512  
Epoch 94/100  
37/37 [=====] - 0s 5ms/step - loss:  
19122.4160 - mae: 19122.4160 - val_loss: 22388.3027 - val_mae:  
22388.3027  
Epoch 95/100  
37/37 [=====] - 0s 5ms/step - loss:  
19199.4160 - mae: 19199.4160 - val_loss: 23051.0137 - val_mae:  
23051.0137  
Epoch 96/100  
37/37 [=====] - 0s 5ms/step - loss:  
19111.0098 - mae: 19111.0098 - val_loss: 21941.6074 - val_mae:  
21941.6074  
Epoch 97/100  
37/37 [=====] - 0s 5ms/step - loss:  
18997.9277 - mae: 18997.9277 - val_loss: 21908.0293 - val_mae:  
21908.0293  
Epoch 98/100  
37/37 [=====] - 0s 5ms/step - loss:  
19020.6602 - mae: 19020.6602 - val_loss: 23446.9980 - val_mae:  
23446.9980  
Epoch 99/100  
37/37 [=====] - 0s 5ms/step - loss:  
19389.2285 - mae: 19389.2285 - val_loss: 22727.7031 - val_mae:  
22727.7031  
Epoch 100/100  
37/37 [=====] - 0s 6ms/step - loss:  
18999.2148 - mae: 18999.2148 - val_loss: 21808.8535 - val_mae:  
21808.8535
```

Модель стала сложнее, но начала давать лучшие результаты!

## Добавление скрытого слоя

Добавим в нашу модель скрытый слой с 64 нейронами и функцией активации `relu`, сглаживающей градиент:

```
model = Sequential([
    Dense(64, input_dim=X_train.shape[1], activation='linear'),
    Dense(64, input_dim=X_train.shape[1], activation='relu'),
    Dense(1, activation='linear')
])
random.set_seed(40)

model.compile(optimizer=Adam(learning_rate=0.05),
              loss='mae',
              metrics=['mae'])

history = model.fit(X_train, y_train, epochs=100, batch_size=32,
                     validation_data=(X_val, y_val))

Epoch 1/100
37/37 [=====] - 1s 10ms/step - loss:
103426.7188 - mae: 103426.7188 - val_loss: 61318.7617 - val_mae:
61318.7617
Epoch 2/100
37/37 [=====] - 0s 6ms/step - loss:
48620.0898 - mae: 48620.0898 - val_loss: 53357.0000 - val_mae:
53357.0000
Epoch 3/100
37/37 [=====] - 0s 5ms/step - loss:
40950.1797 - mae: 40950.1797 - val_loss: 45458.1758 - val_mae:
45458.1758
Epoch 4/100
37/37 [=====] - 0s 5ms/step - loss:
32536.2773 - mae: 32536.2773 - val_loss: 36496.8203 - val_mae:
36496.8203
Epoch 5/100
37/37 [=====] - 0s 5ms/step - loss:
28428.8301 - mae: 28428.8301 - val_loss: 33238.9727 - val_mae:
33238.9727
Epoch 6/100
37/37 [=====] - 0s 5ms/step - loss:
26452.7617 - mae: 26452.7617 - val_loss: 30875.3555 - val_mae:
30875.3555
Epoch 7/100
37/37 [=====] - 0s 5ms/step - loss:
24857.3496 - mae: 24857.3496 - val_loss: 28884.1914 - val_mae:
28884.1914
Epoch 8/100
37/37 [=====] - 0s 6ms/step - loss:
23925.9375 - mae: 23925.9375 - val_loss: 27413.1875 - val_mae:
27413.1875
Epoch 9/100
37/37 [=====] - 0s 5ms/step - loss:
23830.8320 - mae: 23830.8320 - val_loss: 26242.4609 - val_mae:
26242.4609
```

```
Epoch 10/100
37/37 [=====] - 0s 6ms/step - loss:
22708.7148 - mae: 22708.7148 - val_loss: 24813.2754 - val_mae:
24813.2754
Epoch 11/100
37/37 [=====] - 0s 5ms/step - loss:
21930.2012 - mae: 21930.2012 - val_loss: 24411.8516 - val_mae:
24411.8516
Epoch 12/100
37/37 [=====] - 0s 5ms/step - loss:
22275.0684 - mae: 22275.0684 - val_loss: 25387.7852 - val_mae:
25387.7852
Epoch 13/100
37/37 [=====] - 0s 6ms/step - loss:
21693.6387 - mae: 21693.6387 - val_loss: 24000.1191 - val_mae:
24000.1191
Epoch 14/100
37/37 [=====] - 0s 6ms/step - loss:
21048.7910 - mae: 21048.7910 - val_loss: 24923.6641 - val_mae:
24923.6641
Epoch 15/100
37/37 [=====] - 0s 6ms/step - loss:
21127.2266 - mae: 21127.2266 - val_loss: 23302.2285 - val_mae:
23302.2285
Epoch 16/100
37/37 [=====] - 0s 6ms/step - loss:
20588.2891 - mae: 20588.2891 - val_loss: 23713.9805 - val_mae:
23713.9805
Epoch 17/100
37/37 [=====] - 0s 5ms/step - loss:
20375.0781 - mae: 20375.0781 - val_loss: 22736.1699 - val_mae:
22736.1699
Epoch 18/100
37/37 [=====] - 0s 6ms/step - loss:
20039.2949 - mae: 20039.2949 - val_loss: 24950.5996 - val_mae:
24950.5996
Epoch 19/100
37/37 [=====] - 0s 6ms/step - loss:
21461.1875 - mae: 21461.1875 - val_loss: 23540.3867 - val_mae:
23540.3867
Epoch 20/100
37/37 [=====] - 0s 5ms/step - loss:
20120.2285 - mae: 20120.2285 - val_loss: 24792.1602 - val_mae:
24792.1602
Epoch 21/100
37/37 [=====] - 0s 5ms/step - loss:
21129.4258 - mae: 21129.4258 - val_loss: 22602.3125 - val_mae:
22602.3125
Epoch 22/100
```

```
37/37 [=====] - 0s 5ms/step - loss:  
20570.2129 - mae: 20570.2129 - val_loss: 23303.4219 - val_mae:  
23303.4219  
Epoch 23/100  
37/37 [=====] - 0s 6ms/step - loss:  
19969.1758 - mae: 19969.1758 - val_loss: 23733.5215 - val_mae:  
23733.5215  
Epoch 24/100  
37/37 [=====] - 0s 5ms/step - loss:  
20658.1270 - mae: 20658.1270 - val_loss: 22778.8125 - val_mae:  
22778.8125  
Epoch 25/100  
37/37 [=====] - 0s 5ms/step - loss:  
19271.6289 - mae: 19271.6289 - val_loss: 21793.4453 - val_mae:  
21793.4453  
Epoch 26/100  
37/37 [=====] - 0s 5ms/step - loss:  
19549.8301 - mae: 19549.8301 - val_loss: 21850.0215 - val_mae:  
21850.0215  
Epoch 27/100  
37/37 [=====] - 0s 6ms/step - loss:  
19328.9121 - mae: 19328.9121 - val_loss: 23991.3535 - val_mae:  
23991.3535  
Epoch 28/100  
37/37 [=====] - 0s 5ms/step - loss:  
19841.1758 - mae: 19841.1758 - val_loss: 24238.8848 - val_mae:  
24238.8848  
Epoch 29/100  
37/37 [=====] - 0s 6ms/step - loss:  
22758.9062 - mae: 22758.9062 - val_loss: 22564.8125 - val_mae:  
22564.8125  
Epoch 30/100  
37/37 [=====] - 0s 5ms/step - loss:  
22583.6172 - mae: 22583.6172 - val_loss: 22855.1973 - val_mae:  
22855.1973  
Epoch 31/100  
37/37 [=====] - 0s 6ms/step - loss:  
19729.4414 - mae: 19729.4414 - val_loss: 21909.7266 - val_mae:  
21909.7266  
Epoch 32/100  
37/37 [=====] - 0s 5ms/step - loss:  
19617.7617 - mae: 19617.7617 - val_loss: 22452.8496 - val_mae:  
22452.8496  
Epoch 33/100  
37/37 [=====] - 0s 5ms/step - loss:  
19415.5371 - mae: 19415.5371 - val_loss: 21341.2012 - val_mae:  
21341.2012  
Epoch 34/100  
37/37 [=====] - 0s 6ms/step - loss:
```

```
18881.4395 - mae: 18881.4395 - val_loss: 21656.7070 - val_mae:  
21656.7070  
Epoch 35/100  
37/37 [=====] - 0s 5ms/step - loss:  
19156.4609 - mae: 19156.4609 - val_loss: 21365.9766 - val_mae:  
21365.9766  
Epoch 36/100  
37/37 [=====] - 0s 6ms/step - loss:  
18985.6113 - mae: 18985.6113 - val_loss: 22432.3945 - val_mae:  
22432.3945  
Epoch 37/100  
37/37 [=====] - 0s 6ms/step - loss:  
19259.9023 - mae: 19259.9023 - val_loss: 20889.8613 - val_mae:  
20889.8613  
Epoch 38/100  
37/37 [=====] - 0s 5ms/step - loss:  
19841.2207 - mae: 19841.2207 - val_loss: 24143.2852 - val_mae:  
24143.2852  
Epoch 39/100  
37/37 [=====] - 0s 6ms/step - loss:  
19669.7852 - mae: 19669.7852 - val_loss: 20820.4434 - val_mae:  
20820.4434  
Epoch 40/100  
37/37 [=====] - 0s 5ms/step - loss:  
19535.9785 - mae: 19535.9785 - val_loss: 21941.6309 - val_mae:  
21941.6309  
Epoch 41/100  
37/37 [=====] - 0s 5ms/step - loss:  
18562.8613 - mae: 18562.8613 - val_loss: 21081.2500 - val_mae:  
21081.2500  
Epoch 42/100  
37/37 [=====] - 0s 5ms/step - loss:  
19232.9941 - mae: 19232.9941 - val_loss: 21032.7188 - val_mae:  
21032.7188  
Epoch 43/100  
37/37 [=====] - 0s 5ms/step - loss:  
20342.8320 - mae: 20342.8320 - val_loss: 20777.4316 - val_mae:  
20777.4316  
Epoch 44/100  
37/37 [=====] - 0s 5ms/step - loss:  
19099.2988 - mae: 19099.2988 - val_loss: 21010.5762 - val_mae:  
21010.5762  
Epoch 45/100  
37/37 [=====] - 0s 6ms/step - loss:  
18517.2559 - mae: 18517.2559 - val_loss: 21860.6523 - val_mae:  
21860.6523  
Epoch 46/100  
37/37 [=====] - 0s 5ms/step - loss:  
19078.2402 - mae: 19078.2402 - val_loss: 21541.7090 - val_mae:
```

```
21541.7090
Epoch 47/100
37/37 [=====] - 0s 5ms/step - loss:
18593.6699 - mae: 18593.6699 - val_loss: 21432.2930 - val_mae:
21432.2930
Epoch 48/100
37/37 [=====] - 0s 5ms/step - loss:
18814.0352 - mae: 18814.0352 - val_loss: 20481.0469 - val_mae:
20481.0469
Epoch 49/100
37/37 [=====] - 0s 5ms/step - loss:
19102.0508 - mae: 19102.0508 - val_loss: 21579.2363 - val_mae:
21579.2363
Epoch 50/100
37/37 [=====] - 0s 5ms/step - loss:
19063.6621 - mae: 19063.6621 - val_loss: 21890.8379 - val_mae:
21890.8379
Epoch 51/100
37/37 [=====] - 0s 5ms/step - loss:
19228.9277 - mae: 19228.9277 - val_loss: 24624.0566 - val_mae:
24624.0566
Epoch 52/100
37/37 [=====] - 0s 5ms/step - loss:
20291.6895 - mae: 20291.6895 - val_loss: 21325.6602 - val_mae:
21325.6602
Epoch 53/100
37/37 [=====] - 0s 5ms/step - loss:
20405.2324 - mae: 20405.2324 - val_loss: 20299.4551 - val_mae:
20299.4551
Epoch 54/100
37/37 [=====] - 0s 5ms/step - loss:
18789.1230 - mae: 18789.1230 - val_loss: 20782.0078 - val_mae:
20782.0078
Epoch 55/100
37/37 [=====] - 0s 6ms/step - loss:
19347.6602 - mae: 19347.6602 - val_loss: 21950.9922 - val_mae:
21950.9922
Epoch 56/100
37/37 [=====] - 0s 6ms/step - loss:
18749.4160 - mae: 18749.4160 - val_loss: 21986.0020 - val_mae:
21986.0020
Epoch 57/100
37/37 [=====] - 0s 5ms/step - loss:
19506.5332 - mae: 19506.5332 - val_loss: 20582.2500 - val_mae:
20582.2500
Epoch 58/100
37/37 [=====] - 0s 5ms/step - loss:
18246.1680 - mae: 18246.1680 - val_loss: 20367.5977 - val_mae:
20367.5977
```

```
Epoch 59/100
37/37 [=====] - 0s 6ms/step - loss:
18734.3867 - mae: 18734.3867 - val_loss: 20200.2480 - val_mae:
20200.2480
Epoch 60/100
37/37 [=====] - 0s 5ms/step - loss:
18912.3867 - mae: 18912.3867 - val_loss: 20443.4277 - val_mae:
20443.4277
Epoch 61/100
37/37 [=====] - 0s 5ms/step - loss:
18708.6641 - mae: 18708.6641 - val_loss: 24364.7734 - val_mae:
24364.7734
Epoch 62/100
37/37 [=====] - 0s 5ms/step - loss:
19218.8945 - mae: 19218.8945 - val_loss: 22601.2578 - val_mae:
22601.2578
Epoch 63/100
37/37 [=====] - 0s 5ms/step - loss:
17905.4375 - mae: 17905.4375 - val_loss: 20044.5371 - val_mae:
20044.5371
Epoch 64/100
37/37 [=====] - 0s 5ms/step - loss:
18266.3730 - mae: 18266.3730 - val_loss: 20294.7012 - val_mae:
20294.7012
Epoch 65/100
37/37 [=====] - 0s 5ms/step - loss:
18947.7910 - mae: 18947.7910 - val_loss: 19993.9258 - val_mae:
19993.9258
Epoch 66/100
37/37 [=====] - 0s 5ms/step - loss:
18757.6543 - mae: 18757.6543 - val_loss: 20360.6797 - val_mae:
20360.6797
Epoch 67/100
37/37 [=====] - 0s 5ms/step - loss:
19755.4570 - mae: 19755.4570 - val_loss: 20314.2949 - val_mae:
20314.2949
Epoch 68/100
37/37 [=====] - 0s 5ms/step - loss:
18421.4844 - mae: 18421.4844 - val_loss: 20374.4590 - val_mae:
20374.4590
Epoch 69/100
37/37 [=====] - 0s 5ms/step - loss:
18645.7500 - mae: 18645.7500 - val_loss: 20371.6172 - val_mae:
20371.6172
Epoch 70/100
37/37 [=====] - 0s 5ms/step - loss:
18371.4609 - mae: 18371.4609 - val_loss: 20070.4355 - val_mae:
20070.4355
Epoch 71/100
```

```
37/37 [=====] - 0s 5ms/step - loss:  
18718.3965 - mae: 18718.3965 - val_loss: 26429.0215 - val_mae:  
26429.0215  
Epoch 72/100  
37/37 [=====] - 0s 5ms/step - loss:  
20283.7910 - mae: 20283.7910 - val_loss: 20352.2422 - val_mae:  
20352.2422  
Epoch 73/100  
37/37 [=====] - 0s 5ms/step - loss:  
18538.7520 - mae: 18538.7520 - val_loss: 19908.0723 - val_mae:  
19908.0723  
Epoch 74/100  
37/37 [=====] - 0s 5ms/step - loss:  
19342.9785 - mae: 19342.9785 - val_loss: 27620.3809 - val_mae:  
27620.3809  
Epoch 75/100  
37/37 [=====] - 0s 5ms/step - loss:  
18515.0938 - mae: 18515.0938 - val_loss: 20077.7461 - val_mae:  
20077.7461  
Epoch 76/100  
37/37 [=====] - 0s 5ms/step - loss:  
19391.9414 - mae: 19391.9414 - val_loss: 20007.7637 - val_mae:  
20007.7637  
Epoch 77/100  
37/37 [=====] - 0s 5ms/step - loss:  
18898.7031 - mae: 18898.7031 - val_loss: 22396.3457 - val_mae:  
22396.3457  
Epoch 78/100  
37/37 [=====] - 0s 6ms/step - loss:  
18878.2461 - mae: 18878.2461 - val_loss: 19900.8828 - val_mae:  
19900.8828  
Epoch 79/100  
37/37 [=====] - 0s 6ms/step - loss:  
17808.6484 - mae: 17808.6484 - val_loss: 20809.4746 - val_mae:  
20809.4746  
Epoch 80/100  
37/37 [=====] - 0s 6ms/step - loss:  
18980.5449 - mae: 18980.5449 - val_loss: 24374.0039 - val_mae:  
24374.0039  
Epoch 81/100  
37/37 [=====] - 0s 5ms/step - loss:  
18486.4375 - mae: 18486.4375 - val_loss: 20007.1445 - val_mae:  
20007.1445  
Epoch 82/100  
37/37 [=====] - 0s 5ms/step - loss:  
18302.1172 - mae: 18302.1172 - val_loss: 20245.6973 - val_mae:  
20245.6973  
Epoch 83/100  
37/37 [=====] - 0s 5ms/step - loss:
```

```
18581.0625 - mae: 18581.0625 - val_loss: 20319.9102 - val_mae:  
20319.9102  
Epoch 84/100  
37/37 [=====] - 0s 5ms/step - loss:  
19161.4805 - mae: 19161.4805 - val_loss: 20368.4297 - val_mae:  
20368.4297  
Epoch 85/100  
37/37 [=====] - 0s 5ms/step - loss:  
18482.4629 - mae: 18482.4629 - val_loss: 20022.3945 - val_mae:  
20022.3945  
Epoch 86/100  
37/37 [=====] - 0s 5ms/step - loss:  
18061.1953 - mae: 18061.1953 - val_loss: 20393.4297 - val_mae:  
20393.4297  
Epoch 87/100  
37/37 [=====] - 0s 5ms/step - loss:  
18038.9473 - mae: 18038.9473 - val_loss: 20042.5469 - val_mae:  
20042.5469  
Epoch 88/100  
37/37 [=====] - 0s 5ms/step - loss:  
17657.1445 - mae: 17657.1445 - val_loss: 19878.4668 - val_mae:  
19878.4668  
Epoch 89/100  
37/37 [=====] - 0s 6ms/step - loss:  
18679.3613 - mae: 18679.3613 - val_loss: 20697.5488 - val_mae:  
20697.5488  
Epoch 90/100  
37/37 [=====] - 0s 5ms/step - loss:  
17988.2969 - mae: 17988.2969 - val_loss: 21578.6641 - val_mae:  
21578.6641  
Epoch 91/100  
37/37 [=====] - 0s 6ms/step - loss:  
18561.6797 - mae: 18561.6797 - val_loss: 20374.3223 - val_mae:  
20374.3223  
Epoch 92/100  
37/37 [=====] - 0s 6ms/step - loss:  
18588.4922 - mae: 18588.4922 - val_loss: 19808.9297 - val_mae:  
19808.9297  
Epoch 93/100  
37/37 [=====] - 0s 6ms/step - loss:  
18352.7930 - mae: 18352.7930 - val_loss: 20073.5996 - val_mae:  
20073.5996  
Epoch 94/100  
37/37 [=====] - 0s 5ms/step - loss:  
17866.8164 - mae: 17866.8164 - val_loss: 22691.7109 - val_mae:  
22691.7109  
Epoch 95/100  
37/37 [=====] - 0s 5ms/step - loss:  
18623.6426 - mae: 18623.6426 - val_loss: 20942.8691 - val_mae:
```

```
20942.8691
Epoch 96/100
37/37 [=====] - 0s 5ms/step - loss:
18274.9922 - mae: 18274.9922 - val_loss: 23134.0254 - val_mae:
23134.0254
Epoch 97/100
37/37 [=====] - 0s 5ms/step - loss:
18425.1152 - mae: 18425.1152 - val_loss: 20464.8633 - val_mae:
20464.8633
Epoch 98/100
37/37 [=====] - 0s 6ms/step - loss:
18647.0449 - mae: 18647.0449 - val_loss: 24356.5352 - val_mae:
24356.5352
Epoch 99/100
37/37 [=====] - 0s 5ms/step - loss:
19365.7422 - mae: 19365.7422 - val_loss: 19928.2598 - val_mae:
19928.2598
Epoch 100/100
37/37 [=====] - 0s 5ms/step - loss:
18030.3730 - mae: 18030.3730 - val_loss: 19939.0762 - val_mae:
19939.0762
```

Получили очередную прибавку в качестве за счёт усложнения модели!

## Оптимизаторы и функции потерь

До этого мы использовали универсальный и достаточно эффективный оптимизатор Adam, посмотрим, что изменится, если мы сменим его на Adamax (модель оставим при этом прежней, по сути задев только часть с её обучением):

```
model = Sequential([
    Dense(64, input_dim=X_train.shape[1], activation='linear'),
    Dense(64, input_dim=X_train.shape[1], activation='relu'),
    Dense(1, activation='linear')
])
random.set_seed(40)

from tensorflow.keras.optimizers import Adamax

model.compile(optimizer=Adamax(learning_rate=0.05),
              loss='mae',
              metrics=['mae'])

history = model.fit(X_train, y_train, epochs=100, batch_size=32,
                     validation_data=(X_val, y_val))

Epoch 1/100
37/37 [=====] - 1s 11ms/step - loss:
19153.0215 - mae: 19153.0215 - val_loss: 21948.6055 - val_mae:
```

```
21948.6055
Epoch 2/100
37/37 [=====] - 0s 5ms/step - loss:
17735.7500 - mae: 17735.7500 - val_loss: 19453.1855 - val_mae:
19453.1855
Epoch 3/100
37/37 [=====] - 0s 5ms/step - loss:
17022.7148 - mae: 17022.7148 - val_loss: 19745.9277 - val_mae:
19745.9277
Epoch 4/100
37/37 [=====] - 0s 5ms/step - loss:
17006.7773 - mae: 17006.7773 - val_loss: 19882.2598 - val_mae:
19882.2598
Epoch 5/100
37/37 [=====] - 0s 4ms/step - loss:
17108.5508 - mae: 17108.5508 - val_loss: 19519.9512 - val_mae:
19519.9512
Epoch 6/100
37/37 [=====] - 0s 4ms/step - loss:
16751.0586 - mae: 16751.0586 - val_loss: 21604.1543 - val_mae:
21604.1543
Epoch 7/100
37/37 [=====] - 0s 4ms/step - loss:
16882.4863 - mae: 16882.4863 - val_loss: 19094.3887 - val_mae:
19094.3887
Epoch 8/100
37/37 [=====] - 0s 4ms/step - loss:
16394.0195 - mae: 16394.0195 - val_loss: 18990.9727 - val_mae:
18990.9727
Epoch 9/100
37/37 [=====] - 0s 4ms/step - loss:
16878.5352 - mae: 16878.5352 - val_loss: 19250.2109 - val_mae:
19250.2109
Epoch 10/100
37/37 [=====] - 0s 5ms/step - loss:
17286.0547 - mae: 17286.0547 - val_loss: 20664.9883 - val_mae:
20664.9883
Epoch 11/100
37/37 [=====] - 0s 4ms/step - loss:
16793.2500 - mae: 16793.2500 - val_loss: 19694.8184 - val_mae:
19694.8184
Epoch 12/100
37/37 [=====] - 0s 4ms/step - loss:
16278.4229 - mae: 16278.4229 - val_loss: 19180.7363 - val_mae:
19180.7363
Epoch 13/100
37/37 [=====] - 0s 5ms/step - loss:
16607.0547 - mae: 16607.0547 - val_loss: 19223.0762 - val_mae:
19223.0762
```

```
Epoch 14/100
37/37 [=====] - 0s 5ms/step - loss:
16644.8828 - mae: 16644.8828 - val_loss: 18828.6914 - val_mae:
18828.6914
Epoch 15/100
37/37 [=====] - 0s 5ms/step - loss:
16883.3809 - mae: 16883.3809 - val_loss: 19664.5469 - val_mae:
19664.5469
Epoch 16/100
37/37 [=====] - 0s 5ms/step - loss:
16200.1885 - mae: 16200.1885 - val_loss: 19812.2578 - val_mae:
19812.2578
Epoch 17/100
37/37 [=====] - 0s 6ms/step - loss:
16650.3516 - mae: 16650.3516 - val_loss: 18743.3652 - val_mae:
18743.3652
Epoch 18/100
37/37 [=====] - 0s 5ms/step - loss:
16031.3301 - mae: 16031.3301 - val_loss: 18627.2715 - val_mae:
18627.2715
Epoch 19/100
37/37 [=====] - 0s 6ms/step - loss:
16084.3926 - mae: 16084.3926 - val_loss: 19601.8535 - val_mae:
19601.8535
Epoch 20/100
37/37 [=====] - 0s 5ms/step - loss:
16011.1230 - mae: 16011.1230 - val_loss: 18547.5156 - val_mae:
18547.5156
Epoch 21/100
37/37 [=====] - 0s 5ms/step - loss:
15919.6113 - mae: 15919.6113 - val_loss: 18676.4102 - val_mae:
18676.4102
Epoch 22/100
37/37 [=====] - 0s 5ms/step - loss:
15978.4541 - mae: 15978.4541 - val_loss: 18507.5488 - val_mae:
18507.5488
Epoch 23/100
37/37 [=====] - 0s 4ms/step - loss:
15873.7656 - mae: 15873.7656 - val_loss: 18712.9434 - val_mae:
18712.9434
Epoch 24/100
37/37 [=====] - 0s 5ms/step - loss:
16717.2656 - mae: 16717.2656 - val_loss: 19633.3145 - val_mae:
19633.3145
Epoch 25/100
37/37 [=====] - 0s 5ms/step - loss:
15800.7002 - mae: 15800.7002 - val_loss: 18340.6484 - val_mae:
18340.6484
Epoch 26/100
```

```
37/37 [=====] - 0s 7ms/step - loss:  
15654.9756 - mae: 15654.9756 - val_loss: 18397.3301 - val_mae:  
18397.3301  
Epoch 27/100  
37/37 [=====] - 0s 5ms/step - loss:  
16182.0020 - mae: 16182.0020 - val_loss: 19250.0742 - val_mae:  
19250.0742  
Epoch 28/100  
37/37 [=====] - 0s 5ms/step - loss:  
15761.6523 - mae: 15761.6523 - val_loss: 18341.1211 - val_mae:  
18341.1211  
Epoch 29/100  
37/37 [=====] - 0s 5ms/step - loss:  
16305.0254 - mae: 16305.0254 - val_loss: 18859.0273 - val_mae:  
18859.0273  
Epoch 30/100  
37/37 [=====] - 0s 5ms/step - loss:  
15905.5410 - mae: 15905.5410 - val_loss: 18438.9355 - val_mae:  
18438.9355  
Epoch 31/100  
37/37 [=====] - 0s 6ms/step - loss:  
15909.3994 - mae: 15909.3994 - val_loss: 18083.3242 - val_mae:  
18083.3242  
Epoch 32/100  
37/37 [=====] - 0s 5ms/step - loss:  
16449.9785 - mae: 16449.9785 - val_loss: 18739.6621 - val_mae:  
18739.6621  
Epoch 33/100  
37/37 [=====] - 0s 5ms/step - loss:  
15972.4043 - mae: 15972.4043 - val_loss: 18921.7285 - val_mae:  
18921.7285  
Epoch 34/100  
37/37 [=====] - 0s 5ms/step - loss:  
15776.6133 - mae: 15776.6133 - val_loss: 18917.3926 - val_mae:  
18917.3926  
Epoch 35/100  
37/37 [=====] - 0s 5ms/step - loss:  
15686.5361 - mae: 15686.5361 - val_loss: 18280.9219 - val_mae:  
18280.9219  
Epoch 36/100  
37/37 [=====] - 0s 6ms/step - loss:  
16084.3906 - mae: 16084.3906 - val_loss: 18142.0723 - val_mae:  
18142.0723  
Epoch 37/100  
37/37 [=====] - 0s 5ms/step - loss:  
15967.7891 - mae: 15967.7891 - val_loss: 18319.3555 - val_mae:  
18319.3555  
Epoch 38/100  
37/37 [=====] - 0s 5ms/step - loss:
```

