supplementry

December 6, 2020

1 load the data

[1]:
```
import pandas as pd
from sklearn.metrics import r2_score
import numpy as np
```

[2]:
```
df = pd.read_csv('data_thesis.csv')
```

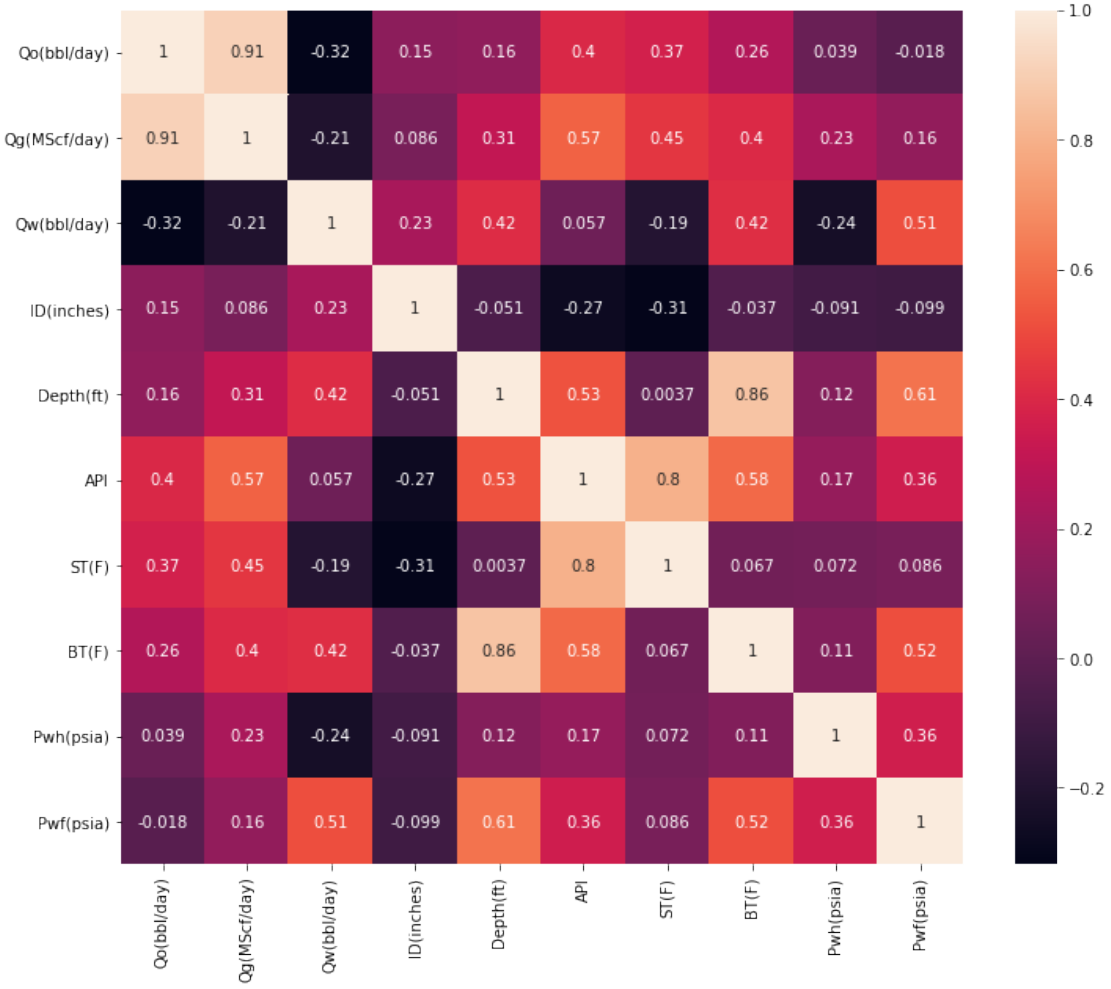
[3]:
```
df=df.dropna()
df.to_csv("my_description.csv")
```

[4]:
```
table=df.head()
table.to_csv("data.csv")
```

2 Explore the data

[5]:
```
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
```

[6]:
```
plt.figure(figsize=(12,10))
sns.heatmap(df.corr(),annot=True)
plt.savefig('heatmap.png', dpi=300)
```



3 Training and testing the data

[7]:
```
#output
y=df['Pwf(psia)']
```

[8]:
```
#input
X=df.drop('Pwf(psia)',axis=1)
```

[ ]:
```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
↪random_state=101)
```

[11]:
```
X_train .shape
```

[11]: (165, 9)

[12]:
```
X_test.shape
```

[12]:
```
(41, 9)
```

4 Feature selection

[13]:
```
# reduce the number of the input data by using filtter by correlation method
def correlation(dataset,threshold):
    col_corr = set()
    corr_matrix = dataset.corr()
    for i in range(len(corr_matrix.columns)):
        for j in range(i):
            if abs(corr_matrix.iloc[i,j]) > threshold:
                colname= corr_matrix.columns[i]
                col_corr.add(colname)
    return col_corr
```

[14]:
```
corr_features = correlation(X_train,0.8)
len(set(corr_features))
```

[14]:
```
3
```

[15]:
```
corr_features
```

[15]:
```
{'BT(F)', 'Qg(MScf/day)', 'ST(F)'}
```

[16]:
```
#drop the corr features from the X_test and X-train
X_train.drop(labels=corr_features,axis=1,inplace=True)
X_test.drop(labels=corr_features,axis=1,inplace=True)


X_train.shape,X_test.shape
```

[16]:
```
((165, 6), (41, 6))
```

[17]:
```
df_train=pd.DataFrame(X_train)
```

[18]:
```
df_test=pd.DataFrame(X_test)
```

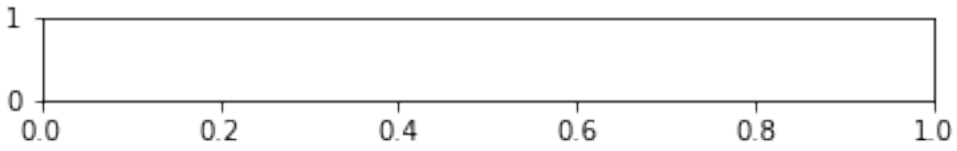
[19]:
```
table=y_train.describe()
table.to_csv("train_out.csv")
```

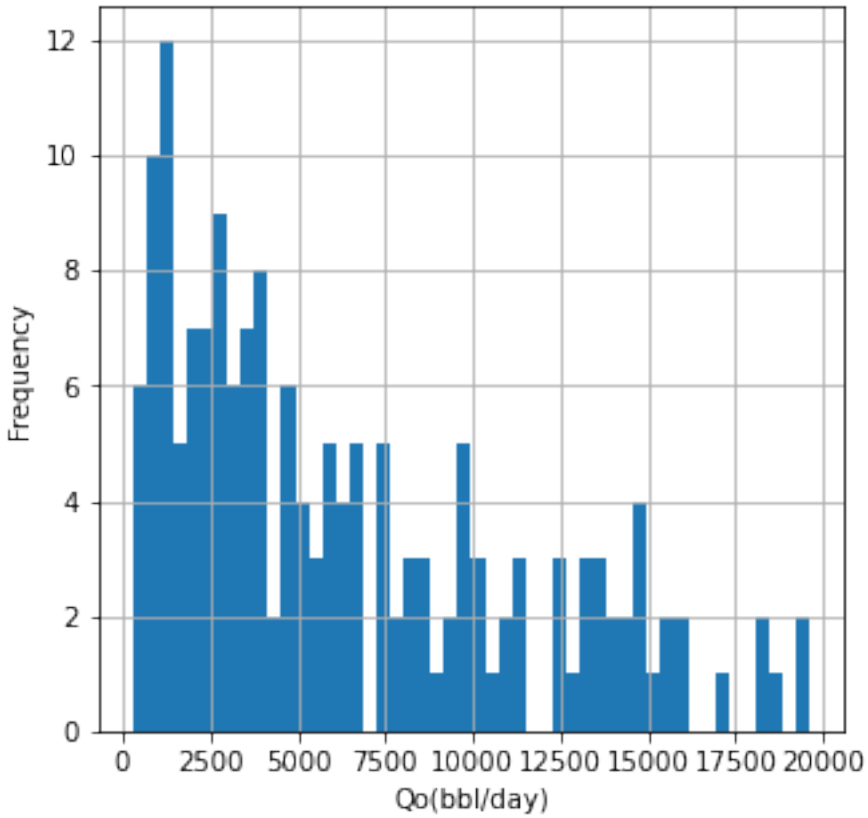
[20]:
```
table2=y_test.describe()
table2.to_csv("test_out_.csv")
```

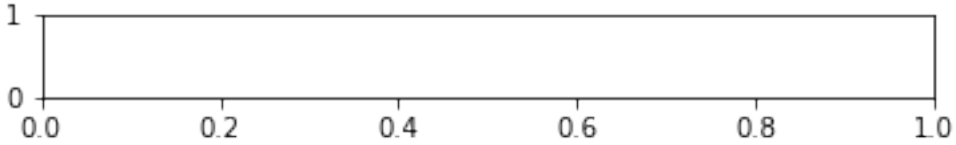
[21]:
```
X_test.skew()
```

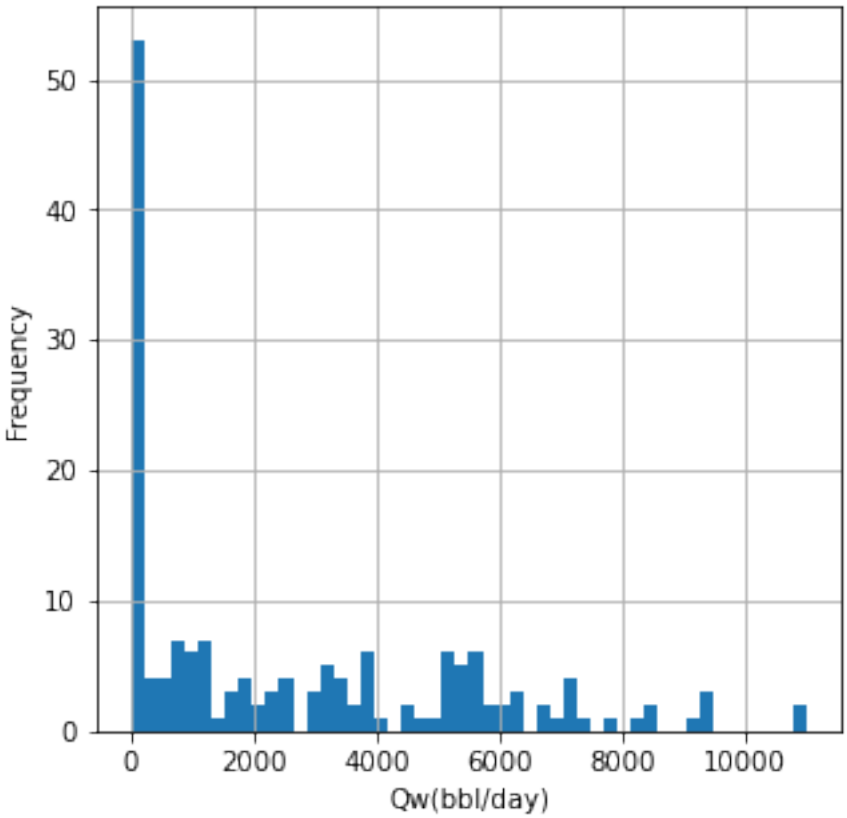
[21]:
```
Qo(bbl/day)    0.920679
Qw(bbl/day)    0.731498
ID(inches)    -0.829107
Depth(ft)     -1.615509
API            0.361125
Pwh(psia)      1.538948
dtype: float64
```

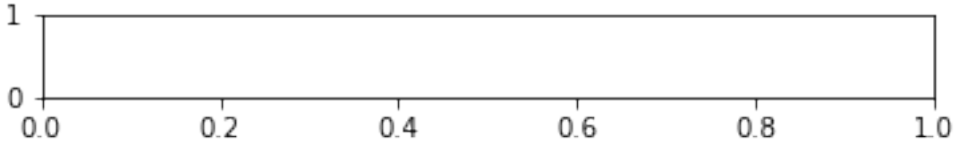
[81]:
```
# Plot the histogram of train daat
plt.close()
fig=plt.figure()
for i in range (len(dtrain.columns)):
  plt.subplot(6,1,i+1)
  plt.figure(figsize = (5, 5))
  plt.hist(dtrain[dtrain.columns[i]],bins = 50)
  plt.xlabel(dtrain.columns[i])
  plt.ylabel("Frequency")
  plt.grid()

  #plt.savefig("train dis_%.png" %i)
  fig.savefig('train dis'+str(i)+'.png')
  plt.show();
```

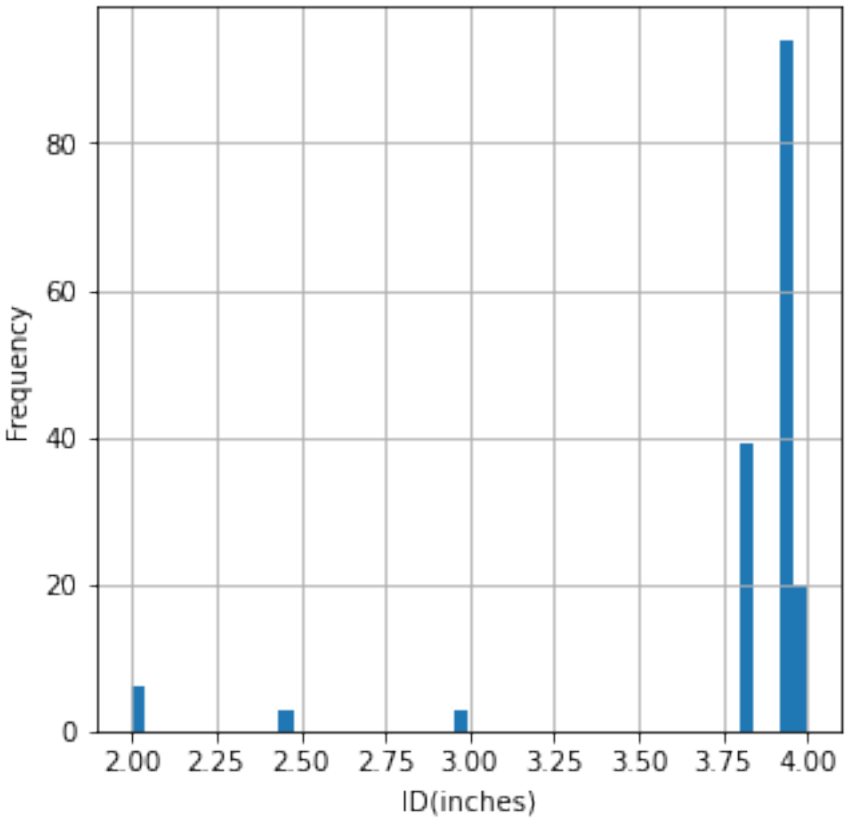


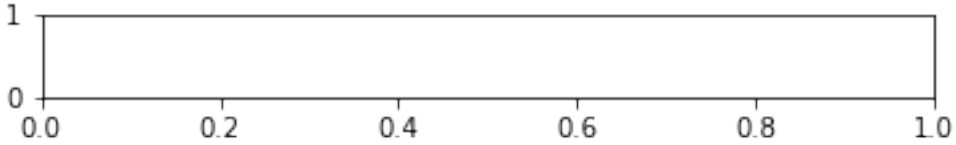

12
10
8
6
4
2
0
Frequency
0
2500
5000
7500
10000
12500
15000
17500
20000
Qo(bbl/day)

