NeuralNet

November 10, 2024

[156]:
```
try:
    import os
    import glob
    import numpy as np
    import pandas as pd

    # Importing libraries for data visualization
    import seaborn as sns
    import matplotlib.pyplot as plt

    # Creating a model
    from tensorflow.keras.models import Sequential
    from tensorflow.keras.layers import Dense, Activation

    # Importing libraries for evaluation
    from sklearn.preprocessing import MinMaxScaler, OneHotEncoder
    from sklearn.model_selection import train_test_split
    from sklearn.metrics import␣
 ↪mean_squared_error,mean_absolute_error,explained_variance_score
    from sklearn.metrics import classification_report,confusion_matrix

except Exception as e:
    print(f"Error : {e}")
```

[157]:
```
# Find the CSV file in the Datasets directory
data_path = '../Datasets/*.csv'
file_list = glob.glob(data_path)

for file in file_list:
    print(f"Found file: {file}")

# Ensure there is exactly one file
if len(file_list) == 1:
    # Load the dataset
    df = pd.read_csv(file_list[0])
    print(f"Loaded dataset: {file_list[0]}")
else:
```

```
    raise FileNotFoundError("No CSV file found or multiple CSV files found in␣
 ↪the Datasets directory.")
```

```
Found file: ../Datasets/Dataset.csv
Loaded dataset: ../Datasets/Dataset.csv
```

[158]:
```
# File path to save the trained model
destination = '../Models/'
os.makedirs(destination, exist_ok=True)
print(f"Model will be saved to: {destination}")
```

```
Model will be saved to: ../Models/
```

[159]:
```
categorical_cols_unified = ['partType', 'microstructure', 'seedLocation',␣
 ↪'castType']

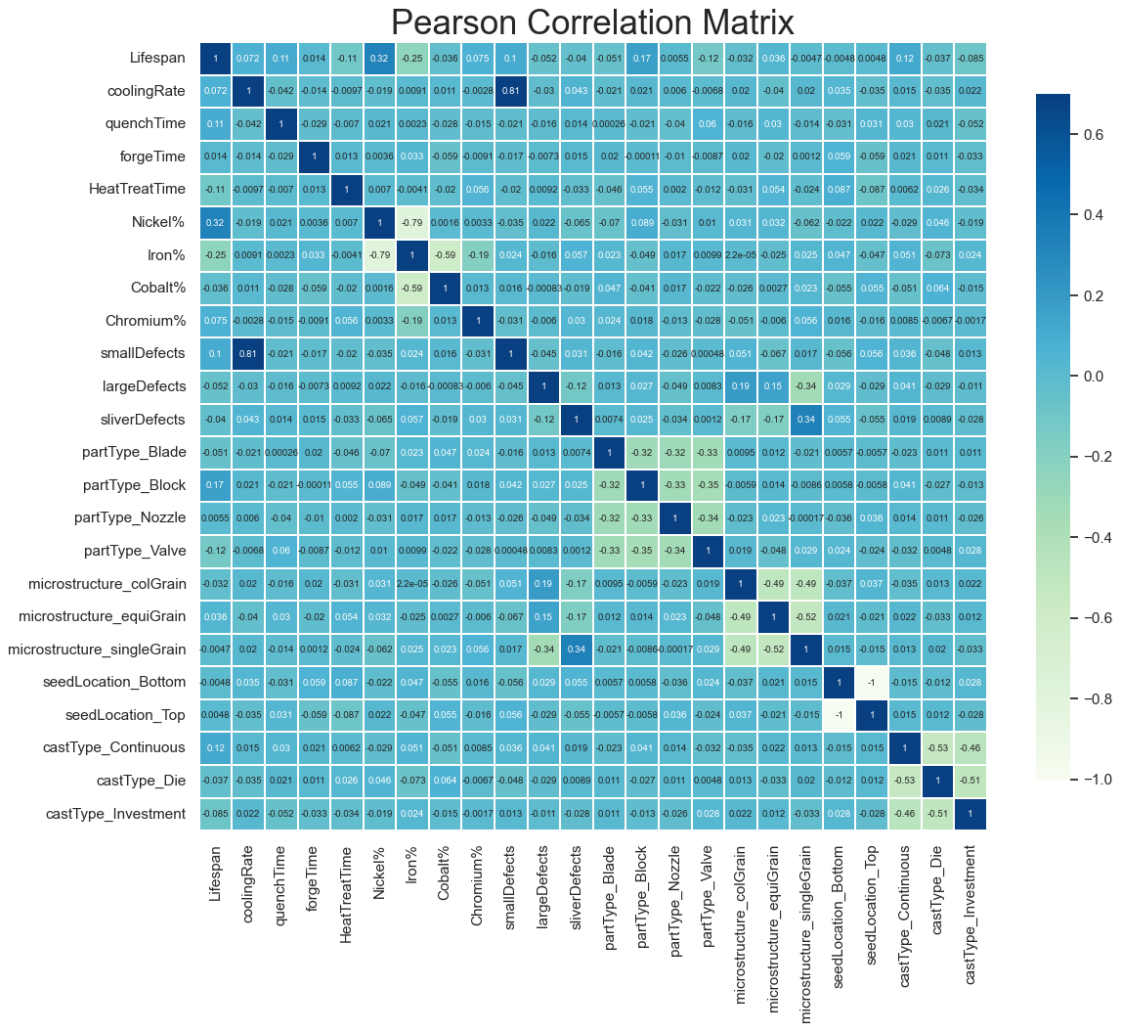
# Initialize and fit the encoder
encoder = OneHotEncoder(sparse_output=False, drop=None)
# Reshape the data to handle multiple categorical columns
encoded_data = encoder.fit_transform(df[categorical_cols_unified].values)

# Convert to DataFrame with feature names
encoded_df = pd.DataFrame(
    encoded_data,
    columns=encoder.get_feature_names_out(categorical_cols_unified)
)

# Combine with non-categorical columns if needed
df = pd.concat([df.drop(columns=categorical_cols_unified), encoded_df], axis=1)
```

[160]:
```
sns.set(style="whitegrid", font_scale=1)

plt.figure(figsize=(13,13))
plt.title('Pearson Correlation Matrix',fontsize=25)
sns.heatmap(df.corr(),linewidths=0.25,vmax=0.
 ↪7,square=True,cmap="GnBu",linecolor='w',
            annot=True, annot_kws={"size":7}, cbar_kws={"shrink": .7})
plt.show()
```



[161]:
```
# Features
X = df.drop('Lifespan',axis=1)

# Target
y = df['Lifespan']

# Split
X_train, X_test, y_train, y_test = train_test_split(X,y,test_size=0.
↪3,random_state=101)
```

[162]:
```
print(X_train.shape)
print(X_test.shape)
print(y_train.shape)
print(y_test.shape)
```

```
(700, 23)
```

```
(300, 23)
(700,)
(300,)
```

[ ]:
```
# Create the scaler
scaler = MinMaxScaler()

# fit and transfrom
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)

# everything has been scaled between 1 and 0
print('Max: ',X_train.max())
print('Min: ', X_train.min())
```

```
Max:  1.0
Min:  0.0
```

[164]:
```
model = Sequential()

# input layer
model.add(Dense(19,activation='relu'))

# hidden layers
model.add(Dense(19,activation='relu'))
model.add(Dense(19,activation='relu'))
model.add(Dense(19,activation='relu'))

# output layer
model.add(Dense(1))

model.compile(optimizer='adam',loss='mse')
```