```
15678.8701 - mae: 15678.8701 - val_loss: 19679.0605 - val_mae:  
19679.0605  
Epoch 39/100  
37/37 [=====] - 0s 5ms/step - loss:  
16119.2773 - mae: 16119.2773 - val_loss: 18063.4512 - val_mae:  
18063.4512  
Epoch 40/100  
37/37 [=====] - 0s 5ms/step - loss:  
15522.3252 - mae: 15522.3252 - val_loss: 18155.5215 - val_mae:  
18155.5215  
Epoch 41/100  
37/37 [=====] - 0s 5ms/step - loss:  
15261.6074 - mae: 15261.6074 - val_loss: 18188.7578 - val_mae:  
18188.7578  
Epoch 42/100  
37/37 [=====] - 0s 5ms/step - loss:  
15305.6709 - mae: 15305.6709 - val_loss: 18020.3613 - val_mae:  
18020.3613  
Epoch 43/100  
37/37 [=====] - 0s 5ms/step - loss:  
15490.0391 - mae: 15490.0391 - val_loss: 19284.0410 - val_mae:  
19284.0410  
Epoch 44/100  
37/37 [=====] - 0s 5ms/step - loss:  
15605.1133 - mae: 15605.1133 - val_loss: 18208.1953 - val_mae:  
18208.1953  
Epoch 45/100  
37/37 [=====] - 0s 5ms/step - loss:  
15703.0664 - mae: 15703.0664 - val_loss: 17880.2344 - val_mae:  
17880.2344  
Epoch 46/100  
37/37 [=====] - 0s 5ms/step - loss:  
15423.4199 - mae: 15423.4199 - val_loss: 18124.3711 - val_mae:  
18124.3711  
Epoch 47/100  
37/37 [=====] - 0s 5ms/step - loss:  
15997.8994 - mae: 15997.8994 - val_loss: 17852.3926 - val_mae:  
17852.3926  
Epoch 48/100  
37/37 [=====] - 0s 5ms/step - loss:  
15280.4521 - mae: 15280.4521 - val_loss: 18895.4102 - val_mae:  
18895.4102  
Epoch 49/100  
37/37 [=====] - 0s 5ms/step - loss:  
15419.8135 - mae: 15419.8135 - val_loss: 17904.4434 - val_mae:  
17904.4434  
Epoch 50/100  
37/37 [=====] - 0s 5ms/step - loss:  
15353.9932 - mae: 15353.9932 - val_loss: 17748.7988 - val_mae:
```

```
17748.7988
Epoch 51/100
37/37 [=====] - 0s 5ms/step - loss:
15863.2324 - mae: 15863.2324 - val_loss: 17703.4453 - val_mae:
17703.4453
Epoch 52/100
37/37 [=====] - 0s 5ms/step - loss:
15713.2549 - mae: 15713.2549 - val_loss: 17999.0938 - val_mae:
17999.0938
Epoch 53/100
37/37 [=====] - 0s 5ms/step - loss:
16246.2256 - mae: 16246.2256 - val_loss: 18948.6504 - val_mae:
18948.6504
Epoch 54/100
37/37 [=====] - 0s 5ms/step - loss:
15613.1113 - mae: 15613.1113 - val_loss: 18138.5957 - val_mae:
18138.5957
Epoch 55/100
37/37 [=====] - 0s 5ms/step - loss:
15431.5586 - mae: 15431.5586 - val_loss: 18413.1777 - val_mae:
18413.1777
Epoch 56/100
37/37 [=====] - 0s 4ms/step - loss:
15316.6953 - mae: 15316.6953 - val_loss: 18137.9863 - val_mae:
18137.9863
Epoch 57/100
37/37 [=====] - 0s 5ms/step - loss:
15057.2188 - mae: 15057.2188 - val_loss: 17838.1875 - val_mae:
17838.1875
Epoch 58/100
37/37 [=====] - 0s 5ms/step - loss:
15244.0244 - mae: 15244.0244 - val_loss: 17653.0898 - val_mae:
17653.0898
Epoch 59/100
37/37 [=====] - 0s 5ms/step - loss:
15118.9932 - mae: 15118.9932 - val_loss: 17699.8691 - val_mae:
17699.8691
Epoch 60/100
37/37 [=====] - 0s 5ms/step - loss:
15544.2363 - mae: 15544.2363 - val_loss: 17733.7754 - val_mae:
17733.7754
Epoch 61/100
37/37 [=====] - 0s 5ms/step - loss:
16476.4922 - mae: 16476.4922 - val_loss: 17573.2090 - val_mae:
17573.2090
Epoch 62/100
37/37 [=====] - 0s 5ms/step - loss:
15095.2207 - mae: 15095.2207 - val_loss: 17678.6602 - val_mae:
17678.6602
```

```
Epoch 63/100
37/37 [=====] - 0s 5ms/step - loss:
15084.8643 - mae: 15084.8643 - val_loss: 18053.5996 - val_mae:
18053.5996
Epoch 64/100
37/37 [=====] - 0s 5ms/step - loss:
15333.2451 - mae: 15333.2451 - val_loss: 18619.1094 - val_mae:
18619.1094
Epoch 65/100
37/37 [=====] - 0s 5ms/step - loss:
15282.6904 - mae: 15282.6904 - val_loss: 17677.7324 - val_mae:
17677.7324
Epoch 66/100
37/37 [=====] - 0s 5ms/step - loss:
15440.3633 - mae: 15440.3633 - val_loss: 19400.6367 - val_mae:
19400.6367
Epoch 67/100
37/37 [=====] - 0s 6ms/step - loss:
15817.5049 - mae: 15817.5049 - val_loss: 20790.5371 - val_mae:
20790.5371
Epoch 68/100
37/37 [=====] - 0s 5ms/step - loss:
16981.1680 - mae: 16981.1680 - val_loss: 18493.1855 - val_mae:
18493.1855
Epoch 69/100
37/37 [=====] - 0s 6ms/step - loss:
15463.2910 - mae: 15463.2910 - val_loss: 17458.1777 - val_mae:
17458.1777
Epoch 70/100
37/37 [=====] - 0s 5ms/step - loss:
15422.6436 - mae: 15422.6436 - val_loss: 18030.0234 - val_mae:
18030.0234
Epoch 71/100
37/37 [=====] - 0s 5ms/step - loss:
15621.8320 - mae: 15621.8320 - val_loss: 19146.2031 - val_mae:
19146.2031
Epoch 72/100
37/37 [=====] - 0s 5ms/step - loss:
15138.4951 - mae: 15138.4951 - val_loss: 17349.3027 - val_mae:
17349.3027
Epoch 73/100
37/37 [=====] - 0s 5ms/step - loss:
15012.5000 - mae: 15012.5000 - val_loss: 17522.5215 - val_mae:
17522.5215
Epoch 74/100
37/37 [=====] - 0s 5ms/step - loss:
15252.5498 - mae: 15252.5498 - val_loss: 18707.7422 - val_mae:
18707.7422
Epoch 75/100
```

```
37/37 [=====] - 0s 5ms/step - loss:  
15389.5459 - mae: 15389.5459 - val_loss: 18037.9922 - val_mae:  
18037.9922  
Epoch 76/100  
37/37 [=====] - 0s 7ms/step - loss:  
15318.1182 - mae: 15318.1182 - val_loss: 17439.6699 - val_mae:  
17439.6699  
Epoch 77/100  
37/37 [=====] - 0s 6ms/step - loss:  
15151.5117 - mae: 15151.5117 - val_loss: 18396.2910 - val_mae:  
18396.2910  
Epoch 78/100  
37/37 [=====] - 0s 5ms/step - loss:  
15287.7461 - mae: 15287.7461 - val_loss: 17357.1074 - val_mae:  
17357.1074  
Epoch 79/100  
37/37 [=====] - 0s 6ms/step - loss:  
14903.8271 - mae: 14903.8271 - val_loss: 17829.1309 - val_mae:  
17829.1309  
Epoch 80/100  
37/37 [=====] - 0s 6ms/step - loss:  
15752.7344 - mae: 15752.7344 - val_loss: 17377.3516 - val_mae:  
17377.3516  
Epoch 81/100  
37/37 [=====] - 0s 5ms/step - loss:  
15019.5176 - mae: 15019.5176 - val_loss: 17417.7324 - val_mae:  
17417.7324  
Epoch 82/100  
37/37 [=====] - 0s 5ms/step - loss:  
15636.1406 - mae: 15636.1406 - val_loss: 17585.1582 - val_mae:  
17585.1582  
Epoch 83/100  
37/37 [=====] - 0s 5ms/step - loss:  
15411.0957 - mae: 15411.0957 - val_loss: 17823.2148 - val_mae:  
17823.2148  
Epoch 84/100  
37/37 [=====] - 0s 5ms/step - loss:  
15040.4316 - mae: 15040.4316 - val_loss: 17865.8457 - val_mae:  
17865.8457  
Epoch 85/100  
37/37 [=====] - 0s 5ms/step - loss:  
15016.1230 - mae: 15016.1230 - val_loss: 17664.3047 - val_mae:  
17664.3047  
Epoch 86/100  
37/37 [=====] - 0s 5ms/step - loss:  
15047.1953 - mae: 15047.1953 - val_loss: 17339.3340 - val_mae:  
17339.3340  
Epoch 87/100  
37/37 [=====] - 0s 5ms/step - loss:
```

```
15123.1025 - mae: 15123.1025 - val_loss: 18203.0977 - val_mae:  
18203.0977  
Epoch 88/100  
37/37 [=====] - 0s 5ms/step - loss:  
14743.5908 - mae: 14743.5908 - val_loss: 17518.0918 - val_mae:  
17518.0918  
Epoch 89/100  
37/37 [=====] - 0s 5ms/step - loss:  
15507.4707 - mae: 15507.4707 - val_loss: 19740.4707 - val_mae:  
19740.4707  
Epoch 90/100  
37/37 [=====] - 0s 6ms/step - loss:  
15944.1006 - mae: 15944.1006 - val_loss: 18043.4023 - val_mae:  
18043.4023  
Epoch 91/100  
37/37 [=====] - 0s 5ms/step - loss:  
15457.4824 - mae: 15457.4824 - val_loss: 17424.5508 - val_mae:  
17424.5508  
Epoch 92/100  
37/37 [=====] - 0s 5ms/step - loss:  
14861.3594 - mae: 14861.3594 - val_loss: 17502.1523 - val_mae:  
17502.1523  
Epoch 93/100  
37/37 [=====] - 0s 5ms/step - loss:  
15216.2607 - mae: 15216.2607 - val_loss: 18120.6250 - val_mae:  
18120.6250  
Epoch 94/100  
37/37 [=====] - 0s 5ms/step - loss:  
15800.8252 - mae: 15800.8252 - val_loss: 17189.1016 - val_mae:  
17189.1016  
Epoch 95/100  
37/37 [=====] - 0s 5ms/step - loss:  
14939.9316 - mae: 14939.9316 - val_loss: 17565.8047 - val_mae:  
17565.8047  
Epoch 96/100  
37/37 [=====] - 0s 6ms/step - loss:  
14748.3066 - mae: 14748.3066 - val_loss: 17467.9121 - val_mae:  
17467.9121  
Epoch 97/100  
37/37 [=====] - 0s 5ms/step - loss:  
14976.9336 - mae: 14976.9336 - val_loss: 18687.3867 - val_mae:  
18687.3867  
Epoch 98/100  
37/37 [=====] - 0s 5ms/step - loss:  
15029.2070 - mae: 15029.2070 - val_loss: 17409.6875 - val_mae:  
17409.6875  
Epoch 99/100  
37/37 [=====] - 0s 5ms/step - loss:  
15021.1025 - mae: 15021.1025 - val_loss: 18266.4102 - val_mae:
```

```
18266.4102
Epoch 100/100
37/37 [=====] - 0s 6ms/step - loss:
15260.1211 - mae: 15260.1211 - val_loss: 17370.8066 - val_mae:
17370.8066
```

Выиграли существенный кусок в точности!

В целом у оптимизатора существует множество параметров, но самым важны, пожалуй, является `learning_rate`, регулирующий величину шага в градиентном спуске (получается, чем меньше - тем более точно, но медленнее). Посмотрим на результаты, изменив `learning_rate` с 0.05 до 0.001 (при этом увеличив `batch_size` до 64 для быстротройствия):

```
model = Sequential([
    Dense(64, input_dim=X_train.shape[1], activation='linear'),
    Dense(64, input_dim=X_train.shape[1], activation='relu'),
    Dense(1, activation='linear')
])
random.set_seed(40)

from tensorflow.keras.optimizers import Adamax

model.compile(optimizer=Adamax(learning_rate=0.001),
              loss='mae',
              metrics=['mae'])

history = model.fit(X_train, y_train, epochs=100, batch_size=64,
                     validation_data=(X_val, y_val))

Epoch 1/100
19/19 [=====] - 1s 14ms/step - loss:
178157.0312 - mae: 178157.0312 - val_loss: 191899.7344 - val_mae:
191899.7344
Epoch 2/100
19/19 [=====] - 0s 7ms/step - loss:
178122.0625 - mae: 178122.0625 - val_loss: 191855.8750 - val_mae:
191855.8750
Epoch 3/100
19/19 [=====] - 0s 6ms/step - loss:
178065.5156 - mae: 178065.5156 - val_loss: 191782.2812 - val_mae:
191782.2812
Epoch 4/100
19/19 [=====] - 0s 6ms/step - loss:
177973.4531 - mae: 177973.4531 - val_loss: 191667.0781 - val_mae:
191667.0781
Epoch 5/100
19/19 [=====] - 0s 6ms/step - loss:
177835.0469 - mae: 177835.0469 - val_loss: 191499.7031 - val_mae:
191499.7031
```

```
Epoch 6/100
19/19 [=====] - 0s 6ms/step - loss:
177639.5000 - mae: 177639.5000 - val_loss: 191270.0781 - val_mae:
191270.0781
Epoch 7/100
19/19 [=====] - 0s 6ms/step - loss:
177377.2969 - mae: 177377.2969 - val_loss: 190967.2812 - val_mae:
190967.2812
Epoch 8/100
19/19 [=====] - 0s 6ms/step - loss:
177035.8906 - mae: 177035.8906 - val_loss: 190580.9531 - val_mae:
190580.9531
Epoch 9/100
19/19 [=====] - 0s 6ms/step - loss:
176606.1875 - mae: 176606.1875 - val_loss: 190099.7031 - val_mae:
190099.7031
Epoch 10/100
19/19 [=====] - 0s 6ms/step - loss:
176075.5625 - mae: 176075.5625 - val_loss: 189511.3438 - val_mae:
189511.3438
Epoch 11/100
19/19 [=====] - 0s 6ms/step - loss:
175431.5938 - mae: 175431.5938 - val_loss: 188808.0312 - val_mae:
188808.0312
Epoch 12/100
19/19 [=====] - 0s 6ms/step - loss:
174668.3594 - mae: 174668.3594 - val_loss: 187977.4219 - val_mae:
187977.4219
Epoch 13/100
19/19 [=====] - 0s 6ms/step - loss:
173773.7188 - mae: 173773.7188 - val_loss: 187006.3594 - val_mae:
187006.3594
Epoch 14/100
19/19 [=====] - 0s 6ms/step - loss:
172733.7656 - mae: 172733.7656 - val_loss: 185886.4531 - val_mae:
185886.4531
Epoch 15/100
19/19 [=====] - 0s 6ms/step - loss:
171536.8750 - mae: 171536.8750 - val_loss: 184605.0625 - val_mae:
184605.0625
Epoch 16/100
19/19 [=====] - 0s 7ms/step - loss:
170170.1406 - mae: 170170.1406 - val_loss: 183147.9062 - val_mae:
183147.9062
Epoch 17/100
19/19 [=====] - 0s 6ms/step - loss:
168625.3906 - mae: 168625.3906 - val_loss: 181505.3438 - val_mae:
181505.3438
Epoch 18/100
```

```
19/19 [=====] - 0s 6ms/step - loss:  
166890.8594 - mae: 166890.8594 - val_loss: 179668.9219 - val_mae:  
179668.9219  
Epoch 19/100  
19/19 [=====] - 0s 6ms/step - loss:  
164957.6406 - mae: 164957.6406 - val_loss: 177623.5469 - val_mae:  
177623.5469  
Epoch 20/100  
19/19 [=====] - 0s 6ms/step - loss:  
162803.0938 - mae: 162803.0938 - val_loss: 175366.7812 - val_mae:  
175366.7812  
Epoch 21/100  
19/19 [=====] - 0s 6ms/step - loss:  
160434.6875 - mae: 160434.6875 - val_loss: 172871.9375 - val_mae:  
172871.9375  
Epoch 22/100  
19/19 [=====] - 0s 7ms/step - loss:  
157824.2812 - mae: 157824.2812 - val_loss: 170136.2656 - val_mae:  
170136.2656  
Epoch 23/100  
19/19 [=====] - 0s 6ms/step - loss:  
154966.1094 - mae: 154966.1094 - val_loss: 167147.8594 - val_mae:  
167147.8594  
Epoch 24/100  
19/19 [=====] - 0s 5ms/step - loss:  
151847.5625 - mae: 151847.5625 - val_loss: 163901.4219 - val_mae:  
163901.4219  
Epoch 25/100  
19/19 [=====] - 0s 6ms/step - loss:  
148476.5312 - mae: 148476.5312 - val_loss: 160389.0000 - val_mae:  
160389.0000  
Epoch 26/100  
19/19 [=====] - 0s 6ms/step - loss:  
144819.7188 - mae: 144819.7188 - val_loss: 156578.1875 - val_mae:  
156578.1875  
Epoch 27/100  
19/19 [=====] - 0s 6ms/step - loss:  
140857.0625 - mae: 140857.0625 - val_loss: 152473.3438 - val_mae:  
152473.3438  
Epoch 28/100  
19/19 [=====] - 0s 6ms/step - loss:  
136601.0938 - mae: 136601.0938 - val_loss: 148049.8594 - val_mae:  
148049.8594  
Epoch 29/100  
19/19 [=====] - 0s 6ms/step - loss:  
132034.1719 - mae: 132034.1719 - val_loss: 143304.7969 - val_mae:  
143304.7969  
Epoch 30/100  
19/19 [=====] - 0s 6ms/step - loss:
```

```
127155.9844 - mae: 127155.9844 - val_loss: 138226.5469 - val_mae:  
138226.5469  
Epoch 31/100  
19/19 [=====] - 0s 6ms/step - loss:  
121953.9844 - mae: 121953.9844 - val_loss: 132865.7656 - val_mae:  
132865.7656  
Epoch 32/100  
19/19 [=====] - 0s 6ms/step - loss:  
116468.7500 - mae: 116468.7500 - val_loss: 127178.2500 - val_mae:  
127178.2500  
Epoch 33/100  
19/19 [=====] - 0s 7ms/step - loss:  
110652.8750 - mae: 110652.8750 - val_loss: 121181.2344 - val_mae:  
121181.2344  
Epoch 34/100  
19/19 [=====] - 0s 6ms/step - loss:  
104497.5312 - mae: 104497.5312 - val_loss: 114837.3984 - val_mae:  
114837.3984  
Epoch 35/100  
19/19 [=====] - 0s 5ms/step - loss:  
98084.6875 - mae: 98084.6875 - val_loss: 108361.0000 - val_mae:  
108361.0000  
Epoch 36/100  
19/19 [=====] - 0s 6ms/step - loss:  
91526.6562 - mae: 91526.6562 - val_loss: 101762.9688 - val_mae:  
101762.9688  
Epoch 37/100  
19/19 [=====] - 0s 5ms/step - loss:  
84959.0859 - mae: 84959.0859 - val_loss: 95089.4141 - val_mae:  
95089.4141  
Epoch 38/100  
19/19 [=====] - 0s 6ms/step - loss:  
78522.0312 - mae: 78522.0312 - val_loss: 88395.5156 - val_mae:  
88395.5156  
Epoch 39/100  
19/19 [=====] - 0s 6ms/step - loss:  
72369.1484 - mae: 72369.1484 - val_loss: 82254.6406 - val_mae:  
82254.6406  
Epoch 40/100  
19/19 [=====] - 0s 5ms/step - loss:  
66813.9453 - mae: 66813.9453 - val_loss: 76919.9453 - val_mae:  
76919.9453  
Epoch 41/100  
19/19 [=====] - 0s 6ms/step - loss:  
62068.9727 - mae: 62068.9727 - val_loss: 72231.5156 - val_mae:  
72231.5156  
Epoch 42/100  
19/19 [=====] - 0s 5ms/step - loss:  
58218.0273 - mae: 58218.0273 - val_loss: 68740.7109 - val_mae:
```

```
68740.7109
Epoch 43/100
19/19 [=====] - 0s 5ms/step - loss:
55599.0508 - mae: 55599.0508 - val_loss: 66212.9766 - val_mae:
66212.9766
Epoch 44/100
19/19 [=====] - 0s 5ms/step - loss:
53876.0938 - mae: 53876.0938 - val_loss: 64614.3164 - val_mae:
64614.3164
Epoch 45/100
19/19 [=====] - 0s 5ms/step - loss:
52834.5312 - mae: 52834.5312 - val_loss: 63589.7344 - val_mae:
63589.7344
Epoch 46/100
19/19 [=====] - 0s 6ms/step - loss:
52231.6406 - mae: 52231.6406 - val_loss: 62870.7812 - val_mae:
62870.7812
Epoch 47/100
19/19 [=====] - 0s 6ms/step - loss:
51802.8477 - mae: 51802.8477 - val_loss: 62455.5820 - val_mae:
62455.5820
Epoch 48/100
19/19 [=====] - 0s 6ms/step - loss:
51571.0195 - mae: 51571.0195 - val_loss: 62158.7266 - val_mae:
62158.7266
Epoch 49/100
19/19 [=====] - 0s 5ms/step - loss:
51448.0977 - mae: 51448.0977 - val_loss: 61944.2188 - val_mae:
61944.2188
Epoch 50/100
19/19 [=====] - 0s 6ms/step - loss:
51374.3906 - mae: 51374.3906 - val_loss: 61742.4922 - val_mae:
61742.4922
Epoch 51/100
19/19 [=====] - 0s 6ms/step - loss:
51282.6641 - mae: 51282.6641 - val_loss: 61658.6914 - val_mae:
61658.6914
Epoch 52/100
19/19 [=====] - 0s 6ms/step - loss:
51225.8281 - mae: 51225.8281 - val_loss: 61524.3828 - val_mae:
61524.3828
Epoch 53/100
19/19 [=====] - 0s 6ms/step - loss:
51166.0117 - mae: 51166.0117 - val_loss: 61434.9258 - val_mae:
61434.9258
Epoch 54/100
19/19 [=====] - 0s 6ms/step - loss:
51110.1289 - mae: 51110.1289 - val_loss: 61349.1250 - val_mae:
61349.1250
```

```
Epoch 55/100
19/19 [=====] - 0s 6ms/step - loss:
51062.1953 - mae: 51062.1953 - val_loss: 61260.2266 - val_mae:
61260.2266
Epoch 56/100
19/19 [=====] - 0s 7ms/step - loss:
51012.1602 - mae: 51012.1602 - val_loss: 61225.8633 - val_mae:
61225.8633
Epoch 57/100
19/19 [=====] - 0s 6ms/step - loss:
50958.6172 - mae: 50958.6172 - val_loss: 61147.7109 - val_mae:
61147.7109
Epoch 58/100
19/19 [=====] - 0s 6ms/step - loss:
50908.4570 - mae: 50908.4570 - val_loss: 61063.8906 - val_mae:
61063.8906
Epoch 59/100
19/19 [=====] - 0s 6ms/step - loss:
50856.5625 - mae: 50856.5625 - val_loss: 61014.9180 - val_mae:
61014.9180
Epoch 60/100
19/19 [=====] - 0s 6ms/step - loss:
50807.0391 - mae: 50807.0391 - val_loss: 60959.9375 - val_mae:
60959.9375
Epoch 61/100
19/19 [=====] - 0s 6ms/step - loss:
50756.8398 - mae: 50756.8398 - val_loss: 60922.8477 - val_mae:
60922.8477
Epoch 62/100
19/19 [=====] - 0s 6ms/step - loss:
50707.3984 - mae: 50707.3984 - val_loss: 60894.4102 - val_mae:
60894.4102
Epoch 63/100
19/19 [=====] - 0s 6ms/step - loss:
50659.2930 - mae: 50659.2930 - val_loss: 60819.2656 - val_mae:
60819.2656
Epoch 64/100
19/19 [=====] - 0s 7ms/step - loss:
50616.2031 - mae: 50616.2031 - val_loss: 60759.7070 - val_mae:
60759.7070
Epoch 65/100
19/19 [=====] - 0s 6ms/step - loss:
50571.1445 - mae: 50571.1445 - val_loss: 60736.4805 - val_mae:
60736.4805
Epoch 66/100
19/19 [=====] - 0s 7ms/step - loss:
50526.5977 - mae: 50526.5977 - val_loss: 60659.8086 - val_mae:
60659.8086
Epoch 67/100
```

```
19/19 [=====] - 0s 6ms/step - loss:  
50474.9336 - mae: 50474.9336 - val_loss: 60614.9844 - val_mae:  
60614.9844  
Epoch 68/100  
19/19 [=====] - 0s 6ms/step - loss:  
50427.4648 - mae: 50427.4648 - val_loss: 60583.3203 - val_mae:  
60583.3203  
Epoch 69/100  
19/19 [=====] - 0s 6ms/step - loss:  
50386.7461 - mae: 50386.7461 - val_loss: 60527.1250 - val_mae:  
60527.1250  
Epoch 70/100  
19/19 [=====] - 0s 6ms/step - loss:  
50338.4219 - mae: 50338.4219 - val_loss: 60506.5898 - val_mae:  
60506.5898  
Epoch 71/100  
19/19 [=====] - 0s 6ms/step - loss:  
50290.3750 - mae: 50290.3750 - val_loss: 60442.6562 - val_mae:  
60442.6562  
Epoch 72/100  
19/19 [=====] - 0s 6ms/step - loss:  
50242.1172 - mae: 50242.1172 - val_loss: 60360.7656 - val_mae:  
60360.7656  
Epoch 73/100  
19/19 [=====] - 0s 5ms/step - loss:  
50192.3594 - mae: 50192.3594 - val_loss: 60321.4805 - val_mae:  
60321.4805  
Epoch 74/100  
19/19 [=====] - 0s 6ms/step - loss:  
50147.9023 - mae: 50147.9023 - val_loss: 60240.6641 - val_mae:  
60240.6641  
Epoch 75/100  
19/19 [=====] - 0s 5ms/step - loss:  
50100.2930 - mae: 50100.2930 - val_loss: 60215.6094 - val_mae:  
60215.6094  
Epoch 76/100  
19/19 [=====] - 0s 6ms/step - loss:  
50051.9805 - mae: 50051.9805 - val_loss: 60159.6797 - val_mae:  
60159.6797  
Epoch 77/100  
19/19 [=====] - 0s 6ms/step - loss:  
50013.5586 - mae: 50013.5586 - val_loss: 60105.9375 - val_mae:  
60105.9375  
Epoch 78/100  
19/19 [=====] - 0s 6ms/step - loss:  
49950.9453 - mae: 49950.9453 - val_loss: 60086.6367 - val_mae:  
60086.6367  
Epoch 79/100  
19/19 [=====] - 0s 6ms/step - loss:
```

```
49906.3750 - mae: 49906.3750 - val_loss: 60044.1992 - val_mae:  
60044.1992  
Epoch 80/100  
19/19 [=====] - 0s 6ms/step - loss:  
49859.6992 - mae: 49859.6992 - val_loss: 59998.2461 - val_mae:  
59998.2461  
Epoch 81/100  
19/19 [=====] - 0s 5ms/step - loss:  
49807.6445 - mae: 49807.6445 - val_loss: 59911.6523 - val_mae:  
59911.6523  
Epoch 82/100  
19/19 [=====] - 0s 6ms/step - loss:  
49771.6719 - mae: 49771.6719 - val_loss: 59888.6289 - val_mae:  
59888.6289  
Epoch 83/100  
19/19 [=====] - 0s 5ms/step - loss:  
49712.9023 - mae: 49712.9023 - val_loss: 59803.7812 - val_mae:  
59803.7812  
Epoch 84/100  
19/19 [=====] - 0s 6ms/step - loss:  
49668.2969 - mae: 49668.2969 - val_loss: 59747.1367 - val_mae:  
59747.1367  
Epoch 85/100  
19/19 [=====] - 0s 5ms/step - loss:  
49622.9375 - mae: 49622.9375 - val_loss: 59660.4102 - val_mae:  
59660.4102  
Epoch 86/100  
19/19 [=====] - 0s 5ms/step - loss:  
49578.9844 - mae: 49578.9844 - val_loss: 59655.6445 - val_mae:  
59655.6445  
Epoch 87/100  
19/19 [=====] - 0s 6ms/step - loss:  
49524.8477 - mae: 49524.8477 - val_loss: 59608.3008 - val_mae:  
59608.3008  
Epoch 88/100  
19/19 [=====] - 0s 6ms/step - loss:  
49476.2539 - mae: 49476.2539 - val_loss: 59535.4258 - val_mae:  
59535.4258  
Epoch 89/100  
19/19 [=====] - 0s 6ms/step - loss:  
49429.1719 - mae: 49429.1719 - val_loss: 59453.7383 - val_mae:  
59453.7383  
Epoch 90/100  
19/19 [=====] - 0s 6ms/step - loss:  
49390.9141 - mae: 49390.9141 - val_loss: 59449.9453 - val_mae:  
59449.9453  
Epoch 91/100  
19/19 [=====] - 0s 6ms/step - loss:  
49337.3398 - mae: 49337.3398 - val_loss: 59386.1719 - val_mae:
```

```
59386.1719
Epoch 92/100
19/19 [=====] - 0s 6ms/step - loss:
49296.8047 - mae: 49296.8047 - val_loss: 59353.5898 - val_mae:
59353.5898
Epoch 93/100
19/19 [=====] - 0s 6ms/step - loss:
49247.2461 - mae: 49247.2461 - val_loss: 59307.9297 - val_mae:
59307.9297
Epoch 94/100
19/19 [=====] - 0s 6ms/step - loss:
49201.6250 - mae: 49201.6250 - val_loss: 59209.8008 - val_mae:
59209.8008
Epoch 95/100
19/19 [=====] - 0s 5ms/step - loss:
49155.2734 - mae: 49155.2734 - val_loss: 59146.4258 - val_mae:
59146.4258
Epoch 96/100
19/19 [=====] - 0s 6ms/step - loss:
49115.8477 - mae: 49115.8477 - val_loss: 59068.3359 - val_mae:
59068.3359
Epoch 97/100
19/19 [=====] - 0s 6ms/step - loss:
49069.3906 - mae: 49069.3906 - val_loss: 59046.8633 - val_mae:
59046.8633
Epoch 98/100
19/19 [=====] - 0s 6ms/step - loss:
49023.6055 - mae: 49023.6055 - val_loss: 58983.7070 - val_mae:
58983.7070
Epoch 99/100
19/19 [=====] - 0s 6ms/step - loss:
48971.1406 - mae: 48971.1406 - val_loss: 58949.2656 - val_mae:
58949.2656
Epoch 100/100
19/19 [=====] - 0s 6ms/step - loss:
48921.7109 - mae: 48921.7109 - val_loss: 58952.3008 - val_mae:
58952.3008
```

Видим, что не хватает количества эпох, происходит недообучение, исправим это, увеличением параметра `epochs` до 500:

```
model = Sequential([
    Dense(64, input_dim=X_train.shape[1], activation='linear'),
    Dense(64, input_dim=X_train.shape[1], activation='relu'),
    Dense(1, activation='linear')
])
random.set_seed(40)
```

```
from tensorflow.keras.optimizers import Adamax

model.compile(optimizer=Adamax(learning_rate=0.001),
              loss='mae',
              metrics=['mae'])

history = model.fit(X_train, y_train, epochs=500, batch_size=64,
                     validation_data=(X_val, y_val))

Epoch 1/500
19/19 [=====] - 1s 14ms/step - loss:
178152.4688 - mae: 178152.4688 - val_loss: 191891.6250 - val_mae:
191891.6250
Epoch 2/500
19/19 [=====] - 0s 7ms/step - loss:
178111.6406 - mae: 178111.6406 - val_loss: 191842.8438 - val_mae:
191842.8438
Epoch 3/500
19/19 [=====] - 0s 8ms/step - loss:
178050.4844 - mae: 178050.4844 - val_loss: 191764.8125 - val_mae:
191764.8125
Epoch 4/500
19/19 [=====] - 0s 6ms/step - loss:
177954.1406 - mae: 177954.1406 - val_loss: 191646.2188 - val_mae:
191646.2188
Epoch 5/500
19/19 [=====] - 0s 6ms/step - loss:
177813.7188 - mae: 177813.7188 - val_loss: 191478.3125 - val_mae:
191478.3125
Epoch 6/500
19/19 [=====] - 0s 6ms/step - loss:
177619.6562 - mae: 177619.6562 - val_loss: 191252.8906 - val_mae:
191252.8906
Epoch 7/500
19/19 [=====] - 0s 6ms/step - loss:
177364.3906 - mae: 177364.3906 - val_loss: 190960.6406 - val_mae:
190960.6406
Epoch 8/500
19/19 [=====] - 0s 6ms/step - loss:
177037.2656 - mae: 177037.2656 - val_loss: 190592.9062 - val_mae:
190592.9062
Epoch 9/500
19/19 [=====] - 0s 6ms/step - loss:
176630.5000 - mae: 176630.5000 - val_loss: 190140.1875 - val_mae:
190140.1875
Epoch 10/500
19/19 [=====] - 0s 6ms/step - loss:
176133.8125 - mae: 176133.8125 - val_loss: 189592.2188 - val_mae:
189592.2188
Epoch 11/500
```

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19/19 [=====] - 0s 7ms/step - loss:  
175536.6562 - mae: 175536.6562 - val_loss: 188942.9375 - val_mae:  
188942.9375  
Epoch 12/500  
19/19 [=====] - 0s 6ms/step - loss:  
174834.6094 - mae: 174834.6094 - val_loss: 188181.7500 - val_mae:  
188181.7656  
Epoch 13/500  
19/19 [=====] - 0s 7ms/step - loss:  
174017.2656 - mae: 174017.2656 - val_loss: 187297.1719 - val_mae:  
187297.1719  
Epoch 14/500  
19/19 [=====] - 0s 7ms/step - loss:  
173072.3750 - mae: 173072.3750 - val_loss: 186282.9062 - val_mae:  
186282.9062  
Epoch 15/500  
19/19 [=====] - 0s 7ms/step - loss:  
171990.9219 - mae: 171990.9219 - val_loss: 185127.8438 - val_mae:  
185127.8438  
Epoch 16/500  
19/19 [=====] - 0s 7ms/step - loss:  
170761.5000 - mae: 170761.5000 - val_loss: 183820.1406 - val_mae:  
183820.1406  
Epoch 17/500  
19/19 [=====] - 0s 6ms/step - loss:  
169378.0156 - mae: 169378.0156 - val_loss: 182351.9844 - val_mae:  
182351.9844  
Epoch 18/500  
19/19 [=====] - 0s 6ms/step - loss:  
167830.2812 - mae: 167830.2812 - val_loss: 180716.3906 - val_mae:  
180716.3906  
Epoch 19/500  
19/19 [=====] - 0s 6ms/step - loss:  
166111.0312 - mae: 166111.0312 - val_loss: 178900.2344 - val_mae:  
178900.2344  
Epoch 20/500  
19/19 [=====] - 0s 5ms/step - loss:  
164200.6719 - mae: 164200.6719 - val_loss: 176902.7812 - val_mae:  
176902.7812  
Epoch 21/500  
19/19 [=====] - 0s 6ms/step - loss:  
162107.4375 - mae: 162107.4375 - val_loss: 174700.2188 - val_mae:  
174700.2188  
Epoch 22/500  
19/19 [=====] - 0s 6ms/step - loss:  
159805.1562 - mae: 159805.1562 - val_loss: 172290.7500 - val_mae:  
172290.7500  
Epoch 23/500  
19/19 [=====] - 0s 6ms/step - loss:
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157290.6406 - mae: 157290.6406 - val_loss: 169664.6719 - val_mae:  
169664.6719  
Epoch 24/500  
19/19 [=====] - 0s 6ms/step - loss:  
154553.0625 - mae: 154553.0625 - val_loss: 166817.8750 - val_mae:  
166817.8750  
Epoch 25/500  
19/19 [=====] - 0s 6ms/step - loss:  
151599.6094 - mae: 151599.6094 - val_loss: 163744.0625 - val_mae:  
163744.0625  
Epoch 26/500  
19/19 [=====] - 0s 6ms/step - loss:  
148401.8281 - mae: 148401.8281 - val_loss: 160414.1094 - val_mae:  
160414.1094  
Epoch 27/500  
19/19 [=====] - 0s 6ms/step - loss:  
144942.0312 - mae: 144942.0312 - val_loss: 156833.4844 - val_mae:  
156833.4844  
Epoch 28/500  
19/19 [=====] - 0s 6ms/step - loss:  
141226.9062 - mae: 141226.9062 - val_loss: 152978.6094 - val_mae:  
152978.6094  
Epoch 29/500  
19/19 [=====] - 0s 6ms/step - loss:  
137233.7344 - mae: 137233.7344 - val_loss: 148845.0469 - val_mae:  
148845.0469  
Epoch 30/500  
19/19 [=====] - 0s 6ms/step - loss:  
132976.9375 - mae: 132976.9375 - val_loss: 144428.8281 - val_mae:  
144428.8281  
Epoch 31/500  
19/19 [=====] - 0s 6ms/step - loss:  
128458.9453 - mae: 128458.9453 - val_loss: 139770.0781 - val_mae:  
139770.0781  
Epoch 32/500  
19/19 [=====] - 0s 7ms/step - loss:  
123680.2188 - mae: 123680.2188 - val_loss: 134794.9531 - val_mae:  
134794.9531  
Epoch 33/500  
19/19 [=====] - 0s 6ms/step - loss:  
118587.7500 - mae: 118587.7500 - val_loss: 129544.1250 - val_mae:  
129544.1250  
Epoch 34/500  
19/19 [=====] - 0s 6ms/step - loss:  
113215.0938 - mae: 113215.0938 - val_loss: 124046.0859 - val_mae:  
124046.0859  
Epoch 35/500  
19/19 [=====] - 0s 6ms/step - loss:  
107599.3047 - mae: 107599.3047 - val_loss: 118238.2344 - val_mae:
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118238.2344
Epoch 36/500
19/19 [=====] - 0s 6ms/step - loss:
101697.0156 - mae: 101697.0156 - val_loss: 112205.5234 - val_mae:
112205.5234
Epoch 37/500
19/19 [=====] - 0s 6ms/step - loss:
95585.6094 - mae: 95585.6094 - val_loss: 106024.1641 - val_mae:
106024.1641
Epoch 38/500
19/19 [=====] - 0s 6ms/step - loss:
89309.4844 - mae: 89309.4844 - val_loss: 99648.2031 - val_mae:
99648.2031
Epoch 39/500
19/19 [=====] - 0s 6ms/step - loss:
83135.7500 - mae: 83135.7500 - val_loss: 93295.6875 - val_mae:
93295.6875
Epoch 40/500
19/19 [=====] - 0s 6ms/step - loss:
77039.3828 - mae: 77039.3828 - val_loss: 87105.7969 - val_mae:
87105.7969
Epoch 41/500
19/19 [=====] - 0s 6ms/step - loss:
71297.2188 - mae: 71297.2188 - val_loss: 81354.7266 - val_mae:
81354.7266
Epoch 42/500
19/19 [=====] - 0s 6ms/step - loss:
66124.5312 - mae: 66124.5312 - val_loss: 76318.6406 - val_mae:
76318.6406
Epoch 43/500
19/19 [=====] - 0s 6ms/step - loss:
61665.8359 - mae: 61665.8359 - val_loss: 71999.4141 - val_mae:
71999.4141
Epoch 44/500
19/19 [=====] - 0s 6ms/step - loss:
58204.8906 - mae: 58204.8906 - val_loss: 68892.2656 - val_mae:
68892.2656
Epoch 45/500
19/19 [=====] - 0s 6ms/step - loss:
55805.8008 - mae: 55805.8008 - val_loss: 66545.2500 - val_mae:
66545.2500
Epoch 46/500
19/19 [=====] - 0s 6ms/step - loss:
54219.1797 - mae: 54219.1797 - val_loss: 64890.3555 - val_mae:
64890.3555
Epoch 47/500
19/19 [=====] - 0s 5ms/step - loss:
53125.1758 - mae: 53125.1758 - val_loss: 63921.0703 - val_mae:
63921.0703
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Epoch 48/500
19/19 [=====] - 0s 6ms/step - loss:
52454.7461 - mae: 52454.7461 - val_loss: 63265.4375 - val_mae:
63265.4453
Epoch 49/500
19/19 [=====] - 0s 6ms/step - loss:
52051.1523 - mae: 52051.1523 - val_loss: 62779.9922 - val_mae:
62779.9922
Epoch 50/500
19/19 [=====] - 0s 6ms/step - loss:
51768.5820 - mae: 51768.5820 - val_loss: 62385.4570 - val_mae:
62385.4570
Epoch 51/500
19/19 [=====] - 0s 8ms/step - loss:
51547.5977 - mae: 51547.5977 - val_loss: 62134.9453 - val_mae:
62134.9453
Epoch 52/500
19/19 [=====] - 0s 6ms/step - loss:
51424.4219 - mae: 51424.4219 - val_loss: 61889.2109 - val_mae:
61889.2109
Epoch 53/500
19/19 [=====] - 0s 6ms/step - loss:
51317.2539 - mae: 51317.2539 - val_loss: 61727.6250 - val_mae:
61727.6250
Epoch 54/500
19/19 [=====] - 0s 6ms/step - loss:
51238.0156 - mae: 51238.0156 - val_loss: 61598.6445 - val_mae:
61598.6445
Epoch 55/500
19/19 [=====] - 0s 6ms/step - loss:
51185.3047 - mae: 51185.3047 - val_loss: 61474.0195 - val_mae:
61474.0195
Epoch 56/500
19/19 [=====] - 0s 6ms/step - loss:
51127.5938 - mae: 51127.5938 - val_loss: 61423.2930 - val_mae:
61423.2930
Epoch 57/500
19/19 [=====] - 0s 5ms/step - loss:
51076.6836 - mae: 51076.6836 - val_loss: 61331.7617 - val_mae:
61331.7617
Epoch 58/500
19/19 [=====] - 0s 6ms/step - loss:
51025.0469 - mae: 51025.0469 - val_loss: 61228.2344 - val_mae:
61228.2344
Epoch 59/500
19/19 [=====] - 0s 6ms/step - loss:
50974.5508 - mae: 50974.5508 - val_loss: 61145.2109 - val_mae:
61145.2109
Epoch 60/500
```