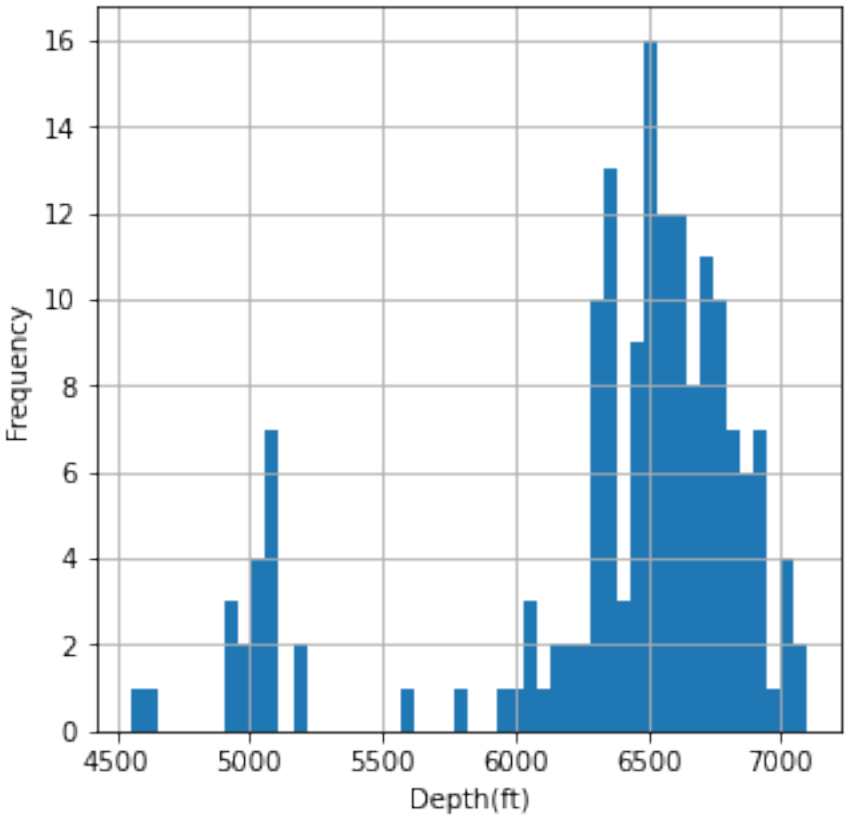

1
0
0.0
0.2
0.4
0.6
0.8
1.0

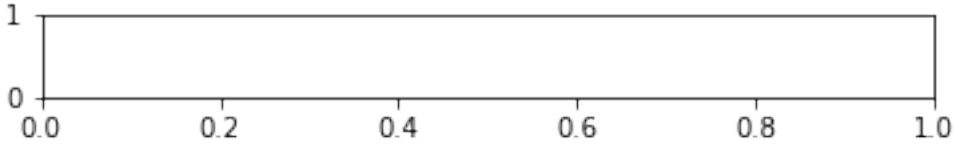

50
40
30
20
10
0
Frequency
0
2000
4000
6000
8000
10000
Qw(bbl/day)

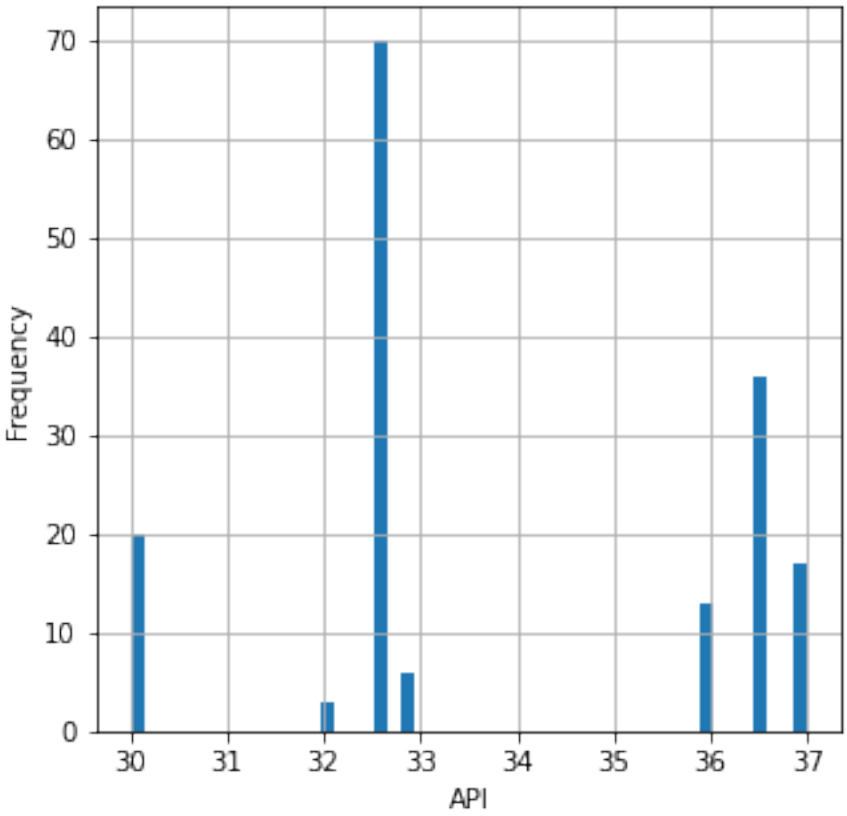

1
0
0.0
0.2
0.4
0.6
0.8
1.0

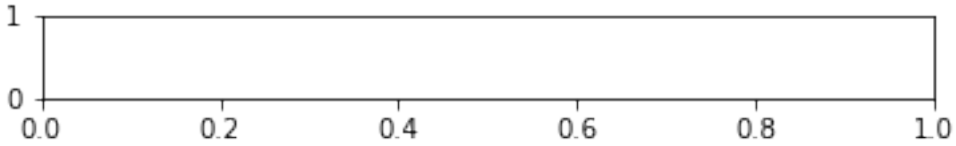

Frequency
0
20
40
60
80
2.00
2.25
2.50
2.75
3.00
3.25
3.50
3.75
4.00
ID(inches)

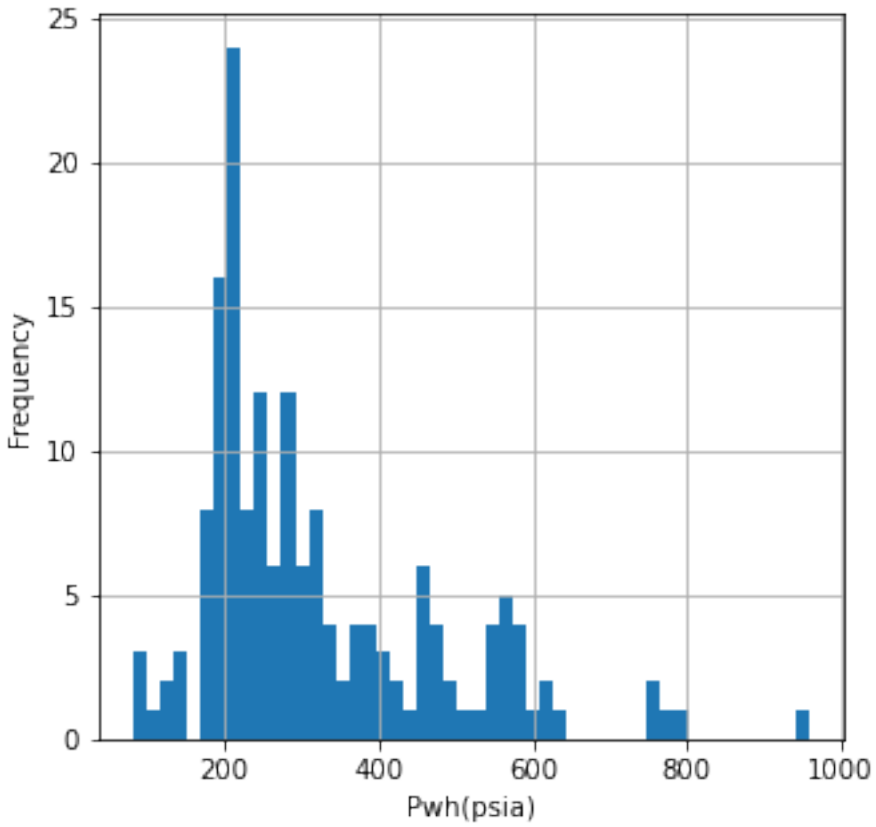

1
0
0.0
0.2
0.4
0.6
0.8
1.0


16
14
12
10
8
6
4
2
0
Frequency
4500
5000
5500
6000
6500
7000
Depth(ft)

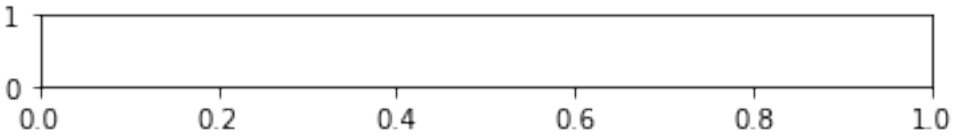

1
0
0.0
0.2
0.4
0.6
0.8
1.0

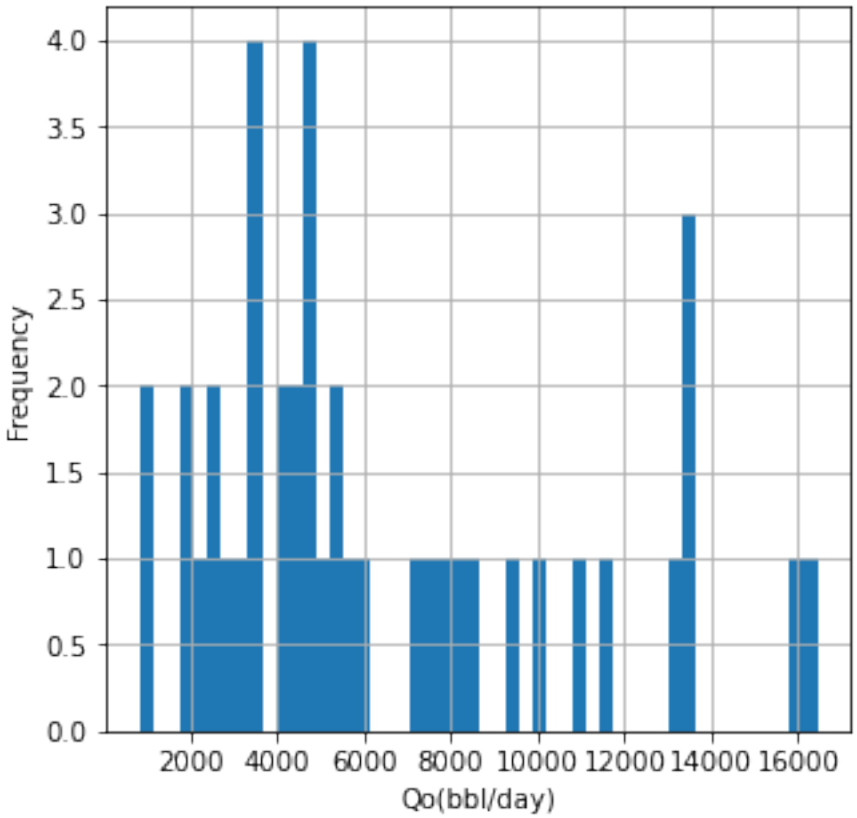

70
60
50
40
30
20
10
0
Frequency
30
31
32
33
34
35
36
37
API

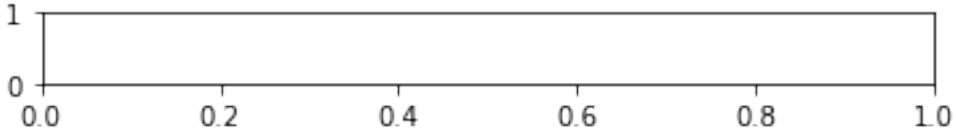

1
0
0.0
0.2
0.4
0.6
0.8
1.0

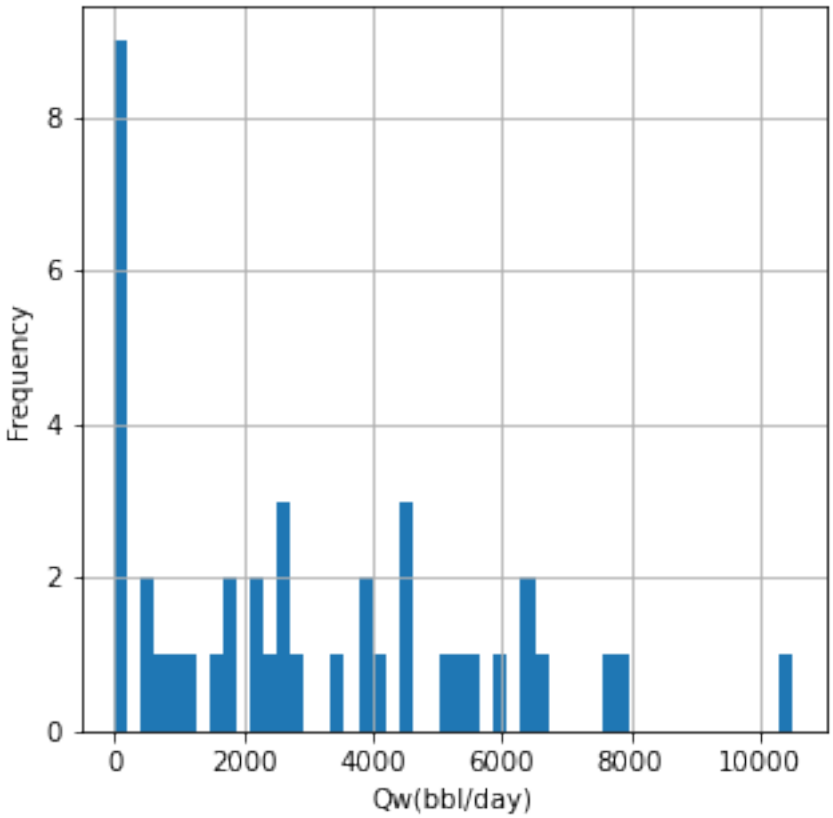


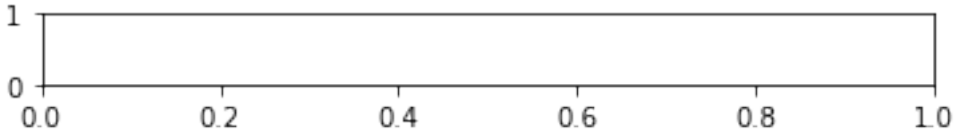
[376]:
```
# Plot the histogram of test daat
for i in range (len(dtest.columns)):
  plt.subplot(7,1,i+1)
  plt.figure(figsize = (5, 5))
  plt.hist(dtest[dtest.columns[i]],bins = 50)

  plt.xlabel(dt.columns[i])
  plt.ylabel("Frequency")
  plt.grid()
  plt.show();
```