[165]:
```
model.fit(x=X_train,y=y_train.values,
          validation_data=(X_test,y_test.values),
          batch_size=128,epochs=400)
```

```
Epoch 1/400
6/6             1s 12ms/step - loss:
1819937.3750 - val_loss: 1775516.1250
Epoch 2/400
6/6             0s 3ms/step - loss:
1814551.7500 - val_loss: 1774902.5000
Epoch 3/400
6/6             0s 3ms/step - loss:
1834421.5000 - val_loss: 1774101.8750
Epoch 4/400
6/6             0s 3ms/step - loss:
1805315.2500 - val_loss: 1773027.5000
```

```
Epoch 5/400
6/6             0s 3ms/step - loss:
1821080.2500 - val_loss: 1771558.0000
Epoch 6/400
6/6             0s 3ms/step - loss:
1811977.6250 - val_loss: 1769510.0000
Epoch 7/400
6/6             0s 3ms/step - loss:
1787055.6250 - val_loss: 1766659.2500
Epoch 8/400
6/6             0s 3ms/step - loss:
1809282.1250 - val_loss: 1762696.0000
Epoch 9/400
6/6             0s 3ms/step - loss:
1771939.3750 - val_loss: 1757192.3750
Epoch 10/400
6/6             0s 3ms/step - loss:
1808698.8750 - val_loss: 1749569.0000
Epoch 11/400
6/6             0s 3ms/step - loss:
1798255.3750 - val_loss: 1739071.8750
Epoch 12/400
6/6             0s 2ms/step - loss:
1764121.3750 - val_loss: 1724495.6250
Epoch 13/400
6/6             0s 2ms/step - loss:
1756222.0000 - val_loss: 1704358.2500
Epoch 14/400
6/6             0s 2ms/step - loss:
1743637.8750 - val_loss: 1677245.2500
Epoch 15/400
6/6             0s 2ms/step - loss:
1680074.8750 - val_loss: 1641304.7500
Epoch 16/400
6/6             0s 3ms/step - loss:
1658027.6250 - val_loss: 1594494.1250
Epoch 17/400
6/6             0s 3ms/step - loss:
1639554.0000 - val_loss: 1534604.0000
Epoch 18/400
6/6             0s 3ms/step - loss:
1557717.5000 - val_loss: 1459368.1250
Epoch 19/400
6/6             0s 8ms/step - loss:
1481609.0000 - val_loss: 1366699.6250
Epoch 20/400
6/6             0s 3ms/step - loss:
1351851.0000 - val_loss: 1254963.6250
```

```
Epoch 21/400
6/6             0s 2ms/step - loss:
1261172.0000 - val_loss: 1123578.0000
Epoch 22/400
6/6             0s 2ms/step - loss:
1145046.1250 - val_loss: 973979.0625
Epoch 23/400
6/6             0s 3ms/step - loss:
962898.1250 - val_loss: 810491.9375
Epoch 24/400
6/6             0s 3ms/step - loss:
795762.8125 - val_loss: 640047.0625
Epoch 25/400
6/6             0s 2ms/step - loss:
602934.6875 - val_loss: 474673.9062
Epoch 26/400
6/6             0s 2ms/step - loss:
456615.0000 - val_loss: 327592.0625
Epoch 27/400
6/6             0s 3ms/step - loss:
329896.8750 - val_loss: 216190.3906
Epoch 28/400
6/6             0s 3ms/step - loss:
210392.5781 - val_loss: 150018.2031
Epoch 29/400
6/6             0s 2ms/step - loss:
139606.6094 - val_loss: 126251.6016
Epoch 30/400
6/6             0s 2ms/step - loss:
122133.8672 - val_loss: 128277.8906
Epoch 31/400
6/6             0s 3ms/step - loss:
118853.2500 - val_loss: 134069.2812
Epoch 32/400
6/6             0s 3ms/step - loss:
120066.7578 - val_loss: 134880.5156
Epoch 33/400
6/6             0s 3ms/step - loss:
126691.8984 - val_loss: 131026.4531
Epoch 34/400
6/6             0s 3ms/step - loss:
123377.5234 - val_loss: 127355.1875
Epoch 35/400
6/6             0s 2ms/step - loss:
122658.8828 - val_loss: 125090.9609
Epoch 36/400
6/6             0s 8ms/step - loss:
119586.2500 - val_loss: 124193.8828
```

```
Epoch 37/400
6/6             0s 3ms/step - loss:
123977.8906 - val_loss: 123705.9609
Epoch 38/400
6/6             0s 2ms/step - loss:
120168.4453 - val_loss: 123560.2266
Epoch 39/400
6/6             0s 2ms/step - loss:
119272.0781 - val_loss: 123403.9609
Epoch 40/400
6/6             0s 2ms/step - loss:
118913.3984 - val_loss: 123631.5312
Epoch 41/400
6/6             0s 2ms/step - loss:
114956.9297 - val_loss: 123793.6797
Epoch 42/400
6/6             0s 3ms/step - loss:
112836.9766 - val_loss: 124052.1562
Epoch 43/400
6/6             0s 3ms/step - loss:
117430.7734 - val_loss: 123793.3594
Epoch 44/400
6/6             0s 3ms/step - loss:
119202.6953 - val_loss: 123380.8516
Epoch 45/400
6/6             0s 3ms/step - loss:
118179.0312 - val_loss: 123219.2031
Epoch 46/400
6/6             0s 3ms/step - loss:
114825.2109 - val_loss: 122854.6953
Epoch 47/400
6/6             0s 3ms/step - loss:
111322.9453 - val_loss: 122618.2969
Epoch 48/400
6/6             0s 3ms/step - loss:
113135.3516 - val_loss: 122291.9219
Epoch 49/400
6/6             0s 3ms/step - loss:
119800.9297 - val_loss: 122209.9219
Epoch 50/400
6/6             0s 3ms/step - loss:
115347.8594 - val_loss: 122118.2969
Epoch 51/400
6/6             0s 3ms/step - loss:
117821.9062 - val_loss: 121951.0781
Epoch 52/400
6/6             0s 4ms/step - loss:
111437.2656 - val_loss: 121581.5469
```

```
Epoch 53/400
6/6             0s 3ms/step - loss:
114550.1719 - val_loss: 121260.6172
Epoch 54/400
6/6             0s 3ms/step - loss:
110185.0547 - val_loss: 121056.4922
Epoch 55/400
6/6             0s 3ms/step - loss:
117154.5859 - val_loss: 120902.5859
Epoch 56/400
6/6             0s 3ms/step - loss:
116766.6953 - val_loss: 120975.4141
Epoch 57/400
6/6             0s 4ms/step - loss:
112272.4453 - val_loss: 120992.7031
Epoch 58/400
6/6             0s 2ms/step - loss:
109210.0391 - val_loss: 120808.5625
Epoch 59/400
6/6             0s 2ms/step - loss:
113178.0781 - val_loss: 120832.6953
Epoch 60/400
6/6             0s 2ms/step - loss:
111321.1719 - val_loss: 120632.5625
Epoch 61/400
6/6             0s 3ms/step - loss:
110396.7734 - val_loss: 120427.5312
Epoch 62/400
6/6             0s 3ms/step - loss:
110315.0078 - val_loss: 120245.0391
Epoch 63/400
6/6             0s 3ms/step - loss:
114655.0469 - val_loss: 120052.5859
Epoch 64/400
6/6             0s 3ms/step - loss:
109990.2031 - val_loss: 119796.1875
Epoch 65/400
6/6             0s 3ms/step - loss:
111900.3906 - val_loss: 119798.3594
Epoch 66/400
6/6             0s 3ms/step - loss:
108670.2266 - val_loss: 119666.7500
Epoch 67/400
6/6             0s 3ms/step - loss:
108652.0000 - val_loss: 119499.3047
Epoch 68/400
6/6             0s 7ms/step - loss:
109646.5625 - val_loss: 119365.7891
```

```
Epoch 69/400
6/6             0s 3ms/step - loss:
107762.9375 - val_loss: 119082.7734
Epoch 70/400
6/6             0s 2ms/step - loss:
108786.6953 - val_loss: 118916.2812
Epoch 71/400
6/6             0s 3ms/step - loss:
107109.2500 - val_loss: 118844.7969
Epoch 72/400
6/6             0s 3ms/step - loss:
103020.8828 - val_loss: 118322.2109
Epoch 73/400
6/6             0s 2ms/step - loss:
110247.4375 - val_loss: 118178.5469
Epoch 74/400
6/6             0s 2ms/step - loss:
105024.7266 - val_loss: 118669.9609
Epoch 75/400
6/6             0s 3ms/step - loss:
106410.5234 - val_loss: 119004.1094
Epoch 76/400
6/6             0s 2ms/step - loss:
110367.5234 - val_loss: 118685.4688
Epoch 77/400
6/6             0s 2ms/step - loss:
101639.2031 - val_loss: 118435.2109
Epoch 78/400
6/6             0s 2ms/step - loss:
106626.4688 - val_loss: 117821.2109
Epoch 79/400
6/6             0s 2ms/step - loss:
104904.3828 - val_loss: 117488.3438
Epoch 80/400
6/6             0s 2ms/step - loss:
107230.8516 - val_loss: 117617.6250
Epoch 81/400
6/6             0s 2ms/step - loss:
104780.2188 - val_loss: 117497.1562
Epoch 82/400
6/6             0s 2ms/step - loss:
100462.8125 - val_loss: 117661.3828
Epoch 83/400
6/6             0s 3ms/step - loss:
111990.6328 - val_loss: 117670.8828
Epoch 84/400
6/6             0s 4ms/step - loss:
104479.3438 - val_loss: 117386.9766
```

```
Epoch 85/400
6/6             0s 3ms/step - loss:
106663.9531 - val_loss: 117102.7734
Epoch 86/400
6/6             0s 3ms/step - loss:
111808.9453 - val_loss: 116762.6797
Epoch 87/400
6/6             0s 2ms/step - loss:
104954.0547 - val_loss: 116893.6562
Epoch 88/400
6/6             0s 2ms/step - loss:
109097.5234 - val_loss: 116859.2266
Epoch 89/400
6/6             0s 2ms/step - loss:
105312.4688 - val_loss: 116788.6016
Epoch 90/400
6/6             0s 2ms/step - loss:
107743.2109 - val_loss: 116490.9062
Epoch 91/400
6/6             0s 2ms/step - loss:
103914.7031 - val_loss: 116475.5703
Epoch 92/400
6/6             0s 2ms/step - loss:
102433.9062 - val_loss: 116310.4766
Epoch 93/400
6/6             0s 2ms/step - loss:
105096.9219 - val_loss: 116133.1328
Epoch 94/400
6/6             0s 2ms/step - loss:
101475.5469 - val_loss: 116130.0703
Epoch 95/400
6/6             0s 2ms/step - loss:
103310.3125 - val_loss: 116069.2812
Epoch 96/400
6/6             0s 2ms/step - loss:
102872.2734 - val_loss: 116373.2266
Epoch 97/400
6/6             0s 2ms/step - loss:
101132.0312 - val_loss: 115884.9609
Epoch 98/400
6/6             0s 2ms/step - loss:
106295.7266 - val_loss: 115991.2109
Epoch 99/400
6/6             0s 2ms/step - loss:
106143.9453 - val_loss: 115673.0000
Epoch 100/400
6/6             0s 2ms/step - loss:
103689.6094 - val_loss: 115171.4141
```

```
Epoch 101/400
6/6             0s 6ms/step - loss:
102461.9688 - val_loss: 115117.0156
Epoch 102/400
6/6             0s 4ms/step - loss:
108110.4375 - val_loss: 115261.6953
Epoch 103/400
6/6             0s 2ms/step - loss:
104474.0312 - val_loss: 114762.2812
Epoch 104/400
6/6             0s 2ms/step - loss:
103253.9453 - val_loss: 114856.6172
Epoch 105/400
6/6             0s 2ms/step - loss:
102904.0391 - val_loss: 114516.5234
Epoch 106/400
6/6             0s 2ms/step - loss:
97545.2422 - val_loss: 114559.7578
Epoch 107/400
6/6             0s 2ms/step - loss:
98829.3047 - val_loss: 114614.6406
Epoch 108/400
6/6             0s 2ms/step - loss:
109854.3516 - val_loss: 114887.8672
Epoch 109/400
6/6             0s 2ms/step - loss:
102514.9453 - val_loss: 114638.9062
Epoch 110/400
6/6             0s 2ms/step - loss:
102045.7500 - val_loss: 114962.2969
Epoch 111/400
6/6             0s 2ms/step - loss:
98195.1016 - val_loss: 114602.5312
Epoch 112/400
6/6             0s 2ms/step - loss:
103257.7188 - val_loss: 114540.7500
Epoch 113/400
6/6             0s 2ms/step - loss:
98452.1875 - val_loss: 114090.7031
Epoch 114/400
6/6             0s 2ms/step - loss:
105622.2422 - val_loss: 113950.6406
Epoch 115/400
6/6             0s 2ms/step - loss:
98502.8906 - val_loss: 113889.7969
Epoch 116/400
6/6             0s 2ms/step - loss:
99989.9766 - val_loss: 114129.1328
```

```
Epoch 117/400
6/6             0s 2ms/step - loss:
98660.0859 - val_loss: 114246.1562
Epoch 118/400
6/6             0s 3ms/step - loss:
98019.0781 - val_loss: 114340.4922
Epoch 119/400
6/6             0s 2ms/step - loss:
100036.4062 - val_loss: 113745.6172
Epoch 120/400
6/6             0s 2ms/step - loss:
97700.4453 - val_loss: 113930.1562
Epoch 121/400
6/6             0s 2ms/step - loss:
102860.2344 - val_loss: 113651.6172
Epoch 122/400
6/6             0s 6ms/step - loss:
104874.1016 - val_loss: 113212.2266
Epoch 123/400
6/6             0s 2ms/step - loss:
99323.6797 - val_loss: 112685.4297
Epoch 124/400
6/6             0s 2ms/step - loss:
101578.6797 - val_loss: 112835.9453
Epoch 125/400
6/6             0s 2ms/step - loss:
102078.9375 - val_loss: 113092.4141
Epoch 126/400
6/6             0s 2ms/step - loss:
102415.4219 - val_loss: 113137.9062
Epoch 127/400
6/6             0s 2ms/step - loss:
100358.6016 - val_loss: 112316.4922
Epoch 128/400
6/6             0s 2ms/step - loss:
99254.6719 - val_loss: 112207.0156
Epoch 129/400
6/6             0s 2ms/step - loss:
97217.8984 - val_loss: 112444.8125
Epoch 130/400
6/6             0s 2ms/step - loss:
97046.7812 - val_loss: 112692.3750
Epoch 131/400
6/6             0s 2ms/step - loss:
96367.3984 - val_loss: 112710.8906
Epoch 132/400
6/6             0s 2ms/step - loss:
98706.4922 - val_loss: 112191.9062
```

```
Epoch 133/400
6/6             0s 2ms/step - loss:
98006.7109 - val_loss: 111801.5000
Epoch 134/400
6/6             0s 2ms/step - loss:
98361.1719 - val_loss: 112207.3203
Epoch 135/400
6/6             0s 2ms/step - loss:
98070.4766 - val_loss: 112923.3359
Epoch 136/400
6/6             0s 2ms/step - loss:
97748.4375 - val_loss: 112546.8906
Epoch 137/400
6/6             0s 2ms/step - loss:
98737.1406 - val_loss: 112384.0156
Epoch 138/400
6/6             0s 2ms/step - loss:
97716.1875 - val_loss: 112085.3750
Epoch 139/400
6/6             0s 2ms/step - loss:
98283.9141 - val_loss: 111771.3516
Epoch 140/400
6/6             0s 2ms/step - loss:
97093.0391 - val_loss: 111548.3672
Epoch 141/400
6/6             0s 3ms/step - loss:
95252.0156 - val_loss: 111813.6016
Epoch 142/400
6/6             0s 2ms/step - loss:
101327.4688 - val_loss: 111369.0781
Epoch 143/400
6/6             0s 2ms/step - loss:
94222.5703 - val_loss: 111577.5703
Epoch 144/400
6/6             0s 2ms/step - loss:
98134.1719 - val_loss: 111690.7266
Epoch 145/400
6/6             0s 2ms/step - loss:
100345.1484 - val_loss: 111245.5312
Epoch 146/400
6/6             0s 2ms/step - loss:
96658.1172 - val_loss: 111506.8828
Epoch 147/400
6/6             0s 2ms/step - loss:
96013.8203 - val_loss: 110836.4297
Epoch 148/400
6/6             0s 2ms/step - loss:
99181.6562 - val_loss: 110508.7891
```

```
Epoch 149/400
6/6             0s 2ms/step - loss:
95296.0234 - val_loss: 110899.4297
Epoch 150/400
6/6             0s 2ms/step - loss:
94639.5469 - val_loss: 111447.1953
Epoch 151/400
6/6             0s 2ms/step - loss:
96391.1016 - val_loss: 110918.3203
Epoch 152/400
6/6             0s 2ms/step - loss:
96020.0078 - val_loss: 110732.4922
Epoch 153/400
6/6             0s 2ms/step - loss:
96805.9062 - val_loss: 110833.1094
Epoch 154/400
6/6             0s 2ms/step - loss:
96074.4844 - val_loss: 110868.1250
Epoch 155/400
6/6             0s 2ms/step - loss:
95204.5078 - val_loss: 111120.7422
Epoch 156/400
6/6             0s 2ms/step - loss:
96211.8594 - val_loss: 110651.7109
Epoch 157/400
6/6             0s 2ms/step - loss:
94772.8047 - val_loss: 110540.0547
Epoch 158/400
6/6             0s 2ms/step - loss:
94690.0234 - val_loss: 110450.5312
Epoch 159/400
6/6             0s 6ms/step - loss:
90832.4922 - val_loss: 110214.1953
Epoch 160/400
6/6             0s 2ms/step - loss:
96529.7734 - val_loss: 110263.5859
Epoch 161/400
6/6             0s 2ms/step - loss:
96774.3984 - val_loss: 110681.6875
Epoch 162/400
6/6             0s 2ms/step - loss:
97718.1406 - val_loss: 110968.5078
Epoch 163/400
6/6             0s 2ms/step - loss:
93428.1250 - val_loss: 111002.3516
Epoch 164/400
6/6             0s 2ms/step - loss:
93197.6484 - val_loss: 110615.3594
```

```
Epoch 165/400
6/6             0s 2ms/step - loss:
98993.0234 - val_loss: 110075.1172
Epoch 166/400
6/6             0s 2ms/step - loss:
88931.4219 - val_loss: 109576.2969
Epoch 167/400
6/6             0s 2ms/step - loss:
94664.4531 - val_loss: 109793.6484
Epoch 168/400
6/6             0s 2ms/step - loss:
97629.1875 - val_loss: 110226.7812
Epoch 169/400
6/6             0s 2ms/step - loss:
94654.1328 - val_loss: 110211.3750
Epoch 170/400
6/6             0s 3ms/step - loss:
95436.6953 - val_loss: 109094.2656
Epoch 171/400
6/6             0s 2ms/step - loss:
97258.0078 - val_loss: 109274.2344
Epoch 172/400
6/6             0s 2ms/step - loss:
91902.5859 - val_loss: 109177.8203
Epoch 173/400
6/6             0s 3ms/step - loss:
90337.4688 - val_loss: 109234.8281
Epoch 174/400
6/6             0s 5ms/step - loss:
91576.4531 - val_loss: 109292.8281
Epoch 175/400
6/6             0s 2ms/step - loss:
99666.7109 - val_loss: 109996.0781
Epoch 176/400
6/6             0s 2ms/step - loss:
87911.8047 - val_loss: 110105.1719
Epoch 177/400
6/6             0s 2ms/step - loss:
92993.7109 - val_loss: 109032.0078
Epoch 178/400
6/6             0s 3ms/step - loss:
90627.9141 - val_loss: 108420.7109
Epoch 179/400
6/6             0s 2ms/step - loss:
88687.5078 - val_loss: 109379.9453
Epoch 180/400
6/6             0s 2ms/step - loss:
94302.1719 - val_loss: 109765.6016
```

```
Epoch 181/400
6/6             0s 2ms/step - loss:
90971.7656 - val_loss: 110365.1406
Epoch 182/400
6/6             0s 3ms/step - loss:
94163.1484 - val_loss: 109035.3047
Epoch 183/400
6/6             0s 3ms/step - loss:
93391.6406 - val_loss: 108550.4766
Epoch 184/400
6/6             0s 3ms/step - loss:
94477.3516 - val_loss: 108385.2500
Epoch 185/400
6/6             0s 2ms/step - loss:
88947.7266 - val_loss: 108207.7109
Epoch 186/400
6/6             0s 3ms/step - loss:
89471.4219 - val_loss: 108995.2734
Epoch 187/400
6/6             0s 4ms/step - loss:
90249.4141 - val_loss: 109544.1484
Epoch 188/400
6/6             0s 4ms/step - loss:
94341.9062 - val_loss: 108543.2812
Epoch 189/400
6/6             0s 5ms/step - loss:
92137.7500 - val_loss: 108487.3984
Epoch 190/400
6/6             0s 3ms/step - loss:
92902.0859 - val_loss: 108302.2109
Epoch 191/400
6/6             0s 3ms/step - loss:
92276.5234 - val_loss: 108629.5078
Epoch 192/400
6/6             0s 3ms/step - loss:
88845.3438 - val_loss: 108826.6016
Epoch 193/400
6/6             0s 2ms/step - loss:
90887.9141 - val_loss: 108592.0625
Epoch 194/400
6/6             0s 2ms/step - loss:
89024.6641 - val_loss: 108343.4141
Epoch 195/400
6/6             0s 3ms/step - loss:
89592.8203 - val_loss: 107940.2031
Epoch 196/400
6/6             0s 4ms/step - loss:
88006.6484 - val_loss: 108130.6484
```

```
Epoch 197/400
6/6             0s 3ms/step - loss:
93790.0234 - val_loss: 108441.0156
Epoch 198/400
6/6             0s 3ms/step - loss:
91230.0078 - val_loss: 108442.4766
Epoch 199/400
6/6             0s 4ms/step - loss:
89317.3828 - val_loss: 108015.4375
Epoch 200/400
6/6             0s 3ms/step - loss:
90899.8750 - val_loss: 108223.6797
Epoch 201/400
6/6             0s 3ms/step - loss:
89723.3125 - val_loss: 107851.3516
Epoch 202/400
6/6             0s 21ms/step - loss:
90614.9922 - val_loss: 108597.1172
Epoch 203/400
6/6             0s 6ms/step - loss:
87957.8594 - val_loss: 108224.7109
Epoch 204/400
6/6             0s 3ms/step - loss:
89541.8906 - val_loss: 107575.3594
Epoch 205/400
6/6             0s 2ms/step - loss:
92335.7031 - val_loss: 107548.0391
Epoch 206/400
6/6             0s 2ms/step - loss:
89110.9453 - val_loss: 108462.7734
Epoch 207/400
6/6             0s 2ms/step - loss:
96530.5547 - val_loss: 108200.7500
Epoch 208/400
6/6             0s 2ms/step - loss:
89586.0312 - val_loss: 107559.1328
Epoch 209/400
6/6             0s 2ms/step - loss:
89890.8047 - val_loss: 107560.4766
Epoch 210/400
6/6             0s 3ms/step - loss:
90282.8984 - val_loss: 107990.6562
Epoch 211/400
6/6             0s 4ms/step - loss:
93354.3438 - val_loss: 107951.4062
Epoch 212/400
6/6             0s 4ms/step - loss:
94410.2812 - val_loss: 107660.7500
```

```
Epoch 213/400
6/6             0s 3ms/step - loss:
89824.8594 - val_loss: 107443.6406
Epoch 214/400
6/6             0s 3ms/step - loss:
89773.1250 - val_loss: 107613.3984
Epoch 215/400
6/6             0s 3ms/step - loss:
94100.9609 - val_loss: 107716.5703
Epoch 216/400
6/6             0s 3ms/step - loss:
90076.0312 - val_loss: 107654.8516
Epoch 217/400
6/6             0s 2ms/step - loss:
87924.8203 - val_loss: 107329.6797
Epoch 218/400
6/6             0s 3ms/step - loss:
90423.2656 - val_loss: 108064.8047
Epoch 219/400
6/6             0s 3ms/step - loss:
89514.8750 - val_loss: 108202.2422
Epoch 220/400
6/6             0s 2ms/step - loss:
93605.6094 - val_loss: 107974.1172
Epoch 221/400
6/6             0s 3ms/step - loss:
90389.1406 - val_loss: 107418.7422
Epoch 222/400
6/6             0s 2ms/step - loss:
87132.9531 - val_loss: 107114.5547
Epoch 223/400
6/6             0s 4ms/step - loss:
88393.7422 - val_loss: 107487.3359
Epoch 224/400
6/6             0s 2ms/step - loss:
87727.1719 - val_loss: 107421.5156
Epoch 225/400
6/6             0s 2ms/step - loss:
88609.5156 - val_loss: 107607.2109
Epoch 226/400
6/6             0s 2ms/step - loss:
90929.6953 - val_loss: 107820.4453
Epoch 227/400
6/6             0s 2ms/step - loss:
87169.1562 - val_loss: 107220.6562
Epoch 228/400
6/6             0s 2ms/step - loss:
89676.2656 - val_loss: 107251.7969
```

```
Epoch 229/400
6/6             0s 2ms/step - loss:
93135.4062 - val_loss: 107328.0859
Epoch 230/400
6/6             0s 2ms/step - loss:
92025.5078 - val_loss: 107570.8516
Epoch 231/400
6/6             0s 2ms/step - loss:
90353.1172 - val_loss: 107720.5078
Epoch 232/400
6/6             0s 2ms/step - loss:
88645.4609 - val_loss: 107009.6172
Epoch 233/400
6/6             0s 2ms/step - loss:
86084.0156 - val_loss: 106707.5156
Epoch 234/400
6/6             0s 2ms/step - loss:
90035.9453 - val_loss: 106854.4609
Epoch 235/400
6/6             0s 2ms/step - loss:
88612.1875 - val_loss: 107467.4062
Epoch 236/400
6/6             0s 4ms/step - loss:
87730.5547 - val_loss: 108081.1172
Epoch 237/400
6/6             0s 2ms/step - loss:
85486.9375 - val_loss: 107445.0391
Epoch 238/400
6/6             0s 3ms/step - loss:
88752.3281 - val_loss: 107267.3594
Epoch 239/400
6/6             0s 3ms/step - loss:
90761.1953 - val_loss: 107042.7969
Epoch 240/400
6/6             0s 3ms/step - loss:
91484.7422 - val_loss: 107884.6094
Epoch 241/400
6/6             0s 2ms/step - loss:
89807.7344 - val_loss: 107492.1016
Epoch 242/400
6/6             0s 3ms/step - loss:
90370.1797 - val_loss: 107244.0234
Epoch 243/400
6/6             0s 3ms/step - loss:
88742.8359 - val_loss: 106464.0703
Epoch 244/400
6/6             0s 3ms/step - loss:
92070.2422 - val_loss: 106486.4141
```