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19/19 [=====] - 0s 6ms/step - loss:  
50925.8359 - mae: 50925.8359 - val_loss: 61079.9844 - val_mae:  
61079.9844  
Epoch 61/500  
19/19 [=====] - 0s 6ms/step - loss:  
50881.1094 - mae: 50881.1094 - val_loss: 61034.6445 - val_mae:  
61034.6445  
Epoch 62/500  
19/19 [=====] - 0s 6ms/step - loss:  
50834.1680 - mae: 50834.1680 - val_loss: 61001.6367 - val_mae:  
61001.6367  
Epoch 63/500  
19/19 [=====] - 0s 6ms/step - loss:  
50789.9375 - mae: 50789.9375 - val_loss: 60931.2891 - val_mae:  
60931.2891  
Epoch 64/500  
19/19 [=====] - 0s 5ms/step - loss:  
50749.9688 - mae: 50749.9688 - val_loss: 60871.4180 - val_mae:  
60871.4180  
Epoch 65/500  
19/19 [=====] - 0s 5ms/step - loss:  
50708.0977 - mae: 50708.0977 - val_loss: 60850.8164 - val_mae:  
60850.8164  
Epoch 66/500  
19/19 [=====] - 0s 5ms/step - loss:  
50667.2305 - mae: 50667.2305 - val_loss: 60777.6641 - val_mae:  
60777.6641  
Epoch 67/500  
19/19 [=====] - 0s 5ms/step - loss:  
50620.0703 - mae: 50620.0703 - val_loss: 60737.6641 - val_mae:  
60737.6641  
Epoch 68/500  
19/19 [=====] - 0s 6ms/step - loss:  
50576.3203 - mae: 50576.3203 - val_loss: 60713.2070 - val_mae:  
60713.2070  
Epoch 69/500  
19/19 [=====] - 0s 6ms/step - loss:  
50539.3242 - mae: 50539.3242 - val_loss: 60657.1914 - val_mae:  
60657.1914  
Epoch 70/500  
19/19 [=====] - 0s 6ms/step - loss:  
50493.9258 - mae: 50493.9258 - val_loss: 60637.8164 - val_mae:  
60637.8164  
Epoch 71/500  
19/19 [=====] - 0s 5ms/step - loss:  
50448.8750 - mae: 50448.8750 - val_loss: 60581.3086 - val_mae:  
60581.3086  
Epoch 72/500  
19/19 [=====] - 0s 5ms/step - loss:
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50403.8086 - mae: 50403.8086 - val_loss: 60507.1445 - val_mae:  
60507.1445  
Epoch 73/500  
19/19 [=====] - 0s 6ms/step - loss:  
50357.4023 - mae: 50357.4023 - val_loss: 60469.6562 - val_mae:  
60469.6562  
Epoch 74/500  
19/19 [=====] - 0s 5ms/step - loss:  
50315.4570 - mae: 50315.4570 - val_loss: 60392.3438 - val_mae:  
60392.3438  
Epoch 75/500  
19/19 [=====] - 0s 5ms/step - loss:  
50270.2383 - mae: 50270.2383 - val_loss: 60368.3008 - val_mae:  
60368.3008  
Epoch 76/500  
19/19 [=====] - 0s 5ms/step - loss:  
50224.9648 - mae: 50224.9648 - val_loss: 60311.2266 - val_mae:  
60311.2266  
Epoch 77/500  
19/19 [=====] - 0s 5ms/step - loss:  
50188.9609 - mae: 50188.9609 - val_loss: 60255.9648 - val_mae:  
60255.9648  
Epoch 78/500  
19/19 [=====] - 0s 5ms/step - loss:  
50128.0938 - mae: 50128.0938 - val_loss: 60238.3906 - val_mae:  
60238.3906  
Epoch 79/500  
19/19 [=====] - 0s 6ms/step - loss:  
50083.9102 - mae: 50083.9102 - val_loss: 60205.6523 - val_mae:  
60205.6523  
Epoch 80/500  
19/19 [=====] - 0s 7ms/step - loss:  
50040.0820 - mae: 50040.0820 - val_loss: 60169.6719 - val_mae:  
60169.6719  
Epoch 81/500  
19/19 [=====] - 0s 6ms/step - loss:  
49991.8438 - mae: 49991.8438 - val_loss: 60093.1719 - val_mae:  
60093.1719  
Epoch 82/500  
19/19 [=====] - 0s 6ms/step - loss:  
49957.4688 - mae: 49957.4688 - val_loss: 60071.0000 - val_mae:  
60071.0000  
Epoch 83/500  
19/19 [=====] - 0s 6ms/step - loss:  
49901.7344 - mae: 49901.7344 - val_loss: 59990.5078 - val_mae:  
59990.5000  
Epoch 84/500  
19/19 [=====] - 0s 6ms/step - loss:  
49859.2070 - mae: 49859.2070 - val_loss: 59937.2734 - val_mae:
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59937.2734
Epoch 85/500
19/19 [=====] - 0s 6ms/step - loss:
49816.7031 - mae: 49816.7031 - val_loss: 59854.5352 - val_mae:
59854.5352
Epoch 86/500
19/19 [=====] - 0s 6ms/step - loss:
49773.6797 - mae: 49773.6797 - val_loss: 59848.0898 - val_mae:
59848.0898
Epoch 87/500
19/19 [=====] - 0s 6ms/step - loss:
49723.2070 - mae: 49723.2070 - val_loss: 59794.8984 - val_mae:
59794.8984
Epoch 88/500
19/19 [=====] - 0s 6ms/step - loss:
49677.8477 - mae: 49677.8477 - val_loss: 59726.4727 - val_mae:
59726.4727
Epoch 89/500
19/19 [=====] - 0s 6ms/step - loss:
49633.4062 - mae: 49633.4062 - val_loss: 59646.7734 - val_mae:
59646.7734
Epoch 90/500
19/19 [=====] - 0s 6ms/step - loss:
49597.1367 - mae: 49597.1367 - val_loss: 59646.5898 - val_mae:
59646.5898
Epoch 91/500
19/19 [=====] - 0s 6ms/step - loss:
49548.2148 - mae: 49548.2148 - val_loss: 59588.4805 - val_mae:
59588.4805
Epoch 92/500
19/19 [=====] - 0s 6ms/step - loss:
49509.1406 - mae: 49509.1406 - val_loss: 59556.7539 - val_mae:
59556.7539
Epoch 93/500
19/19 [=====] - 0s 6ms/step - loss:
49463.2031 - mae: 49463.2031 - val_loss: 59509.7656 - val_mae:
59509.7656
Epoch 94/500
19/19 [=====] - 0s 6ms/step - loss:
49419.9648 - mae: 49419.9648 - val_loss: 59411.2539 - val_mae:
59411.2539
Epoch 95/500
19/19 [=====] - 0s 5ms/step - loss:
49375.6680 - mae: 49375.6680 - val_loss: 59346.8086 - val_mae:
59346.8086
Epoch 96/500
19/19 [=====] - 0s 7ms/step - loss:
49338.7422 - mae: 49338.7422 - val_loss: 59277.1641 - val_mae:
59277.1641
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Epoch 97/500
19/19 [=====] - 0s 6ms/step - loss:
49295.3594 - mae: 49295.3594 - val_loss: 59254.4453 - val_mae:
59254.4453
Epoch 98/500
19/19 [=====] - 0s 5ms/step - loss:
49253.9023 - mae: 49253.9023 - val_loss: 59189.7383 - val_mae:
59189.7383
Epoch 99/500
19/19 [=====] - 0s 6ms/step - loss:
49205.2734 - mae: 49205.2734 - val_loss: 59155.3828 - val_mae:
59155.3828
Epoch 100/500
19/19 [=====] - 0s 6ms/step - loss:
49158.0469 - mae: 49158.0469 - val_loss: 59162.2930 - val_mae:
59162.2930
Epoch 101/500
19/19 [=====] - 0s 6ms/step - loss:
49112.2031 - mae: 49112.2031 - val_loss: 59119.1914 - val_mae:
59119.1914
Epoch 102/500
19/19 [=====] - 0s 6ms/step - loss:
49072.7344 - mae: 49072.7344 - val_loss: 59061.5352 - val_mae:
59061.5352
Epoch 103/500
19/19 [=====] - 0s 5ms/step - loss:
49019.6758 - mae: 49019.6758 - val_loss: 59002.5156 - val_mae:
59002.5156
Epoch 104/500
19/19 [=====] - 0s 6ms/step - loss:
48974.9570 - mae: 48974.9570 - val_loss: 58952.9727 - val_mae:
58952.9727
Epoch 105/500
19/19 [=====] - 0s 5ms/step - loss:
48928.9297 - mae: 48928.9297 - val_loss: 58919.9375 - val_mae:
58919.9375
Epoch 106/500
19/19 [=====] - 0s 6ms/step - loss:
48888.1641 - mae: 48888.1641 - val_loss: 58873.6562 - val_mae:
58873.6562
Epoch 107/500
19/19 [=====] - 0s 5ms/step - loss:
48849.4336 - mae: 48849.4336 - val_loss: 58869.1914 - val_mae:
58869.1914
Epoch 108/500
19/19 [=====] - 0s 6ms/step - loss:
48814.6992 - mae: 48814.6992 - val_loss: 58785.6289 - val_mae:
58785.6289
Epoch 109/500
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19/19 [=====] - 0s 5ms/step - loss:  
48771.9883 - mae: 48771.9883 - val_loss: 58737.1445 - val_mae:  
58737.1445  
Epoch 110/500  
19/19 [=====] - 0s 6ms/step - loss:  
48734.1758 - mae: 48734.1758 - val_loss: 58700.1719 - val_mae:  
58700.1719  
Epoch 111/500  
19/19 [=====] - 0s 5ms/step - loss:  
48693.7305 - mae: 48693.7305 - val_loss: 58663.4648 - val_mae:  
58663.4648  
Epoch 112/500  
19/19 [=====] - 0s 6ms/step - loss:  
48659.5430 - mae: 48659.5430 - val_loss: 58626.0430 - val_mae:  
58626.0430  
Epoch 113/500  
19/19 [=====] - 0s 7ms/step - loss:  
48620.8086 - mae: 48620.8086 - val_loss: 58585.6719 - val_mae:  
58585.6719  
Epoch 114/500  
19/19 [=====] - 0s 5ms/step - loss:  
48575.9219 - mae: 48575.9219 - val_loss: 58492.3828 - val_mae:  
58492.3828  
Epoch 115/500  
19/19 [=====] - 0s 5ms/step - loss:  
48538.4805 - mae: 48538.4805 - val_loss: 58419.7734 - val_mae:  
58419.7734  
Epoch 116/500  
19/19 [=====] - 0s 6ms/step - loss:  
48492.5117 - mae: 48492.5117 - val_loss: 58417.0820 - val_mae:  
58417.0820  
Epoch 117/500  
19/19 [=====] - 0s 6ms/step - loss:  
48452.6523 - mae: 48452.6523 - val_loss: 58388.6445 - val_mae:  
58388.6445  
Epoch 118/500  
19/19 [=====] - 0s 6ms/step - loss:  
48410.5703 - mae: 48410.5703 - val_loss: 58347.1172 - val_mae:  
58347.1172  
Epoch 119/500  
19/19 [=====] - 0s 7ms/step - loss:  
48374.7891 - mae: 48374.7891 - val_loss: 58264.1094 - val_mae:  
58264.1094  
Epoch 120/500  
19/19 [=====] - 0s 7ms/step - loss:  
48328.8672 - mae: 48328.8672 - val_loss: 58247.2461 - val_mae:  
58247.2461  
Epoch 121/500  
19/19 [=====] - 0s 6ms/step - loss:
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48289.2148 - mae: 48289.2148 - val_loss: 58194.2617 - val_mae:  
58194.2617  
Epoch 122/500  
19/19 [=====] - 0s 6ms/step - loss:  
48251.9844 - mae: 48251.9844 - val_loss: 58130.6797 - val_mae:  
58130.6797  
Epoch 123/500  
19/19 [=====] - 0s 6ms/step - loss:  
48208.1797 - mae: 48208.1797 - val_loss: 58093.2383 - val_mae:  
58093.2383  
Epoch 124/500  
19/19 [=====] - 0s 6ms/step - loss:  
48170.0391 - mae: 48170.0391 - val_loss: 58065.2461 - val_mae:  
58065.2461  
Epoch 125/500  
19/19 [=====] - 0s 7ms/step - loss:  
48125.2031 - mae: 48125.2031 - val_loss: 58009.0430 - val_mae:  
58009.0430  
Epoch 126/500  
19/19 [=====] - 0s 6ms/step - loss:  
48098.3906 - mae: 48098.3906 - val_loss: 57946.4531 - val_mae:  
57946.4531  
Epoch 127/500  
19/19 [=====] - 0s 6ms/step - loss:  
48033.0664 - mae: 48033.0664 - val_loss: 57947.2461 - val_mae:  
57947.2461  
Epoch 128/500  
19/19 [=====] - 0s 6ms/step - loss:  
47993.4375 - mae: 47993.4375 - val_loss: 57930.1016 - val_mae:  
57930.1016  
Epoch 129/500  
19/19 [=====] - 0s 7ms/step - loss:  
47952.5625 - mae: 47952.5625 - val_loss: 57859.6562 - val_mae:  
57859.6562  
Epoch 130/500  
19/19 [=====] - 0s 6ms/step - loss:  
47906.9141 - mae: 47906.9141 - val_loss: 57788.5547 - val_mae:  
57788.5547  
Epoch 131/500  
19/19 [=====] - 0s 6ms/step - loss:  
47860.7852 - mae: 47860.7852 - val_loss: 57765.8711 - val_mae:  
57765.8711  
Epoch 132/500  
19/19 [=====] - 0s 6ms/step - loss:  
47816.9141 - mae: 47816.9141 - val_loss: 57706.7461 - val_mae:  
57706.7461  
Epoch 133/500  
19/19 [=====] - 0s 6ms/step - loss:  
47768.5195 - mae: 47768.5195 - val_loss: 57657.4258 - val_mae:  
57657.4258
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Epoch 134/500
19/19 [=====] - 0s 6ms/step - loss:
47719.1484 - mae: 47719.1484 - val_loss: 57573.3438 - val_mae:
57573.3438
Epoch 135/500
19/19 [=====] - 0s 7ms/step - loss:
47671.8633 - mae: 47671.8633 - val_loss: 57505.9727 - val_mae:
57505.9727
Epoch 136/500
19/19 [=====] - 0s 5ms/step - loss:
47625.9844 - mae: 47625.9844 - val_loss: 57451.7109 - val_mae:
57451.7109
Epoch 137/500
19/19 [=====] - 0s 6ms/step - loss:
47575.6094 - mae: 47575.6094 - val_loss: 57416.3164 - val_mae:
57416.3164
Epoch 138/500
19/19 [=====] - 0s 6ms/step - loss:
47529.0781 - mae: 47529.0781 - val_loss: 57399.2188 - val_mae:
57399.2188
Epoch 139/500
19/19 [=====] - 0s 5ms/step - loss:
47478.6953 - mae: 47478.6953 - val_loss: 57330.0312 - val_mae:
57330.0312
Epoch 140/500
19/19 [=====] - 0s 5ms/step - loss:
47433.9844 - mae: 47433.9844 - val_loss: 57258.2539 - val_mae:
57258.2539
Epoch 141/500
19/19 [=====] - 0s 6ms/step - loss:
47384.2305 - mae: 47384.2305 - val_loss: 57249.9062 - val_mae:
57249.9062
Epoch 142/500
19/19 [=====] - 0s 5ms/step - loss:
47339.6953 - mae: 47339.6953 - val_loss: 57240.3594 - val_mae:
57240.3594
Epoch 143/500
19/19 [=====] - 0s 5ms/step - loss:
47294.0391 - mae: 47294.0391 - val_loss: 57135.2617 - val_mae:
57135.2617
Epoch 144/500
19/19 [=====] - 0s 6ms/step - loss:
47242.9336 - mae: 47242.9336 - val_loss: 57119.4531 - val_mae:
57119.4531
Epoch 145/500
19/19 [=====] - 0s 5ms/step - loss:
47196.9609 - mae: 47196.9609 - val_loss: 57062.5469 - val_mae:
57062.5469
Epoch 146/500
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19/19 [=====] - 0s 5ms/step - loss:  
47146.2109 - mae: 47146.2109 - val_loss: 56991.2930 - val_mae:  
56991.2930  
Epoch 147/500  
19/19 [=====] - 0s 5ms/step - loss:  
47097.8984 - mae: 47097.8984 - val_loss: 56944.5547 - val_mae:  
56944.5547  
Epoch 148/500  
19/19 [=====] - 0s 6ms/step - loss:  
47050.9023 - mae: 47050.9023 - val_loss: 56894.8516 - val_mae:  
56894.8516  
Epoch 149/500  
19/19 [=====] - 0s 5ms/step - loss:  
47007.1328 - mae: 47007.1328 - val_loss: 56868.3047 - val_mae:  
56868.3047  
Epoch 150/500  
19/19 [=====] - 0s 5ms/step - loss:  
46953.0664 - mae: 46953.0664 - val_loss: 56775.2070 - val_mae:  
56775.2070  
Epoch 151/500  
19/19 [=====] - 0s 5ms/step - loss:  
46903.0781 - mae: 46903.0781 - val_loss: 56718.8828 - val_mae:  
56718.8828  
Epoch 152/500  
19/19 [=====] - 0s 5ms/step - loss:  
46852.0703 - mae: 46852.0703 - val_loss: 56676.3828 - val_mae:  
56676.3828  
Epoch 153/500  
19/19 [=====] - 0s 6ms/step - loss:  
46799.0234 - mae: 46799.0234 - val_loss: 56612.5391 - val_mae:  
56612.5391  
Epoch 154/500  
19/19 [=====] - 0s 6ms/step - loss:  
46747.2305 - mae: 46747.2305 - val_loss: 56531.8906 - val_mae:  
56531.8906  
Epoch 155/500  
19/19 [=====] - 0s 6ms/step - loss:  
46695.2773 - mae: 46695.2773 - val_loss: 56471.0898 - val_mae:  
56471.0898  
Epoch 156/500  
19/19 [=====] - 0s 5ms/step - loss:  
46652.4258 - mae: 46652.4258 - val_loss: 56411.1992 - val_mae:  
56411.1992  
Epoch 157/500  
19/19 [=====] - 0s 6ms/step - loss:  
46592.0938 - mae: 46592.0938 - val_loss: 56396.6172 - val_mae:  
56396.6172  
Epoch 158/500  
19/19 [=====] - 0s 6ms/step - loss:
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46544.5078 - mae: 46544.5078 - val_loss: 56303.4570 - val_mae:  
56303.4570  
Epoch 159/500  
19/19 [=====] - 0s 6ms/step - loss:  
46479.6367 - mae: 46479.6367 - val_loss: 56226.4961 - val_mae:  
56226.4961  
Epoch 160/500  
19/19 [=====] - 0s 6ms/step - loss:  
46423.7734 - mae: 46423.7734 - val_loss: 56199.7109 - val_mae:  
56199.7109  
Epoch 161/500  
19/19 [=====] - 0s 6ms/step - loss:  
46369.6328 - mae: 46369.6328 - val_loss: 56163.7500 - val_mae:  
56163.7500  
Epoch 162/500  
19/19 [=====] - 0s 6ms/step - loss:  
46315.0156 - mae: 46315.0156 - val_loss: 56080.5508 - val_mae:  
56080.5508  
Epoch 163/500  
19/19 [=====] - 0s 6ms/step - loss:  
46259.7461 - mae: 46259.7461 - val_loss: 56013.1523 - val_mae:  
56013.1523  
Epoch 164/500  
19/19 [=====] - 0s 8ms/step - loss:  
46202.4531 - mae: 46202.4531 - val_loss: 55935.6523 - val_mae:  
55935.6523  
Epoch 165/500  
19/19 [=====] - 0s 6ms/step - loss:  
46149.9453 - mae: 46149.9453 - val_loss: 55876.8750 - val_mae:  
55876.8750  
Epoch 166/500  
19/19 [=====] - 0s 6ms/step - loss:  
46098.3398 - mae: 46098.3398 - val_loss: 55782.3984 - val_mae:  
55782.3984  
Epoch 167/500  
19/19 [=====] - 0s 6ms/step - loss:  
46047.8477 - mae: 46047.8477 - val_loss: 55727.9531 - val_mae:  
55727.9531  
Epoch 168/500  
19/19 [=====] - 0s 6ms/step - loss:  
45999.4805 - mae: 45999.4805 - val_loss: 55746.5273 - val_mae:  
55746.5273  
Epoch 169/500  
19/19 [=====] - 0s 6ms/step - loss:  
45970.1562 - mae: 45970.1562 - val_loss: 55706.7109 - val_mae:  
55706.7070  
Epoch 170/500  
19/19 [=====] - 0s 5ms/step - loss:  
45937.0781 - mae: 45937.0781 - val_loss: 55673.3164 - val_mae:
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55673.3164
Epoch 171/500
19/19 [=====] - 0s 6ms/step - loss:
45907.4023 - mae: 45907.4023 - val_loss: 55654.6016 - val_mae:
55654.6016
Epoch 172/500
19/19 [=====] - 0s 6ms/step - loss:
45870.5078 - mae: 45870.5078 - val_loss: 55574.6523 - val_mae:
55574.6523
Epoch 173/500
19/19 [=====] - 0s 6ms/step - loss:
45836.0234 - mae: 45836.0234 - val_loss: 55551.6055 - val_mae:
55551.6055
Epoch 174/500
19/19 [=====] - 0s 6ms/step - loss:
45803.7227 - mae: 45803.7227 - val_loss: 55549.6445 - val_mae:
55549.6445
Epoch 175/500
19/19 [=====] - 0s 6ms/step - loss:
45761.7344 - mae: 45761.7344 - val_loss: 55492.2266 - val_mae:
55492.2266
Epoch 176/500
19/19 [=====] - 0s 6ms/step - loss:
45724.3516 - mae: 45724.3516 - val_loss: 55439.4180 - val_mae:
55439.4180
Epoch 177/500
19/19 [=====] - 0s 6ms/step - loss:
45688.2539 - mae: 45688.2539 - val_loss: 55398.2305 - val_mae:
55398.2305
Epoch 178/500
19/19 [=====] - 0s 6ms/step - loss:
45652.5195 - mae: 45652.5195 - val_loss: 55370.0430 - val_mae:
55370.0430
Epoch 179/500
19/19 [=====] - 0s 5ms/step - loss:
45613.6836 - mae: 45613.6836 - val_loss: 55290.5234 - val_mae:
55290.5234
Epoch 180/500
19/19 [=====] - 0s 6ms/step - loss:
45566.9922 - mae: 45566.9922 - val_loss: 55258.8438 - val_mae:
55258.8438
Epoch 181/500
19/19 [=====] - 0s 6ms/step - loss:
45532.3906 - mae: 45532.3906 - val_loss: 55194.7305 - val_mae:
55194.7305
Epoch 182/500
19/19 [=====] - 0s 6ms/step - loss:
45486.1875 - mae: 45486.1875 - val_loss: 55161.5273 - val_mae:
55161.5273
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Epoch 183/500
19/19 [=====] - 0s 6ms/step - loss:
45442.8086 - mae: 45442.8086 - val_loss: 55143.5156 - val_mae:
55143.5156
Epoch 184/500
19/19 [=====] - 0s 6ms/step - loss:
45398.6250 - mae: 45398.6250 - val_loss: 55064.4023 - val_mae:
55064.4023
Epoch 185/500
19/19 [=====] - 0s 7ms/step - loss:
45353.4375 - mae: 45353.4375 - val_loss: 55010.7617 - val_mae:
55010.7617
Epoch 186/500
19/19 [=====] - 0s 6ms/step - loss:
45317.5625 - mae: 45317.5625 - val_loss: 54987.9023 - val_mae:
54987.9023
Epoch 187/500
19/19 [=====] - 0s 6ms/step - loss:
45270.0820 - mae: 45270.0820 - val_loss: 54883.6055 - val_mae:
54883.6055
Epoch 188/500
19/19 [=====] - 0s 6ms/step - loss:
45218.5781 - mae: 45218.5781 - val_loss: 54842.8164 - val_mae:
54842.8164
Epoch 189/500
19/19 [=====] - 0s 6ms/step - loss:
45169.4102 - mae: 45169.4102 - val_loss: 54827.9258 - val_mae:
54827.9258
Epoch 190/500
19/19 [=====] - 0s 6ms/step - loss:
45129.1094 - mae: 45129.1094 - val_loss: 54801.5820 - val_mae:
54801.5820
Epoch 191/500
19/19 [=====] - 0s 6ms/step - loss:
45072.7695 - mae: 45072.7695 - val_loss: 54716.3633 - val_mae:
54716.3633
Epoch 192/500
19/19 [=====] - 0s 6ms/step - loss:
45028.0195 - mae: 45028.0195 - val_loss: 54681.3203 - val_mae:
54681.3203
Epoch 193/500
19/19 [=====] - 0s 6ms/step - loss:
44980.2461 - mae: 44980.2461 - val_loss: 54618.2344 - val_mae:
54618.2344
Epoch 194/500
19/19 [=====] - 0s 8ms/step - loss:
44929.6797 - mae: 44929.6797 - val_loss: 54557.3242 - val_mae:
54557.3242
Epoch 195/500
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19/19 [=====] - 0s 6ms/step - loss:  
44890.8398 - mae: 44890.8398 - val_loss: 54507.2656 - val_mae:  
54507.2656  
Epoch 196/500  
19/19 [=====] - 0s 7ms/step - loss:  
44847.9883 - mae: 44847.9883 - val_loss: 54484.7656 - val_mae:  
54484.7656  
Epoch 197/500  
19/19 [=====] - 0s 7ms/step - loss:  
44805.0508 - mae: 44805.0508 - val_loss: 54464.1094 - val_mae:  
54464.1094  
Epoch 198/500  
19/19 [=====] - 0s 6ms/step - loss:  
44761.9648 - mae: 44761.9648 - val_loss: 54435.1797 - val_mae:  
54435.1797  
Epoch 199/500  
19/19 [=====] - 0s 6ms/step - loss:  
44718.4570 - mae: 44718.4570 - val_loss: 54387.9648 - val_mae:  
54387.9648  
Epoch 200/500  
19/19 [=====] - 0s 6ms/step - loss:  
44668.5273 - mae: 44668.5273 - val_loss: 54311.7305 - val_mae:  
54311.7305  
Epoch 201/500  
19/19 [=====] - 0s 5ms/step - loss:  
44623.8008 - mae: 44623.8008 - val_loss: 54244.5859 - val_mae:  
54244.5859  
Epoch 202/500  
19/19 [=====] - 0s 6ms/step - loss:  
44584.8945 - mae: 44584.8945 - val_loss: 54174.3633 - val_mae:  
54174.3633  
Epoch 203/500  
19/19 [=====] - 0s 6ms/step - loss:  
44532.0742 - mae: 44532.0742 - val_loss: 54100.4219 - val_mae:  
54100.4219  
Epoch 204/500  
19/19 [=====] - 0s 6ms/step - loss:  
44484.5508 - mae: 44484.5508 - val_loss: 54085.6992 - val_mae:  
54085.6992  
Epoch 205/500  
19/19 [=====] - 0s 5ms/step - loss:  
44435.7344 - mae: 44435.7344 - val_loss: 54059.7969 - val_mae:  
54059.7969  
Epoch 206/500  
19/19 [=====] - 0s 6ms/step - loss:  
44378.7812 - mae: 44378.7812 - val_loss: 53972.0742 - val_mae:  
53972.0742  
Epoch 207/500  
19/19 [=====] - 0s 6ms/step - loss:
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44332.1445 - mae: 44332.1445 - val_loss: 53930.4883 - val_mae:  
53930.4883  
Epoch 208/500  
19/19 [=====] - 0s 5ms/step - loss:  
44278.1836 - mae: 44278.1836 - val_loss: 53839.7227 - val_mae:  
53839.7227  
Epoch 209/500  
19/19 [=====] - 0s 6ms/step - loss:  
44222.2656 - mae: 44222.2656 - val_loss: 53793.9531 - val_mae:  
53793.9531  
Epoch 210/500  
19/19 [=====] - 0s 6ms/step - loss:  
44176.8945 - mae: 44176.8945 - val_loss: 53768.5508 - val_mae:  
53768.5508  
Epoch 211/500  
19/19 [=====] - 0s 6ms/step - loss:  
44113.2852 - mae: 44113.2852 - val_loss: 53676.7930 - val_mae:  
53676.7930  
Epoch 212/500  
19/19 [=====] - 0s 7ms/step - loss:  
44079.9844 - mae: 44079.9844 - val_loss: 53584.3242 - val_mae:  
53584.3242  
Epoch 213/500  
19/19 [=====] - 0s 6ms/step - loss:  
44031.6953 - mae: 44031.6953 - val_loss: 53543.1445 - val_mae:  
53543.1445  
Epoch 214/500  
19/19 [=====] - 0s 6ms/step - loss:  
43980.6172 - mae: 43980.6172 - val_loss: 53513.0430 - val_mae:  
53513.0430  
Epoch 215/500  
19/19 [=====] - 0s 6ms/step - loss:  
43934.3047 - mae: 43934.3047 - val_loss: 53490.9844 - val_mae:  
53490.9844  
Epoch 216/500  
19/19 [=====] - 0s 6ms/step - loss:  
43889.4570 - mae: 43889.4570 - val_loss: 53454.1562 - val_mae:  
53454.1562  
Epoch 217/500  
19/19 [=====] - 0s 6ms/step - loss:  
43853.9219 - mae: 43853.9219 - val_loss: 53436.7070 - val_mae:  
53436.7070  
Epoch 218/500  
19/19 [=====] - 0s 6ms/step - loss:  
43791.3828 - mae: 43791.3828 - val_loss: 53340.8711 - val_mae:  
53340.8711  
Epoch 219/500  
19/19 [=====] - 0s 5ms/step - loss:  
43744.3477 - mae: 43744.3477 - val_loss: 53269.2539 - val_mae:
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53269.2539
Epoch 220/500
19/19 [=====] - 0s 7ms/step - loss:
43695.3672 - mae: 43695.3672 - val_loss: 53199.0586 - val_mae:
53199.0586
Epoch 221/500
19/19 [=====] - 0s 6ms/step - loss:
43642.1680 - mae: 43642.1680 - val_loss: 53166.7852 - val_mae:
53166.7852
Epoch 222/500
19/19 [=====] - 0s 6ms/step - loss:
43593.3086 - mae: 43593.3086 - val_loss: 53118.8438 - val_mae:
53118.8438
Epoch 223/500
19/19 [=====] - 0s 6ms/step - loss:
43542.6875 - mae: 43542.6875 - val_loss: 53052.8750 - val_mae:
53052.8750
Epoch 224/500
19/19 [=====] - 0s 7ms/step - loss:
43491.5898 - mae: 43491.5898 - val_loss: 52962.9297 - val_mae:
52962.9297
Epoch 225/500
19/19 [=====] - 0s 6ms/step - loss:
43439.2148 - mae: 43439.2148 - val_loss: 52919.9531 - val_mae:
52919.9531
Epoch 226/500
19/19 [=====] - 0s 6ms/step - loss:
43385.8984 - mae: 43385.8984 - val_loss: 52861.0039 - val_mae:
52861.0039
Epoch 227/500
19/19 [=====] - 0s 7ms/step - loss:
43336.0859 - mae: 43336.0859 - val_loss: 52760.4414 - val_mae:
52760.4414
Epoch 228/500
19/19 [=====] - 0s 6ms/step - loss:
43282.3828 - mae: 43282.3828 - val_loss: 52745.8242 - val_mae:
52745.8242
Epoch 229/500
19/19 [=====] - 0s 6ms/step - loss:
43221.7617 - mae: 43221.7617 - val_loss: 52701.8594 - val_mae:
52701.8594
Epoch 230/500
19/19 [=====] - 0s 5ms/step - loss:
43155.0742 - mae: 43155.0742 - val_loss: 52606.8867 - val_mae:
52606.8867
Epoch 231/500
19/19 [=====] - 0s 8ms/step - loss:
43102.0547 - mae: 43102.0547 - val_loss: 52567.7852 - val_mae:
52567.7852
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Epoch 232/500
19/19 [=====] - 0s 6ms/step - loss:
43045.0039 - mae: 43045.0039 - val_loss: 52453.7148 - val_mae:
52453.7148
Epoch 233/500
19/19 [=====] - 0s 6ms/step - loss:
42983.5234 - mae: 42983.5234 - val_loss: 52423.0078 - val_mae:
52423.0078
Epoch 234/500
19/19 [=====] - 0s 6ms/step - loss:
42926.2070 - mae: 42926.2070 - val_loss: 52374.3477 - val_mae:
52374.3477
Epoch 235/500
19/19 [=====] - 0s 5ms/step - loss:
42869.5742 - mae: 42869.5742 - val_loss: 52323.9023 - val_mae:
52323.9023
Epoch 236/500
19/19 [=====] - 0s 6ms/step - loss:
42821.0977 - mae: 42821.0977 - val_loss: 52265.3281 - val_mae:
52265.3320
Epoch 237/500
19/19 [=====] - 0s 5ms/step - loss:
42765.2539 - mae: 42765.2539 - val_loss: 52239.5352 - val_mae:
52239.5352
Epoch 238/500
19/19 [=====] - 0s 7ms/step - loss:
42718.2109 - mae: 42718.2109 - val_loss: 52175.4258 - val_mae:
52175.4258
Epoch 239/500
19/19 [=====] - 0s 6ms/step - loss:
42672.6133 - mae: 42672.6133 - val_loss: 52124.2109 - val_mae:
52124.2109
Epoch 240/500
19/19 [=====] - 0s 5ms/step - loss:
42621.7773 - mae: 42621.7773 - val_loss: 52059.4336 - val_mae:
52059.4336
Epoch 241/500
19/19 [=====] - 0s 5ms/step - loss:
42575.5000 - mae: 42575.5000 - val_loss: 51967.9727 - val_mae:
51967.9727
Epoch 242/500
19/19 [=====] - 0s 6ms/step - loss:
42526.0508 - mae: 42526.0508 - val_loss: 51954.4688 - val_mae:
51954.4688
Epoch 243/500
19/19 [=====] - 0s 6ms/step - loss:
42478.5000 - mae: 42478.5000 - val_loss: 51848.8164 - val_mae:
51848.8164
Epoch 244/500
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19/19 [=====] - 0s 6ms/step - loss:  
42420.3633 - mae: 42420.3633 - val_loss: 51818.5117 - val_mae:  
51818.5117  
Epoch 245/500  
19/19 [=====] - 0s 5ms/step - loss:  
42371.4297 - mae: 42371.4297 - val_loss: 51731.1797 - val_mae:  
51731.1797  
Epoch 246/500  
19/19 [=====] - 0s 5ms/step - loss:  
42315.4336 - mae: 42315.4336 - val_loss: 51693.3711 - val_mae:  
51693.3711  
Epoch 247/500  
19/19 [=====] - 0s 6ms/step - loss:  
42255.1953 - mae: 42255.1953 - val_loss: 51589.4805 - val_mae:  
51589.4805  
Epoch 248/500  
19/19 [=====] - 0s 6ms/step - loss:  
42203.3320 - mae: 42203.3320 - val_loss: 51522.6719 - val_mae:  
51522.6719  
Epoch 249/500  
19/19 [=====] - 0s 5ms/step - loss:  
42146.8359 - mae: 42146.8359 - val_loss: 51468.5469 - val_mae:  
51468.5469  
Epoch 250/500  
19/19 [=====] - 0s 5ms/step - loss:  
42093.4570 - mae: 42093.4570 - val_loss: 51453.4258 - val_mae:  
51453.4258  
Epoch 251/500  
19/19 [=====] - 0s 5ms/step - loss:  
42037.3750 - mae: 42037.3750 - val_loss: 51338.8672 - val_mae:  
51338.8672  
Epoch 252/500  
19/19 [=====] - 0s 7ms/step - loss:  
41992.2617 - mae: 41992.2617 - val_loss: 51334.0625 - val_mae:  
51334.0625  
Epoch 253/500  
19/19 [=====] - 0s 5ms/step - loss:  
41929.8086 - mae: 41929.8086 - val_loss: 51256.2617 - val_mae:  
51256.2617  
Epoch 254/500  
19/19 [=====] - 0s 6ms/step - loss:  
41877.5703 - mae: 41877.5703 - val_loss: 51143.1367 - val_mae:  
51143.1367  
Epoch 255/500  
19/19 [=====] - 0s 5ms/step - loss:  
41828.1094 - mae: 41828.1094 - val_loss: 51095.1719 - val_mae:  
51095.1719  
Epoch 256/500  
19/19 [=====] - 0s 6ms/step - loss:
```

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41770.1914 - mae: 41770.1914 - val_loss: 51095.3281 - val_mae:  
51095.3281  
Epoch 257/500  
19/19 [=====] - 0s 6ms/step - loss:  
41713.0742 - mae: 41713.0742 - val_loss: 51039.5703 - val_mae:  
51039.5703  
Epoch 258/500  
19/19 [=====] - 0s 6ms/step - loss:  
41663.5742 - mae: 41663.5742 - val_loss: 50981.9102 - val_mae:  
50981.9102  
Epoch 259/500  
19/19 [=====] - 0s 6ms/step - loss:  
41600.7930 - mae: 41600.7930 - val_loss: 50937.6836 - val_mae:  
50937.6836  
Epoch 260/500  
19/19 [=====] - 0s 6ms/step - loss:  
41557.9297 - mae: 41557.9297 - val_loss: 50854.6680 - val_mae:  
50854.6680  
Epoch 261/500  
19/19 [=====] - 0s 6ms/step - loss:  
41487.8789 - mae: 41487.8789 - val_loss: 50823.2344 - val_mae:  
50823.2344  
Epoch 262/500  
19/19 [=====] - 0s 6ms/step - loss:  
41429.4727 - mae: 41429.4727 - val_loss: 50771.5703 - val_mae:  
50771.5703  
Epoch 263/500  
19/19 [=====] - 0s 6ms/step - loss:  
41375.1328 - mae: 41375.1328 - val_loss: 50668.3281 - val_mae:  
50668.3281  
Epoch 264/500  
19/19 [=====] - 0s 6ms/step - loss:  
41310.9375 - mae: 41310.9375 - val_loss: 50644.3789 - val_mae:  
50644.3789  
Epoch 265/500  
19/19 [=====] - 0s 7ms/step - loss:  
41254.3516 - mae: 41254.3516 - val_loss: 50592.3516 - val_mae:  
50592.3516  
Epoch 266/500  
19/19 [=====] - 0s 5ms/step - loss:  
41199.0469 - mae: 41199.0469 - val_loss: 50487.2148 - val_mae:  
50487.2148  
Epoch 267/500  
19/19 [=====] - 0s 6ms/step - loss:  
41135.7773 - mae: 41135.7773 - val_loss: 50449.7930 - val_mae:  
50449.7930  
Epoch 268/500  
19/19 [=====] - 0s 7ms/step - loss:  
41073.8867 - mae: 41073.8867 - val_loss: 50345.1523 - val_mae:  
50345.1523
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Epoch 269/500
19/19 [=====] - 0s 6ms/step - loss:
41010.1367 - mae: 41010.1367 - val_loss: 50268.5820 - val_mae:
50268.5820
Epoch 270/500
19/19 [=====] - 0s 6ms/step - loss:
40958.8750 - mae: 40958.8750 - val_loss: 50240.3477 - val_mae:
50240.3477
Epoch 271/500
19/19 [=====] - 0s 5ms/step - loss:
40885.7773 - mae: 40885.7773 - val_loss: 50105.3203 - val_mae:
50105.3203
Epoch 272/500
19/19 [=====] - 0s 6ms/step - loss:
40826.8477 - mae: 40826.8477 - val_loss: 50054.8945 - val_mae:
50054.8945
Epoch 273/500
19/19 [=====] - 0s 5ms/step - loss:
40767.7500 - mae: 40767.7500 - val_loss: 50013.4609 - val_mae:
50013.4609
Epoch 274/500
19/19 [=====] - 0s 6ms/step - loss:
40698.3789 - mae: 40698.3789 - val_loss: 49974.2891 - val_mae:
49974.2891
Epoch 275/500
19/19 [=====] - 0s 6ms/step - loss:
40640.7812 - mae: 40640.7812 - val_loss: 49905.8828 - val_mae:
49905.8828
Epoch 276/500
19/19 [=====] - 0s 5ms/step - loss:
40578.7656 - mae: 40578.7656 - val_loss: 49807.2500 - val_mae:
49807.2500
Epoch 277/500
19/19 [=====] - 0s 6ms/step - loss:
40514.8203 - mae: 40514.8203 - val_loss: 49767.7070 - val_mae:
49767.7070
Epoch 278/500
19/19 [=====] - 0s 6ms/step - loss:
40452.9766 - mae: 40452.9766 - val_loss: 49720.2148 - val_mae:
49720.2148
Epoch 279/500
19/19 [=====] - 0s 6ms/step - loss:
40391.9258 - mae: 40391.9258 - val_loss: 49690.4492 - val_mae:
49690.4492
Epoch 280/500
19/19 [=====] - 0s 5ms/step - loss:
40337.2695 - mae: 40337.2695 - val_loss: 49567.4375 - val_mae:
49567.4375
Epoch 281/500
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19/19 [=====] - 0s 6ms/step - loss:  
40265.6016 - mae: 40265.6016 - val_loss: 49571.6250 - val_mae:  
49571.6250  
Epoch 282/500  
19/19 [=====] - 0s 6ms/step - loss:  
40207.2344 - mae: 40207.2344 - val_loss: 49485.6953 - val_mae:  
49485.6953  
Epoch 283/500  
19/19 [=====] - 0s 6ms/step - loss:  
40143.6836 - mae: 40143.6836 - val_loss: 49434.7461 - val_mae:  
49434.7461  
Epoch 284/500  
19/19 [=====] - 0s 6ms/step - loss:  
40082.6914 - mae: 40082.6914 - val_loss: 49331.5312 - val_mae:  
49331.5312  
Epoch 285/500  
19/19 [=====] - 0s 6ms/step - loss:  
40014.2461 - mae: 40014.2461 - val_loss: 49287.2773 - val_mae:  
49287.2773  
Epoch 286/500  
19/19 [=====] - 0s 7ms/step - loss:  
39949.0078 - mae: 39949.0078 - val_loss: 49195.2578 - val_mae:  
49195.2578  
Epoch 287/500  
19/19 [=====] - 0s 6ms/step - loss:  
39886.6172 - mae: 39886.6172 - val_loss: 49141.2695 - val_mae:  
49141.2695  
Epoch 288/500  
19/19 [=====] - 0s 5ms/step - loss:  
39826.3945 - mae: 39826.3945 - val_loss: 49034.0156 - val_mae:  
49034.0156  
Epoch 289/500  
19/19 [=====] - 0s 5ms/step - loss:  
39762.8984 - mae: 39762.8984 - val_loss: 48955.5625 - val_mae:  
48955.5625  
Epoch 290/500  
19/19 [=====] - 0s 6ms/step - loss:  
39695.6250 - mae: 39695.6250 - val_loss: 48930.0117 - val_mae:  
48930.0117  
Epoch 291/500  
19/19 [=====] - 0s 7ms/step - loss:  
39636.1680 - mae: 39636.1680 - val_loss: 48833.2227 - val_mae:  
48833.2227  
Epoch 292/500  
19/19 [=====] - 0s 6ms/step - loss:  
39581.4102 - mae: 39581.4102 - val_loss: 48780.2930 - val_mae:  
48780.2930  
Epoch 293/500  
19/19 [=====] - 0s 6ms/step - loss:
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39522.8320 - mae: 39522.8320 - val_loss: 48726.2383 - val_mae:  
48726.2383  
Epoch 294/500  
19/19 [=====] - 0s 6ms/step - loss:  
39465.0508 - mae: 39465.0508 - val_loss: 48653.2305 - val_mae:  
48653.2305  
Epoch 295/500  
19/19 [=====] - 0s 6ms/step - loss:  
39413.2852 - mae: 39413.2852 - val_loss: 48653.1523 - val_mae:  
48653.1523  
Epoch 296/500  
19/19 [=====] - 0s 6ms/step - loss:  
39343.3477 - mae: 39343.3477 - val_loss: 48564.2461 - val_mae:  
48564.2461  
Epoch 297/500  
19/19 [=====] - 0s 6ms/step - loss:  
39279.9570 - mae: 39279.9570 - val_loss: 48470.0938 - val_mae:  
48470.0938  
Epoch 298/500  
19/19 [=====] - 0s 6ms/step - loss:  
39216.6641 - mae: 39216.6641 - val_loss: 48359.7617 - val_mae:  
48359.7617  
Epoch 299/500  
19/19 [=====] - 0s 6ms/step - loss:  
39163.0586 - mae: 39163.0586 - val_loss: 48256.9453 - val_mae:  
48256.9453  
Epoch 300/500  
19/19 [=====] - 0s 6ms/step - loss:  
39107.3594 - mae: 39107.3594 - val_loss: 48295.4023 - val_mae:  
48295.4023  
Epoch 301/500  
19/19 [=====] - 0s 6ms/step - loss:  
39060.1797 - mae: 39060.1797 - val_loss: 48186.7969 - val_mae:  
48186.7969  
Epoch 302/500  
19/19 [=====] - 0s 6ms/step - loss:  
39019.0742 - mae: 39019.0742 - val_loss: 48133.7930 - val_mae:  
48133.7930  
Epoch 303/500  
19/19 [=====] - 0s 6ms/step - loss:  
38977.5391 - mae: 38977.5391 - val_loss: 48136.0781 - val_mae:  
48136.0781  
Epoch 304/500  
19/19 [=====] - 0s 7ms/step - loss:  
38934.7070 - mae: 38934.7070 - val_loss: 48141.5430 - val_mae:  
48141.5430  
Epoch 305/500  
19/19 [=====] - 0s 6ms/step - loss:  
38891.1797 - mae: 38891.1797 - val_loss: 48128.0938 - val_mae:
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48128.0938
Epoch 306/500
19/19 [=====] - 0s 5ms/step - loss:
38852.2656 - mae: 38852.2656 - val_loss: 48075.2344 - val_mae:
48075.2344
Epoch 307/500
19/19 [=====] - 0s 7ms/step - loss:
38804.8008 - mae: 38804.8008 - val_loss: 48011.8477 - val_mae:
48011.8477
Epoch 308/500
19/19 [=====] - 0s 7ms/step - loss:
38758.5664 - mae: 38758.5664 - val_loss: 47979.6250 - val_mae:
47979.6250
Epoch 309/500
19/19 [=====] - 0s 6ms/step - loss:
38713.4336 - mae: 38713.4336 - val_loss: 47875.6367 - val_mae:
47875.6367
Epoch 310/500
19/19 [=====] - 0s 6ms/step - loss:
38668.3711 - mae: 38668.3711 - val_loss: 47856.5430 - val_mae:
47856.5430
Epoch 311/500
19/19 [=====] - 0s 5ms/step - loss:
38618.0703 - mae: 38618.0703 - val_loss: 47726.4453 - val_mae:
47726.4453
Epoch 312/500
19/19 [=====] - 0s 6ms/step - loss:
38570.1523 - mae: 38570.1523 - val_loss: 47686.9023 - val_mae:
47686.9023
Epoch 313/500
19/19 [=====] - 0s 6ms/step - loss:
38518.8711 - mae: 38518.8711 - val_loss: 47676.9727 - val_mae:
47676.9727
Epoch 314/500
19/19 [=====] - 0s 6ms/step - loss:
38477.1016 - mae: 38477.1016 - val_loss: 47719.9805 - val_mae:
47719.9805
Epoch 315/500
19/19 [=====] - 0s 6ms/step - loss:
38422.6094 - mae: 38422.6094 - val_loss: 47627.7461 - val_mae:
47627.7461
Epoch 316/500
19/19 [=====] - 0s 6ms/step - loss:
38377.1133 - mae: 38377.1133 - val_loss: 47553.7812 - val_mae:
47553.7812
Epoch 317/500
19/19 [=====] - 0s 6ms/step - loss:
38329.4258 - mae: 38329.4258 - val_loss: 47544.3242 - val_mae:
47544.3242
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Epoch 318/500
19/19 [=====] - 0s 5ms/step - loss:
38275.9883 - mae: 38275.9883 - val_loss: 47456.2383 - val_mae:
47456.2383
Epoch 319/500
19/19 [=====] - 0s 6ms/step - loss:
38223.5039 - mae: 38223.5039 - val_loss: 47419.8945 - val_mae:
47419.8945
Epoch 320/500
19/19 [=====] - 0s 6ms/step - loss:
38168.8477 - mae: 38168.8477 - val_loss: 47341.3672 - val_mae:
47341.3672
Epoch 321/500
19/19 [=====] - 0s 6ms/step - loss:
38114.1914 - mae: 38114.1914 - val_loss: 47276.6641 - val_mae:
47276.6641
Epoch 322/500
19/19 [=====] - 0s 7ms/step - loss:
38058.4375 - mae: 38058.4375 - val_loss: 47191.3125 - val_mae:
47191.3125
Epoch 323/500
19/19 [=====] - 0s 7ms/step - loss:
38003.2969 - mae: 38003.2969 - val_loss: 47088.0938 - val_mae:
47088.0938
Epoch 324/500
19/19 [=====] - 0s 6ms/step - loss:
37942.3477 - mae: 37942.3477 - val_loss: 47087.0625 - val_mae:
47087.0625
Epoch 325/500
19/19 [=====] - 0s 7ms/step - loss:
37891.0938 - mae: 37891.0938 - val_loss: 47027.3945 - val_mae:
47027.3945
Epoch 326/500
19/19 [=====] - 0s 6ms/step - loss:
37833.5977 - mae: 37833.5977 - val_loss: 47006.5352 - val_mae:
47006.5352
Epoch 327/500
19/19 [=====] - 0s 7ms/step - loss:
37772.1094 - mae: 37772.1094 - val_loss: 46934.2539 - val_mae:
46934.2539
Epoch 328/500
19/19 [=====] - 0s 6ms/step - loss:
37714.0312 - mae: 37714.0312 - val_loss: 46844.7852 - val_mae:
46844.7852
Epoch 329/500
19/19 [=====] - 0s 6ms/step - loss:
37653.1094 - mae: 37653.1094 - val_loss: 46717.6055 - val_mae:
46717.6055
Epoch 330/500
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19/19 [=====] - 0s 6ms/step - loss:  
37594.9531 - mae: 37594.9531 - val_loss: 46643.3477 - val_mae:  
46643.3477  
Epoch 331/500  
19/19 [=====] - 0s 6ms/step - loss:  
37535.2852 - mae: 37535.2852 - val_loss: 46562.3164 - val_mae:  
46562.3164  
Epoch 332/500  
19/19 [=====] - 0s 6ms/step - loss:  
37469.6523 - mae: 37469.6523 - val_loss: 46572.5430 - val_mae:  
46572.5430  
Epoch 333/500  
19/19 [=====] - 0s 6ms/step - loss:  
37421.2266 - mae: 37421.2266 - val_loss: 46485.9648 - val_mae:  
46485.9648  
Epoch 334/500  
19/19 [=====] - 0s 6ms/step - loss:  
37363.8828 - mae: 37363.8828 - val_loss: 46433.6992 - val_mae:  
46433.6992  
Epoch 335/500  
19/19 [=====] - 0s 6ms/step - loss:  
37309.0352 - mae: 37309.0352 - val_loss: 46357.6641 - val_mae:  
46357.6641  
Epoch 336/500  
19/19 [=====] - 0s 6ms/step - loss:  
37264.9727 - mae: 37264.9727 - val_loss: 46353.7539 - val_mae:  
46353.7539  
Epoch 337/500  
19/19 [=====] - 0s 6ms/step - loss:  
37192.6133 - mae: 37192.6133 - val_loss: 46243.6953 - val_mae:  
46243.6953  
Epoch 338/500  
19/19 [=====] - 0s 7ms/step - loss:  
37142.1641 - mae: 37142.1641 - val_loss: 46163.8828 - val_mae:  
46163.8828  
Epoch 339/500  
19/19 [=====] - 0s 8ms/step - loss:  
37085.5703 - mae: 37085.5703 - val_loss: 46098.2188 - val_mae:  
46098.2188  
Epoch 340/500  
19/19 [=====] - 0s 6ms/step - loss:  
37027.1445 - mae: 37027.1445 - val_loss: 45981.7188 - val_mae:  
45981.7188  
Epoch 341/500  
19/19 [=====] - 0s 6ms/step - loss:  
36970.2109 - mae: 36970.2109 - val_loss: 46004.3594 - val_mae:  
46004.3594  
Epoch 342/500  
19/19 [=====] - 0s 6ms/step - loss:
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36924.4336 - mae: 36924.4336 - val_loss: 45947.2109 - val_mae:  
45947.2109  
Epoch 343/500  
19/19 [=====] - 0s 5ms/step - loss:  
36872.3281 - mae: 36872.3281 - val_loss: 45930.2930 - val_mae:  
45930.2930  
Epoch 344/500  
19/19 [=====] - 0s 6ms/step - loss:  
36821.5977 - mae: 36821.5977 - val_loss: 45849.8477 - val_mae:  
45849.8477  
Epoch 345/500  
19/19 [=====] - 0s 6ms/step - loss:  
36774.1953 - mae: 36774.1953 - val_loss: 45788.4023 - val_mae:  
45788.4023  
Epoch 346/500  
19/19 [=====] - 0s 6ms/step - loss:  
36720.8125 - mae: 36720.8125 - val_loss: 45710.0625 - val_mae:  
45710.0625  
Epoch 347/500  
19/19 [=====] - 0s 5ms/step - loss:  
36665.6250 - mae: 36665.6250 - val_loss: 45620.1406 - val_mae:  
45620.1406  
Epoch 348/500  
19/19 [=====] - 0s 6ms/step - loss:  
36614.7383 - mae: 36614.7383 - val_loss: 45587.0000 - val_mae:  
45587.0000  
Epoch 349/500  
19/19 [=====] - 0s 7ms/step - loss:  
36553.9570 - mae: 36553.9570 - val_loss: 45544.3711 - val_mae:  
45544.3750  
Epoch 350/500  
19/19 [=====] - 0s 6ms/step - loss:  
36503.1172 - mae: 36503.1172 - val_loss: 45494.3203 - val_mae:  
45494.3203  
Epoch 351/500  
19/19 [=====] - 0s 6ms/step - loss:  
36441.9922 - mae: 36441.9922 - val_loss: 45478.6133 - val_mae:  
45478.6133  
Epoch 352/500  
19/19 [=====] - 0s 6ms/step - loss:  
36388.1328 - mae: 36388.1328 - val_loss: 45397.6250 - val_mae:  
45397.6250  
Epoch 353/500  
19/19 [=====] - 0s 6ms/step - loss:  
36334.7109 - mae: 36334.7109 - val_loss: 45338.1406 - val_mae:  
45338.1406  
Epoch 354/500  
19/19 [=====] - 0s 5ms/step - loss:  
36264.6055 - mae: 36264.6055 - val_loss: 45206.6094 - val_mae:
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45206.6094
Epoch 355/500
19/19 [=====] - 0s 7ms/step - loss:
36205.7773 - mae: 36205.7773 - val_loss: 45117.9570 - val_mae:
45117.9570
Epoch 356/500
19/19 [=====] - 0s 7ms/step - loss:
36145.6250 - mae: 36145.6250 - val_loss: 45128.9648 - val_mae:
45128.9648
Epoch 357/500
19/19 [=====] - 0s 5ms/step - loss:
36081.9727 - mae: 36081.9727 - val_loss: 45003.6523 - val_mae:
45003.6523
Epoch 358/500
19/19 [=====] - 0s 6ms/step - loss:
36025.3555 - mae: 36025.3555 - val_loss: 44916.3398 - val_mae:
44916.3398
Epoch 359/500
19/19 [=====] - 0s 6ms/step - loss:
35962.9336 - mae: 35962.9336 - val_loss: 44851.7461 - val_mae:
44851.7461
Epoch 360/500
19/19 [=====] - 0s 6ms/step - loss:
35899.9297 - mae: 35899.9297 - val_loss: 44827.5273 - val_mae:
44827.5273
Epoch 361/500
19/19 [=====] - 0s 6ms/step - loss:
35836.4727 - mae: 35836.4727 - val_loss: 44758.4961 - val_mae:
44758.4961
Epoch 362/500
19/19 [=====] - 0s 5ms/step - loss:
35773.5391 - mae: 35773.5391 - val_loss: 44664.1250 - val_mae:
44664.1250
Epoch 363/500
19/19 [=====] - 0s 6ms/step - loss:
35705.6172 - mae: 35705.6172 - val_loss: 44569.5664 - val_mae:
44569.5664
Epoch 364/500
19/19 [=====] - 0s 5ms/step - loss:
35641.8984 - mae: 35641.8984 - val_loss: 44545.5117 - val_mae:
44545.5117
Epoch 365/500
19/19 [=====] - 0s 6ms/step - loss:
35570.8320 - mae: 35570.8320 - val_loss: 44453.5781 - val_mae:
44453.5781
Epoch 366/500
19/19 [=====] - 0s 5ms/step - loss:
35507.7617 - mae: 35507.7617 - val_loss: 44410.9492 - val_mae:
44410.9492
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Epoch 367/500
19/19 [=====] - 0s 6ms/step - loss:
35446.1562 - mae: 35446.1562 - val_loss: 44279.2734 - val_mae:
44279.2734
Epoch 368/500
19/19 [=====] - 0s 6ms/step - loss:
35383.8633 - mae: 35383.8633 - val_loss: 44217.6992 - val_mae:
44217.6992
Epoch 369/500
19/19 [=====] - 0s 6ms/step - loss:
35325.1172 - mae: 35325.1172 - val_loss: 44179.2930 - val_mae:
44179.2930
Epoch 370/500
19/19 [=====] - 0s 6ms/step - loss:
35267.1484 - mae: 35267.1484 - val_loss: 44097.5430 - val_mae:
44097.5430
Epoch 371/500
19/19 [=====] - 0s 7ms/step - loss:
35209.6719 - mae: 35209.6719 - val_loss: 44084.8242 - val_mae:
44084.8242
Epoch 372/500
19/19 [=====] - 0s 6ms/step - loss:
35155.2109 - mae: 35155.2109 - val_loss: 43956.4492 - val_mae:
43956.4492
Epoch 373/500
19/19 [=====] - 0s 6ms/step - loss:
35079.8984 - mae: 35079.8984 - val_loss: 43957.6250 - val_mae:
43957.6250
Epoch 374/500
19/19 [=====] - 0s 7ms/step - loss:
35014.7734 - mae: 35014.7734 - val_loss: 43915.6797 - val_mae:
43915.6797
Epoch 375/500
19/19 [=====] - 0s 6ms/step - loss:
34953.2305 - mae: 34953.2305 - val_loss: 43867.5625 - val_mae:
43867.5625
Epoch 376/500
19/19 [=====] - 0s 7ms/step - loss:
34896.1797 - mae: 34896.1797 - val_loss: 43798.0000 - val_mae:
43798.0000
Epoch 377/500
19/19 [=====] - 0s 7ms/step - loss:
34840.2070 - mae: 34840.2070 - val_loss: 43831.2617 - val_mae:
43831.2617
Epoch 378/500
19/19 [=====] - 0s 6ms/step - loss:
34790.1367 - mae: 34790.1367 - val_loss: 43705.2578 - val_mae:
43705.2578
Epoch 379/500
```