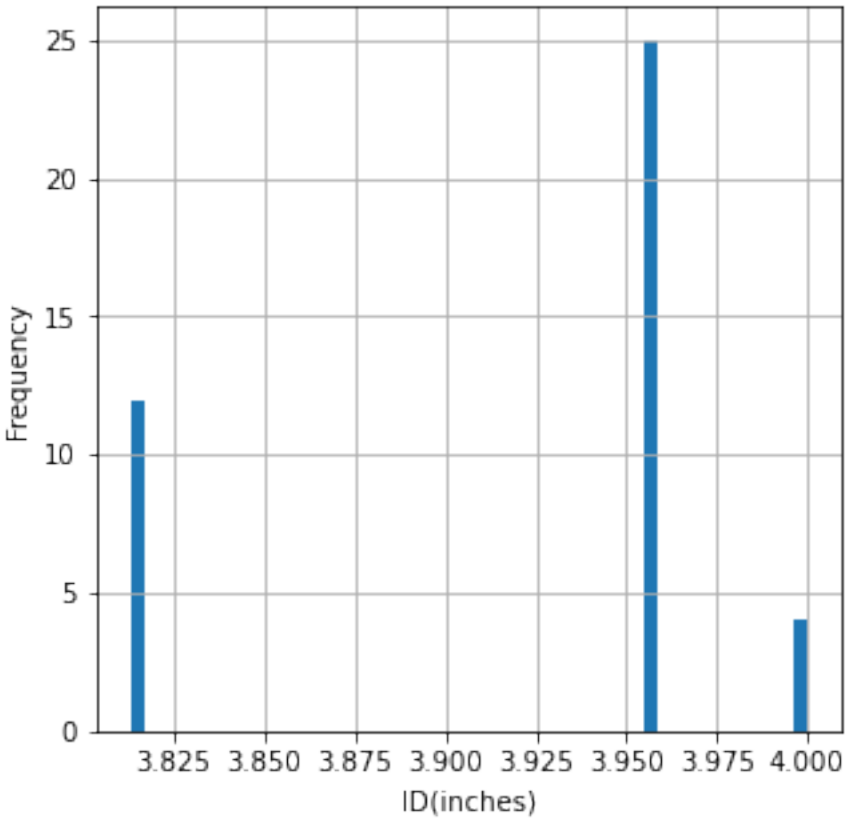


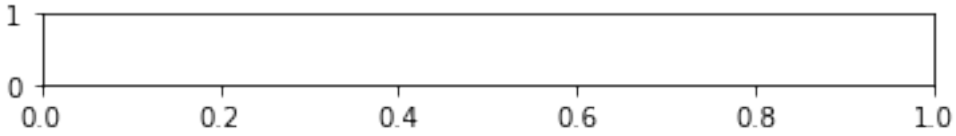

4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Frequency
2000
4000
6000
8000
10000
12000
14000
16000
Qo(bbl/day)

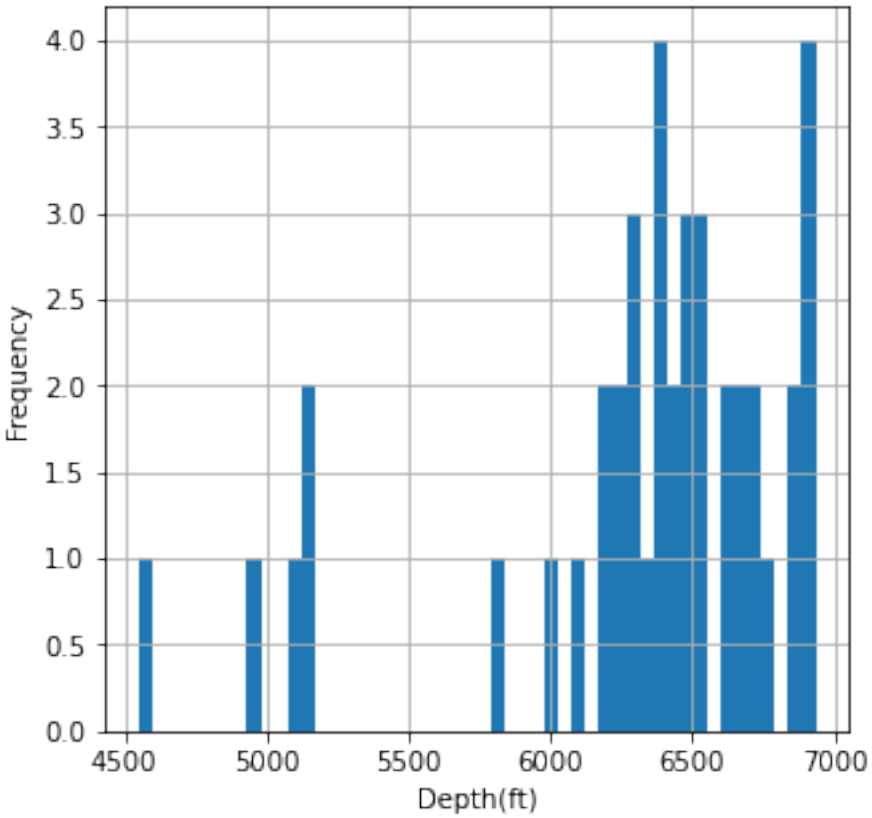

1
0
0.0
0.2
0.4
0.6
0.8
1.0

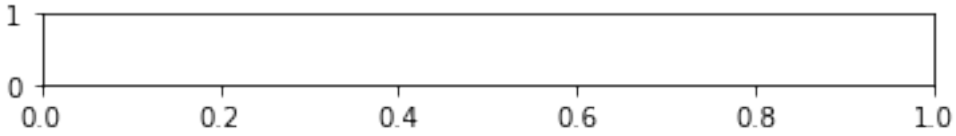

Frequency
8
6
4
2
0
0
2000
4000
6000
8000
10000
Qw(bbl/day)

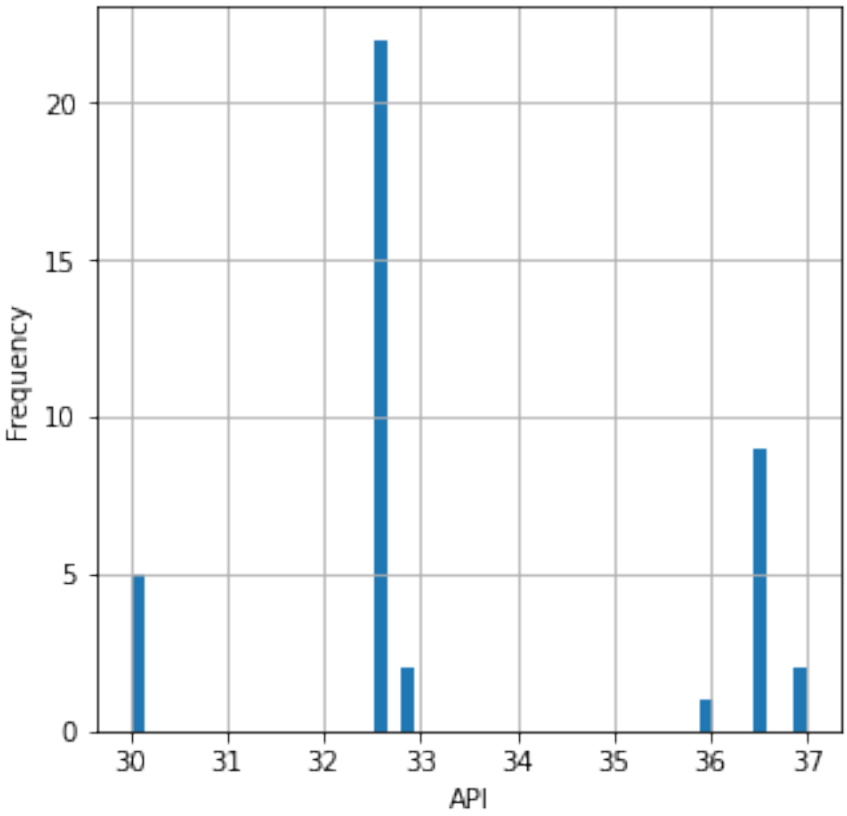

1
0
0.0
0.2
0.4
0.6
0.8
1.0

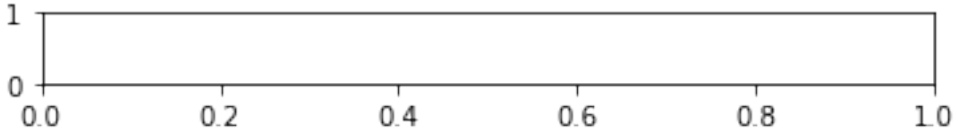

25
20
15
10
5
0
Frequency
3.825
3.850
3.875
3.900
3.925
3.950
3.975
4.000
ID(inches)

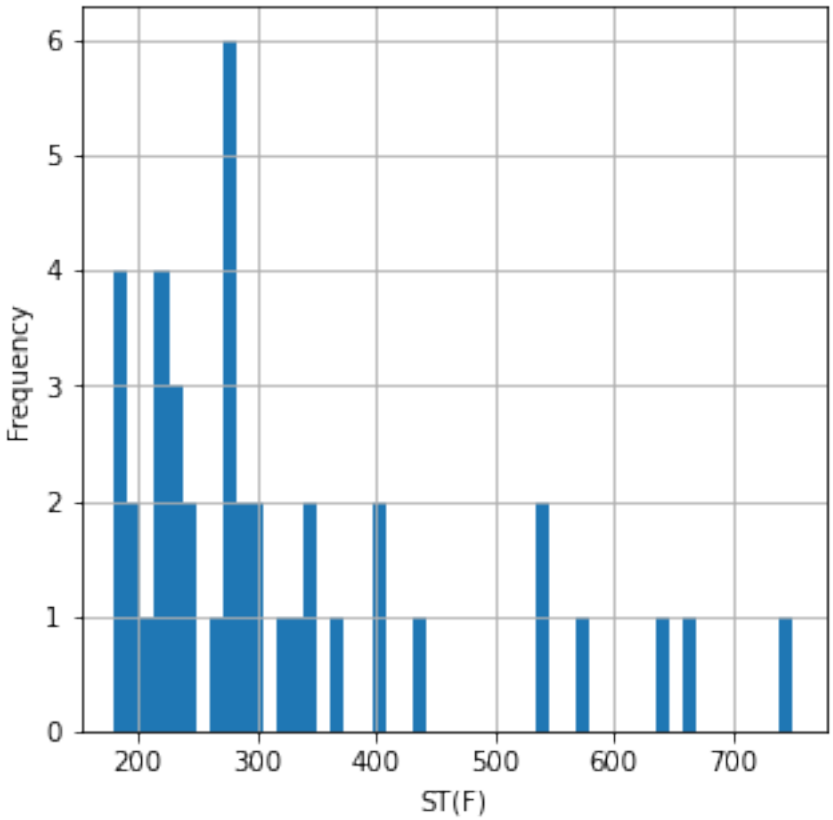

1
0
0.0
0.2
0.4
0.6
0.8
1.0


4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Frequency
4500
5000
5500
6000
6500
7000
Depth(ft)


1
0
0.0
0.2
0.4
0.6
0.8
1.0


Frequency
20
15
10
5
0
30
31
32
33
34
35
36
37
API


1
0
0.0
0.2
0.4
0.6
0.8
1.0



5 Scaling the input dataset

[24]:
```
from sklearn.preprocessing import MinMaxScaler
scaler = MinMaxScaler()
```

[25]:
```
# to prevent data leakage fit only to the train
scaler.fit(X_train)
```

[25]: MinMaxScaler()

[26]:
```
X_test = scaler.transform(X_test)
X_train = scaler.transform(X_train)
```

[27]:
```
X_train.max()
```

[27]: 1.0

[28]:
```
import tensorflow as tf
```

[129]:
```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Activation
```

[ ]:
```
# Improving the ANN
# Dropout Regularization to reduce overfitting if needed

# Tuning the ANN
from tensorflow.keras.wrappers.scikit_learn import KerasRegressor
from sklearn.model_selection import GridSearchCV
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
def build_regressor(optimizer):
    regressor = Sequential()
    regressor.add(Dense(units = 6, kernel_initializer = 'uniform', activation =␣
 ↪'relu', input_dim = 6))
    regressor.add(Dense(units = 6, kernel_initializer = 'uniform', activation =␣
 ↪'relu'))
    regressor.add(Dense(units = 1, kernel_initializer = 'uniform', activation =␣
 ↪'sigmoid'))
    regressor.compile(optimizer = optimizer, loss = 'mse')
    return regressor
regressor = KerasRegressor(build_fn = build_regressor)
parameters = {'batch_size': [25, 32],
              'epochs': [100, 1000],
              'optimizer': ['adam', 'rmsprop']}
grid_search = GridSearchCV(estimator = regressor,
                           param_grid = parameters,
                           cv = 10)
grid_search = grid_search.fit(X_train, y_train)
best_parameters = grid_search.best_params_
best_accuracy = grid_search.best_score_
```