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Epoch 245/400
6/6             0s 2ms/step - loss:
86635.8750 - val_loss: 106664.3203
Epoch 246/400
6/6             0s 5ms/step - loss:
91732.4531 - val_loss: 106735.8516
Epoch 247/400
6/6             0s 4ms/step - loss:
92798.2031 - val_loss: 106645.3359
Epoch 248/400
6/6             0s 3ms/step - loss:
91542.8047 - val_loss: 106762.7969
Epoch 249/400
6/6             0s 2ms/step - loss:
86597.5859 - val_loss: 107078.5703
Epoch 250/400
6/6             0s 3ms/step - loss:
89636.2188 - val_loss: 106993.7656
Epoch 251/400
6/6             0s 3ms/step - loss:
90184.1328 - val_loss: 106695.2031
Epoch 252/400
6/6             0s 3ms/step - loss:
93240.4297 - val_loss: 107212.5703
Epoch 253/400
6/6             0s 3ms/step - loss:
93983.4062 - val_loss: 107194.0781
Epoch 254/400
6/6             0s 2ms/step - loss:
92513.9766 - val_loss: 106539.3984
Epoch 255/400
6/6             0s 2ms/step - loss:
90359.2188 - val_loss: 106379.8438
Epoch 256/400
6/6             0s 2ms/step - loss:
87712.0547 - val_loss: 106801.6250
Epoch 257/400
6/6             0s 3ms/step - loss:
86235.2500 - val_loss: 107970.7969
Epoch 258/400
6/6             0s 2ms/step - loss:
89782.1172 - val_loss: 107068.9766
Epoch 259/400
6/6             0s 5ms/step - loss:
85534.7188 - val_loss: 106406.3281
Epoch 260/400
6/6             0s 2ms/step - loss:
89162.5547 - val_loss: 106010.5703
```

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Epoch 261/400
6/6             0s 2ms/step - loss:
88878.1641 - val_loss: 106583.1719
Epoch 262/400
6/6             0s 3ms/step - loss:
88761.0625 - val_loss: 108115.5547
Epoch 263/400
6/6             0s 2ms/step - loss:
85107.6641 - val_loss: 106933.5000
Epoch 264/400
6/6             0s 2ms/step - loss:
89114.9062 - val_loss: 106439.2578
Epoch 265/400
6/6             0s 2ms/step - loss:
86611.2109 - val_loss: 106386.6953
Epoch 266/400
6/6             0s 2ms/step - loss:
85674.8594 - val_loss: 106805.9688
Epoch 267/400
6/6             0s 2ms/step - loss:
90384.8594 - val_loss: 107299.5156
Epoch 268/400
6/6             0s 2ms/step - loss:
84610.0000 - val_loss: 107476.0625
Epoch 269/400
6/6             0s 2ms/step - loss:
85105.8828 - val_loss: 106706.9609
Epoch 270/400
6/6             0s 2ms/step - loss:
88928.1016 - val_loss: 106373.4922
Epoch 271/400
6/6             0s 2ms/step - loss:
91152.7422 - val_loss: 106008.5312
Epoch 272/400
6/6             0s 2ms/step - loss:
83982.1484 - val_loss: 106419.0703
Epoch 273/400
6/6             0s 2ms/step - loss:
88417.5391 - val_loss: 107447.6641
Epoch 274/400
6/6             0s 2ms/step - loss:
91683.7422 - val_loss: 107242.0547
Epoch 275/400
6/6             0s 2ms/step - loss:
92272.3516 - val_loss: 106167.4453
Epoch 276/400
6/6             0s 2ms/step - loss:
89277.7578 - val_loss: 106196.9688
```