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19/19 [=====] - 0s 7ms/step - loss:  
34736.7930 - mae: 34736.7930 - val_loss: 43668.3125 - val_mae:  
43668.3125  
Epoch 380/500  
19/19 [=====] - 0s 6ms/step - loss:  
34683.9570 - mae: 34683.9570 - val_loss: 43611.9844 - val_mae:  
43611.9844  
Epoch 381/500  
19/19 [=====] - 0s 6ms/step - loss:  
34628.4922 - mae: 34628.4922 - val_loss: 43529.3359 - val_mae:  
43529.3359  
Epoch 382/500  
19/19 [=====] - 0s 6ms/step - loss:  
34582.4570 - mae: 34582.4570 - val_loss: 43400.3555 - val_mae:  
43400.3555  
Epoch 383/500  
19/19 [=====] - 0s 6ms/step - loss:  
34526.0078 - mae: 34526.0078 - val_loss: 43414.8477 - val_mae:  
43414.8477  
Epoch 384/500  
19/19 [=====] - 0s 6ms/step - loss:  
34473.5742 - mae: 34473.5742 - val_loss: 43343.7617 - val_mae:  
43343.7617  
Epoch 385/500  
19/19 [=====] - 0s 6ms/step - loss:  
34425.6055 - mae: 34425.6055 - val_loss: 43294.6523 - val_mae:  
43294.6523  
Epoch 386/500  
19/19 [=====] - 0s 6ms/step - loss:  
34377.4414 - mae: 34377.4414 - val_loss: 43329.7539 - val_mae:  
43329.7539  
Epoch 387/500  
19/19 [=====] - 0s 6ms/step - loss:  
34314.0234 - mae: 34314.0234 - val_loss: 43204.8164 - val_mae:  
43204.8164  
Epoch 388/500  
19/19 [=====] - 0s 7ms/step - loss:  
34257.8047 - mae: 34257.8047 - val_loss: 43102.8945 - val_mae:  
43102.8945  
Epoch 389/500  
19/19 [=====] - 0s 6ms/step - loss:  
34201.9336 - mae: 34201.9336 - val_loss: 43021.3164 - val_mae:  
43021.3164  
Epoch 390/500  
19/19 [=====] - 0s 6ms/step - loss:  
34150.7773 - mae: 34150.7773 - val_loss: 42984.8008 - val_mae:  
42984.8008  
Epoch 391/500  
19/19 [=====] - 0s 7ms/step - loss:
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34105.1914 - mae: 34105.1914 - val_loss: 42819.1211 - val_mae:  
42819.1211  
Epoch 392/500  
19/19 [=====] - 0s 6ms/step - loss:  
34034.3164 - mae: 34034.3164 - val_loss: 42771.4102 - val_mae:  
42771.4102  
Epoch 393/500  
19/19 [=====] - 0s 6ms/step - loss:  
33980.6016 - mae: 33980.6016 - val_loss: 42769.2070 - val_mae:  
42769.2070  
Epoch 394/500  
19/19 [=====] - 0s 7ms/step - loss:  
33926.5430 - mae: 33926.5430 - val_loss: 42685.2344 - val_mae:  
42685.2344  
Epoch 395/500  
19/19 [=====] - 0s 6ms/step - loss:  
33870.0859 - mae: 33870.0859 - val_loss: 42580.6250 - val_mae:  
42580.6250  
Epoch 396/500  
19/19 [=====] - 0s 6ms/step - loss:  
33812.4492 - mae: 33812.4492 - val_loss: 42535.8398 - val_mae:  
42535.8398  
Epoch 397/500  
19/19 [=====] - 0s 6ms/step - loss:  
33759.6914 - mae: 33759.6914 - val_loss: 42456.2812 - val_mae:  
42456.2812  
Epoch 398/500  
19/19 [=====] - 0s 6ms/step - loss:  
33695.8789 - mae: 33695.8789 - val_loss: 42398.9023 - val_mae:  
42398.9023  
Epoch 399/500  
19/19 [=====] - 0s 5ms/step - loss:  
33645.8594 - mae: 33645.8594 - val_loss: 42365.5039 - val_mae:  
42365.5039  
Epoch 400/500  
19/19 [=====] - 0s 7ms/step - loss:  
33586.8242 - mae: 33586.8242 - val_loss: 42218.6016 - val_mae:  
42218.6016  
Epoch 401/500  
19/19 [=====] - 0s 6ms/step - loss:  
33533.3750 - mae: 33533.3750 - val_loss: 42198.2344 - val_mae:  
42198.2344  
Epoch 402/500  
19/19 [=====] - 0s 6ms/step - loss:  
33482.3281 - mae: 33482.3281 - val_loss: 42153.7344 - val_mae:  
42153.7344  
Epoch 403/500  
19/19 [=====] - 0s 6ms/step - loss:  
33433.4688 - mae: 33433.4688 - val_loss: 42032.5898 - val_mae:  
42032.5898
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Epoch 404/500
19/19 [=====] - 0s 6ms/step - loss:
33387.4336 - mae: 33387.4336 - val_loss: 42028.8789 - val_mae:
42028.8789
Epoch 405/500
19/19 [=====] - 0s 6ms/step - loss:
33338.1250 - mae: 33338.1250 - val_loss: 41949.7617 - val_mae:
41949.7617
Epoch 406/500
19/19 [=====] - 0s 6ms/step - loss:
33290.0938 - mae: 33290.0938 - val_loss: 41917.3555 - val_mae:
41917.3555
Epoch 407/500
19/19 [=====] - 0s 6ms/step - loss:
33247.6328 - mae: 33247.6328 - val_loss: 41876.0977 - val_mae:
41876.0977
Epoch 408/500
19/19 [=====] - 0s 5ms/step - loss:
33195.8359 - mae: 33195.8359 - val_loss: 41804.1445 - val_mae:
41804.1445
Epoch 409/500
19/19 [=====] - 0s 5ms/step - loss:
33147.3945 - mae: 33147.3945 - val_loss: 41772.2578 - val_mae:
41772.2578
Epoch 410/500
19/19 [=====] - 0s 6ms/step - loss:
33100.3320 - mae: 33100.3320 - val_loss: 41724.1328 - val_mae:
41724.1328
Epoch 411/500
19/19 [=====] - 0s 6ms/step - loss:
33052.7070 - mae: 33052.7070 - val_loss: 41668.8867 - val_mae:
41668.8867
Epoch 412/500
19/19 [=====] - 0s 6ms/step - loss:
32991.7578 - mae: 32991.7578 - val_loss: 41536.3203 - val_mae:
41536.3203
Epoch 413/500
19/19 [=====] - 0s 8ms/step - loss:
32950.5508 - mae: 32950.5508 - val_loss: 41490.3711 - val_mae:
41490.3711
Epoch 414/500
19/19 [=====] - 0s 5ms/step - loss:
32910.1797 - mae: 32910.1797 - val_loss: 41409.7734 - val_mae:
41409.7734
Epoch 415/500
19/19 [=====] - 0s 6ms/step - loss:
32852.8828 - mae: 32852.8828 - val_loss: 41456.6250 - val_mae:
41456.6250
Epoch 416/500
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19/19 [=====] - 0s 6ms/step - loss:  
32808.7383 - mae: 32808.7383 - val_loss: 41323.3750 - val_mae:  
41323.3750  
Epoch 417/500  
19/19 [=====] - 0s 6ms/step - loss:  
32757.6035 - mae: 32757.6035 - val_loss: 41258.4805 - val_mae:  
41258.4805  
Epoch 418/500  
19/19 [=====] - 0s 6ms/step - loss:  
32712.6406 - mae: 32712.6406 - val_loss: 41217.4023 - val_mae:  
41217.4023  
Epoch 419/500  
19/19 [=====] - 0s 6ms/step - loss:  
32667.5352 - mae: 32667.5352 - val_loss: 41213.8086 - val_mae:  
41213.8086  
Epoch 420/500  
19/19 [=====] - 0s 6ms/step - loss:  
32624.4414 - mae: 32624.4414 - val_loss: 41146.2656 - val_mae:  
41146.2656  
Epoch 421/500  
19/19 [=====] - 0s 6ms/step - loss:  
32582.9355 - mae: 32582.9355 - val_loss: 41123.5508 - val_mae:  
41123.5508  
Epoch 422/500  
19/19 [=====] - 0s 6ms/step - loss:  
32543.1875 - mae: 32543.1875 - val_loss: 41049.3242 - val_mae:  
41049.3242  
Epoch 423/500  
19/19 [=====] - 0s 6ms/step - loss:  
32506.8730 - mae: 32506.8730 - val_loss: 40969.2539 - val_mae:  
40969.2539  
Epoch 424/500  
19/19 [=====] - 0s 5ms/step - loss:  
32464.4688 - mae: 32464.4688 - val_loss: 40893.1094 - val_mae:  
40893.1094  
Epoch 425/500  
19/19 [=====] - 0s 5ms/step - loss:  
32428.0723 - mae: 32428.0723 - val_loss: 40896.5977 - val_mae:  
40896.5977  
Epoch 426/500  
19/19 [=====] - 0s 5ms/step - loss:  
32374.9824 - mae: 32374.9824 - val_loss: 40823.6523 - val_mae:  
40823.6523  
Epoch 427/500  
19/19 [=====] - 0s 5ms/step - loss:  
32336.2285 - mae: 32336.2285 - val_loss: 40775.4570 - val_mae:  
40775.4570  
Epoch 428/500  
19/19 [=====] - 0s 6ms/step - loss:
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32295.2812 - mae: 32295.2812 - val_loss: 40742.2266 - val_mae:  
40742.2266  
Epoch 429/500  
19/19 [=====] - 0s 9ms/step - loss:  
32255.2363 - mae: 32255.2363 - val_loss: 40633.0312 - val_mae:  
40633.0312  
Epoch 430/500  
19/19 [=====] - 0s 6ms/step - loss:  
32216.6367 - mae: 32216.6367 - val_loss: 40602.4180 - val_mae:  
40602.4180  
Epoch 431/500  
19/19 [=====] - 0s 6ms/step - loss:  
32174.9102 - mae: 32174.9102 - val_loss: 40551.6797 - val_mae:  
40551.6797  
Epoch 432/500  
19/19 [=====] - 0s 6ms/step - loss:  
32136.5898 - mae: 32136.5898 - val_loss: 40475.0703 - val_mae:  
40475.0703  
Epoch 433/500  
19/19 [=====] - 0s 6ms/step - loss:  
32102.9961 - mae: 32102.9961 - val_loss: 40403.9727 - val_mae:  
40403.9727  
Epoch 434/500  
19/19 [=====] - 0s 5ms/step - loss:  
32067.4316 - mae: 32067.4316 - val_loss: 40437.5039 - val_mae:  
40437.5039  
Epoch 435/500  
19/19 [=====] - 0s 6ms/step - loss:  
32029.6367 - mae: 32029.6367 - val_loss: 40281.4219 - val_mae:  
40281.4219  
Epoch 436/500  
19/19 [=====] - 0s 6ms/step - loss:  
31985.0762 - mae: 31985.0762 - val_loss: 40336.2539 - val_mae:  
40336.2539  
Epoch 437/500  
19/19 [=====] - 0s 6ms/step - loss:  
31955.9316 - mae: 31955.9316 - val_loss: 40221.4414 - val_mae:  
40221.4414  
Epoch 438/500  
19/19 [=====] - 0s 6ms/step - loss:  
31927.0352 - mae: 31927.0352 - val_loss: 40236.0664 - val_mae:  
40236.0664  
Epoch 439/500  
19/19 [=====] - 0s 5ms/step - loss:  
31893.4238 - mae: 31893.4238 - val_loss: 40204.9609 - val_mae:  
40204.9609  
Epoch 440/500  
19/19 [=====] - 0s 6ms/step - loss:  
31861.7402 - mae: 31861.7402 - val_loss: 40103.8086 - val_mae:
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40103.8086
Epoch 441/500
19/19 [=====] - 0s 6ms/step - loss:
31832.2598 - mae: 31832.2598 - val_loss: 40110.6602 - val_mae:
40110.6602
Epoch 442/500
19/19 [=====] - 0s 7ms/step - loss:
31796.2637 - mae: 31796.2637 - val_loss: 40070.9180 - val_mae:
40070.9180
Epoch 443/500
19/19 [=====] - 0s 8ms/step - loss:
31765.5781 - mae: 31765.5781 - val_loss: 40052.3555 - val_mae:
40052.3555
Epoch 444/500
19/19 [=====] - 0s 6ms/step - loss:
31740.2578 - mae: 31740.2578 - val_loss: 39946.4062 - val_mae:
39946.4062
Epoch 445/500
19/19 [=====] - 0s 6ms/step - loss:
31699.1582 - mae: 31699.1582 - val_loss: 40006.4805 - val_mae:
40006.4805
Epoch 446/500
19/19 [=====] - 0s 5ms/step - loss:
31672.7715 - mae: 31672.7715 - val_loss: 39969.8984 - val_mae:
39969.8984
Epoch 447/500
19/19 [=====] - 0s 6ms/step - loss:
31633.6641 - mae: 31633.6641 - val_loss: 39925.9570 - val_mae:
39925.9570
Epoch 448/500
19/19 [=====] - 0s 7ms/step - loss:
31595.8223 - mae: 31595.8223 - val_loss: 39812.4922 - val_mae:
39812.4922
Epoch 449/500
19/19 [=====] - 0s 6ms/step - loss:
31566.5078 - mae: 31566.5078 - val_loss: 39776.1523 - val_mae:
39776.1523
Epoch 450/500
19/19 [=====] - 0s 7ms/step - loss:
31532.2578 - mae: 31532.2578 - val_loss: 39723.4062 - val_mae:
39723.4062
Epoch 451/500
19/19 [=====] - 0s 6ms/step - loss:
31504.1367 - mae: 31504.1367 - val_loss: 39644.6875 - val_mae:
39644.6875
Epoch 452/500
19/19 [=====] - 0s 5ms/step - loss:
31464.8008 - mae: 31464.8008 - val_loss: 39652.1250 - val_mae:
39652.1250
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Epoch 453/500
19/19 [=====] - 0s 6ms/step - loss:
31430.3008 - mae: 31430.3008 - val_loss: 39585.0000 - val_mae:
39585.0000
Epoch 454/500
19/19 [=====] - 0s 7ms/step - loss:
31396.6777 - mae: 31396.6777 - val_loss: 39525.2266 - val_mae:
39525.2266
Epoch 455/500
19/19 [=====] - 0s 7ms/step - loss:
31365.4785 - mae: 31365.4785 - val_loss: 39513.6055 - val_mae:
39513.6055
Epoch 456/500
19/19 [=====] - 0s 8ms/step - loss:
31329.0312 - mae: 31329.0312 - val_loss: 39472.1602 - val_mae:
39472.1602
Epoch 457/500
19/19 [=====] - 0s 6ms/step - loss:
31299.6641 - mae: 31299.6641 - val_loss: 39483.2734 - val_mae:
39483.2734
Epoch 458/500
19/19 [=====] - 0s 5ms/step - loss:
31264.7988 - mae: 31264.7988 - val_loss: 39433.7266 - val_mae:
39433.7266
Epoch 459/500
19/19 [=====] - 0s 6ms/step - loss:
31244.2266 - mae: 31244.2266 - val_loss: 39333.9258 - val_mae:
39333.9258
Epoch 460/500
19/19 [=====] - 0s 6ms/step - loss:
31202.9863 - mae: 31202.9863 - val_loss: 39321.5547 - val_mae:
39321.5547
Epoch 461/500
19/19 [=====] - 0s 6ms/step - loss:
31168.8223 - mae: 31168.8223 - val_loss: 39271.6250 - val_mae:
39271.6250
Epoch 462/500
19/19 [=====] - 0s 6ms/step - loss:
31137.9688 - mae: 31137.9688 - val_loss: 39275.1641 - val_mae:
39275.1641
Epoch 463/500
19/19 [=====] - 0s 6ms/step - loss:
31105.3047 - mae: 31105.3047 - val_loss: 39201.5156 - val_mae:
39201.5156
Epoch 464/500
19/19 [=====] - 0s 6ms/step - loss:
31077.8086 - mae: 31077.8086 - val_loss: 39103.9180 - val_mae:
39103.9180
Epoch 465/500
```

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19/19 [=====] - 0s 6ms/step - loss:  
31047.7812 - mae: 31047.7812 - val_loss: 39062.3047 - val_mae:  
39062.3047  
Epoch 466/500  
19/19 [=====] - 0s 6ms/step - loss:  
31002.2578 - mae: 31002.2578 - val_loss: 39078.1953 - val_mae:  
39078.1953  
Epoch 467/500  
19/19 [=====] - 0s 6ms/step - loss:  
30980.7578 - mae: 30980.7578 - val_loss: 39093.4844 - val_mae:  
39093.4844  
Epoch 468/500  
19/19 [=====] - 0s 6ms/step - loss:  
30956.2871 - mae: 30956.2871 - val_loss: 38965.4844 - val_mae:  
38965.4844  
Epoch 469/500  
19/19 [=====] - 0s 6ms/step - loss:  
30917.2227 - mae: 30917.2227 - val_loss: 38931.6992 - val_mae:  
38931.6992  
Epoch 470/500  
19/19 [=====] - 0s 8ms/step - loss:  
30888.1191 - mae: 30888.1191 - val_loss: 38917.8789 - val_mae:  
38917.8789  
Epoch 471/500  
19/19 [=====] - 0s 5ms/step - loss:  
30864.8945 - mae: 30864.8945 - val_loss: 38897.5781 - val_mae:  
38897.5781  
Epoch 472/500  
19/19 [=====] - 0s 7ms/step - loss:  
30836.5234 - mae: 30836.5234 - val_loss: 38902.8672 - val_mae:  
38902.8672  
Epoch 473/500  
19/19 [=====] - 0s 6ms/step - loss:  
30809.1035 - mae: 30809.1035 - val_loss: 38825.9492 - val_mae:  
38825.9492  
Epoch 474/500  
19/19 [=====] - 0s 7ms/step - loss:  
30779.4727 - mae: 30779.4727 - val_loss: 38777.6289 - val_mae:  
38777.6289  
Epoch 475/500  
19/19 [=====] - 0s 6ms/step - loss:  
30751.4922 - mae: 30751.4922 - val_loss: 38734.2227 - val_mae:  
38734.2227  
Epoch 476/500  
19/19 [=====] - 0s 5ms/step - loss:  
30721.6328 - mae: 30721.6328 - val_loss: 38692.7422 - val_mae:  
38692.7422  
Epoch 477/500  
19/19 [=====] - 0s 5ms/step - loss:
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30687.8457 - mae: 30687.8457 - val_loss: 38686.8516 - val_mae:  
38686.8516  
Epoch 478/500  
19/19 [=====] - 0s 7ms/step - loss:  
30661.9824 - mae: 30661.9824 - val_loss: 38666.0156 - val_mae:  
38666.0156  
Epoch 479/500  
19/19 [=====] - 0s 6ms/step - loss:  
30641.3555 - mae: 30641.3555 - val_loss: 38633.1289 - val_mae:  
38633.1289  
Epoch 480/500  
19/19 [=====] - 0s 6ms/step - loss:  
30602.3145 - mae: 30602.3145 - val_loss: 38540.5781 - val_mae:  
38540.5781  
Epoch 481/500  
19/19 [=====] - 0s 5ms/step - loss:  
30577.1953 - mae: 30577.1953 - val_loss: 38483.2656 - val_mae:  
38483.2656  
Epoch 482/500  
19/19 [=====] - 0s 6ms/step - loss:  
30538.4277 - mae: 30538.4277 - val_loss: 38391.2812 - val_mae:  
38391.2812  
Epoch 483/500  
19/19 [=====] - 0s 7ms/step - loss:  
30519.0371 - mae: 30519.0371 - val_loss: 38359.5586 - val_mae:  
38359.5586  
Epoch 484/500  
19/19 [=====] - 0s 7ms/step - loss:  
30482.3770 - mae: 30482.3770 - val_loss: 38286.0508 - val_mae:  
38286.0508  
Epoch 485/500  
19/19 [=====] - 0s 6ms/step - loss:  
30459.2090 - mae: 30459.2090 - val_loss: 38334.1172 - val_mae:  
38334.1172  
Epoch 486/500  
19/19 [=====] - 0s 6ms/step - loss:  
30418.9102 - mae: 30418.9102 - val_loss: 38237.0156 - val_mae:  
38237.0156  
Epoch 487/500  
19/19 [=====] - 0s 6ms/step - loss:  
30387.2539 - mae: 30387.2539 - val_loss: 38219.3047 - val_mae:  
38219.3047  
Epoch 488/500  
19/19 [=====] - 0s 5ms/step - loss:  
30354.8770 - mae: 30354.8770 - val_loss: 38179.2070 - val_mae:  
38179.2070  
Epoch 489/500  
19/19 [=====] - 0s 6ms/step - loss:  
30325.7812 - mae: 30325.7812 - val_loss: 38161.9180 - val_mae:
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38161.9180
Epoch 490/500
19/19 [=====] - 0s 7ms/step - loss:
30293.5410 - mae: 30293.5410 - val_loss: 38111.6289 - val_mae:
38111.6289
Epoch 491/500
19/19 [=====] - 0s 6ms/step - loss:
30267.9863 - mae: 30267.9863 - val_loss: 38064.1914 - val_mae:
38064.1914
Epoch 492/500
19/19 [=====] - 0s 5ms/step - loss:
30229.6172 - mae: 30229.6172 - val_loss: 38033.3711 - val_mae:
38033.3711
Epoch 493/500
19/19 [=====] - 0s 5ms/step - loss:
30202.2188 - mae: 30202.2188 - val_loss: 37982.4414 - val_mae:
37982.4414
Epoch 494/500
19/19 [=====] - 0s 6ms/step - loss:
30173.3535 - mae: 30173.3535 - val_loss: 37893.4570 - val_mae:
37893.4570
Epoch 495/500
19/19 [=====] - 0s 6ms/step - loss:
30139.3047 - mae: 30139.3047 - val_loss: 37940.1797 - val_mae:
37940.1797
Epoch 496/500
19/19 [=====] - 0s 5ms/step - loss:
30109.3906 - mae: 30109.3906 - val_loss: 37925.4023 - val_mae:
37925.4023
Epoch 497/500
19/19 [=====] - 0s 5ms/step - loss:
30081.5449 - mae: 30081.5449 - val_loss: 37877.2578 - val_mae:
37877.2578
Epoch 498/500
19/19 [=====] - 0s 6ms/step - loss:
30043.9004 - mae: 30043.9004 - val_loss: 37775.2305 - val_mae:
37775.2305
Epoch 499/500
19/19 [=====] - 0s 5ms/step - loss:
30035.1406 - mae: 30035.1406 - val_loss: 37680.9570 - val_mae:
37680.9570
Epoch 500/500
19/19 [=====] - 0s 7ms/step - loss:
29998.5410 - mae: 29998.5410 - val_loss: 37799.7969 - val_mae:
37799.7969
```