[130]:
```
model = Sequential()

model.add(Dense(50,activation='relu'))
model.add(Dense(50,activation='relu'))
model.add(Dense(50,activation='relu'))
model.add(Dense(50,activation='relu'))
model.add(Dense(50,activation='relu'))
model.add(Dense(50,activation='relu'))
model.add(Dense(50,activation='relu'))
model.add(Dense(50,activation='relu'))
model.add(Dense(50,activation='relu'))
# Final output node for prediction
model.add(Dense(1))

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

[131]:
```
model.fit(X_train,y_train,epochs=1000)
```

```
Epoch 1/1000
6/6 [==============================] - 0s 1ms/step - loss: 6328302.5000
Epoch 2/1000
6/6 [==============================] - 0s 1ms/step - loss: 6327314.5000
Epoch 3/1000
6/6 [==============================] - 0s 1ms/step - loss: 6324252.5000
Epoch 4/1000
6/6 [==============================] - 0s 1ms/step - loss: 6315058.0000
Epoch 5/1000
6/6 [==============================] - 0s 1ms/step - loss: 6288546.0000
Epoch 6/1000
6/6 [==============================] - 0s 1ms/step - loss: 6211128.0000
Epoch 7/1000
6/6 [==============================] - 0s 1ms/step - loss: 5989972.5000
Epoch 8/1000
6/6 [==============================] - 0s 1ms/step - loss: 5373073.0000
Epoch 9/1000
6/6 [==============================] - 0s 2ms/step - loss: 3842849.7500
Epoch 10/1000
6/6 [==============================] - 0s 1ms/step - loss: 1111060.1250
Epoch 11/1000
6/6 [==============================] - 0s 1ms/step - loss: 682903.4375
Epoch 12/1000
6/6 [==============================] - 0s 1ms/step - loss: 217793.7031
Epoch 13/1000
6/6 [==============================] - 0s 1ms/step - loss: 316915.3438
Epoch 14/1000
6/6 [==============================] - 0s 1ms/step - loss: 195450.2344
Epoch 15/1000
6/6 [==============================] - 0s 1ms/step - loss: 161199.1094
Epoch 16/1000
6/6 [==============================] - 0s 1ms/step - loss: 137172.2031
Epoch 17/1000
6/6 [==============================] - 0s 1ms/step - loss: 126399.2578
Epoch 18/1000
6/6 [==============================] - 0s 1ms/step - loss: 112338.4609
Epoch 19/1000
6/6 [==============================] - 0s 1ms/step - loss: 105416.6797
Epoch 20/1000
6/6 [==============================] - 0s 1ms/step - loss: 97426.5156
Epoch 21/1000
6/6 [==============================] - 0s 2ms/step - loss: 90161.7969
Epoch 22/1000
6/6 [==============================] - 0s 1ms/step - loss: 85199.1875
Epoch 23/1000
6/6 [==============================] - 0s 2ms/step - loss: 77995.8125
```

```
Epoch 24/1000
6/6 [==============================] - 0s 1ms/step - loss: 73279.6641
Epoch 25/1000
6/6 [==============================] - 0s 1ms/step - loss: 70109.6094
Epoch 26/1000
6/6 [==============================] - 0s 2ms/step - loss: 63867.2188
Epoch 27/1000
6/6 [==============================] - 0s 997us/step - loss: 60258.7344
Epoch 28/1000
6/6 [==============================] - 0s 2ms/step - loss: 57784.1953
Epoch 29/1000
6/6 [==============================] - 0s 1ms/step - loss: 53615.4062
Epoch 30/1000
6/6 [==============================] - 0s 1ms/step - loss: 51838.2305
Epoch 31/1000
6/6 [==============================] - 0s 1ms/step - loss: 47304.8789
Epoch 32/1000
6/6 [==============================] - 0s 1ms/step - loss: 49084.9375
Epoch 33/1000
6/6 [==============================] - 0s 1ms/step - loss: 42773.1406
Epoch 34/1000
6/6 [==============================] - 0s 1ms/step - loss: 41342.0781
Epoch 35/1000
6/6 [==============================] - 0s 1ms/step - loss: 40828.7500
Epoch 36/1000
6/6 [==============================] - 0s 1ms/step - loss: 39273.5469
Epoch 37/1000
6/6 [==============================] - 0s 1ms/step - loss: 38214.8984
Epoch 38/1000
6/6 [==============================] - 0s 2ms/step - loss: 39311.7109
Epoch 39/1000
6/6 [==============================] - 0s 1ms/step - loss: 35443.8477
Epoch 40/1000
6/6 [==============================] - 0s 1ms/step - loss: 34362.9023
Epoch 41/1000
6/6 [==============================] - 0s 1ms/step - loss: 34027.1641
Epoch 42/1000
6/6 [==============================] - 0s 1ms/step - loss: 33013.9141
Epoch 43/1000
6/6 [==============================] - 0s 1ms/step - loss: 32473.5273
Epoch 44/1000
6/6 [==============================] - 0s 1ms/step - loss: 33028.4531
Epoch 45/1000
6/6 [==============================] - 0s 1ms/step - loss: 31950.5312
Epoch 46/1000
6/6 [==============================] - 0s 1ms/step - loss: 30924.0918
Epoch 47/1000
6/6 [==============================] - 0s 1ms/step - loss: 30972.9941
```

```
Epoch 48/1000
6/6 [==============================] - 0s 1ms/step - loss: 30424.0176
Epoch 49/1000
6/6 [==============================] - 0s 1ms/step - loss: 29441.4727
Epoch 50/1000
6/6 [==============================] - 0s 1ms/step - loss: 29127.8086
Epoch 51/1000
6/6 [==============================] - 0s 995us/step - loss: 28770.9160
Epoch 52/1000
6/6 [==============================] - 0s 1ms/step - loss: 28634.6602
Epoch 53/1000
6/6 [==============================] - 0s 997us/step - loss: 29445.5996
Epoch 54/1000
6/6 [==============================] - 0s 1ms/step - loss: 30975.7969
Epoch 55/1000
6/6 [==============================] - 0s 1ms/step - loss: 27147.0723
Epoch 56/1000
6/6 [==============================] - 0s 1ms/step - loss: 28211.6445
Epoch 57/1000
6/6 [==============================] - 0s 1ms/step - loss: 27809.3340
Epoch 58/1000
6/6 [==============================] - 0s 1ms/step - loss: 27639.5723
Epoch 59/1000
6/6 [==============================] - 0s 1ms/step - loss: 26989.0000
Epoch 60/1000
6/6 [==============================] - 0s 2ms/step - loss: 25388.8496
Epoch 61/1000
6/6 [==============================] - 0s 1ms/step - loss: 27313.6035
Epoch 62/1000
6/6 [==============================] - 0s 1ms/step - loss: 27380.0508
Epoch 63/1000
6/6 [==============================] - 0s 1ms/step - loss: 25779.9453
Epoch 64/1000
6/6 [==============================] - 0s 1ms/step - loss: 25060.5098
Epoch 65/1000
6/6 [==============================] - 0s 1ms/step - loss: 25009.5859
Epoch 66/1000
6/6 [==============================] - 0s 1ms/step - loss: 24086.1289
Epoch 67/1000
6/6 [==============================] - 0s 1ms/step - loss: 24249.6875
Epoch 68/1000
6/6 [==============================] - 0s 1ms/step - loss: 25331.6387
Epoch 69/1000
6/6 [==============================] - 0s 1ms/step - loss: 23201.3125
Epoch 70/1000
6/6 [==============================] - 0s 997us/step - loss: 23675.3457
Epoch 71/1000
6/6 [==============================] - 0s 1ms/step - loss: 23144.9570
```

```
Epoch 72/1000
6/6 [==============================] - 0s 1ms/step - loss: 23573.8418
Epoch 73/1000
6/6 [==============================] - 0s 1ms/step - loss: 22553.4277
Epoch 74/1000
6/6 [==============================] - 0s 1ms/step - loss: 23963.8105
Epoch 75/1000
6/6 [==============================] - 0s 1ms/step - loss: 21646.3203
Epoch 76/1000
6/6 [==============================] - 0s 1ms/step - loss: 21727.8008
Epoch 77/1000
6/6 [==============================] - 0s 1ms/step - loss: 22681.2930
Epoch 78/1000
6/6 [==============================] - 0s 1ms/step - loss: 23646.9629
Epoch 79/1000
6/6 [==============================] - 0s 1ms/step - loss: 23193.0625
Epoch 80/1000
6/6 [==============================] - 0s 1ms/step - loss: 21310.2090
Epoch 81/1000
6/6 [==============================] - 0s 1ms/step - loss: 20692.0508
Epoch 82/1000
6/6 [==============================] - 0s 1ms/step - loss: 20228.4258
Epoch 83/1000
6/6 [==============================] - 0s 1ms/step - loss: 20785.9414
Epoch 84/1000
6/6 [==============================] - 0s 1ms/step - loss: 20103.4570
Epoch 85/1000
6/6 [==============================] - 0s 1ms/step - loss: 20211.8594
Epoch 86/1000
6/6 [==============================] - 0s 1ms/step - loss: 20216.7812
Epoch 87/1000
6/6 [==============================] - 0s 1ms/step - loss: 20903.5059
Epoch 88/1000
6/6 [==============================] - 0s 1ms/step - loss: 19820.4043
Epoch 89/1000
6/6 [==============================] - 0s 1ms/step - loss: 19440.6875
Epoch 90/1000
6/6 [==============================] - 0s 1ms/step - loss: 20078.9668
Epoch 91/1000
6/6 [==============================] - 0s 1ms/step - loss: 22132.1855
Epoch 92/1000
6/6 [==============================] - 0s 1ms/step - loss: 22425.7129
Epoch 93/1000
6/6 [==============================] - 0s 1ms/step - loss: 19600.2402
Epoch 94/1000
6/6 [==============================] - 0s 1ms/step - loss: 19813.4746
Epoch 95/1000
6/6 [==============================] - 0s 1ms/step - loss: 18837.2090
```

```
Epoch 96/1000
6/6 [==============================] - 0s 1ms/step - loss: 19444.8750
Epoch 97/1000
6/6 [==============================] - 0s 1ms/step - loss: 20660.3223
Epoch 98/1000
6/6 [==============================] - 0s 1ms/step - loss: 20252.5293
Epoch 99/1000
6/6 [==============================] - 0s 997us/step - loss: 18981.2578
Epoch 100/1000
6/6 [==============================] - 0s 1ms/step - loss: 20445.5781
Epoch 101/1000
6/6 [==============================] - 0s 1ms/step - loss: 18969.4980
Epoch 102/1000
6/6 [==============================] - 0s 1ms/step - loss: 19024.1465
Epoch 103/1000
6/6 [==============================] - 0s 1ms/step - loss: 18032.9355
Epoch 104/1000
6/6 [==============================] - 0s 997us/step - loss: 18275.5664
Epoch 105/1000
6/6 [==============================] - 0s 997us/step - loss: 18380.8066
Epoch 106/1000
6/6 [==============================] - 0s 1ms/step - loss: 18053.2793
Epoch 107/1000
6/6 [==============================] - 0s 997us/step - loss: 17760.6035
Epoch 108/1000
6/6 [==============================] - 0s 1ms/step - loss: 18352.8281
Epoch 109/1000
6/6 [==============================] - 0s 1ms/step - loss: 18908.9297
Epoch 110/1000
6/6 [==============================] - 0s 997us/step - loss: 18211.4727
Epoch 111/1000
6/6 [==============================] - 0s 1ms/step - loss: 18752.3809
Epoch 112/1000
6/6 [==============================] - 0s 997us/step - loss: 18236.5645
Epoch 113/1000
6/6 [==============================] - 0s 1ms/step - loss: 17604.7656
Epoch 114/1000
6/6 [==============================] - 0s 1ms/step - loss: 18865.7070
Epoch 115/1000
6/6 [==============================] - 0s 1ms/step - loss: 21200.8965
Epoch 116/1000
6/6 [==============================] - 0s 1ms/step - loss: 19763.0840
Epoch 117/1000
6/6 [==============================] - 0s 997us/step - loss: 19246.3906
Epoch 118/1000
6/6 [==============================] - 0s 1ms/step - loss: 18487.6875
Epoch 119/1000
6/6 [==============================] - 0s 997us/step - loss: 16685.3457
```

```
Epoch 120/1000
6/6 [==============================] - 0s 1ms/step - loss: 16993.5918
Epoch 121/1000
6/6 [==============================] - 0s 998us/step - loss: 19379.7773
Epoch 122/1000
6/6 [==============================] - 0s 997us/step - loss: 17015.0039
Epoch 123/1000
6/6 [==============================] - 0s 1ms/step - loss: 18072.9707
Epoch 124/1000
6/6 [==============================] - 0s 1ms/step - loss: 17784.4102
Epoch 125/1000
6/6 [==============================] - 0s 1ms/step - loss: 17423.9023
Epoch 126/1000
6/6 [==============================] - 0s 1ms/step - loss: 17051.9355
Epoch 127/1000
6/6 [==============================] - 0s 1ms/step - loss: 17781.8848
Epoch 128/1000
6/6 [==============================] - 0s 1ms/step - loss: 20123.9883
Epoch 129/1000
6/6 [==============================] - 0s 997us/step - loss: 25451.7930
Epoch 130/1000
6/6 [==============================] - 0s 1ms/step - loss: 20777.1270
Epoch 131/1000
6/6 [==============================] - 0s 997us/step - loss: 19732.2676
Epoch 132/1000
6/6 [==============================] - 0s 1ms/step - loss: 17635.1523
Epoch 133/1000
6/6 [==============================] - 0s 997us/step - loss: 20398.2734
Epoch 134/1000
6/6 [==============================] - 0s 1ms/step - loss: 16479.9492
Epoch 135/1000
6/6 [==============================] - 0s 1ms/step - loss: 16725.2969
Epoch 136/1000
6/6 [==============================] - 0s 997us/step - loss: 16475.8320
Epoch 137/1000
6/6 [==============================] - 0s 1ms/step - loss: 18297.6680
Epoch 138/1000
6/6 [==============================] - 0s 1ms/step - loss: 17263.6309
Epoch 139/1000
6/6 [==============================] - 0s 1ms/step - loss: 17013.9648
Epoch 140/1000
6/6 [==============================] - 0s 1ms/step - loss: 22396.5234
Epoch 141/1000
6/6 [==============================] - 0s 1ms/step - loss: 22505.2070
Epoch 142/1000
6/6 [==============================] - 0s 1ms/step - loss: 22085.3105
Epoch 143/1000
6/6 [==============================] - 0s 1ms/step - loss: 20141.1484
```