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Epoch 277/400
6/6             0s 3ms/step - loss:
89609.6406 - val_loss: 107005.3828
Epoch 278/400
6/6             0s 2ms/step - loss:
92346.2578 - val_loss: 107212.6641
Epoch 279/400
6/6             0s 2ms/step - loss:
87587.0234 - val_loss: 106831.1641
Epoch 280/400
6/6             0s 2ms/step - loss:
88523.3203 - val_loss: 106899.3516
Epoch 281/400
6/6             0s 2ms/step - loss:
88081.6016 - val_loss: 105867.9844
Epoch 282/400
6/6             0s 2ms/step - loss:
86006.5156 - val_loss: 106142.8359
Epoch 283/400
6/6             0s 2ms/step - loss:
87802.6641 - val_loss: 107503.8750
Epoch 284/400
6/6             0s 2ms/step - loss:
89428.9062 - val_loss: 108541.9219
Epoch 285/400
6/6             0s 2ms/step - loss:
88372.9688 - val_loss: 106855.8281
Epoch 286/400
6/6             0s 2ms/step - loss:
88564.3203 - val_loss: 106672.8203
Epoch 287/400
6/6             0s 2ms/step - loss:
86925.2578 - val_loss: 106256.0469
Epoch 288/400
6/6             0s 2ms/step - loss:
87952.9297 - val_loss: 106715.9531
Epoch 289/400
6/6             0s 2ms/step - loss:
86400.1484 - val_loss: 106807.1484
Epoch 290/400
6/6             0s 2ms/step - loss:
90472.0156 - val_loss: 107422.4531
Epoch 291/400
6/6             0s 3ms/step - loss:
87693.1484 - val_loss: 106704.5703
Epoch 292/400
6/6             0s 2ms/step - loss:
89335.4766 - val_loss: 106583.3047
```

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Epoch 293/400
6/6             0s 3ms/step - loss:
89490.0078 - val_loss: 107248.5625
Epoch 294/400
6/6             0s 3ms/step - loss:
89725.6719 - val_loss: 106213.6562
Epoch 295/400
6/6             0s 3ms/step - loss:
87927.5938 - val_loss: 106381.2188
Epoch 296/400
6/6             0s 3ms/step - loss:
87858.6484 - val_loss: 106787.8594
Epoch 297/400
6/6             0s 3ms/step - loss:
86178.2812 - val_loss: 106149.8984
Epoch 298/400
6/6             0s 3ms/step - loss:
87538.1719 - val_loss: 106148.5234
Epoch 299/400
6/6             0s 3ms/step - loss:
87750.8828 - val_loss: 107139.4922
Epoch 300/400
6/6             0s 8ms/step - loss:
88466.6094 - val_loss: 106720.3438
Epoch 301/400
6/6             0s 3ms/step - loss:
89579.1484 - val_loss: 106497.5469
Epoch 302/400
6/6             0s 3ms/step - loss:
88372.0781 - val_loss: 106569.4688
Epoch 303/400
6/6             0s 3ms/step - loss:
87217.2344 - val_loss: 106284.9453
Epoch 304/400
6/6             0s 3ms/step - loss:
82623.2734 - val_loss: 105745.7969
Epoch 305/400
6/6             0s 3ms/step - loss:
89877.9688 - val_loss: 106627.0703
Epoch 306/400
6/6             0s 3ms/step - loss:
83830.3125 - val_loss: 106644.8125
Epoch 307/400
6/6             0s 3ms/step - loss:
88410.6953 - val_loss: 106465.9766
Epoch 308/400
6/6             0s 2ms/step - loss:
84691.6250 - val_loss: 105641.6797
```