Что ж, видимо, ставить маленький шаг всё же не лучшая идея, так как мы сходимся ну уж очень медленно!

Попробуем функцию потерь `msle`:

```
model = Sequential([
    Dense(64, input_dim=X_train.shape[1], activation='linear'),
    Dense(64, input_dim=X_train.shape[1], activation='relu'),
    Dense(1, activation='linear')
])
random.set_seed(40)

from tensorflow.keras.optimizers import Adamax

model.compile(optimizer=Adamax(learning_rate=0.05),
              loss='msle',
              metrics=['mae'])

history = model.fit(X_train, y_train, epochs=500, batch_size=32,
                     validation_data=(X_val, y_val))

Epoch 1/500
37/37 [=====] - 0s 8ms/step - loss: 0.1384 -
mae: 51059.8750 - val_loss: 0.1635 - val_mae: 60868.2109
Epoch 2/500
37/37 [=====] - 0s 5ms/step - loss: 0.1382 -
mae: 51034.2852 - val_loss: 0.1631 - val_mae: 60820.2266
Epoch 3/500
37/37 [=====] - 0s 6ms/step - loss: 0.1380 -
mae: 51013.1602 - val_loss: 0.1624 - val_mae: 60751.9805
Epoch 4/500
37/37 [=====] - 0s 6ms/step - loss: 0.1377 -
mae: 50992.3906 - val_loss: 0.1621 - val_mae: 60704.7930
Epoch 5/500
37/37 [=====] - 0s 6ms/step - loss: 0.1376 -
mae: 50949.2031 - val_loss: 0.1619 - val_mae: 60667.5898
Epoch 6/500
37/37 [=====] - 0s 6ms/step - loss: 0.1373 -
mae: 50924.8906 - val_loss: 0.1615 - val_mae: 60609.9805
Epoch 7/500
37/37 [=====] - 0s 6ms/step - loss: 0.1371 -
mae: 50891.1406 - val_loss: 0.1610 - val_mae: 60552.2539
Epoch 8/500
37/37 [=====] - 0s 6ms/step - loss: 0.1368 -
mae: 50853.5977 - val_loss: 0.1607 - val_mae: 60502.7461
Epoch 9/500
37/37 [=====] - 0s 5ms/step - loss: 0.1366 -
mae: 50801.5859 - val_loss: 0.1604 - val_mae: 60454.5000
Epoch 10/500
37/37 [=====] - 0s 6ms/step - loss: 0.1363 -
mae: 50741.0195 - val_loss: 0.1602 - val_mae: 60407.5977
Epoch 11/500
37/37 [=====] - 0s 5ms/step - loss: 0.1361 -
mae: 50706.4609 - val_loss: 0.1598 - val_mae: 60342.5078
Epoch 12/500
```

```
37/37 [=====] - 0s 5ms/step - loss: 0.1358 -  
mae: 50638.6875 - val_loss: 0.1595 - val_mae: 60289.6016  
Epoch 13/500  
37/37 [=====] - 0s 6ms/step - loss: 0.1355 -  
mae: 50599.3945 - val_loss: 0.1592 - val_mae: 60233.3750  
Epoch 14/500  
37/37 [=====] - 0s 5ms/step - loss: 0.1352 -  
mae: 50544.9141 - val_loss: 0.1589 - val_mae: 60175.5742  
Epoch 15/500  
37/37 [=====] - 0s 6ms/step - loss: 0.1349 -  
mae: 50486.2773 - val_loss: 0.1584 - val_mae: 60105.5195  
Epoch 16/500  
37/37 [=====] - 0s 5ms/step - loss: 0.1346 -  
mae: 50405.9844 - val_loss: 0.1582 - val_mae: 60048.9922  
Epoch 17/500  
37/37 [=====] - 0s 6ms/step - loss: 0.1343 -  
mae: 50342.6758 - val_loss: 0.1578 - val_mae: 59977.3164  
Epoch 18/500  
37/37 [=====] - 0s 6ms/step - loss: 0.1339 -  
mae: 50279.5234 - val_loss: 0.1574 - val_mae: 59909.0000  
Epoch 19/500  
37/37 [=====] - 0s 5ms/step - loss: 0.1336 -  
mae: 50242.0156 - val_loss: 0.1566 - val_mae: 59812.2188  
Epoch 20/500  
37/37 [=====] - 0s 5ms/step - loss: 0.1332 -  
mae: 50138.7695 - val_loss: 0.1564 - val_mae: 59745.1172  
Epoch 21/500  
37/37 [=====] - 0s 6ms/step - loss: 0.1328 -  
mae: 50069.0156 - val_loss: 0.1560 - val_mae: 59673.1641  
Epoch 22/500  
37/37 [=====] - 0s 5ms/step - loss: 0.1324 -  
mae: 49988.1172 - val_loss: 0.1556 - val_mae: 59590.7930  
Epoch 23/500  
37/37 [=====] - 0s 5ms/step - loss: 0.1321 -  
mae: 49938.0938 - val_loss: 0.1547 - val_mae: 59478.8555  
Epoch 24/500  
37/37 [=====] - 0s 5ms/step - loss: 0.1316 -  
mae: 49822.7383 - val_loss: 0.1547 - val_mae: 59418.0820  
Epoch 25/500  
37/37 [=====] - 0s 5ms/step - loss: 0.1312 -  
mae: 49730.0742 - val_loss: 0.1543 - val_mae: 59332.6797  
Epoch 26/500  
37/37 [=====] - 0s 5ms/step - loss: 0.1307 -  
mae: 49646.9141 - val_loss: 0.1538 - val_mae: 59239.2812  
Epoch 27/500  
37/37 [=====] - 0s 5ms/step - loss: 0.1302 -  
mae: 49555.6016 - val_loss: 0.1530 - val_mae: 59122.4258  
Epoch 28/500  
37/37 [=====] - 0s 5ms/step - loss: 0.1297 -
```

```
mae: 49436.2656 - val_loss: 0.1524 - val_mae: 59013.5352
Epoch 29/500
37/37 [=====] - 0s 6ms/step - loss: 0.1292 -
mae: 49368.6133 - val_loss: 0.1516 - val_mae: 58890.3906
Epoch 30/500
37/37 [=====] - 0s 6ms/step - loss: 0.1287 -
mae: 49251.9062 - val_loss: 0.1513 - val_mae: 58795.2812
Epoch 31/500
37/37 [=====] - 0s 6ms/step - loss: 0.1282 -
mae: 49111.9414 - val_loss: 0.1507 - val_mae: 58675.3438
Epoch 32/500
37/37 [=====] - 0s 6ms/step - loss: 0.1276 -
mae: 49032.5781 - val_loss: 0.1496 - val_mae: 58521.9922
Epoch 33/500
37/37 [=====] - 0s 6ms/step - loss: 0.1270 -
mae: 48911.9492 - val_loss: 0.1492 - val_mae: 58414.5898
Epoch 34/500
37/37 [=====] - 0s 5ms/step - loss: 0.1264 -
mae: 48744.1797 - val_loss: 0.1488 - val_mae: 58301.2812
Epoch 35/500
37/37 [=====] - 0s 5ms/step - loss: 0.1257 -
mae: 48604.2227 - val_loss: 0.1479 - val_mae: 58144.5898
Epoch 36/500
37/37 [=====] - 0s 5ms/step - loss: 0.1251 -
mae: 48502.7109 - val_loss: 0.1471 - val_mae: 57996.8086
Epoch 37/500
37/37 [=====] - 0s 5ms/step - loss: 0.1243 -
mae: 48352.3398 - val_loss: 0.1462 - val_mae: 57829.5898
Epoch 38/500
37/37 [=====] - 0s 6ms/step - loss: 0.1236 -
mae: 48185.8594 - val_loss: 0.1452 - val_mae: 57656.2656
Epoch 39/500
37/37 [=====] - 0s 5ms/step - loss: 0.1229 -
mae: 48099.1172 - val_loss: 0.1442 - val_mae: 57480.2188
Epoch 40/500
37/37 [=====] - 0s 5ms/step - loss: 0.1220 -
mae: 47845.3984 - val_loss: 0.1440 - val_mae: 57355.4062
Epoch 41/500
37/37 [=====] - 0s 5ms/step - loss: 0.1213 -
mae: 47700.4141 - val_loss: 0.1429 - val_mae: 57158.3086
Epoch 42/500
37/37 [=====] - 0s 5ms/step - loss: 0.1203 -
mae: 47516.9297 - val_loss: 0.1417 - val_mae: 56936.1562
Epoch 43/500
37/37 [=====] - 0s 6ms/step - loss: 0.1194 -
mae: 47333.9844 - val_loss: 0.1406 - val_mae: 56727.6758
Epoch 44/500
37/37 [=====] - 0s 5ms/step - loss: 0.1185 -
mae: 47105.6602 - val_loss: 0.1394 - val_mae: 56501.1641
```

```
Epoch 45/500
37/37 [=====] - 0s 6ms/step - loss: 0.1174 -
mae: 46900.5664 - val_loss: 0.1379 - val_mae: 56251.6328
Epoch 46/500
37/37 [=====] - 0s 6ms/step - loss: 0.1165 -
mae: 46729.2461 - val_loss: 0.1368 - val_mae: 56017.0195
Epoch 47/500
37/37 [=====] - 0s 6ms/step - loss: 0.1153 -
mae: 46426.1094 - val_loss: 0.1362 - val_mae: 55817.6406
Epoch 48/500
37/37 [=====] - 0s 6ms/step - loss: 0.1141 -
mae: 46152.3125 - val_loss: 0.1344 - val_mae: 55506.6641
Epoch 49/500
37/37 [=====] - 0s 6ms/step - loss: 0.1129 -
mae: 45948.2930 - val_loss: 0.1330 - val_mae: 55218.1211
Epoch 50/500
37/37 [=====] - 0s 5ms/step - loss: 0.1118 -
mae: 45692.5664 - val_loss: 0.1317 - val_mae: 54941.2109
Epoch 51/500
37/37 [=====] - 0s 5ms/step - loss: 0.1102 -
mae: 45324.9141 - val_loss: 0.1309 - val_mae: 54715.5703
Epoch 52/500
37/37 [=====] - 0s 5ms/step - loss: 0.1089 -
mae: 45044.9258 - val_loss: 0.1285 - val_mae: 54285.7930
Epoch 53/500
37/37 [=====] - 0s 5ms/step - loss: 0.1073 -
mae: 44693.3633 - val_loss: 0.1268 - val_mae: 53936.9570
Epoch 54/500
37/37 [=====] - 0s 5ms/step - loss: 0.1056 -
mae: 44318.4297 - val_loss: 0.1247 - val_mae: 53506.9570
Epoch 55/500
37/37 [=====] - 0s 5ms/step - loss: 0.1040 -
mae: 43966.4258 - val_loss: 0.1228 - val_mae: 53099.4727
Epoch 56/500
37/37 [=====] - 0s 5ms/step - loss: 0.1022 -
mae: 43548.5039 - val_loss: 0.1212 - val_mae: 52717.9141
Epoch 57/500
37/37 [=====] - 0s 5ms/step - loss: 0.1003 -
mae: 43135.5938 - val_loss: 0.1186 - val_mae: 52180.8750
Epoch 58/500
37/37 [=====] - 0s 6ms/step - loss: 0.0983 -
mae: 42654.8516 - val_loss: 0.1157 - val_mae: 51607.5586
Epoch 59/500
37/37 [=====] - 0s 7ms/step - loss: 0.0961 -
mae: 42163.9023 - val_loss: 0.1143 - val_mae: 51204.0859
Epoch 60/500
37/37 [=====] - 0s 6ms/step - loss: 0.0938 -
mae: 41639.9141 - val_loss: 0.1111 - val_mae: 50558.8477
Epoch 61/500
```

```
37/37 [=====] - 0s 6ms/step - loss: 0.0914 -  
mae: 41086.7930 - val_loss: 0.1096 - val_mae: 50146.9336  
Epoch 62/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0889 -  
mae: 40499.8672 - val_loss: 0.1057 - val_mae: 49356.3203  
Epoch 63/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0862 -  
mae: 39846.2891 - val_loss: 0.1022 - val_mae: 48624.3281  
Epoch 64/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0836 -  
mae: 39250.0156 - val_loss: 0.1011 - val_mae: 48259.9922  
Epoch 65/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0809 -  
mae: 38584.7070 - val_loss: 0.0968 - val_mae: 47382.6523  
Epoch 66/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0781 -  
mae: 37939.5898 - val_loss: 0.0942 - val_mae: 46765.2656  
Epoch 67/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0753 -  
mae: 37227.6758 - val_loss: 0.0906 - val_mae: 45953.2617  
Epoch 68/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0723 -  
mae: 36524.4688 - val_loss: 0.0888 - val_mae: 45504.7305  
Epoch 69/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0697 -  
mae: 35916.1953 - val_loss: 0.0862 - val_mae: 44872.2422  
Epoch 70/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0666 -  
mae: 35032.7969 - val_loss: 0.0804 - val_mae: 43435.3203  
Epoch 71/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0636 -  
mae: 34205.9688 - val_loss: 0.0770 - val_mae: 42557.7969  
Epoch 72/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0609 -  
mae: 33512.2070 - val_loss: 0.0746 - val_mae: 41839.3633  
Epoch 73/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0582 -  
mae: 32852.8477 - val_loss: 0.0705 - val_mae: 40790.2578  
Epoch 74/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0558 -  
mae: 32331.7988 - val_loss: 0.0710 - val_mae: 40696.5977  
Epoch 75/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0537 -  
mae: 31576.2949 - val_loss: 0.0661 - val_mae: 39379.6055  
Epoch 76/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0517 -  
mae: 30938.1602 - val_loss: 0.0630 - val_mae: 38482.4609  
Epoch 77/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0496 -
```

```
mae: 30467.6816 - val_loss: 0.0664 - val_mae: 39191.4805
Epoch 78/500
37/37 [=====] - 0s 6ms/step - loss: 0.0488 -
mae: 30003.2988 - val_loss: 0.0602 - val_mae: 37466.5078
Epoch 79/500
37/37 [=====] - 0s 6ms/step - loss: 0.0472 -
mae: 29520.3008 - val_loss: 0.0564 - val_mae: 36591.6445
Epoch 80/500
37/37 [=====] - 0s 6ms/step - loss: 0.0463 -
mae: 29209.5859 - val_loss: 0.0559 - val_mae: 36156.8398
Epoch 81/500
37/37 [=====] - 0s 6ms/step - loss: 0.0451 -
mae: 28954.6504 - val_loss: 0.0568 - val_mae: 36232.9570
Epoch 82/500
37/37 [=====] - 0s 5ms/step - loss: 0.0442 -
mae: 28503.1543 - val_loss: 0.0531 - val_mae: 35327.7422
Epoch 83/500
37/37 [=====] - 0s 6ms/step - loss: 0.0432 -
mae: 28271.3066 - val_loss: 0.0528 - val_mae: 35084.2266
Epoch 84/500
37/37 [=====] - 0s 5ms/step - loss: 0.0425 -
mae: 28135.9141 - val_loss: 0.0529 - val_mae: 35056.3008
Epoch 85/500
37/37 [=====] - 0s 5ms/step - loss: 0.0418 -
mae: 27755.9082 - val_loss: 0.0504 - val_mae: 34376.6328
Epoch 86/500
37/37 [=====] - 0s 6ms/step - loss: 0.0410 -
mae: 27560.4023 - val_loss: 0.0488 - val_mae: 34032.6250
Epoch 87/500
37/37 [=====] - 0s 5ms/step - loss: 0.0401 -
mae: 27297.0488 - val_loss: 0.0498 - val_mae: 34133.7422
Epoch 88/500
37/37 [=====] - 0s 6ms/step - loss: 0.0394 -
mae: 27022.8203 - val_loss: 0.0467 - val_mae: 33408.6250
Epoch 89/500
37/37 [=====] - 0s 5ms/step - loss: 0.0391 -
mae: 26891.2754 - val_loss: 0.0461 - val_mae: 33137.1211
Epoch 90/500
37/37 [=====] - 0s 5ms/step - loss: 0.0380 -
mae: 26577.4727 - val_loss: 0.0452 - val_mae: 32925.6250
Epoch 91/500
37/37 [=====] - 0s 6ms/step - loss: 0.0374 -
mae: 26332.3203 - val_loss: 0.0434 - val_mae: 32490.0586
Epoch 92/500
37/37 [=====] - 0s 6ms/step - loss: 0.0368 -
mae: 26115.7070 - val_loss: 0.0457 - val_mae: 32812.5586
Epoch 93/500
37/37 [=====] - 0s 6ms/step - loss: 0.0362 -
mae: 25836.6387 - val_loss: 0.0436 - val_mae: 32310.2188
```

```
Epoch 94/500
37/37 [=====] - 0s 6ms/step - loss: 0.0355 -
mae: 25809.2383 - val_loss: 0.0416 - val_mae: 31752.3223
Epoch 95/500
37/37 [=====] - 0s 6ms/step - loss: 0.0356 -
mae: 25814.7051 - val_loss: 0.0398 - val_mae: 31436.8672
Epoch 96/500
37/37 [=====] - 0s 6ms/step - loss: 0.0348 -
mae: 25563.2422 - val_loss: 0.0395 - val_mae: 31209.0625
Epoch 97/500
37/37 [=====] - 0s 6ms/step - loss: 0.0339 -
mae: 25242.4199 - val_loss: 0.0386 - val_mae: 30938.9316
Epoch 98/500
37/37 [=====] - 0s 6ms/step - loss: 0.0332 -
mae: 24963.0977 - val_loss: 0.0383 - val_mae: 30704.0898
Epoch 99/500
37/37 [=====] - 0s 6ms/step - loss: 0.0329 -
mae: 24876.0762 - val_loss: 0.0377 - val_mae: 30483.0645
Epoch 100/500
37/37 [=====] - 0s 6ms/step - loss: 0.0324 -
mae: 24587.3828 - val_loss: 0.0361 - val_mae: 30252.2285
Epoch 101/500
37/37 [=====] - 0s 6ms/step - loss: 0.0318 -
mae: 24380.7793 - val_loss: 0.0358 - val_mae: 29801.3906
Epoch 102/500
37/37 [=====] - 0s 6ms/step - loss: 0.0310 -
mae: 24061.0059 - val_loss: 0.0367 - val_mae: 29982.7734
Epoch 103/500
37/37 [=====] - 0s 5ms/step - loss: 0.0305 -
mae: 23929.0254 - val_loss: 0.0343 - val_mae: 29342.6816
Epoch 104/500
37/37 [=====] - 0s 6ms/step - loss: 0.0299 -
mae: 23783.0645 - val_loss: 0.0355 - val_mae: 29542.5918
Epoch 105/500
37/37 [=====] - 0s 6ms/step - loss: 0.0300 -
mae: 23850.8555 - val_loss: 0.0381 - val_mae: 30315.3828
Epoch 106/500
37/37 [=====] - 0s 6ms/step - loss: 0.0292 -
mae: 23436.8789 - val_loss: 0.0321 - val_mae: 28642.2852
Epoch 107/500
37/37 [=====] - 0s 6ms/step - loss: 0.0292 -
mae: 23329.3906 - val_loss: 0.0314 - val_mae: 28542.1172
Epoch 108/500
37/37 [=====] - 0s 6ms/step - loss: 0.0284 -
mae: 22962.8906 - val_loss: 0.0315 - val_mae: 28213.3223
Epoch 109/500
37/37 [=====] - 0s 6ms/step - loss: 0.0279 -
mae: 22890.4043 - val_loss: 0.0303 - val_mae: 28037.4199
Epoch 110/500
```

```
37/37 [=====] - 0s 6ms/step - loss: 0.0274 -  
mae: 22746.3633 - val_loss: 0.0321 - val_mae: 28373.2930  
Epoch 111/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0278 -  
mae: 22834.7578 - val_loss: 0.0310 - val_mae: 27982.6035  
Epoch 112/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0278 -  
mae: 22777.8535 - val_loss: 0.0294 - val_mae: 27555.6113  
Epoch 113/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0273 -  
mae: 22489.7695 - val_loss: 0.0287 - val_mae: 27451.5605  
Epoch 114/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0268 -  
mae: 22422.9102 - val_loss: 0.0286 - val_mae: 27488.2715  
Epoch 115/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0262 -  
mae: 22028.0469 - val_loss: 0.0290 - val_mae: 27306.2969  
Epoch 116/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0262 -  
mae: 22027.5293 - val_loss: 0.0278 - val_mae: 26979.8672  
Epoch 117/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0259 -  
mae: 21881.2188 - val_loss: 0.0274 - val_mae: 26835.4160  
Epoch 118/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0253 -  
mae: 21802.5977 - val_loss: 0.0271 - val_mae: 26766.8320  
Epoch 119/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0257 -  
mae: 21952.4980 - val_loss: 0.0268 - val_mae: 26625.2422  
Epoch 120/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0251 -  
mae: 21647.7852 - val_loss: 0.0271 - val_mae: 26581.0098  
Epoch 121/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0257 -  
mae: 21900.3867 - val_loss: 0.0263 - val_mae: 26418.6914  
Epoch 122/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0251 -  
mae: 21650.7012 - val_loss: 0.0263 - val_mae: 26322.2246  
Epoch 123/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0254 -  
mae: 21767.9863 - val_loss: 0.0265 - val_mae: 26314.5273  
Epoch 124/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0248 -  
mae: 21425.5898 - val_loss: 0.0265 - val_mae: 26289.1172  
Epoch 125/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0245 -  
mae: 21253.8906 - val_loss: 0.0256 - val_mae: 26060.5723  
Epoch 126/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0240 -
```