```
Epoch 144/1000
6/6 [==============================] - 0s 1ms/step - loss: 18853.3008
Epoch 145/1000
6/6 [==============================] - 0s 992us/step - loss: 16306.3438
Epoch 146/1000
6/6 [==============================] - 0s 997us/step - loss: 16282.1035
Epoch 147/1000
6/6 [==============================] - 0s 1ms/step - loss: 15363.7773
Epoch 148/1000
6/6 [==============================] - 0s 997us/step - loss: 15438.8320
Epoch 149/1000
6/6 [==============================] - 0s 1ms/step - loss: 15483.8867
Epoch 150/1000
6/6 [==============================] - 0s 1ms/step - loss: 15891.8545
Epoch 151/1000
6/6 [==============================] - 0s 997us/step - loss: 16068.6016
Epoch 152/1000
6/6 [==============================] - 0s 1ms/step - loss: 15556.2939
Epoch 153/1000
6/6 [==============================] - ETA: 0s - loss: 15838.075 - 0s 997us/step
- loss: 15509.9443
Epoch 154/1000
6/6 [==============================] - 0s 1ms/step - loss: 15357.3076
Epoch 155/1000
6/6 [==============================] - 0s 1ms/step - loss: 15594.0049
Epoch 156/1000
6/6 [==============================] - 0s 1ms/step - loss: 15465.8242
Epoch 157/1000
6/6 [==============================] - 0s 1ms/step - loss: 15093.8496
Epoch 158/1000
6/6 [==============================] - 0s 1ms/step - loss: 15582.2275
Epoch 159/1000
6/6 [==============================] - 0s 1ms/step - loss: 16281.1104
Epoch 160/1000
6/6 [==============================] - 0s 1ms/step - loss: 16875.9219
Epoch 161/1000
6/6 [==============================] - 0s 1ms/step - loss: 15052.6348
Epoch 162/1000
6/6 [==============================] - 0s 1ms/step - loss: 16738.8281
Epoch 163/1000
6/6 [==============================] - 0s 1ms/step - loss: 14903.4336
Epoch 164/1000
6/6 [==============================] - 0s 1ms/step - loss: 15228.3027
Epoch 165/1000
6/6 [==============================] - 0s 1ms/step - loss: 15359.9941
Epoch 166/1000
6/6 [==============================] - 0s 1ms/step - loss: 14857.3027
Epoch 167/1000
```

```
6/6 [==============================] - 0s 1ms/step - loss: 15554.4199
Epoch 168/1000
6/6 [==============================] - 0s 997us/step - loss: 14892.8682
Epoch 169/1000
6/6 [==============================] - 0s 1ms/step - loss: 15444.8936
Epoch 170/1000
6/6 [==============================] - 0s 1ms/step - loss: 16865.1562
Epoch 171/1000
6/6 [==============================] - 0s 1ms/step - loss: 16257.2305
Epoch 172/1000
6/6 [==============================] - 0s 1ms/step - loss: 15468.8291
Epoch 173/1000
6/6 [==============================] - 0s 1ms/step - loss: 14815.4619
Epoch 174/1000
6/6 [==============================] - 0s 1ms/step - loss: 15647.1572
Epoch 175/1000
6/6 [==============================] - 0s 1ms/step - loss: 15580.1699
Epoch 176/1000
6/6 [==============================] - 0s 1ms/step - loss: 14774.1367
Epoch 177/1000
6/6 [==============================] - 0s 1ms/step - loss: 14808.6045
Epoch 178/1000
6/6 [==============================] - 0s 1ms/step - loss: 14499.8818
Epoch 179/1000
6/6 [==============================] - 0s 997us/step - loss: 15466.4951
Epoch 180/1000
6/6 [==============================] - 0s 1ms/step - loss: 15713.4717
Epoch 181/1000
6/6 [==============================] - 0s 1ms/step - loss: 15961.6924
Epoch 182/1000
6/6 [==============================] - 0s 1ms/step - loss: 14144.7744
Epoch 183/1000
6/6 [==============================] - 0s 1ms/step - loss: 14452.3564
Epoch 184/1000
6/6 [==============================] - 0s 1ms/step - loss: 14890.6367
Epoch 185/1000
6/6 [==============================] - 0s 1ms/step - loss: 14910.0762
Epoch 186/1000
6/6 [==============================] - 0s 1ms/step - loss: 14385.8965
Epoch 187/1000
6/6 [==============================] - 0s 1ms/step - loss: 14373.9922
Epoch 188/1000
6/6 [==============================] - 0s 1ms/step - loss: 14758.3848
Epoch 189/1000
6/6 [==============================] - 0s 1ms/step - loss: 14983.9258
Epoch 190/1000
6/6 [==============================] - 0s 1ms/step - loss: 16976.7207
Epoch 191/1000
```

```
6/6 [==============================] - 0s 1ms/step - loss: 15730.7285
Epoch 192/1000
6/6 [==============================] - 0s 1ms/step - loss: 14595.5020
Epoch 193/1000
6/6 [==============================] - 0s 1ms/step - loss: 13745.1104
Epoch 194/1000
6/6 [==============================] - 0s 1ms/step - loss: 14494.9951
Epoch 195/1000
6/6 [==============================] - 0s 1ms/step - loss: 13747.7227
Epoch 196/1000
6/6 [==============================] - 0s 1ms/step - loss: 14189.1621
Epoch 197/1000
6/6 [==============================] - 0s 1ms/step - loss: 16134.8789
Epoch 198/1000
6/6 [==============================] - 0s 1ms/step - loss: 14624.0352
Epoch 199/1000
6/6 [==============================] - 0s 997us/step - loss: 14015.4238
Epoch 200/1000
6/6 [==============================] - 0s 1ms/step - loss: 14371.0898
Epoch 201/1000
6/6 [==============================] - 0s 997us/step - loss: 14172.5557
Epoch 202/1000
6/6 [==============================] - 0s 1ms/step - loss: 14729.4805
Epoch 203/1000
6/6 [==============================] - 0s 1ms/step - loss: 15205.2012
Epoch 204/1000
6/6 [==============================] - 0s 996us/step - loss: 14430.2246
Epoch 205/1000
6/6 [==============================] - 0s 1ms/step - loss: 14471.7754
Epoch 206/1000
6/6 [==============================] - 0s 997us/step - loss: 15240.0195
Epoch 207/1000
6/6 [==============================] - 0s 997us/step - loss: 14912.5557
Epoch 208/1000
6/6 [==============================] - 0s 1ms/step - loss: 13346.4805
Epoch 209/1000
6/6 [==============================] - 0s 997us/step - loss: 14956.1904
Epoch 210/1000
6/6 [==============================] - 0s 1ms/step - loss: 13290.8789
Epoch 211/1000
6/6 [==============================] - 0s 997us/step - loss: 15168.6318
Epoch 212/1000
6/6 [==============================] - 0s 1ms/step - loss: 14201.7715
Epoch 213/1000
6/6 [==============================] - 0s 1ms/step - loss: 13428.9336
Epoch 214/1000
6/6 [==============================] - 0s 1ms/step - loss: 13935.3359
Epoch 215/1000
```

```
6/6 [==============================] - 0s 1ms/step - loss: 13672.4062
Epoch 216/1000
6/6 [==============================] - 0s 997us/step - loss: 15045.4785
Epoch 217/1000
6/6 [==============================] - 0s 1ms/step - loss: 13723.7441
Epoch 218/1000
6/6 [==============================] - 0s 1ms/step - loss: 13093.5215
Epoch 219/1000
6/6 [==============================] - 0s 1ms/step - loss: 15941.3154
Epoch 220/1000
6/6 [==============================] - 0s 1ms/step - loss: 14796.3955
Epoch 221/1000
6/6 [==============================] - 0s 1ms/step - loss: 13321.6807
Epoch 222/1000
6/6 [==============================] - 0s 1ms/step - loss: 12971.8545
Epoch 223/1000
6/6 [==============================] - 0s 1ms/step - loss: 13031.1738
Epoch 224/1000
6/6 [==============================] - 0s 1ms/step - loss: 13035.6152
Epoch 225/1000
6/6 [==============================] - 0s 1ms/step - loss: 14873.6787
Epoch 226/1000
6/6 [==============================] - 0s 1ms/step - loss: 13264.2500
Epoch 227/1000
6/6 [==============================] - 0s 1ms/step - loss: 12812.0244
Epoch 228/1000
6/6 [==============================] - 0s 997us/step - loss: 13254.9717
Epoch 229/1000
6/6 [==============================] - 0s 1ms/step - loss: 13841.3848
Epoch 230/1000
6/6 [==============================] - 0s 997us/step - loss: 13568.7119
Epoch 231/1000
6/6 [==============================] - 0s 1ms/step - loss: 13740.1182
Epoch 232/1000
6/6 [==============================] - 0s 1ms/step - loss: 14595.4756
Epoch 233/1000
6/6 [==============================] - 0s 997us/step - loss: 15386.0088
Epoch 234/1000
6/6 [==============================] - 0s 1ms/step - loss: 12962.0879
Epoch 235/1000
6/6 [==============================] - 0s 1ms/step - loss: 14103.1777
Epoch 236/1000
6/6 [==============================] - 0s 1ms/step - loss: 15433.3662
Epoch 237/1000
6/6 [==============================] - 0s 997us/step - loss: 14812.4336
Epoch 238/1000
6/6 [==============================] - 0s 1ms/step - loss: 13521.4609
Epoch 239/1000
```

```
6/6 [==============================] - 0s 1ms/step - loss: 13107.1641
Epoch 240/1000
6/6 [==============================] - 0s 2ms/step - loss: 12862.3398
Epoch 241/1000
6/6 [==============================] - 0s 1ms/step - loss: 12517.4355
Epoch 242/1000
6/6 [==============================] - 0s 1ms/step - loss: 12528.5615
Epoch 243/1000
6/6 [==============================] - 0s 2ms/step - loss: 12806.1562
Epoch 244/1000
6/6 [==============================] - 0s 1ms/step - loss: 12990.0186
Epoch 245/1000
6/6 [==============================] - 0s 997us/step - loss: 12903.6982
Epoch 246/1000
6/6 [==============================] - 0s 1ms/step - loss: 14711.0107
Epoch 247/1000
6/6 [==============================] - 0s 1ms/step - loss: 13541.1602
Epoch 248/1000
6/6 [==============================] - 0s 1ms/step - loss: 12674.4844
Epoch 249/1000
6/6 [==============================] - 0s 1ms/step - loss: 13103.4971
Epoch 250/1000
6/6 [==============================] - 0s 1ms/step - loss: 15250.8438
Epoch 251/1000
6/6 [==============================] - 0s 997us/step - loss: 13673.1162
Epoch 252/1000
6/6 [==============================] - 0s 1ms/step - loss: 12643.0957
Epoch 253/1000
6/6 [==============================] - 0s 997us/step - loss: 13576.9180
Epoch 254/1000
6/6 [==============================] - 0s 1ms/step - loss: 14756.5439
Epoch 255/1000
6/6 [==============================] - 0s 997us/step - loss: 14578.1572
Epoch 256/1000
6/6 [==============================] - 0s 1ms/step - loss: 13611.8965
Epoch 257/1000
6/6 [==============================] - 0s 1ms/step - loss: 12830.9844
Epoch 258/1000
6/6 [==============================] - 0s 997us/step - loss: 12726.0654
Epoch 259/1000
6/6 [==============================] - 0s 1ms/step - loss: 13830.8350
Epoch 260/1000
6/6 [==============================] - 0s 1ms/step - loss: 13273.7803
Epoch 261/1000
6/6 [==============================] - 0s 997us/step - loss: 11897.5254
Epoch 262/1000
6/6 [==============================] - 0s 998us/step - loss: 12597.5781
Epoch 263/1000
```

```
6/6 [==============================] - 0s 1ms/step - loss: 12953.9287
Epoch 264/1000
6/6 [==============================] - 0s 1ms/step - loss: 12620.7139
Epoch 265/1000
6/6 [==============================] - 0s 1ms/step - loss: 12518.6191
Epoch 266/1000
6/6 [==============================] - 0s 1ms/step - loss: 12019.1836
Epoch 267/1000
6/6 [==============================] - 0s 997us/step - loss: 13566.6807
Epoch 268/1000
6/6 [==============================] - 0s 1ms/step - loss: 13578.5088
Epoch 269/1000
6/6 [==============================] - 0s 1ms/step - loss: 12078.8975
Epoch 270/1000
6/6 [==============================] - 0s 997us/step - loss: 11831.0225
Epoch 271/1000
6/6 [==============================] - 0s 1ms/step - loss: 11850.7188
Epoch 272/1000
6/6 [==============================] - 0s 1ms/step - loss: 11868.2480
Epoch 273/1000
6/6 [==============================] - 0s 1ms/step - loss: 11484.0029
Epoch 274/1000
6/6 [==============================] - 0s 997us/step - loss: 12363.1963
Epoch 275/1000
6/6 [==============================] - 0s 997us/step - loss: 13782.4473
Epoch 276/1000
6/6 [==============================] - 0s 1ms/step - loss: 14256.4229
Epoch 277/1000
6/6 [==============================] - 0s 1ms/step - loss: 14908.5938
Epoch 278/1000
6/6 [==============================] - 0s 1ms/step - loss: 15308.1270
Epoch 279/1000
6/6 [==============================] - 0s 1ms/step - loss: 14467.4365
Epoch 280/1000
6/6 [==============================] - 0s 1ms/step - loss: 13823.0830
Epoch 281/1000
6/6 [==============================] - 0s 1ms/step - loss: 12894.5625
Epoch 282/1000
6/6 [==============================] - 0s 1ms/step - loss: 12542.3447
Epoch 283/1000
6/6 [==============================] - 0s 1ms/step - loss: 12610.4746
Epoch 284/1000
6/6 [==============================] - 0s 1ms/step - loss: 11299.1846
Epoch 285/1000
6/6 [==============================] - ETA: 0s - loss: 14024.061 - 0s 1ms/step -
loss: 13269.2725
Epoch 286/1000
6/6 [==============================] - 0s 1ms/step - loss: 12100.6533
```