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Epoch 309/400
6/6             0s 2ms/step - loss:
84223.8828 - val_loss: 106782.2578
Epoch 310/400
6/6             0s 3ms/step - loss:
86464.1172 - val_loss: 106430.9062
Epoch 311/400
6/6             0s 8ms/step - loss:
87665.9531 - val_loss: 106549.8828
Epoch 312/400
6/6             0s 3ms/step - loss:
85651.8359 - val_loss: 106795.0312
Epoch 313/400
6/6             0s 3ms/step - loss:
89288.6484 - val_loss: 106245.7969
Epoch 314/400
6/6             0s 3ms/step - loss:
83874.6719 - val_loss: 106064.6562
Epoch 315/400
6/6             0s 3ms/step - loss:
87701.8125 - val_loss: 106300.3203
Epoch 316/400
6/6             0s 3ms/step - loss:
86216.4609 - val_loss: 106450.6172
Epoch 317/400
6/6             0s 3ms/step - loss:
90734.5781 - val_loss: 106962.6875
Epoch 318/400
6/6             0s 2ms/step - loss:
83655.7969 - val_loss: 106335.9297
Epoch 319/400
6/6             0s 3ms/step - loss:
86773.8438 - val_loss: 107248.7656
Epoch 320/400
6/6             0s 2ms/step - loss:
87550.8125 - val_loss: 107155.7734
Epoch 321/400
6/6             0s 2ms/step - loss:
86886.8047 - val_loss: 106208.5234
Epoch 322/400
6/6             0s 2ms/step - loss:
83222.0000 - val_loss: 106274.3359
Epoch 323/400
6/6             0s 2ms/step - loss:
88737.9844 - val_loss: 106398.3984
Epoch 324/400
6/6             0s 2ms/step - loss:
83759.2891 - val_loss: 107464.9219
```

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Epoch 325/400
6/6             0s 2ms/step - loss:
88876.3125 - val_loss: 107560.2656
Epoch 326/400
6/6             0s 2ms/step - loss:
84535.6094 - val_loss: 107665.0938
Epoch 327/400
6/6             0s 3ms/step - loss:
87867.3672 - val_loss: 107273.7344
Epoch 328/400
6/6             0s 2ms/step - loss:
86903.4219 - val_loss: 105759.0547
Epoch 329/400
6/6             0s 3ms/step - loss:
82724.6172 - val_loss: 106009.3047
Epoch 330/400
6/6             0s 3ms/step - loss:
88764.5000 - val_loss: 106468.9453
Epoch 331/400
6/6             0s 2ms/step - loss:
88067.5078 - val_loss: 107466.6406
Epoch 332/400
6/6             0s 2ms/step - loss:
89447.3281 - val_loss: 106714.6406
Epoch 333/400
6/6             0s 2ms/step - loss:
89493.1250 - val_loss: 105996.3047
Epoch 334/400
6/6             0s 2ms/step - loss:
88554.9297 - val_loss: 105774.7578
Epoch 335/400
6/6             0s 3ms/step - loss:
83233.0938 - val_loss: 106206.9219
Epoch 336/400
6/6             0s 2ms/step - loss:
83315.7344 - val_loss: 106397.5234
Epoch 337/400
6/6             0s 2ms/step - loss:
89630.4609 - val_loss: 108378.6875
Epoch 338/400
6/6             0s 2ms/step - loss:
85909.4297 - val_loss: 107483.1797
Epoch 339/400
6/6             0s 7ms/step - loss:
90776.8125 - val_loss: 106685.3828
Epoch 340/400
6/6             0s 3ms/step - loss:
87666.3672 - val_loss: 105992.1250
```