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mae: 21122.7891 - val_loss: 0.0260 - val_mae: 26064.9414
Epoch 127/500
37/37 [=====] - 0s 5ms/step - loss: 0.0253 -
mae: 21571.7969 - val_loss: 0.0252 - val_mae: 25841.8516
Epoch 128/500
37/37 [=====] - 0s 6ms/step - loss: 0.0240 -
mae: 21107.2852 - val_loss: 0.0251 - val_mae: 25719.0352
Epoch 129/500
37/37 [=====] - 0s 6ms/step - loss: 0.0240 -
mae: 21029.5078 - val_loss: 0.0263 - val_mae: 25996.8535
Epoch 130/500
37/37 [=====] - 0s 6ms/step - loss: 0.0240 -
mae: 21109.8047 - val_loss: 0.0316 - val_mae: 27712.3379
Epoch 131/500
37/37 [=====] - 0s 6ms/step - loss: 0.0249 -
mae: 21327.7852 - val_loss: 0.0251 - val_mae: 25659.7637
Epoch 132/500
37/37 [=====] - 0s 6ms/step - loss: 0.0240 -
mae: 21074.1680 - val_loss: 0.0244 - val_mae: 25331.6055
Epoch 133/500
37/37 [=====] - 0s 6ms/step - loss: 0.0237 -
mae: 20824.2773 - val_loss: 0.0247 - val_mae: 25472.2461
Epoch 134/500
37/37 [=====] - 0s 6ms/step - loss: 0.0240 -
mae: 21116.3828 - val_loss: 0.0247 - val_mae: 25440.8652
Epoch 135/500
37/37 [=====] - 0s 6ms/step - loss: 0.0235 -
mae: 20703.6133 - val_loss: 0.0242 - val_mae: 25221.0391
Epoch 136/500
37/37 [=====] - 0s 6ms/step - loss: 0.0235 -
mae: 20760.4062 - val_loss: 0.0242 - val_mae: 25166.2852
Epoch 137/500
37/37 [=====] - 0s 6ms/step - loss: 0.0235 -
mae: 20887.0879 - val_loss: 0.0243 - val_mae: 25182.7500
Epoch 138/500
37/37 [=====] - 0s 6ms/step - loss: 0.0234 -
mae: 20679.4922 - val_loss: 0.0239 - val_mae: 25013.9883
Epoch 139/500
37/37 [=====] - 0s 6ms/step - loss: 0.0232 -
mae: 20612.0078 - val_loss: 0.0239 - val_mae: 25066.7578
Epoch 140/500
37/37 [=====] - 0s 6ms/step - loss: 0.0229 -
mae: 20460.0918 - val_loss: 0.0245 - val_mae: 25087.7148
Epoch 141/500
37/37 [=====] - 0s 5ms/step - loss: 0.0230 -
mae: 20441.2988 - val_loss: 0.0237 - val_mae: 24850.3340
Epoch 142/500
37/37 [=====] - 0s 5ms/step - loss: 0.0232 -
mae: 20728.1348 - val_loss: 0.0271 - val_mae: 25800.7871
```

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Epoch 143/500
37/37 [=====] - 0s 6ms/step - loss: 0.0244 -
mae: 21345.8359 - val_loss: 0.0273 - val_mae: 25825.1289
Epoch 144/500
37/37 [=====] - 0s 6ms/step - loss: 0.0237 -
mae: 20799.6270 - val_loss: 0.0242 - val_mae: 24929.4023
Epoch 145/500
37/37 [=====] - 0s 6ms/step - loss: 0.0225 -
mae: 20289.6406 - val_loss: 0.0232 - val_mae: 24636.8730
Epoch 146/500
37/37 [=====] - 0s 5ms/step - loss: 0.0225 -
mae: 20272.1680 - val_loss: 0.0237 - val_mae: 24707.9707
Epoch 147/500
37/37 [=====] - 0s 5ms/step - loss: 0.0224 -
mae: 20135.3535 - val_loss: 0.0237 - val_mae: 24671.7578
Epoch 148/500
37/37 [=====] - 0s 6ms/step - loss: 0.0223 -
mae: 20123.3828 - val_loss: 0.0231 - val_mae: 24455.6543
Epoch 149/500
37/37 [=====] - 0s 6ms/step - loss: 0.0228 -
mae: 20327.7344 - val_loss: 0.0230 - val_mae: 24487.1992
Epoch 150/500
37/37 [=====] - 0s 5ms/step - loss: 0.0227 -
mae: 20344.4316 - val_loss: 0.0230 - val_mae: 24534.3066
Epoch 151/500
37/37 [=====] - 0s 6ms/step - loss: 0.0228 -
mae: 20526.0156 - val_loss: 0.0244 - val_mae: 24832.8496
Epoch 152/500
37/37 [=====] - 0s 5ms/step - loss: 0.0222 -
mae: 20133.9199 - val_loss: 0.0236 - val_mae: 24504.7988
Epoch 153/500
37/37 [=====] - 0s 6ms/step - loss: 0.0226 -
mae: 20168.1426 - val_loss: 0.0237 - val_mae: 24533.8398
Epoch 154/500
37/37 [=====] - 0s 6ms/step - loss: 0.0226 -
mae: 20439.1035 - val_loss: 0.0227 - val_mae: 24286.1152
Epoch 155/500
37/37 [=====] - 0s 6ms/step - loss: 0.0223 -
mae: 20173.2129 - val_loss: 0.0242 - val_mae: 24648.6309
Epoch 156/500
37/37 [=====] - 0s 6ms/step - loss: 0.0221 -
mae: 19906.7852 - val_loss: 0.0226 - val_mae: 24174.5469
Epoch 157/500
37/37 [=====] - 0s 6ms/step - loss: 0.0225 -
mae: 20233.2324 - val_loss: 0.0235 - val_mae: 24456.2988
Epoch 158/500
37/37 [=====] - 0s 6ms/step - loss: 0.0220 -
mae: 20007.1699 - val_loss: 0.0241 - val_mae: 24591.0410
Epoch 159/500
```

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37/37 [=====] - 0s 6ms/step - loss: 0.0219 -  
mae: 19901.2656 - val_loss: 0.0244 - val_mae: 24562.8691  
Epoch 160/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0221 -  
mae: 20064.4844 - val_loss: 0.0232 - val_mae: 24124.6621  
Epoch 161/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0219 -  
mae: 20053.8340 - val_loss: 0.0287 - val_mae: 25883.7988  
Epoch 162/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0226 -  
mae: 20183.8789 - val_loss: 0.0243 - val_mae: 24515.9531  
Epoch 163/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0218 -  
mae: 19961.9023 - val_loss: 0.0235 - val_mae: 24220.0898  
Epoch 164/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0215 -  
mae: 19693.6680 - val_loss: 0.0221 - val_mae: 23804.8867  
Epoch 165/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0214 -  
mae: 19721.9727 - val_loss: 0.0250 - val_mae: 24504.9746  
Epoch 166/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0231 -  
mae: 20347.6934 - val_loss: 0.0240 - val_mae: 24715.2363  
Epoch 167/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0218 -  
mae: 20003.3555 - val_loss: 0.0233 - val_mae: 24057.8359  
Epoch 168/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0215 -  
mae: 19632.3516 - val_loss: 0.0234 - val_mae: 23993.8262  
Epoch 169/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0218 -  
mae: 19832.9023 - val_loss: 0.0222 - val_mae: 23767.3477  
Epoch 170/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0216 -  
mae: 19698.2109 - val_loss: 0.0220 - val_mae: 23640.0957  
Epoch 171/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0220 -  
mae: 19934.9766 - val_loss: 0.0220 - val_mae: 23708.8965  
Epoch 172/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0214 -  
mae: 19660.0859 - val_loss: 0.0235 - val_mae: 24026.6250  
Epoch 173/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0214 -  
mae: 19657.8223 - val_loss: 0.0218 - val_mae: 23689.4414  
Epoch 174/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0217 -  
mae: 19806.6406 - val_loss: 0.0223 - val_mae: 23924.8789  
Epoch 175/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0215 -  
mae: 19752.8203 - val_loss: 0.0218 - val_mae: 23552.2031
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Epoch 176/500
37/37 [=====] - 0s 6ms/step - loss: 0.0210 -
mae: 19414.5859 - val_loss: 0.0216 - val_mae: 23443.8672
Epoch 177/500
37/37 [=====] - 0s 6ms/step - loss: 0.0209 -
mae: 19432.7578 - val_loss: 0.0228 - val_mae: 23815.3555
Epoch 178/500
37/37 [=====] - 0s 6ms/step - loss: 0.0209 -
mae: 19384.3594 - val_loss: 0.0236 - val_mae: 23911.0625
Epoch 179/500
37/37 [=====] - 0s 5ms/step - loss: 0.0210 -
mae: 19477.2207 - val_loss: 0.0216 - val_mae: 23380.2578
Epoch 180/500
37/37 [=====] - 0s 6ms/step - loss: 0.0209 -
mae: 19397.7148 - val_loss: 0.0213 - val_mae: 23272.8789
Epoch 181/500
37/37 [=====] - 0s 6ms/step - loss: 0.0208 -
mae: 19379.8867 - val_loss: 0.0211 - val_mae: 23192.7363
Epoch 182/500
37/37 [=====] - 0s 6ms/step - loss: 0.0210 -
mae: 19435.3555 - val_loss: 0.0229 - val_mae: 23483.5527
Epoch 183/500
37/37 [=====] - 0s 6ms/step - loss: 0.0208 -
mae: 19327.7617 - val_loss: 0.0212 - val_mae: 23239.7734
Epoch 184/500
37/37 [=====] - 0s 6ms/step - loss: 0.0217 -
mae: 19636.3965 - val_loss: 0.0211 - val_mae: 23156.0195
Epoch 185/500
37/37 [=====] - 0s 6ms/step - loss: 0.0206 -
mae: 19203.6914 - val_loss: 0.0217 - val_mae: 23269.1016
Epoch 186/500
37/37 [=====] - 0s 6ms/step - loss: 0.0207 -
mae: 19171.1445 - val_loss: 0.0210 - val_mae: 23067.6094
Epoch 187/500
37/37 [=====] - 0s 5ms/step - loss: 0.0221 -
mae: 19917.4336 - val_loss: 0.0212 - val_mae: 23213.6758
Epoch 188/500
37/37 [=====] - 0s 6ms/step - loss: 0.0210 -
mae: 19499.7266 - val_loss: 0.0230 - val_mae: 23599.1367
Epoch 189/500
37/37 [=====] - 0s 5ms/step - loss: 0.0214 -
mae: 19534.0840 - val_loss: 0.0217 - val_mae: 23503.7715
Epoch 190/500
37/37 [=====] - 0s 5ms/step - loss: 0.0215 -
mae: 19634.7715 - val_loss: 0.0209 - val_mae: 22967.5566
Epoch 191/500
37/37 [=====] - 0s 6ms/step - loss: 0.0207 -
mae: 19247.8105 - val_loss: 0.0210 - val_mae: 23133.0859
Epoch 192/500
```

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37/37 [=====] - 0s 5ms/step - loss: 0.0210 -  
mae: 19445.5586 - val_loss: 0.0223 - val_mae: 23391.2285  
Epoch 193/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0204 -  
mae: 19039.7617 - val_loss: 0.0208 - val_mae: 22981.8301  
Epoch 194/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0206 -  
mae: 19185.3125 - val_loss: 0.0227 - val_mae: 23404.7012  
Epoch 195/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0211 -  
mae: 19342.2949 - val_loss: 0.0264 - val_mae: 24520.7578  
Epoch 196/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0226 -  
mae: 20041.1738 - val_loss: 0.0208 - val_mae: 22924.8516  
Epoch 197/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0213 -  
mae: 19374.8184 - val_loss: 0.0213 - val_mae: 23294.4785  
Epoch 198/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0209 -  
mae: 19302.0020 - val_loss: 0.0254 - val_mae: 24210.5684  
Epoch 199/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0208 -  
mae: 19226.7988 - val_loss: 0.0211 - val_mae: 23033.2578  
Epoch 200/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0202 -  
mae: 19040.7266 - val_loss: 0.0213 - val_mae: 22978.7637  
Epoch 201/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0213 -  
mae: 19624.0488 - val_loss: 0.0246 - val_mae: 23956.4102  
Epoch 202/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0208 -  
mae: 19278.2617 - val_loss: 0.0230 - val_mae: 23529.0430  
Epoch 203/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0213 -  
mae: 19435.0723 - val_loss: 0.0205 - val_mae: 22765.5625  
Epoch 204/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0202 -  
mae: 19035.4863 - val_loss: 0.0208 - val_mae: 22750.9727  
Epoch 205/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0201 -  
mae: 18978.4961 - val_loss: 0.0204 - val_mae: 22841.2109  
Epoch 206/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0205 -  
mae: 19180.3496 - val_loss: 0.0206 - val_mae: 22683.1992  
Epoch 207/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0209 -  
mae: 19404.5723 - val_loss: 0.0215 - val_mae: 23028.7852  
Epoch 208/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0209 -
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mae: 19365.7402 - val_loss: 0.0214 - val_mae: 22910.0410
Epoch 209/500
37/37 [=====] - 0s 6ms/step - loss: 0.0211 -
mae: 19664.3086 - val_loss: 0.0208 - val_mae: 22773.2441
Epoch 210/500
37/37 [=====] - 0s 6ms/step - loss: 0.0216 -
mae: 19468.0000 - val_loss: 0.0204 - val_mae: 22869.4277
Epoch 211/500
37/37 [=====] - 0s 6ms/step - loss: 0.0199 -
mae: 18905.6016 - val_loss: 0.0206 - val_mae: 22755.1348
Epoch 212/500
37/37 [=====] - 0s 6ms/step - loss: 0.0201 -
mae: 18894.4727 - val_loss: 0.0202 - val_mae: 22546.6426
Epoch 213/500
37/37 [=====] - 0s 6ms/step - loss: 0.0201 -
mae: 18840.1953 - val_loss: 0.0207 - val_mae: 22635.9688
Epoch 214/500
37/37 [=====] - 0s 6ms/step - loss: 0.0208 -
mae: 19425.4648 - val_loss: 0.0209 - val_mae: 22760.8965
Epoch 215/500
37/37 [=====] - 0s 6ms/step - loss: 0.0207 -
mae: 19350.7734 - val_loss: 0.0235 - val_mae: 24347.0352
Epoch 216/500
37/37 [=====] - 0s 6ms/step - loss: 0.0211 -
mae: 19269.2168 - val_loss: 0.0212 - val_mae: 22791.0059
Epoch 217/500
37/37 [=====] - 0s 6ms/step - loss: 0.0211 -
mae: 19352.0820 - val_loss: 0.0202 - val_mae: 22681.6934
Epoch 218/500
37/37 [=====] - 0s 7ms/step - loss: 0.0207 -
mae: 19307.9863 - val_loss: 0.0206 - val_mae: 22648.1836
Epoch 219/500
37/37 [=====] - 0s 6ms/step - loss: 0.0207 -
mae: 19232.4902 - val_loss: 0.0212 - val_mae: 22743.7363
Epoch 220/500
37/37 [=====] - 0s 6ms/step - loss: 0.0204 -
mae: 19192.3105 - val_loss: 0.0204 - val_mae: 22555.6465
Epoch 221/500
37/37 [=====] - 0s 6ms/step - loss: 0.0202 -
mae: 18992.5918 - val_loss: 0.0206 - val_mae: 22574.7383
Epoch 222/500
37/37 [=====] - 0s 6ms/step - loss: 0.0198 -
mae: 18763.0664 - val_loss: 0.0203 - val_mae: 22436.4844
Epoch 223/500
37/37 [=====] - 0s 6ms/step - loss: 0.0197 -
mae: 18693.3164 - val_loss: 0.0204 - val_mae: 22434.5801
Epoch 224/500
37/37 [=====] - 0s 5ms/step - loss: 0.0198 -
mae: 18800.8047 - val_loss: 0.0207 - val_mae: 22859.4082
```

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Epoch 225/500
37/37 [=====] - 0s 5ms/step - loss: 0.0203 -
mae: 18989.9238 - val_loss: 0.0208 - val_mae: 22550.3262
Epoch 226/500
37/37 [=====] - 0s 5ms/step - loss: 0.0198 -
mae: 18718.7832 - val_loss: 0.0207 - val_mae: 22498.0488
Epoch 227/500
37/37 [=====] - 0s 6ms/step - loss: 0.0203 -
mae: 18858.4805 - val_loss: 0.0200 - val_mae: 22337.7910
Epoch 228/500
37/37 [=====] - 0s 6ms/step - loss: 0.0198 -
mae: 18659.7852 - val_loss: 0.0204 - val_mae: 22417.3125
Epoch 229/500
37/37 [=====] - 0s 6ms/step - loss: 0.0199 -
mae: 18859.7559 - val_loss: 0.0221 - val_mae: 23610.3672
Epoch 230/500
37/37 [=====] - 0s 6ms/step - loss: 0.0206 -
mae: 19091.4082 - val_loss: 0.0199 - val_mae: 22455.0898
Epoch 231/500
37/37 [=====] - 0s 6ms/step - loss: 0.0206 -
mae: 19065.3848 - val_loss: 0.0200 - val_mae: 22527.2188
Epoch 232/500
37/37 [=====] - 0s 6ms/step - loss: 0.0203 -
mae: 18885.9531 - val_loss: 0.0200 - val_mae: 22371.7422
Epoch 233/500
37/37 [=====] - 0s 6ms/step - loss: 0.0202 -
mae: 19070.5039 - val_loss: 0.0209 - val_mae: 22496.3887
Epoch 234/500
37/37 [=====] - 0s 5ms/step - loss: 0.0197 -
mae: 18572.5918 - val_loss: 0.0212 - val_mae: 22688.0859
Epoch 235/500
37/37 [=====] - 0s 6ms/step - loss: 0.0198 -
mae: 18676.1250 - val_loss: 0.0242 - val_mae: 23509.8262
Epoch 236/500
37/37 [=====] - 0s 6ms/step - loss: 0.0207 -
mae: 19143.1855 - val_loss: 0.0195 - val_mae: 22185.7188
Epoch 237/500
37/37 [=====] - 0s 6ms/step - loss: 0.0199 -
mae: 18779.7266 - val_loss: 0.0200 - val_mae: 22292.6348
Epoch 238/500
37/37 [=====] - 0s 6ms/step - loss: 0.0196 -
mae: 18607.2344 - val_loss: 0.0207 - val_mae: 22400.1914
Epoch 239/500
37/37 [=====] - 0s 6ms/step - loss: 0.0203 -
mae: 18899.7090 - val_loss: 0.0196 - val_mae: 22185.3828
Epoch 240/500
37/37 [=====] - 0s 6ms/step - loss: 0.0195 -
mae: 18545.0137 - val_loss: 0.0193 - val_mae: 22079.8770
Epoch 241/500
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37/37 [=====] - 0s 6ms/step - loss: 0.0206 -  
mae: 19093.8906 - val_loss: 0.0205 - val_mae: 22239.2344  
Epoch 242/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0198 -  
mae: 18591.7090 - val_loss: 0.0236 - val_mae: 23261.2969  
Epoch 243/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0211 -  
mae: 19183.8184 - val_loss: 0.0217 - val_mae: 22710.9785  
Epoch 244/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0199 -  
mae: 18695.9688 - val_loss: 0.0223 - val_mae: 22881.1426  
Epoch 245/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0198 -  
mae: 18658.8594 - val_loss: 0.0195 - val_mae: 22162.8125  
Epoch 246/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0202 -  
mae: 18867.7227 - val_loss: 0.0226 - val_mae: 22925.7891  
Epoch 247/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0197 -  
mae: 18614.1152 - val_loss: 0.0195 - val_mae: 22048.6016  
Epoch 248/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0193 -  
mae: 18506.1914 - val_loss: 0.0196 - val_mae: 22082.6543  
Epoch 249/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0198 -  
mae: 18765.2773 - val_loss: 0.0248 - val_mae: 23540.2363  
Epoch 250/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0202 -  
mae: 18896.8184 - val_loss: 0.0196 - val_mae: 22083.2891  
Epoch 251/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0195 -  
mae: 18558.1270 - val_loss: 0.0196 - val_mae: 22024.6465  
Epoch 252/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0195 -  
mae: 18468.8965 - val_loss: 0.0200 - val_mae: 22078.7031  
Epoch 253/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0195 -  
mae: 18587.2246 - val_loss: 0.0199 - val_mae: 22001.6270  
Epoch 254/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0192 -  
mae: 18382.6582 - val_loss: 0.0195 - val_mae: 21966.2578  
Epoch 255/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0194 -  
mae: 18405.6289 - val_loss: 0.0236 - val_mae: 23138.1621  
Epoch 256/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0203 -  
mae: 18748.1406 - val_loss: 0.0193 - val_mae: 21908.3379  
Epoch 257/500  
37/37 [=====] - 0s 7ms/step - loss: 0.0194 -
```

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mae: 18501.7207 - val_loss: 0.0294 - val_mae: 24873.8867
Epoch 258/500
37/37 [=====] - 0s 7ms/step - loss: 0.0201 -
mae: 18815.3828 - val_loss: 0.0193 - val_mae: 21982.4336
Epoch 259/500
37/37 [=====] - 0s 6ms/step - loss: 0.0196 -
mae: 18377.3398 - val_loss: 0.0194 - val_mae: 21936.1289
Epoch 260/500
37/37 [=====] - 0s 6ms/step - loss: 0.0197 -
mae: 18580.2012 - val_loss: 0.0192 - val_mae: 21859.8672
Epoch 261/500
37/37 [=====] - 0s 6ms/step - loss: 0.0193 -
mae: 18404.2793 - val_loss: 0.0191 - val_mae: 21935.9961
Epoch 262/500
37/37 [=====] - 0s 6ms/step - loss: 0.0200 -
mae: 18637.6953 - val_loss: 0.0189 - val_mae: 21836.1367
Epoch 263/500
37/37 [=====] - 0s 5ms/step - loss: 0.0197 -
mae: 18479.8281 - val_loss: 0.0223 - val_mae: 22716.6152
Epoch 264/500
37/37 [=====] - 0s 6ms/step - loss: 0.0199 -
mae: 18611.7422 - val_loss: 0.0198 - val_mae: 21972.8359
Epoch 265/500
37/37 [=====] - 0s 6ms/step - loss: 0.0193 -
mae: 18364.0801 - val_loss: 0.0202 - val_mae: 22133.1152
Epoch 266/500
37/37 [=====] - 0s 6ms/step - loss: 0.0194 -
mae: 18321.5117 - val_loss: 0.0201 - val_mae: 22043.3984
Epoch 267/500
37/37 [=====] - 0s 6ms/step - loss: 0.0193 -
mae: 18410.0938 - val_loss: 0.0190 - val_mae: 21820.1133
Epoch 268/500
37/37 [=====] - 0s 6ms/step - loss: 0.0195 -
mae: 18553.6055 - val_loss: 0.0190 - val_mae: 21865.1016
Epoch 269/500
37/37 [=====] - 0s 6ms/step - loss: 0.0224 -
mae: 19708.0176 - val_loss: 0.0202 - val_mae: 22614.9043
Epoch 270/500
37/37 [=====] - 0s 5ms/step - loss: 0.0205 -
mae: 19061.2148 - val_loss: 0.0191 - val_mae: 21913.6328
Epoch 271/500
37/37 [=====] - 0s 6ms/step - loss: 0.0189 -
mae: 18212.7969 - val_loss: 0.0192 - val_mae: 22062.5625
Epoch 272/500
37/37 [=====] - 0s 5ms/step - loss: 0.0194 -
mae: 18559.2793 - val_loss: 0.0201 - val_mae: 22069.3672
Epoch 273/500
37/37 [=====] - 0s 6ms/step - loss: 0.0191 -
mae: 18295.9941 - val_loss: 0.0230 - val_mae: 22809.6211
```

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Epoch 274/500
37/37 [=====] - 0s 5ms/step - loss: 0.0192 -
mae: 18295.2520 - val_loss: 0.0193 - val_mae: 21849.8164
Epoch 275/500
37/37 [=====] - 0s 5ms/step - loss: 0.0191 -
mae: 18232.7031 - val_loss: 0.0244 - val_mae: 23265.9453
Epoch 276/500
37/37 [=====] - 0s 6ms/step - loss: 0.0203 -
mae: 19102.9434 - val_loss: 0.0190 - val_mae: 21867.3672
Epoch 277/500
37/37 [=====] - 0s 6ms/step - loss: 0.0196 -
mae: 18265.1738 - val_loss: 0.0192 - val_mae: 21806.4082
Epoch 278/500
37/37 [=====] - 0s 6ms/step - loss: 0.0196 -
mae: 18550.9922 - val_loss: 0.0214 - val_mae: 22374.7754
Epoch 279/500
37/37 [=====] - 0s 5ms/step - loss: 0.0190 -
mae: 18315.4102 - val_loss: 0.0190 - val_mae: 21751.5938
Epoch 280/500
37/37 [=====] - 0s 6ms/step - loss: 0.0192 -
mae: 18245.5078 - val_loss: 0.0200 - val_mae: 21953.9648
Epoch 281/500
37/37 [=====] - 0s 5ms/step - loss: 0.0191 -
mae: 18218.0215 - val_loss: 0.0189 - val_mae: 21814.5488
Epoch 282/500
37/37 [=====] - 0s 6ms/step - loss: 0.0198 -
mae: 18537.8184 - val_loss: 0.0208 - val_mae: 22316.7207
Epoch 283/500
37/37 [=====] - 0s 6ms/step - loss: 0.0192 -
mae: 18139.4570 - val_loss: 0.0187 - val_mae: 21709.8066
Epoch 284/500
37/37 [=====] - 0s 6ms/step - loss: 0.0198 -
mae: 18739.6328 - val_loss: 0.0190 - val_mae: 21786.9336
Epoch 285/500
37/37 [=====] - 0s 5ms/step - loss: 0.0214 -
mae: 19439.7793 - val_loss: 0.0189 - val_mae: 21900.4219
Epoch 286/500
37/37 [=====] - 0s 5ms/step - loss: 0.0195 -
mae: 18637.1211 - val_loss: 0.0189 - val_mae: 21753.7188
Epoch 287/500
37/37 [=====] - 0s 6ms/step - loss: 0.0197 -
mae: 18405.4648 - val_loss: 0.0189 - val_mae: 21650.5273
Epoch 288/500
37/37 [=====] - 0s 6ms/step - loss: 0.0191 -
mae: 18271.0391 - val_loss: 0.0189 - val_mae: 21798.0723
Epoch 289/500
37/37 [=====] - 0s 6ms/step - loss: 0.0195 -
mae: 18563.2910 - val_loss: 0.0207 - val_mae: 22161.6680
Epoch 290/500
```

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37/37 [=====] - 0s 7ms/step - loss: 0.0189 -  
mae: 18104.0547 - val_loss: 0.0194 - val_mae: 22155.3262  
Epoch 291/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0191 -  
mae: 18278.7305 - val_loss: 0.0193 - val_mae: 21648.7266  
Epoch 292/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0188 -  
mae: 18146.0039 - val_loss: 0.0188 - val_mae: 21660.2090  
Epoch 293/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0199 -  
mae: 18650.1094 - val_loss: 0.0188 - val_mae: 21690.1035  
Epoch 294/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0192 -  
mae: 18381.6777 - val_loss: 0.0219 - val_mae: 22299.3945  
Epoch 295/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0200 -  
mae: 18753.1875 - val_loss: 0.0221 - val_mae: 22525.9414  
Epoch 296/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0209 -  
mae: 19158.2852 - val_loss: 0.0215 - val_mae: 22470.9941  
Epoch 297/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0193 -  
mae: 18303.9258 - val_loss: 0.0187 - val_mae: 21666.7148  
Epoch 298/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0195 -  
mae: 18528.0078 - val_loss: 0.0189 - val_mae: 21629.6973  
Epoch 299/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0194 -  
mae: 18414.0918 - val_loss: 0.0187 - val_mae: 21566.5742  
Epoch 300/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0189 -  
mae: 18241.7773 - val_loss: 0.0205 - val_mae: 22078.4551  
Epoch 301/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0188 -  
mae: 18088.4609 - val_loss: 0.0186 - val_mae: 21642.1465  
Epoch 302/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0199 -  
mae: 18753.1016 - val_loss: 0.0192 - val_mae: 21674.9863  
Epoch 303/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0195 -  
mae: 18491.3223 - val_loss: 0.0197 - val_mae: 21741.1738  
Epoch 304/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0200 -  
mae: 18600.5078 - val_loss: 0.0185 - val_mae: 21550.2285  
Epoch 305/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0192 -  
mae: 18177.1191 - val_loss: 0.0213 - val_mae: 22116.6875  
Epoch 306/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0188 -
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mae: 18128.8359 - val_loss: 0.0184 - val_mae: 21471.3633
Epoch 307/500
37/37 [=====] - 0s 6ms/step - loss: 0.0194 -
mae: 18399.3008 - val_loss: 0.0198 - val_mae: 21737.1230
Epoch 308/500
37/37 [=====] - 0s 6ms/step - loss: 0.0203 -
mae: 18885.5918 - val_loss: 0.0196 - val_mae: 21740.9668
Epoch 309/500
37/37 [=====] - 0s 5ms/step - loss: 0.0199 -
mae: 18573.2812 - val_loss: 0.0212 - val_mae: 22172.0254
Epoch 310/500
37/37 [=====] - 0s 5ms/step - loss: 0.0190 -
mae: 18280.8359 - val_loss: 0.0181 - val_mae: 21265.6934
Epoch 311/500
37/37 [=====] - 0s 6ms/step - loss: 0.0191 -
mae: 18152.9297 - val_loss: 0.0196 - val_mae: 21552.3457
Epoch 312/500
37/37 [=====] - 0s 6ms/step - loss: 0.0196 -
mae: 18443.0625 - val_loss: 0.0183 - val_mae: 21184.0430
Epoch 313/500
37/37 [=====] - 0s 5ms/step - loss: 0.0186 -
mae: 17923.3652 - val_loss: 0.0185 - val_mae: 21095.5176
Epoch 314/500
37/37 [=====] - 0s 6ms/step - loss: 0.0185 -
mae: 17773.2383 - val_loss: 0.0178 - val_mae: 20945.6855
Epoch 315/500
37/37 [=====] - 0s 5ms/step - loss: 0.0186 -
mae: 17702.7422 - val_loss: 0.0176 - val_mae: 20776.0078
Epoch 316/500
37/37 [=====] - 0s 6ms/step - loss: 0.0186 -
mae: 17655.5742 - val_loss: 0.0176 - val_mae: 20561.2832
Epoch 317/500
37/37 [=====] - 0s 6ms/step - loss: 0.0182 -
mae: 17391.5605 - val_loss: 0.0171 - val_mae: 20368.5254
Epoch 318/500
37/37 [=====] - 0s 6ms/step - loss: 0.0206 -
mae: 18779.2812 - val_loss: 0.0176 - val_mae: 20433.1816
Epoch 319/500
37/37 [=====] - 0s 6ms/step - loss: 0.0193 -
mae: 17878.8926 - val_loss: 0.0172 - val_mae: 20243.6094
Epoch 320/500
37/37 [=====] - 0s 6ms/step - loss: 0.0177 -
mae: 17233.1113 - val_loss: 0.0165 - val_mae: 19927.5898
Epoch 321/500
37/37 [=====] - 0s 5ms/step - loss: 0.0180 -
mae: 17291.0664 - val_loss: 0.0169 - val_mae: 19652.5527
Epoch 322/500
37/37 [=====] - 0s 5ms/step - loss: 0.0182 -
mae: 17303.1465 - val_loss: 0.0163 - val_mae: 19731.0898
```