```
Epoch 287/1000
6/6 [==============================] - 0s 1ms/step - loss: 14671.7852
Epoch 288/1000
6/6 [==============================] - 0s 1ms/step - loss: 14590.8848
Epoch 289/1000
6/6 [==============================] - 0s 998us/step - loss: 14275.3877
Epoch 290/1000
6/6 [==============================] - 0s 1ms/step - loss: 13040.8271
Epoch 291/1000
6/6 [==============================] - 0s 1ms/step - loss: 12232.6133
Epoch 292/1000
6/6 [==============================] - 0s 1ms/step - loss: 14050.2988
Epoch 293/1000
6/6 [==============================] - 0s 1ms/step - loss: 17217.0977
Epoch 294/1000
6/6 [==============================] - 0s 997us/step - loss: 13884.4756
Epoch 295/1000
6/6 [==============================] - 0s 997us/step - loss: 12058.9072
Epoch 296/1000
6/6 [==============================] - 0s 1ms/step - loss: 10957.1494
Epoch 297/1000
6/6 [==============================] - 0s 997us/step - loss: 10957.3555
Epoch 298/1000
6/6 [==============================] - 0s 1ms/step - loss: 11051.2861
Epoch 299/1000
6/6 [==============================] - 0s 997us/step - loss: 11622.2529
Epoch 300/1000
6/6 [==============================] - 0s 1ms/step - loss: 11357.9746
Epoch 301/1000
6/6 [==============================] - 0s 997us/step - loss: 11734.5557
Epoch 302/1000
6/6 [==============================] - 0s 1ms/step - loss: 12014.0869
Epoch 303/1000
6/6 [==============================] - 0s 1ms/step - loss: 12134.3877
Epoch 304/1000
6/6 [==============================] - 0s 997us/step - loss: 16037.6348
Epoch 305/1000
6/6 [==============================] - 0s 1ms/step - loss: 13532.8213
Epoch 306/1000
6/6 [==============================] - 0s 998us/step - loss: 12978.7471
Epoch 307/1000
6/6 [==============================] - 0s 1ms/step - loss: 11398.4990
Epoch 308/1000
6/6 [==============================] - 0s 1ms/step - loss: 11227.1035
Epoch 309/1000
6/6 [==============================] - 0s 997us/step - loss: 10549.9844
Epoch 310/1000
6/6 [==============================] - 0s 1ms/step - loss: 11647.1221
```

```
Epoch 311/1000
6/6 [==============================] - 0s 997us/step - loss: 11692.6279
Epoch 312/1000
6/6 [==============================] - 0s 997us/step - loss: 12267.0361
Epoch 313/1000
6/6 [==============================] - 0s 1ms/step - loss: 11086.9844
Epoch 314/1000
6/6 [==============================] - 0s 997us/step - loss: 11032.0088
Epoch 315/1000
6/6 [==============================] - 0s 997us/step - loss: 11317.7324
Epoch 316/1000
6/6 [==============================] - 0s 999us/step - loss: 10641.1162
Epoch 317/1000
6/6 [==============================] - 0s 1ms/step - loss: 10498.3779
Epoch 318/1000
6/6 [==============================] - 0s 1ms/step - loss: 11272.1904
Epoch 319/1000
6/6 [==============================] - 0s 1ms/step - loss: 11356.4668
Epoch 320/1000
6/6 [==============================] - 0s 997us/step - loss: 11952.4814
Epoch 321/1000
6/6 [==============================] - 0s 997us/step - loss: 10355.8799
Epoch 322/1000
6/6 [==============================] - 0s 997us/step - loss: 10417.7998
Epoch 323/1000
6/6 [==============================] - 0s 1ms/step - loss: 15771.0166
Epoch 324/1000
6/6 [==============================] - 0s 1ms/step - loss: 12541.9609
Epoch 325/1000
6/6 [==============================] - 0s 1ms/step - loss: 10244.7324
Epoch 326/1000
6/6 [==============================] - 0s 1ms/step - loss: 11667.6133
Epoch 327/1000
6/6 [==============================] - 0s 997us/step - loss: 11155.5791
Epoch 328/1000
6/6 [==============================] - 0s 1ms/step - loss: 11035.5244
Epoch 329/1000
6/6 [==============================] - 0s 997us/step - loss: 10640.3398
Epoch 330/1000
6/6 [==============================] - 0s 996us/step - loss: 10036.9414
Epoch 331/1000
6/6 [==============================] - 0s 997us/step - loss: 11474.6533
Epoch 332/1000
6/6 [==============================] - 0s 1ms/step - loss: 10472.4639
Epoch 333/1000
6/6 [==============================] - 0s 3ms/step - loss: 10859.7109
Epoch 334/1000
6/6 [==============================] - 0s 1ms/step - loss: 10340.2324
```

```
Epoch 335/1000
6/6 [==============================] - 0s 1ms/step - loss: 10599.7012
Epoch 336/1000
6/6 [==============================] - 0s 1ms/step - loss: 10417.2158
Epoch 337/1000
6/6 [==============================] - 0s 1ms/step - loss: 10259.2520
Epoch 338/1000
6/6 [==============================] - 0s 1ms/step - loss: 10264.0527
Epoch 339/1000
6/6 [==============================] - 0s 1ms/step - loss: 11851.4746
Epoch 340/1000
6/6 [==============================] - 0s 1ms/step - loss: 12217.6367
Epoch 341/1000
6/6 [==============================] - 0s 1ms/step - loss: 11016.7588
Epoch 342/1000
6/6 [==============================] - 0s 1ms/step - loss: 12512.7598
Epoch 343/1000
6/6 [==============================] - 0s 1ms/step - loss: 12854.5791
Epoch 344/1000
6/6 [==============================] - 0s 1ms/step - loss: 13187.8818
Epoch 345/1000
6/6 [==============================] - 0s 1ms/step - loss: 15972.6543
Epoch 346/1000
6/6 [==============================] - 0s 1ms/step - loss: 13881.1133
Epoch 347/1000
6/6 [==============================] - 0s 1ms/step - loss: 12854.4209
Epoch 348/1000
6/6 [==============================] - ETA: 0s - loss: 9399.64 - 0s 1ms/step -
loss: 12150.0645
Epoch 349/1000
6/6 [==============================] - 0s 1ms/step - loss: 11523.0645
Epoch 350/1000
6/6 [==============================] - 0s 1ms/step - loss: 10361.3135
Epoch 351/1000
6/6 [==============================] - 0s 997us/step - loss: 11285.4004
Epoch 352/1000
6/6 [==============================] - 0s 1ms/step - loss: 11185.2920
Epoch 353/1000
6/6 [==============================] - 0s 1ms/step - loss: 9921.3604
Epoch 354/1000
6/6 [==============================] - 0s 1ms/step - loss: 10203.4824
Epoch 355/1000
6/6 [==============================] - 0s 997us/step - loss: 9787.8037
Epoch 356/1000
6/6 [==============================] - 0s 1ms/step - loss: 9387.0137
Epoch 357/1000
6/6 [==============================] - 0s 1ms/step - loss: 9397.1104
Epoch 358/1000
```

```
6/6 [==============================] - 0s 1ms/step - loss: 10037.5840
Epoch 359/1000
6/6 [==============================] - 0s 998us/step - loss: 9930.9658
Epoch 360/1000
6/6 [==============================] - 0s 1ms/step - loss: 10366.6484
Epoch 361/1000
6/6 [==============================] - 0s 997us/step - loss: 10509.9346
Epoch 362/1000
6/6 [==============================] - 0s 997us/step - loss: 10956.4404
Epoch 363/1000
6/6 [==============================] - 0s 1ms/step - loss: 9470.7881
Epoch 364/1000
6/6 [==============================] - 0s 1ms/step - loss: 9567.1973
Epoch 365/1000
6/6 [==============================] - 0s 1ms/step - loss: 9439.9668
Epoch 366/1000
6/6 [==============================] - 0s 997us/step - loss: 9248.8965
Epoch 367/1000
6/6 [==============================] - 0s 997us/step - loss: 9410.1758
Epoch 368/1000
6/6 [==============================] - 0s 997us/step - loss: 9173.4912
Epoch 369/1000
6/6 [==============================] - 0s 1ms/step - loss: 10266.2031
Epoch 370/1000
6/6 [==============================] - 0s 1ms/step - loss: 13758.7393
Epoch 371/1000
6/6 [==============================] - 0s 1ms/step - loss: 12947.1641
Epoch 372/1000
6/6 [==============================] - 0s 997us/step - loss: 9935.7148
Epoch 373/1000
6/6 [==============================] - 0s 997us/step - loss: 9696.2666
Epoch 374/1000
6/6 [==============================] - 0s 999us/step - loss: 10130.7344
Epoch 375/1000
6/6 [==============================] - 0s 1ms/step - loss: 12084.8838
Epoch 376/1000
6/6 [==============================] - 0s 1ms/step - loss: 14533.7080
Epoch 377/1000
6/6 [==============================] - 0s 1ms/step - loss: 11576.4541
Epoch 378/1000
6/6 [==============================] - 0s 1ms/step - loss: 9877.9209
Epoch 379/1000
6/6 [==============================] - 0s 1ms/step - loss: 9035.4141
Epoch 380/1000
6/6 [==============================] - 0s 1ms/step - loss: 9171.3496
Epoch 381/1000
6/6 [==============================] - ETA: 0s - loss: 5644.25 - 0s 1ms/step -
loss: 9025.9502
```

```
Epoch 382/1000
6/6 [==============================] - 0s 1ms/step - loss: 8843.3496
Epoch 383/1000
6/6 [==============================] - 0s 1ms/step - loss: 9191.3057
Epoch 384/1000
6/6 [==============================] - 0s 1ms/step - loss: 9243.1758
Epoch 385/1000
6/6 [==============================] - 0s 1ms/step - loss: 9393.1465
Epoch 386/1000
6/6 [==============================] - 0s 1ms/step - loss: 9860.5322
Epoch 387/1000
6/6 [==============================] - 0s 1ms/step - loss: 12479.7393
Epoch 388/1000
6/6 [==============================] - 0s 1ms/step - loss: 12393.3398
Epoch 389/1000
6/6 [==============================] - 0s 1ms/step - loss: 8605.0762
Epoch 390/1000
6/6 [==============================] - 0s 1ms/step - loss: 9438.4609
Epoch 391/1000
6/6 [==============================] - 0s 1ms/step - loss: 8579.9541
Epoch 392/1000
6/6 [==============================] - 0s 1ms/step - loss: 10523.8916
Epoch 393/1000
6/6 [==============================] - 0s 1ms/step - loss: 10041.5039
Epoch 394/1000
6/6 [==============================] - 0s 1ms/step - loss: 9044.2607
Epoch 395/1000
6/6 [==============================] - 0s 997us/step - loss: 11908.8828
Epoch 396/1000
6/6 [==============================] - 0s 1ms/step - loss: 9331.6846
Epoch 397/1000
6/6 [==============================] - 0s 1ms/step - loss: 8692.6348
Epoch 398/1000
6/6 [==============================] - 0s 997us/step - loss: 9114.1836
Epoch 399/1000
6/6 [==============================] - 0s 1ms/step - loss: 9168.4443
Epoch 400/1000
6/6 [==============================] - 0s 997us/step - loss: 8947.0381
Epoch 401/1000
6/6 [==============================] - 0s 1ms/step - loss: 9576.9072
Epoch 402/1000
6/6 [==============================] - 0s 1ms/step - loss: 13493.5518
Epoch 403/1000
6/6 [==============================] - 0s 997us/step - loss: 9754.6094
Epoch 404/1000
6/6 [==============================] - 0s 1ms/step - loss: 12049.3291
Epoch 405/1000
6/6 [==============================] - 0s 1ms/step - loss: 11945.1221
```

```
Epoch 406/1000
6/6 [==============================] - 0s 1ms/step - loss: 16662.9980
Epoch 407/1000
6/6 [==============================] - 0s 1ms/step - loss: 11165.8535
Epoch 408/1000
6/6 [==============================] - 0s 997us/step - loss: 15245.1289
Epoch 409/1000
6/6 [==============================] - 0s 1ms/step - loss: 17075.2891
Epoch 410/1000
6/6 [==============================] - 0s 1ms/step - loss: 11638.3115
Epoch 411/1000
6/6 [==============================] - 0s 1ms/step - loss: 12642.1895
Epoch 412/1000
6/6 [==============================] - 0s 1ms/step - loss: 9415.8623
Epoch 413/1000
6/6 [==============================] - 0s 1ms/step - loss: 10119.7266
Epoch 414/1000
6/6 [==============================] - 0s 1ms/step - loss: 9730.1318
Epoch 415/1000
6/6 [==============================] - 0s 1ms/step - loss: 10134.1807
Epoch 416/1000
6/6 [==============================] - 0s 1ms/step - loss: 8492.9443
Epoch 417/1000
6/6 [==============================] - 0s 1ms/step - loss: 8432.0391
Epoch 418/1000
6/6 [==============================] - 0s 1ms/step - loss: 8829.4951
Epoch 419/1000
6/6 [==============================] - 0s 1ms/step - loss: 8329.3818
Epoch 420/1000
6/6 [==============================] - 0s 1ms/step - loss: 8566.8877
Epoch 421/1000
6/6 [==============================] - 0s 1ms/step - loss: 9467.9551
Epoch 422/1000
6/6 [==============================] - 0s 997us/step - loss: 8282.8457
Epoch 423/1000
6/6 [==============================] - 0s 1ms/step - loss: 8261.5957
Epoch 424/1000
6/6 [==============================] - 0s 1ms/step - loss: 7983.0923
Epoch 425/1000
6/6 [==============================] - 0s 1ms/step - loss: 8329.6338
Epoch 426/1000
6/6 [==============================] - 0s 997us/step - loss: 8542.6807
Epoch 427/1000
6/6 [==============================] - 0s 1ms/step - loss: 8533.7451
Epoch 428/1000
6/6 [==============================] - 0s 1ms/step - loss: 8295.8564
Epoch 429/1000
6/6 [==============================] - 0s 1ms/step - loss: 7936.8447
```