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Epoch 341/400
6/6             0s 2ms/step - loss:
89496.5000 - val_loss: 106458.3594
Epoch 342/400
6/6             0s 2ms/step - loss:
85490.4375 - val_loss: 107017.3984
Epoch 343/400
6/6             0s 2ms/step - loss:
82829.5234 - val_loss: 106479.3438
Epoch 344/400
6/6             0s 2ms/step - loss:
87686.5781 - val_loss: 107007.8203
Epoch 345/400
6/6             0s 2ms/step - loss:
86049.0703 - val_loss: 106964.7266
Epoch 346/400
6/6             0s 2ms/step - loss:
82903.0703 - val_loss: 106966.4297
Epoch 347/400
6/6             0s 2ms/step - loss:
88426.5859 - val_loss: 106777.8594
Epoch 348/400
6/6             0s 2ms/step - loss:
84117.6641 - val_loss: 107062.6328
Epoch 349/400
6/6             0s 2ms/step - loss:
84204.5469 - val_loss: 106835.5234
Epoch 350/400
6/6             0s 2ms/step - loss:
86470.4375 - val_loss: 106886.4766
Epoch 351/400
6/6             0s 7ms/step - loss:
87813.1641 - val_loss: 107505.1953
Epoch 352/400
6/6             0s 2ms/step - loss:
87061.2266 - val_loss: 107804.0938
Epoch 353/400
6/6             0s 2ms/step - loss:
84749.9297 - val_loss: 106985.4375
Epoch 354/400
6/6             0s 2ms/step - loss:
86957.5156 - val_loss: 106187.5703
Epoch 355/400
6/6             0s 2ms/step - loss:
87400.0781 - val_loss: 106601.7031
Epoch 356/400
6/6             0s 2ms/step - loss:
88310.1562 - val_loss: 106642.8750
```