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Epoch 323/500
37/37 [=====] - 0s 5ms/step - loss: 0.0181 -
mae: 17176.8047 - val_loss: 0.0166 - val_mae: 19268.3438
Epoch 324/500
37/37 [=====] - 0s 6ms/step - loss: 0.0174 -
mae: 16775.0801 - val_loss: 0.0160 - val_mae: 19155.9336
Epoch 325/500
37/37 [=====] - 0s 6ms/step - loss: 0.0176 -
mae: 16818.2637 - val_loss: 0.0169 - val_mae: 19101.6719
Epoch 326/500
37/37 [=====] - 0s 6ms/step - loss: 0.0174 -
mae: 16682.7109 - val_loss: 0.0171 - val_mae: 19745.2695
Epoch 327/500
37/37 [=====] - 0s 6ms/step - loss: 0.0176 -
mae: 16829.7480 - val_loss: 0.0174 - val_mae: 19078.2188
Epoch 328/500
37/37 [=====] - 0s 6ms/step - loss: 0.0176 -
mae: 16936.8633 - val_loss: 0.0156 - val_mae: 18575.8672
Epoch 329/500
37/37 [=====] - 0s 6ms/step - loss: 0.0170 -
mae: 16521.3066 - val_loss: 0.0181 - val_mae: 19234.4648
Epoch 330/500
37/37 [=====] - 0s 6ms/step - loss: 0.0173 -
mae: 16731.4160 - val_loss: 0.0151 - val_mae: 18438.7285
Epoch 331/500
37/37 [=====] - 0s 5ms/step - loss: 0.0177 -
mae: 16887.3613 - val_loss: 0.0152 - val_mae: 18480.2559
Epoch 332/500
37/37 [=====] - 0s 5ms/step - loss: 0.0171 -
mae: 16562.6738 - val_loss: 0.0151 - val_mae: 18320.8047
Epoch 333/500
37/37 [=====] - 0s 6ms/step - loss: 0.0182 -
mae: 16921.1602 - val_loss: 0.0154 - val_mae: 18412.4512
Epoch 334/500
37/37 [=====] - 0s 6ms/step - loss: 0.0176 -
mae: 16904.3691 - val_loss: 0.0151 - val_mae: 18143.8711
Epoch 335/500
37/37 [=====] - 0s 5ms/step - loss: 0.0167 -
mae: 16238.6982 - val_loss: 0.0148 - val_mae: 17916.1816
Epoch 336/500
37/37 [=====] - 0s 5ms/step - loss: 0.0167 -
mae: 16241.1494 - val_loss: 0.0148 - val_mae: 17779.5039
Epoch 337/500
37/37 [=====] - 0s 6ms/step - loss: 0.0170 -
mae: 16339.6904 - val_loss: 0.0195 - val_mae: 20257.0059
Epoch 338/500
37/37 [=====] - 0s 6ms/step - loss: 0.0177 -
mae: 16866.1328 - val_loss: 0.0151 - val_mae: 18087.9258
Epoch 339/500
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37/37 [=====] - 0s 5ms/step - loss: 0.0171 -  
mae: 16261.9346 - val_loss: 0.0149 - val_mae: 17798.7188  
Epoch 340/500  
37/37 [=====] - 0s 7ms/step - loss: 0.0168 -  
mae: 16374.5586 - val_loss: 0.0154 - val_mae: 17950.9512  
Epoch 341/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0173 -  
mae: 16615.3145 - val_loss: 0.0232 - val_mae: 20954.1328  
Epoch 342/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0171 -  
mae: 16696.9648 - val_loss: 0.0160 - val_mae: 19176.4609  
Epoch 343/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0172 -  
mae: 16623.3555 - val_loss: 0.0157 - val_mae: 18159.0859  
Epoch 344/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0168 -  
mae: 16239.6768 - val_loss: 0.0178 - val_mae: 19021.3828  
Epoch 345/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0172 -  
mae: 16471.1113 - val_loss: 0.0157 - val_mae: 17997.9375  
Epoch 346/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0168 -  
mae: 16266.9619 - val_loss: 0.0167 - val_mae: 19671.5332  
Epoch 347/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0174 -  
mae: 16552.6250 - val_loss: 0.0155 - val_mae: 17911.9512  
Epoch 348/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0166 -  
mae: 16035.5342 - val_loss: 0.0150 - val_mae: 18433.1230  
Epoch 349/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0169 -  
mae: 16038.8682 - val_loss: 0.0159 - val_mae: 18028.3750  
Epoch 350/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0163 -  
mae: 16007.2881 - val_loss: 0.0168 - val_mae: 18385.9961  
Epoch 351/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0172 -  
mae: 16277.6318 - val_loss: 0.0184 - val_mae: 18936.7812  
Epoch 352/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0164 -  
mae: 16024.6885 - val_loss: 0.0147 - val_mae: 17708.7949  
Epoch 353/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0163 -  
mae: 15961.2998 - val_loss: 0.0148 - val_mae: 18007.7734  
Epoch 354/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0161 -  
mae: 15892.6523 - val_loss: 0.0151 - val_mae: 18394.2285  
Epoch 355/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0166 -  
mae: 16059.1797 - val_loss: 0.0171 - val_mae: 18881.9238
```

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Epoch 356/500
37/37 [=====] - 0s 6ms/step - loss: 0.0166 -
mae: 16063.2119 - val_loss: 0.0168 - val_mae: 19964.2168
Epoch 357/500
37/37 [=====] - 0s 5ms/step - loss: 0.0166 -
mae: 16116.3369 - val_loss: 0.0150 - val_mae: 17795.7500
Epoch 358/500
37/37 [=====] - 0s 6ms/step - loss: 0.0166 -
mae: 16136.3018 - val_loss: 0.0154 - val_mae: 18096.6328
Epoch 359/500
37/37 [=====] - 0s 6ms/step - loss: 0.0165 -
mae: 16005.8232 - val_loss: 0.0146 - val_mae: 17727.2559
Epoch 360/500
37/37 [=====] - 0s 6ms/step - loss: 0.0166 -
mae: 16083.6426 - val_loss: 0.0164 - val_mae: 18449.2480
Epoch 361/500
37/37 [=====] - 0s 6ms/step - loss: 0.0166 -
mae: 16312.1270 - val_loss: 0.0149 - val_mae: 18116.0176
Epoch 362/500
37/37 [=====] - 0s 6ms/step - loss: 0.0164 -
mae: 16096.5273 - val_loss: 0.0156 - val_mae: 18787.4688
Epoch 363/500
37/37 [=====] - 0s 6ms/step - loss: 0.0177 -
mae: 16869.2051 - val_loss: 0.0156 - val_mae: 18063.4375
Epoch 364/500
37/37 [=====] - 0s 5ms/step - loss: 0.0163 -
mae: 15932.8340 - val_loss: 0.0147 - val_mae: 17848.3301
Epoch 365/500
37/37 [=====] - 0s 6ms/step - loss: 0.0165 -
mae: 16140.8066 - val_loss: 0.0154 - val_mae: 18410.4258
Epoch 366/500
37/37 [=====] - 0s 6ms/step - loss: 0.0170 -
mae: 16373.4316 - val_loss: 0.0145 - val_mae: 17763.7676
Epoch 367/500
37/37 [=====] - 0s 6ms/step - loss: 0.0161 -
mae: 15961.1094 - val_loss: 0.0148 - val_mae: 17784.4883
Epoch 368/500
37/37 [=====] - 0s 6ms/step - loss: 0.0161 -
mae: 15761.5117 - val_loss: 0.0147 - val_mae: 17753.9160
Epoch 369/500
37/37 [=====] - 0s 6ms/step - loss: 0.0157 -
mae: 15558.8730 - val_loss: 0.0145 - val_mae: 17766.4883
Epoch 370/500
37/37 [=====] - 0s 6ms/step - loss: 0.0158 -
mae: 15601.4473 - val_loss: 0.0147 - val_mae: 17823.4102
Epoch 371/500
37/37 [=====] - 0s 6ms/step - loss: 0.0156 -
mae: 15679.2725 - val_loss: 0.0161 - val_mae: 18215.7227
Epoch 372/500
```

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37/37 [=====] - 0s 6ms/step - loss: 0.0165 -  
mae: 16345.7412 - val_loss: 0.0152 - val_mae: 17832.3594  
Epoch 373/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0165 -  
mae: 16199.9072 - val_loss: 0.0147 - val_mae: 18228.4336  
Epoch 374/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0158 -  
mae: 15937.4004 - val_loss: 0.0161 - val_mae: 18298.5469  
Epoch 375/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0161 -  
mae: 15751.7607 - val_loss: 0.0157 - val_mae: 18536.3203  
Epoch 376/500  
37/37 [=====] - 0s 7ms/step - loss: 0.0156 -  
mae: 15633.3164 - val_loss: 0.0146 - val_mae: 18279.0938  
Epoch 377/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0154 -  
mae: 15468.6592 - val_loss: 0.0149 - val_mae: 18063.1465  
Epoch 378/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0167 -  
mae: 16261.1113 - val_loss: 0.0146 - val_mae: 17783.2051  
Epoch 379/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0153 -  
mae: 15460.6289 - val_loss: 0.0147 - val_mae: 17773.2578  
Epoch 380/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0152 -  
mae: 15361.7861 - val_loss: 0.0146 - val_mae: 18464.0215  
Epoch 381/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0153 -  
mae: 15539.8301 - val_loss: 0.0143 - val_mae: 17575.2324  
Epoch 382/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0152 -  
mae: 15355.8711 - val_loss: 0.0144 - val_mae: 17763.8027  
Epoch 383/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0153 -  
mae: 15425.5000 - val_loss: 0.0149 - val_mae: 17647.8652  
Epoch 384/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0150 -  
mae: 15275.6074 - val_loss: 0.0143 - val_mae: 17851.2559  
Epoch 385/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0149 -  
mae: 15367.4844 - val_loss: 0.0150 - val_mae: 18277.4609  
Epoch 386/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0152 -  
mae: 15494.7705 - val_loss: 0.0143 - val_mae: 17579.1895  
Epoch 387/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0151 -  
mae: 15431.0547 - val_loss: 0.0145 - val_mae: 17759.2734  
Epoch 388/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0154 -
```

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mae: 15669.3730 - val_loss: 0.0152 - val_mae: 18496.6465
Epoch 389/500
37/37 [=====] - 0s 6ms/step - loss: 0.0153 -
mae: 15485.6406 - val_loss: 0.0157 - val_mae: 18433.2285
Epoch 390/500
37/37 [=====] - 0s 6ms/step - loss: 0.0148 -
mae: 15203.5723 - val_loss: 0.0142 - val_mae: 18116.1172
Epoch 391/500
37/37 [=====] - 0s 6ms/step - loss: 0.0150 -
mae: 15292.2520 - val_loss: 0.0159 - val_mae: 18351.5996
Epoch 392/500
37/37 [=====] - 0s 6ms/step - loss: 0.0150 -
mae: 15434.7607 - val_loss: 0.0147 - val_mae: 17841.6953
Epoch 393/500
37/37 [=====] - 0s 6ms/step - loss: 0.0167 -
mae: 16528.1816 - val_loss: 0.0147 - val_mae: 18867.0254
Epoch 394/500
37/37 [=====] - 0s 5ms/step - loss: 0.0147 -
mae: 15201.6143 - val_loss: 0.0150 - val_mae: 18353.5488
Epoch 395/500
37/37 [=====] - 0s 5ms/step - loss: 0.0147 -
mae: 15343.0840 - val_loss: 0.0142 - val_mae: 18082.3184
Epoch 396/500
37/37 [=====] - 0s 6ms/step - loss: 0.0147 -
mae: 15258.3613 - val_loss: 0.0146 - val_mae: 17746.7578
Epoch 397/500
37/37 [=====] - 0s 5ms/step - loss: 0.0151 -
mae: 15568.4023 - val_loss: 0.0142 - val_mae: 18196.2480
Epoch 398/500
37/37 [=====] - 0s 6ms/step - loss: 0.0153 -
mae: 15947.4795 - val_loss: 0.0141 - val_mae: 17996.4512
Epoch 399/500
37/37 [=====] - 0s 5ms/step - loss: 0.0142 -
mae: 15207.8086 - val_loss: 0.0140 - val_mae: 17863.7012
Epoch 400/500
37/37 [=====] - 0s 5ms/step - loss: 0.0143 -
mae: 15088.9414 - val_loss: 0.0143 - val_mae: 17869.1250
Epoch 401/500
37/37 [=====] - 0s 5ms/step - loss: 0.0143 -
mae: 15103.4678 - val_loss: 0.0150 - val_mae: 17841.6035
Epoch 402/500
37/37 [=====] - 0s 6ms/step - loss: 0.0141 -
mae: 15013.3594 - val_loss: 0.0145 - val_mae: 18588.5645
Epoch 403/500
37/37 [=====] - 0s 5ms/step - loss: 0.0149 -
mae: 15704.6797 - val_loss: 0.0152 - val_mae: 18114.8828
Epoch 404/500
37/37 [=====] - 0s 6ms/step - loss: 0.0141 -
mae: 15060.3936 - val_loss: 0.0144 - val_mae: 17672.4785
```

```
Epoch 405/500
37/37 [=====] - 0s 6ms/step - loss: 0.0145 -
mae: 15463.0869 - val_loss: 0.0149 - val_mae: 18978.0449
Epoch 406/500
37/37 [=====] - 0s 5ms/step - loss: 0.0139 -
mae: 15176.3525 - val_loss: 0.0138 - val_mae: 17755.4980
Epoch 407/500
37/37 [=====] - 0s 6ms/step - loss: 0.0138 -
mae: 14945.0869 - val_loss: 0.0147 - val_mae: 17998.1562
Epoch 408/500
37/37 [=====] - 0s 5ms/step - loss: 0.0139 -
mae: 15011.1094 - val_loss: 0.0140 - val_mae: 17671.2871
Epoch 409/500
37/37 [=====] - 0s 5ms/step - loss: 0.0156 -
mae: 16079.1025 - val_loss: 0.0137 - val_mae: 17508.8398
Epoch 410/500
37/37 [=====] - 0s 6ms/step - loss: 0.0140 -
mae: 15285.9883 - val_loss: 0.0139 - val_mae: 17487.5938
Epoch 411/500
37/37 [=====] - 0s 5ms/step - loss: 0.0139 -
mae: 14996.0156 - val_loss: 0.0141 - val_mae: 18231.3555
Epoch 412/500
37/37 [=====] - 0s 6ms/step - loss: 0.0139 -
mae: 15136.4863 - val_loss: 0.0141 - val_mae: 17773.0527
Epoch 413/500
37/37 [=====] - 0s 6ms/step - loss: 0.0137 -
mae: 15095.9404 - val_loss: 0.0146 - val_mae: 18412.0508
Epoch 414/500
37/37 [=====] - 0s 6ms/step - loss: 0.0139 -
mae: 15186.8867 - val_loss: 0.0145 - val_mae: 17932.1934
Epoch 415/500
37/37 [=====] - 0s 6ms/step - loss: 0.0135 -
mae: 14971.4912 - val_loss: 0.0161 - val_mae: 18557.9082
Epoch 416/500
37/37 [=====] - 0s 5ms/step - loss: 0.0142 -
mae: 15437.0957 - val_loss: 0.0137 - val_mae: 17646.3477
Epoch 417/500
37/37 [=====] - 0s 6ms/step - loss: 0.0129 -
mae: 14676.5684 - val_loss: 0.0154 - val_mae: 18235.4590
Epoch 418/500
37/37 [=====] - 0s 5ms/step - loss: 0.0131 -
mae: 14829.6201 - val_loss: 0.0163 - val_mae: 18623.3008
Epoch 419/500
37/37 [=====] - 0s 6ms/step - loss: 0.0133 -
mae: 14855.3633 - val_loss: 0.0133 - val_mae: 17344.2891
Epoch 420/500
37/37 [=====] - 0s 5ms/step - loss: 0.0130 -
mae: 14793.4844 - val_loss: 0.0144 - val_mae: 18201.8477
Epoch 421/500
```

```
37/37 [=====] - 0s 7ms/step - loss: 0.0130 -  
mae: 14634.3975 - val_loss: 0.0142 - val_mae: 17727.9473  
Epoch 422/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0135 -  
mae: 14764.3203 - val_loss: 0.0150 - val_mae: 17949.5273  
Epoch 423/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0127 -  
mae: 14551.3857 - val_loss: 0.0140 - val_mae: 18096.2422  
Epoch 424/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0126 -  
mae: 14334.3135 - val_loss: 0.0135 - val_mae: 17197.0703  
Epoch 425/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0128 -  
mae: 14539.6475 - val_loss: 0.0137 - val_mae: 17458.2383  
Epoch 426/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0132 -  
mae: 15018.7881 - val_loss: 0.0145 - val_mae: 18332.9668  
Epoch 427/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0128 -  
mae: 14575.4814 - val_loss: 0.0136 - val_mae: 17731.7422  
Epoch 428/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0137 -  
mae: 15025.7705 - val_loss: 0.0140 - val_mae: 17546.3633  
Epoch 429/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0133 -  
mae: 14873.8477 - val_loss: 0.0137 - val_mae: 17392.9492  
Epoch 430/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0126 -  
mae: 14492.7178 - val_loss: 0.0136 - val_mae: 17270.0977  
Epoch 431/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0124 -  
mae: 14246.5410 - val_loss: 0.0129 - val_mae: 16788.8613  
Epoch 432/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0125 -  
mae: 14538.8301 - val_loss: 0.0139 - val_mae: 17383.3066  
Epoch 433/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0138 -  
mae: 15192.9551 - val_loss: 0.0137 - val_mae: 17143.6367  
Epoch 434/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0127 -  
mae: 14580.3838 - val_loss: 0.0132 - val_mae: 16956.9824  
Epoch 435/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0122 -  
mae: 14180.7695 - val_loss: 0.0130 - val_mae: 16912.6406  
Epoch 436/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0125 -  
mae: 14313.8838 - val_loss: 0.0132 - val_mae: 17447.3906  
Epoch 437/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0122 -
```

```
mae: 14227.4062 - val_loss: 0.0132 - val_mae: 16922.2754
Epoch 438/500
37/37 [=====] - 0s 6ms/step - loss: 0.0123 -
mae: 14235.7031 - val_loss: 0.0139 - val_mae: 18234.8203
Epoch 439/500
37/37 [=====] - 0s 5ms/step - loss: 0.0126 -
mae: 14580.3115 - val_loss: 0.0131 - val_mae: 17328.8965
Epoch 440/500
37/37 [=====] - 0s 5ms/step - loss: 0.0127 -
mae: 14616.4756 - val_loss: 0.0132 - val_mae: 16798.0762
Epoch 441/500
37/37 [=====] - 0s 5ms/step - loss: 0.0121 -
mae: 14043.1074 - val_loss: 0.0132 - val_mae: 16890.5742
Epoch 442/500
37/37 [=====] - 0s 5ms/step - loss: 0.0127 -
mae: 14592.5771 - val_loss: 0.0148 - val_mae: 17499.1699
Epoch 443/500
37/37 [=====] - 0s 5ms/step - loss: 0.0120 -
mae: 14028.4580 - val_loss: 0.0127 - val_mae: 16693.8750
Epoch 444/500
37/37 [=====] - 0s 5ms/step - loss: 0.0122 -
mae: 14139.4893 - val_loss: 0.0134 - val_mae: 17831.6094
Epoch 445/500
37/37 [=====] - 0s 6ms/step - loss: 0.0126 -
mae: 14511.5664 - val_loss: 0.0129 - val_mae: 16939.9746
Epoch 446/500
37/37 [=====] - 0s 6ms/step - loss: 0.0120 -
mae: 13924.7832 - val_loss: 0.0126 - val_mae: 16410.0469
Epoch 447/500
37/37 [=====] - 0s 5ms/step - loss: 0.0127 -
mae: 14412.5186 - val_loss: 0.0142 - val_mae: 17460.0645
Epoch 448/500
37/37 [=====] - 0s 5ms/step - loss: 0.0126 -
mae: 14410.6133 - val_loss: 0.0127 - val_mae: 16496.0586
Epoch 449/500
37/37 [=====] - 0s 5ms/step - loss: 0.0129 -
mae: 14746.5518 - val_loss: 0.0140 - val_mae: 17250.7949
Epoch 450/500
37/37 [=====] - 0s 6ms/step - loss: 0.0123 -
mae: 14177.3203 - val_loss: 0.0126 - val_mae: 16483.8262
Epoch 451/500
37/37 [=====] - 0s 5ms/step - loss: 0.0121 -
mae: 14125.2031 - val_loss: 0.0128 - val_mae: 16481.8535
Epoch 452/500
37/37 [=====] - 0s 5ms/step - loss: 0.0121 -
mae: 14233.6562 - val_loss: 0.0136 - val_mae: 17446.3984
Epoch 453/500
37/37 [=====] - 0s 5ms/step - loss: 0.0125 -
mae: 14325.8701 - val_loss: 0.0136 - val_mae: 16877.3926
```

```
Epoch 454/500
37/37 [=====] - 0s 6ms/step - loss: 0.0125 -
mae: 14295.5381 - val_loss: 0.0127 - val_mae: 16404.0488
Epoch 455/500
37/37 [=====] - 0s 6ms/step - loss: 0.0119 -
mae: 13920.1768 - val_loss: 0.0145 - val_mae: 17273.2676
Epoch 456/500
37/37 [=====] - 0s 6ms/step - loss: 0.0122 -
mae: 14092.0938 - val_loss: 0.0125 - val_mae: 16480.7949
Epoch 457/500
37/37 [=====] - 0s 6ms/step - loss: 0.0117 -
mae: 13753.2168 - val_loss: 0.0127 - val_mae: 16477.2617
Epoch 458/500
37/37 [=====] - 0s 5ms/step - loss: 0.0120 -
mae: 13980.9775 - val_loss: 0.0126 - val_mae: 16821.8438
Epoch 459/500
37/37 [=====] - 0s 6ms/step - loss: 0.0119 -
mae: 14028.0664 - val_loss: 0.0125 - val_mae: 16356.0889
Epoch 460/500
37/37 [=====] - 0s 6ms/step - loss: 0.0117 -
mae: 13761.3516 - val_loss: 0.0123 - val_mae: 16096.2500
Epoch 461/500
37/37 [=====] - 0s 6ms/step - loss: 0.0122 -
mae: 13883.3125 - val_loss: 0.0139 - val_mae: 17431.4531
Epoch 462/500
37/37 [=====] - 0s 6ms/step - loss: 0.0120 -
mae: 13718.0020 - val_loss: 0.0139 - val_mae: 17764.2168
Epoch 463/500
37/37 [=====] - 0s 6ms/step - loss: 0.0120 -
mae: 13873.8750 - val_loss: 0.0140 - val_mae: 17887.8984
Epoch 464/500
37/37 [=====] - 0s 6ms/step - loss: 0.0123 -
mae: 14224.9521 - val_loss: 0.0125 - val_mae: 16249.7383
Epoch 465/500
37/37 [=====] - 0s 6ms/step - loss: 0.0119 -
mae: 13806.1250 - val_loss: 0.0122 - val_mae: 16208.1338
Epoch 466/500
37/37 [=====] - 0s 6ms/step - loss: 0.0125 -
mae: 14294.9902 - val_loss: 0.0131 - val_mae: 17059.7578
Epoch 467/500
37/37 [=====] - 0s 6ms/step - loss: 0.0123 -
mae: 14256.8857 - val_loss: 0.0130 - val_mae: 17061.0000
Epoch 468/500
37/37 [=====] - 0s 6ms/step - loss: 0.0119 -
mae: 13885.3652 - val_loss: 0.0128 - val_mae: 17055.2285
Epoch 469/500
37/37 [=====] - 0s 6ms/step - loss: 0.0118 -
mae: 13942.1494 - val_loss: 0.0126 - val_mae: 16430.6328
Epoch 470/500
```

```
37/37 [=====] - 0s 6ms/step - loss: 0.0124 -  
mae: 14328.6729 - val_loss: 0.0124 - val_mae: 16364.0117  
Epoch 471/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0118 -  
mae: 13952.3760 - val_loss: 0.0149 - val_mae: 17659.2637  
Epoch 472/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0125 -  
mae: 14312.4365 - val_loss: 0.0127 - val_mae: 16398.2324  
Epoch 473/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0118 -  
mae: 13858.2275 - val_loss: 0.0127 - val_mae: 16732.9844  
Epoch 474/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0117 -  
mae: 13683.0908 - val_loss: 0.0123 - val_mae: 16129.7881  
Epoch 475/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0115 -  
mae: 13589.7637 - val_loss: 0.0126 - val_mae: 16498.5957  
Epoch 476/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0116 -  
mae: 13770.4688 - val_loss: 0.0128 - val_mae: 16385.7852  
Epoch 477/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0115 -  
mae: 13636.8906 - val_loss: 0.0124 - val_mae: 16290.8711  
Epoch 478/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0122 -  
mae: 14061.5957 - val_loss: 0.0137 - val_mae: 18010.5195  
Epoch 479/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0120 -  
mae: 13993.2432 - val_loss: 0.0131 - val_mae: 16534.9062  
Epoch 480/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0124 -  
mae: 14355.5596 - val_loss: 0.0125 - val_mae: 16478.5098  
Epoch 481/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0118 -  
mae: 13868.9062 - val_loss: 0.0123 - val_mae: 16165.5049  
Epoch 482/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0124 -  
mae: 14266.0771 - val_loss: 0.0124 - val_mae: 16339.9473  
Epoch 483/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0116 -  
mae: 13452.6924 - val_loss: 0.0149 - val_mae: 17354.3477  
Epoch 484/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0117 -  
mae: 13665.9424 - val_loss: 0.0123 - val_mae: 16118.8975  
Epoch 485/500  
37/37 [=====] - 0s 5ms/step - loss: 0.0114 -  
mae: 13461.2266 - val_loss: 0.0131 - val_mae: 16836.9863  
Epoch 486/500  
37/37 [=====] - 0s 6ms/step - loss: 0.0119 -
```

```
mae: 13898.9180 - val_loss: 0.0128 - val_mae: 16808.4414
Epoch 487/500
37/37 [=====] - 0s 6ms/step - loss: 0.0115 -
mae: 13554.2969 - val_loss: 0.0123 - val_mae: 16102.8252
Epoch 488/500
37/37 [=====] - 0s 6ms/step - loss: 0.0114 -
mae: 13440.6279 - val_loss: 0.0124 - val_mae: 16058.9482
Epoch 489/500
37/37 [=====] - 0s 5ms/step - loss: 0.0121 -
mae: 14019.8574 - val_loss: 0.0123 - val_mae: 16009.7021
Epoch 490/500
37/37 [=====] - 0s 5ms/step - loss: 0.0119 -
mae: 13818.0820 - val_loss: 0.0127 - val_mae: 16337.0225
Epoch 491/500
37/37 [=====] - 0s 5ms/step - loss: 0.0120 -
mae: 13879.4365 - val_loss: 0.0135 - val_mae: 16901.1211
Epoch 492/500
37/37 [=====] - 0s 6ms/step - loss: 0.0119 -
mae: 13722.5957 - val_loss: 0.0127 - val_mae: 16189.7295
Epoch 493/500
37/37 [=====] - 0s 6ms/step - loss: 0.0123 -
mae: 14245.2812 - val_loss: 0.0125 - val_mae: 16134.4131
Epoch 494/500
37/37 [=====] - 0s 5ms/step - loss: 0.0115 -
mae: 13384.8926 - val_loss: 0.0126 - val_mae: 16712.0703
Epoch 495/500
37/37 [=====] - 0s 5ms/step - loss: 0.0116 -
mae: 13634.7324 - val_loss: 0.0126 - val_mae: 16582.3477
Epoch 496/500
37/37 [=====] - 0s 6ms/step - loss: 0.0116 -
mae: 13524.4268 - val_loss: 0.0128 - val_mae: 16331.7207
Epoch 497/500
37/37 [=====] - 0s 5ms/step - loss: 0.0121 -
mae: 13889.9336 - val_loss: 0.0148 - val_mae: 19088.3281
Epoch 498/500
37/37 [=====] - 0s 5ms/step - loss: 0.0115 -
mae: 13502.4824 - val_loss: 0.0134 - val_mae: 16567.8301
Epoch 499/500
37/37 [=====] - 0s 5ms/step - loss: 0.0117 -
mae: 13862.3916 - val_loss: 0.0129 - val_mae: 17063.9297
Epoch 500/500
37/37 [=====] - 0s 6ms/step - loss: 0.0115 -
mae: 13483.9756 - val_loss: 0.0123 - val_mae: 16102.0186
```

Результаты на уровне лучших, что неплохо! Вообще функции потерь напрямую влияют на качество модели, так как именно её оптимизатор и старается минимизировать. В целом оптимизировать квадратичные функции всегда приятно, так как мы знаем "близость" к "яме" с минимумом.

## Прогнозирование

Остановимся на последней модели, так как она показала одни из лучших результатов, и сделаем по ней предсказание:

```
preds = model.predict(test_edited)

output = pd.DataFrame(
{
    'Id':test_data['Id'],
    'SalePrice': np.squeeze(preds)
})
output

46/46 [=====] - 0s 1ms/step

      Id      SalePrice
0    1461  111709.000000
1    1462  169595.703125
2    1463  179710.671875
3    1464  186677.718750
4    1465  172030.218750
...
1454  2915  71423.609375
1455  2916  56164.265625
1456  2917  176539.296875
1457  2918  118950.468750
1458  2919  238842.437500

[1459 rows x 2 columns]
```

На этом всё, спасибо!