```
Epoch 430/1000
6/6 [==============================] - 0s 1ms/step - loss: 8648.2637
Epoch 431/1000
6/6 [==============================] - 0s 1ms/step - loss: 9027.4209
Epoch 432/1000
6/6 [==============================] - 0s 997us/step - loss: 13300.2988
Epoch 433/1000
6/6 [==============================] - 0s 1ms/step - loss: 9598.7656
Epoch 434/1000
6/6 [==============================] - 0s 1ms/step - loss: 8403.4141
Epoch 435/1000
6/6 [==============================] - 0s 1ms/step - loss: 8823.9443
Epoch 436/1000
6/6 [==============================] - 0s 1ms/step - loss: 8181.0479
Epoch 437/1000
6/6 [==============================] - 0s 831us/step - loss: 9116.8564
Epoch 438/1000
6/6 [==============================] - 0s 997us/step - loss: 9723.8535
Epoch 439/1000
6/6 [==============================] - 0s 1ms/step - loss: 9755.5322
Epoch 440/1000
6/6 [==============================] - 0s 1ms/step - loss: 12243.1133
Epoch 441/1000
6/6 [==============================] - 0s 1ms/step - loss: 10845.9082
Epoch 442/1000
6/6 [==============================] - 0s 1ms/step - loss: 10452.5010
Epoch 443/1000
6/6 [==============================] - 0s 997us/step - loss: 10235.0059
Epoch 444/1000
6/6 [==============================] - 0s 1ms/step - loss: 8001.8501
Epoch 445/1000
6/6 [==============================] - 0s 997us/step - loss: 7741.6646
Epoch 446/1000
6/6 [==============================] - 0s 1ms/step - loss: 7944.0083
Epoch 447/1000
6/6 [==============================] - 0s 1ms/step - loss: 7910.3696
Epoch 448/1000
6/6 [==============================] - 0s 1ms/step - loss: 8104.8145
Epoch 449/1000
6/6 [==============================] - 0s 1ms/step - loss: 7798.2446
Epoch 450/1000
6/6 [==============================] - 0s 1ms/step - loss: 9204.8428
Epoch 451/1000
6/6 [==============================] - 0s 1ms/step - loss: 9177.6250
Epoch 452/1000
6/6 [==============================] - 0s 1ms/step - loss: 10509.7012
Epoch 453/1000
6/6 [==============================] - 0s 1ms/step - loss: 8778.6846
```

```
Epoch 454/1000
6/6 [==============================] - 0s 997us/step - loss: 8219.7725
Epoch 455/1000
6/6 [==============================] - 0s 1ms/step - loss: 7908.2778
Epoch 456/1000
6/6 [==============================] - 0s 1ms/step - loss: 8037.2280
Epoch 457/1000
6/6 [==============================] - 0s 1ms/step - loss: 10377.8486
Epoch 458/1000
6/6 [==============================] - 0s 997us/step - loss: 9081.3506
Epoch 459/1000
6/6 [==============================] - 0s 1ms/step - loss: 8593.9678
Epoch 460/1000
6/6 [==============================] - 0s 1ms/step - loss: 7608.7798
Epoch 461/1000
6/6 [==============================] - 0s 1ms/step - loss: 7095.4639
Epoch 462/1000
6/6 [==============================] - 0s 997us/step - loss: 7627.0332
Epoch 463/1000
6/6 [==============================] - 0s 1ms/step - loss: 7904.4536
Epoch 464/1000
6/6 [==============================] - 0s 1ms/step - loss: 7399.3242
Epoch 465/1000
6/6 [==============================] - 0s 1ms/step - loss: 7896.4727
Epoch 466/1000
6/6 [==============================] - 0s 1ms/step - loss: 7055.2529
Epoch 467/1000
6/6 [==============================] - 0s 1ms/step - loss: 8184.0581
Epoch 468/1000
6/6 [==============================] - 0s 997us/step - loss: 7962.8120
Epoch 469/1000
6/6 [==============================] - 0s 1ms/step - loss: 8275.9658
Epoch 470/1000
6/6 [==============================] - 0s 997us/step - loss: 8232.9814
Epoch 471/1000
6/6 [==============================] - 0s 997us/step - loss: 8778.7979
Epoch 472/1000
6/6 [==============================] - 0s 997us/step - loss: 12085.7168
Epoch 473/1000
6/6 [==============================] - 0s 1ms/step - loss: 8537.2910
Epoch 474/1000
6/6 [==============================] - 0s 2ms/step - loss: 7983.4688
Epoch 475/1000
6/6 [==============================] - 0s 1ms/step - loss: 9141.1768
Epoch 476/1000
6/6 [==============================] - 0s 1ms/step - loss: 8800.8174
Epoch 477/1000
6/6 [==============================] - 0s 1ms/step - loss: 8254.7461
```

```
Epoch 478/1000
6/6 [==============================] - 0s 1ms/step - loss: 7169.7666
Epoch 479/1000
6/6 [==============================] - 0s 1ms/step - loss: 6860.5889
Epoch 480/1000
6/6 [==============================] - 0s 1ms/step - loss: 7137.6733
Epoch 481/1000
6/6 [==============================] - 0s 1000us/step - loss: 7475.6577
Epoch 482/1000
6/6 [==============================] - 0s 1ms/step - loss: 7586.7969
Epoch 483/1000
6/6 [==============================] - 0s 1ms/step - loss: 8525.4912
Epoch 484/1000
6/6 [==============================] - 0s 1ms/step - loss: 7474.1318
Epoch 485/1000
6/6 [==============================] - 0s 1ms/step - loss: 7473.6343
Epoch 486/1000
6/6 [==============================] - 0s 997us/step - loss: 6806.6992
Epoch 487/1000
6/6 [==============================] - 0s 1ms/step - loss: 6642.5864
Epoch 488/1000
6/6 [==============================] - 0s 997us/step - loss: 6599.5137
Epoch 489/1000
6/6 [==============================] - 0s 1ms/step - loss: 6574.4956
Epoch 490/1000
6/6 [==============================] - 0s 1ms/step - loss: 7844.5332
Epoch 491/1000
6/6 [==============================] - 0s 1ms/step - loss: 6908.5889
Epoch 492/1000
6/6 [==============================] - 0s 1ms/step - loss: 7032.7227
Epoch 493/1000
6/6 [==============================] - 0s 1ms/step - loss: 6584.6562
Epoch 494/1000
6/6 [==============================] - 0s 1ms/step - loss: 7063.3169
Epoch 495/1000
6/6 [==============================] - 0s 1ms/step - loss: 8262.2861
Epoch 496/1000
6/6 [==============================] - 0s 1ms/step - loss: 7376.6426
Epoch 497/1000
6/6 [==============================] - 0s 1ms/step - loss: 8734.7715
Epoch 498/1000
6/6 [==============================] - 0s 1ms/step - loss: 7669.9258
Epoch 499/1000
6/6 [==============================] - 0s 1ms/step - loss: 6368.6128
Epoch 500/1000
6/6 [==============================] - 0s 1ms/step - loss: 6349.4888
Epoch 501/1000
6/6 [==============================] - 0s 1ms/step - loss: 6682.8540
```

```
Epoch 502/1000
6/6 [==============================] - 0s 1ms/step - loss: 6351.5542
Epoch 503/1000
6/6 [==============================] - 0s 997us/step - loss: 6643.0728
Epoch 504/1000
6/6 [==============================] - 0s 1ms/step - loss: 6684.3984
Epoch 505/1000
6/6 [==============================] - 0s 1ms/step - loss: 17611.3691
Epoch 506/1000
6/6 [==============================] - 0s 1ms/step - loss: 12979.6367
Epoch 507/1000
6/6 [==============================] - 0s 1ms/step - loss: 10141.7988
Epoch 508/1000
6/6 [==============================] - 0s 997us/step - loss: 11103.6943
Epoch 509/1000
6/6 [==============================] - 0s 1ms/step - loss: 13067.8262
Epoch 510/1000
6/6 [==============================] - 0s 1ms/step - loss: 8841.4951
Epoch 511/1000
6/6 [==============================] - 0s 1ms/step - loss: 6892.3706
Epoch 512/1000
6/6 [==============================] - 0s 1ms/step - loss: 8233.1201
Epoch 513/1000
6/6 [==============================] - 0s 1ms/step - loss: 7134.3750
Epoch 514/1000
6/6 [==============================] - 0s 1ms/step - loss: 7748.8613
Epoch 515/1000
6/6 [==============================] - 0s 1ms/step - loss: 7726.7900
Epoch 516/1000
6/6 [==============================] - 0s 997us/step - loss: 6202.9453
Epoch 517/1000
6/6 [==============================] - 0s 1ms/step - loss: 6125.9624
Epoch 518/1000
6/6 [==============================] - 0s 1ms/step - loss: 7178.5205
Epoch 519/1000
6/6 [==============================] - 0s 1ms/step - loss: 6303.7070
Epoch 520/1000
6/6 [==============================] - 0s 1ms/step - loss: 6218.3286
Epoch 521/1000
6/6 [==============================] - 0s 1ms/step - loss: 6196.1562
Epoch 522/1000
6/6 [==============================] - 0s 1ms/step - loss: 6800.2197
Epoch 523/1000
6/6 [==============================] - 0s 1ms/step - loss: 6073.4482
Epoch 524/1000
6/6 [==============================] - 0s 997us/step - loss: 5905.6611
Epoch 525/1000
6/6 [==============================] - 0s 1ms/step - loss: 5908.2188
```

```
Epoch 526/1000
6/6 [==============================] - 0s 1ms/step - loss: 6029.8271
Epoch 527/1000
6/6 [==============================] - 0s 997us/step - loss: 6852.4243
Epoch 528/1000
6/6 [==============================] - 0s 1ms/step - loss: 6673.7915
Epoch 529/1000
6/6 [==============================] - 0s 997us/step - loss: 6204.5620
Epoch 530/1000
6/6 [==============================] - 0s 997us/step - loss: 6828.1333
Epoch 531/1000
6/6 [==============================] - 0s 1ms/step - loss: 6374.0752
Epoch 532/1000
6/6 [==============================] - 0s 997us/step - loss: 6449.2212
Epoch 533/1000
6/6 [==============================] - 0s 1ms/step - loss: 9132.9609
Epoch 534/1000
6/6 [==============================] - 0s 831us/step - loss: 8433.7461
Epoch 535/1000
6/6 [==============================] - 0s 1ms/step - loss: 8762.4961
Epoch 536/1000
6/6 [==============================] - 0s 1ms/step - loss: 7831.4351
Epoch 537/1000
6/6 [==============================] - 0s 1ms/step - loss: 7968.3643
Epoch 538/1000
6/6 [==============================] - 0s 1ms/step - loss: 7161.4976
Epoch 539/1000
6/6 [==============================] - 0s 997us/step - loss: 6751.9629
Epoch 540/1000
6/6 [==============================] - 0s 1ms/step - loss: 6215.9316
Epoch 541/1000
6/6 [==============================] - 0s 997us/step - loss: 5893.9341
Epoch 542/1000
6/6 [==============================] - 0s 1ms/step - loss: 5829.5415
Epoch 543/1000
6/6 [==============================] - 0s 1ms/step - loss: 5609.2964
Epoch 544/1000
6/6 [==============================] - 0s 1ms/step - loss: 5919.0527
Epoch 545/1000
6/6 [==============================] - 0s 1ms/step - loss: 5552.4097
Epoch 546/1000
6/6 [==============================] - 0s 997us/step - loss: 5539.4419
Epoch 547/1000
6/6 [==============================] - 0s 1ms/step - loss: 6443.7637
Epoch 548/1000
6/6 [==============================] - 0s 1ms/step - loss: 5639.3862
Epoch 549/1000
6/6 [==============================] - 0s 1ms/step - loss: 5573.2949
```

```
Epoch 550/1000
6/6 [==============================] - 0s 1ms/step - loss: 5667.3662
Epoch 551/1000
6/6 [==============================] - 0s 2ms/step - loss: 6518.8843
Epoch 552/1000
6/6 [==============================] - 0s 1ms/step - loss: 6632.3667
Epoch 553/1000
6/6 [==============================] - 0s 1ms/step - loss: 8119.4614
Epoch 554/1000
6/6 [==============================] - 0s 1ms/step - loss: 6403.9653
Epoch 555/1000
6/6 [==============================] - 0s 1ms/step - loss: 5544.2334
Epoch 556/1000
6/6 [==============================] - 0s 1ms/step - loss: 6096.3003
Epoch 557/1000
6/6 [==============================] - 0s 1ms/step - loss: 5877.2104
Epoch 558/1000
6/6 [==============================] - 0s 1ms/step - loss: 6475.3232
Epoch 559/1000
6/6 [==============================] - 0s 1ms/step - loss: 6198.1646
Epoch 560/1000
6/6 [==============================] - 0s 1ms/step - loss: 9117.0732
Epoch 561/1000
6/6 [==============================] - 0s 1ms/step - loss: 8832.3711
Epoch 562/1000
6/6 [==============================] - 0s 1ms/step - loss: 8132.1221
Epoch 563/1000
6/6 [==============================] - 0s 1ms/step - loss: 7502.1699
Epoch 564/1000
6/6 [==============================] - 0s 1ms/step - loss: 6813.3779
Epoch 565/1000
6/6 [==============================] - 0s 1ms/step - loss: 7240.9878
Epoch 566/1000
6/6 [==============================] - 0s 1ms/step - loss: 6004.6895
Epoch 567/1000
6/6 [==============================] - 0s 997us/step - loss: 5947.9121
Epoch 568/1000
6/6 [==============================] - 0s 1ms/step - loss: 7119.1372
Epoch 569/1000
6/6 [==============================] - 0s 1ms/step - loss: 7909.9106
Epoch 570/1000
6/6 [==============================] - 0s 1ms/step - loss: 5620.6465
Epoch 571/1000
6/6 [==============================] - 0s 1ms/step - loss: 7440.5669
Epoch 572/1000
6/6 [==============================] - 0s 1ms/step - loss: 7038.8608
Epoch 573/1000
6/6 [==============================] - 0s 1ms/step - loss: 6423.9282
```