```
Epoch 357/400
6/6             0s 2ms/step - loss:
87390.3516 - val_loss: 107093.0234
Epoch 358/400
6/6             0s 2ms/step - loss:
85978.0078 - val_loss: 107850.9844
Epoch 359/400
6/6             0s 2ms/step - loss:
87717.8281 - val_loss: 106626.3125
Epoch 360/400
6/6             0s 2ms/step - loss:
89207.5703 - val_loss: 106606.5312
Epoch 361/400
6/6             0s 2ms/step - loss:
86277.4375 - val_loss: 106597.7031
Epoch 362/400
6/6             0s 2ms/step - loss:
89460.3516 - val_loss: 108071.3281
Epoch 363/400
6/6             0s 3ms/step - loss:
86678.2031 - val_loss: 107122.0703
Epoch 364/400
6/6             0s 2ms/step - loss:
87422.8984 - val_loss: 106949.8203
Epoch 365/400
6/6             0s 2ms/step - loss:
85358.6094 - val_loss: 107175.2109
Epoch 366/400
6/6             0s 2ms/step - loss:
86214.2812 - val_loss: 107202.7656
Epoch 367/400
6/6             0s 2ms/step - loss:
86328.5078 - val_loss: 106823.1562
Epoch 368/400
6/6             0s 2ms/step - loss:
86054.2031 - val_loss: 107908.4453
Epoch 369/400
6/6             0s 2ms/step - loss:
85313.1016 - val_loss: 106783.6172
Epoch 370/400
6/6             0s 3ms/step - loss:
84333.2969 - val_loss: 107323.5078
Epoch 371/400
6/6             0s 3ms/step - loss:
88295.7812 - val_loss: 107342.6875
Epoch 372/400
6/6             0s 3ms/step - loss:
86097.6094 - val_loss: 108608.7031
```

```
Epoch 373/400
6/6             0s 7ms/step - loss:
88171.9766 - val_loss: 107182.1562
Epoch 374/400
6/6             0s 2ms/step - loss:
84382.8359 - val_loss: 106069.2812
Epoch 375/400
6/6             0s 2ms/step - loss:
85555.0547 - val_loss: 107163.3203
Epoch 376/400
6/6             0s 3ms/step - loss:
86626.3828 - val_loss: 108699.6328
Epoch 377/400
6/6             0s 2ms/step - loss:
86950.2578 - val_loss: 107049.7344
Epoch 378/400
6/6             0s 2ms/step - loss:
85051.1172 - val_loss: 106599.4297
Epoch 379/400
6/6             0s 2ms/step - loss:
86371.4141 - val_loss: 107000.4141
Epoch 380/400
6/6             0s 2ms/step - loss:
87292.5000 - val_loss: 108751.0000
Epoch 381/400
6/6             0s 2ms/step - loss:
90962.1328 - val_loss: 108741.9531
Epoch 382/400
6/6             0s 2ms/step - loss:
88135.9062 - val_loss: 107717.5234
Epoch 383/400
6/6             0s 5ms/step - loss:
86612.0781 - val_loss: 106565.9844
Epoch 384/400
6/6             0s 2ms/step - loss:
82904.1250 - val_loss: 106232.0156
Epoch 385/400
6/6             0s 3ms/step - loss:
88132.1719 - val_loss: 107573.8359
Epoch 386/400
6/6             0s 3ms/step - loss:
82320.8359 - val_loss: 108305.2656
Epoch 387/400
6/6             0s 3ms/step - loss:
86440.2188 - val_loss: 107160.9844
Epoch 388/400
6/6             0s 2ms/step - loss:
82532.3281 - val_loss: 105971.1719
```

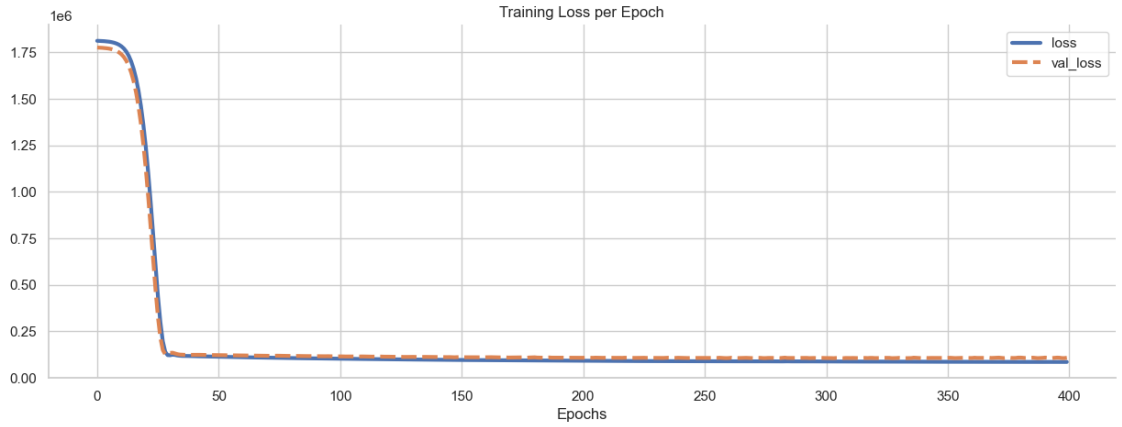
```
Epoch 389/400
6/6             0s 2ms/step - loss:
86378.3984 - val_loss: 106707.3594
Epoch 390/400
6/6             0s 2ms/step - loss:
83857.8984 - val_loss: 107341.3828
Epoch 391/400
6/6             0s 2ms/step - loss:
88376.5938 - val_loss: 108772.5078
Epoch 392/400
6/6             0s 2ms/step - loss:
87843.7656 - val_loss: 107671.9062
Epoch 393/400
6/6             0s 3ms/step - loss:
87286.4141 - val_loss: 105906.7422
Epoch 394/400
6/6             0s 2ms/step - loss:
88434.3906 - val_loss: 106373.0703
Epoch 395/400
6/6             0s 2ms/step - loss:
86266.1484 - val_loss: 107441.0156
Epoch 396/400
6/6             0s 2ms/step - loss:
84540.9688 - val_loss: 108696.9844
Epoch 397/400
6/6             0s 2ms/step - loss:
91064.8516 - val_loss: 108133.7031
Epoch 398/400
6/6             0s 2ms/step - loss:
90119.5703 - val_loss: 106296.8359
Epoch 399/400
6/6             0s 2ms/step - loss:
87005.0156 - val_loss: 106179.3750
Epoch 400/400
6/6             0s 2ms/step - loss:
89093.9453 - val_loss: 108000.2656
```

[165]:
```
<keras.src.callbacks.history.History at 0x15bc2b190>
```

[166]:
```
losses = pd.DataFrame(model.history.history)

plt.figure(figsize=(15,5))
sns.lineplot(data=losses,lw=3)
plt.xlabel('Epochs')
plt.ylabel('')
plt.title('Training Loss per Epoch')
sns.despine()
```

```
plt.show()
```



[167]:
```
# predictions on the test set
predictions = model.predict(X_test)

print('MAE: ',mean_absolute_error(y_test,predictions))
print('MSE: ',mean_squared_error(y_test,predictions))
print('RMSE: ',np.sqrt(mean_squared_error(y_test,predictions)))
print('Variance Regression Score:␣
  ↪',explained_variance_score(y_test,predictions))

print('\n\nDescriptive Statistics:\n',df['Lifespan'].describe())
```

```
10/10             0s 2ms/step
MAE:  285.22125340983075
MSE:  108000.26749535257
RMSE:  328.6339414840661
Variance Regression Score:  0.12039011844668857

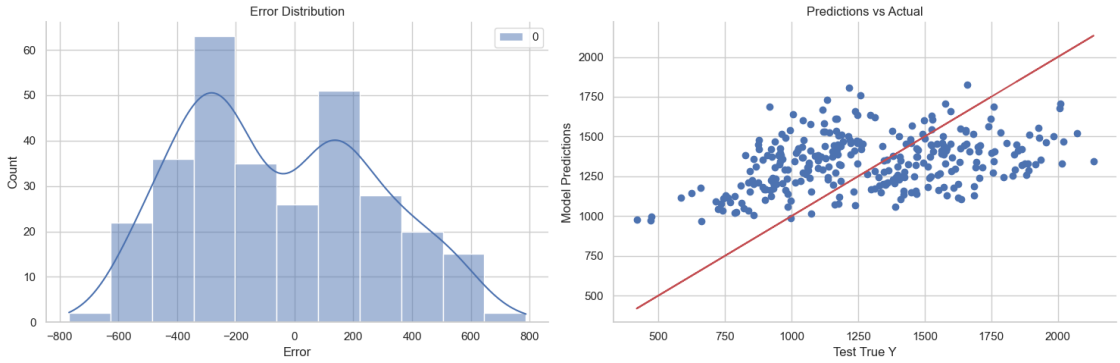

Descriptive Statistics:
 count    1000.000000
mean     1298.556320
std       340.071434
min       417.990000
25%      1047.257500
50%      1266.040000
75%      1563.050000
max      2134.530000
Name: Lifespan, dtype: float64
```

[168]:
```
f, axes = plt.subplots(1, 2, figsize=(15,5))

# Plot 1: Error Distribution
errors = y_test.values.reshape(300, 1) - predictions
sns.histplot(errors, ax=axes[0], kde=True)  # Using histplot instead of␣
 ↪distplot as distplot is deprecated
axes[0].set(xlabel='Error', ylabel='Count', title='Error Distribution')

# Plot 2: Predictions vs Actual
axes[1].scatter(y_test, predictions)
axes[1].plot(y_test, y_test, 'r')  # Perfect predictions line
axes[1].set(xlabel='Test True Y', ylabel='Model Predictions',␣
 ↪title='Predictions vs Actual')

sns.despine()
plt.tight_layout()
plt.show()
```



[169]:
```
# Get features of new part type
single_partType = df.drop('Lifespan', axis=1).iloc[0]
print(f'Features of new part type:\n{single_partType}')

# Convert to DataFrame with feature names
single_partType_df = pd.DataFrame([single_partType.values],␣
 ↪columns=single_partType.index)

# Scale the features while preserving feature names
single_partType_scaled = scaler.transform(single_partType_df)

# Run the model and get the lifespan prediction
print('\nPrediction Lifespan:', model.predict(single_partType_scaled)[0,0])

# Print original lifespan
```

```
print('\nOriginal Lifespan:', df.iloc[0]['Lifespan'])
```

```
Features of new part type:
coolingRate                   13.00
quenchTime                     3.84
forgeTime                      6.47
HeatTreatTime                 46.87
Nickel%                       65.73
Iron%                         16.52
Cobalt%                       16.82
Chromium%                      0.93
smallDefects                  10.00
largeDefects                   0.00
sliverDefects                  0.00
partType_Blade                 0.00
partType_Block                 0.00
partType_Nozzle                1.00
partType_Valve                 0.00
microstructure_colGrain        0.00
microstructure_equiGrain       1.00
microstructure_singleGrain     0.00
seedLocation_Bottom            1.00
seedLocation_Top               0.00
castType_Continuous            0.00
castType_Die                   1.00
castType_Investment            0.00
Name: 0, dtype: float64
1/1             0s 7ms/step

Prediction Lifespan: 1426.9193

Original Lifespan: 1469.17
1/1             0s 7ms/step

Prediction Lifespan: 1426.9193

Original Lifespan: 1469.17
```