```
Epoch 574/1000
6/6 [==============================] - 0s 997us/step - loss: 6787.1279
Epoch 575/1000
6/6 [==============================] - 0s 997us/step - loss: 7177.4160
Epoch 576/1000
6/6 [==============================] - 0s 1ms/step - loss: 7117.5742
Epoch 577/1000
6/6 [==============================] - 0s 1ms/step - loss: 5984.2793
Epoch 578/1000
6/6 [==============================] - 0s 1ms/step - loss: 5302.0396
Epoch 579/1000
6/6 [==============================] - 0s 997us/step - loss: 6261.4219
Epoch 580/1000
6/6 [==============================] - 0s 1ms/step - loss: 6530.0532
Epoch 581/1000
6/6 [==============================] - 0s 1ms/step - loss: 5926.1890
Epoch 582/1000
6/6 [==============================] - 0s 997us/step - loss: 7195.8540
Epoch 583/1000
6/6 [==============================] - 0s 997us/step - loss: 7044.5439
Epoch 584/1000
6/6 [==============================] - 0s 831us/step - loss: 5726.4595
Epoch 585/1000
6/6 [==============================] - 0s 997us/step - loss: 5610.0581
Epoch 586/1000
6/6 [==============================] - 0s 997us/step - loss: 5651.3223
Epoch 587/1000
6/6 [==============================] - 0s 1ms/step - loss: 5412.4360
Epoch 588/1000
6/6 [==============================] - 0s 1ms/step - loss: 7552.5674
Epoch 589/1000
6/6 [==============================] - 0s 997us/step - loss: 6639.7280
Epoch 590/1000
6/6 [==============================] - 0s 1ms/step - loss: 5202.5151
Epoch 591/1000
6/6 [==============================] - 0s 997us/step - loss: 5434.3149
Epoch 592/1000
6/6 [==============================] - 0s 1ms/step - loss: 5144.1509
Epoch 593/1000
6/6 [==============================] - 0s 998us/step - loss: 5422.5186
Epoch 594/1000
6/6 [==============================] - 0s 997us/step - loss: 6449.8750
Epoch 595/1000
6/6 [==============================] - 0s 1ms/step - loss: 6554.9331
Epoch 596/1000
6/6 [==============================] - 0s 997us/step - loss: 6520.0259
Epoch 597/1000
6/6 [==============================] - 0s 1ms/step - loss: 6089.7749
```

```
Epoch 598/1000
6/6 [==============================] - 0s 997us/step - loss: 5494.3345
Epoch 599/1000
6/6 [==============================] - 0s 1ms/step - loss: 5106.2734
Epoch 600/1000
6/6 [==============================] - 0s 1ms/step - loss: 5250.3960
Epoch 601/1000
6/6 [==============================] - 0s 997us/step - loss: 5993.9780
Epoch 602/1000
6/6 [==============================] - 0s 1ms/step - loss: 6419.3740
Epoch 603/1000
6/6 [==============================] - 0s 1ms/step - loss: 6454.0903
Epoch 604/1000
6/6 [==============================] - 0s 1ms/step - loss: 5344.6514
Epoch 605/1000
6/6 [==============================] - 0s 1ms/step - loss: 5086.3003
Epoch 606/1000
6/6 [==============================] - 0s 1ms/step - loss: 5041.3311
Epoch 607/1000
6/6 [==============================] - 0s 1ms/step - loss: 5077.2104
Epoch 608/1000
6/6 [==============================] - 0s 997us/step - loss: 5374.0757
Epoch 609/1000
6/6 [==============================] - 0s 1ms/step - loss: 4995.7485
Epoch 610/1000
6/6 [==============================] - 0s 1ms/step - loss: 5145.3081
Epoch 611/1000
6/6 [==============================] - 0s 997us/step - loss: 5596.5464
Epoch 612/1000
6/6 [==============================] - 0s 1ms/step - loss: 6018.7134
Epoch 613/1000
6/6 [==============================] - 0s 997us/step - loss: 5583.1143
Epoch 614/1000
6/6 [==============================] - 0s 997us/step - loss: 5024.3950
Epoch 615/1000
6/6 [==============================] - 0s 1ms/step - loss: 6913.8818
Epoch 616/1000
6/6 [==============================] - 0s 1ms/step - loss: 5412.9155
Epoch 617/1000
6/6 [==============================] - 0s 1ms/step - loss: 6939.1582
Epoch 618/1000
6/6 [==============================] - 0s 1ms/step - loss: 5712.8740
Epoch 619/1000
6/6 [==============================] - 0s 1ms/step - loss: 4960.2817
Epoch 620/1000
6/6 [==============================] - 0s 997us/step - loss: 5806.2886
Epoch 621/1000
6/6 [==============================] - 0s 1ms/step - loss: 6546.6963
```

```
Epoch 622/1000
6/6 [==============================] - 0s 1ms/step - loss: 5189.8545
Epoch 623/1000
6/6 [==============================] - 0s 1ms/step - loss: 5694.2612
Epoch 624/1000
6/6 [==============================] - 0s 1ms/step - loss: 5771.2529
Epoch 625/1000
6/6 [==============================] - 0s 1ms/step - loss: 7809.4062
Epoch 626/1000
6/6 [==============================] - 0s 1ms/step - loss: 5468.7236
Epoch 627/1000
6/6 [==============================] - 0s 1ms/step - loss: 6217.2197
Epoch 628/1000
6/6 [==============================] - 0s 1ms/step - loss: 5269.7764
Epoch 629/1000
6/6 [==============================] - 0s 1ms/step - loss: 5077.7427
Epoch 630/1000
6/6 [==============================] - 0s 1ms/step - loss: 5089.8584
Epoch 631/1000
6/6 [==============================] - 0s 1ms/step - loss: 4904.6162
Epoch 632/1000
6/6 [==============================] - 0s 1ms/step - loss: 5526.6260
Epoch 633/1000
6/6 [==============================] - 0s 1ms/step - loss: 5891.1885
Epoch 634/1000
6/6 [==============================] - 0s 1ms/step - loss: 6378.4165
Epoch 635/1000
6/6 [==============================] - 0s 997us/step - loss: 4979.4888
Epoch 636/1000
6/6 [==============================] - 0s 997us/step - loss: 5102.7627
Epoch 637/1000
6/6 [==============================] - 0s 1ms/step - loss: 5966.8931
Epoch 638/1000
6/6 [==============================] - 0s 1ms/step - loss: 6273.8726
Epoch 639/1000
6/6 [==============================] - 0s 997us/step - loss: 6539.2886
Epoch 640/1000
6/6 [==============================] - 0s 1ms/step - loss: 5122.0874
Epoch 641/1000
6/6 [==============================] - 0s 997us/step - loss: 4878.0864
Epoch 642/1000
6/6 [==============================] - 0s 1ms/step - loss: 4813.9111
Epoch 643/1000
6/6 [==============================] - 0s 997us/step - loss: 6350.2349
Epoch 644/1000
6/6 [==============================] - 0s 1ms/step - loss: 5823.5581
Epoch 645/1000
6/6 [==============================] - 0s 1ms/step - loss: 7495.7393
```

```
Epoch 646/1000
6/6 [==============================] - 0s 1ms/step - loss: 6384.1006
Epoch 647/1000
6/6 [==============================] - 0s 1ms/step - loss: 5854.1104
Epoch 648/1000
6/6 [==============================] - 0s 1ms/step - loss: 5532.6099
Epoch 649/1000
6/6 [==============================] - 0s 1ms/step - loss: 6079.3574
Epoch 650/1000
6/6 [==============================] - 0s 1ms/step - loss: 5168.1309
Epoch 651/1000
6/6 [==============================] - 0s 997us/step - loss: 6723.5127
Epoch 652/1000
6/6 [==============================] - 0s 1ms/step - loss: 6548.1816
Epoch 653/1000
6/6 [==============================] - 0s 1ms/step - loss: 5430.4937
Epoch 654/1000
6/6 [==============================] - 0s 1ms/step - loss: 5269.2188
Epoch 655/1000
6/6 [==============================] - 0s 1ms/step - loss: 5628.1768
Epoch 656/1000
6/6 [==============================] - 0s 1ms/step - loss: 5218.8555
Epoch 657/1000
6/6 [==============================] - 0s 1ms/step - loss: 5195.5439
Epoch 658/1000
6/6 [==============================] - 0s 997us/step - loss: 5266.0747
Epoch 659/1000
6/6 [==============================] - 0s 1ms/step - loss: 5226.0620
Epoch 660/1000
6/6 [==============================] - 0s 1ms/step - loss: 4762.4941
Epoch 661/1000
6/6 [==============================] - 0s 997us/step - loss: 4757.7441
Epoch 662/1000
6/6 [==============================] - 0s 1ms/step - loss: 5701.2583
Epoch 663/1000
6/6 [==============================] - 0s 1ms/step - loss: 4923.2119
Epoch 664/1000
6/6 [==============================] - 0s 1ms/step - loss: 4693.3184
Epoch 665/1000
6/6 [==============================] - 0s 1ms/step - loss: 5080.8579
Epoch 666/1000
6/6 [==============================] - 0s 1ms/step - loss: 5091.6309
Epoch 667/1000
6/6 [==============================] - 0s 1ms/step - loss: 5146.4668
Epoch 668/1000
6/6 [==============================] - 0s 1ms/step - loss: 4726.5527
Epoch 669/1000
6/6 [==============================] - 0s 1ms/step - loss: 5228.7329
```

```
Epoch 670/1000
6/6 [==============================] - 0s 1ms/step - loss: 4639.5552
Epoch 671/1000
6/6 [==============================] - 0s 1ms/step - loss: 5062.9165
Epoch 672/1000
6/6 [==============================] - 0s 1ms/step - loss: 5606.2017
Epoch 673/1000
6/6 [==============================] - 0s 1ms/step - loss: 4731.5054
Epoch 674/1000
6/6 [==============================] - 0s 1ms/step - loss: 4771.8213
Epoch 675/1000
6/6 [==============================] - 0s 1ms/step - loss: 5549.3623
Epoch 676/1000
6/6 [==============================] - 0s 1ms/step - loss: 4888.0845
Epoch 677/1000
6/6 [==============================] - 0s 1ms/step - loss: 4617.8110
Epoch 678/1000
6/6 [==============================] - 0s 1ms/step - loss: 5749.6631
Epoch 679/1000
6/6 [==============================] - 0s 1ms/step - loss: 5180.8013
Epoch 680/1000
6/6 [==============================] - 0s 997us/step - loss: 4732.9233
Epoch 681/1000
6/6 [==============================] - 0s 1ms/step - loss: 4460.1860
Epoch 682/1000
6/6 [==============================] - 0s 1ms/step - loss: 5659.3276
Epoch 683/1000
6/6 [==============================] - 0s 1ms/step - loss: 9021.1201
Epoch 684/1000
6/6 [==============================] - 0s 1ms/step - loss: 7063.5244
Epoch 685/1000
6/6 [==============================] - 0s 997us/step - loss: 6008.0200
Epoch 686/1000
6/6 [==============================] - 0s 997us/step - loss: 5013.4722
Epoch 687/1000
6/6 [==============================] - 0s 1ms/step - loss: 5015.4355
Epoch 688/1000
6/6 [==============================] - 0s 997us/step - loss: 4638.5381
Epoch 689/1000
6/6 [==============================] - 0s 1ms/step - loss: 5003.5127
Epoch 690/1000
6/6 [==============================] - 0s 1000us/step - loss: 5782.1309
Epoch 691/1000
6/6 [==============================] - 0s 1ms/step - loss: 5060.1611
Epoch 692/1000
6/6 [==============================] - 0s 1ms/step - loss: 5232.3237
Epoch 693/1000
6/6 [==============================] - 0s 997us/step - loss: 5205.7173
```

```
Epoch 694/1000
6/6 [==============================] - 0s 1ms/step - loss: 4983.6548
Epoch 695/1000
6/6 [==============================] - 0s 997us/step - loss: 4838.4331
Epoch 696/1000
6/6 [==============================] - 0s 1ms/step - loss: 5066.5210
Epoch 697/1000
6/6 [==============================] - 0s 831us/step - loss: 5887.6357
Epoch 698/1000
6/6 [==============================] - 0s 997us/step - loss: 5921.3696
Epoch 699/1000
6/6 [==============================] - 0s 997us/step - loss: 5305.6631
Epoch 700/1000
6/6 [==============================] - 0s 1ms/step - loss: 5345.4673
Epoch 701/1000
6/6 [==============================] - 0s 1ms/step - loss: 5041.3613
Epoch 702/1000
6/6 [==============================] - 0s 997us/step - loss: 5569.7222
Epoch 703/1000
6/6 [==============================] - 0s 997us/step - loss: 4930.2593
Epoch 704/1000
6/6 [==============================] - 0s 997us/step - loss: 4883.8657
Epoch 705/1000
6/6 [==============================] - 0s 997us/step - loss: 4891.4561
Epoch 706/1000
6/6 [==============================] - 0s 1ms/step - loss: 4580.7021
Epoch 707/1000
6/6 [==============================] - 0s 997us/step - loss: 5608.4805
Epoch 708/1000
6/6 [==============================] - 0s 997us/step - loss: 6316.7466
Epoch 709/1000
6/6 [==============================] - 0s 997us/step - loss: 7121.0259
Epoch 710/1000
6/6 [==============================] - 0s 1ms/step - loss: 6160.6631
Epoch 711/1000
6/6 [==============================] - 0s 1ms/step - loss: 4641.2544
Epoch 712/1000
6/6 [==============================] - 0s 1ms/step - loss: 4505.7759
Epoch 713/1000
6/6 [==============================] - 0s 1ms/step - loss: 4617.8809
Epoch 714/1000
6/6 [==============================] - 0s 997us/step - loss: 4751.5630
Epoch 715/1000
6/6 [==============================] - 0s 1ms/step - loss: 7029.2842
Epoch 716/1000
6/6 [==============================] - 0s 997us/step - loss: 5664.3042
Epoch 717/1000
6/6 [==============================] - 0s 1ms/step - loss: 5378.2661
```

```
Epoch 718/1000
6/6 [==============================] - 0s 1ms/step - loss: 4657.6113
Epoch 719/1000
6/6 [==============================] - 0s 997us/step - loss: 5686.3438
Epoch 720/1000
6/6 [==============================] - 0s 997us/step - loss: 5300.7314
Epoch 721/1000
6/6 [==============================] - 0s 1ms/step - loss: 5301.2344
Epoch 722/1000
6/6 [==============================] - 0s 1ms/step - loss: 4779.8887
Epoch 723/1000
6/6 [==============================] - 0s 1ms/step - loss: 4815.9224
Epoch 724/1000
6/6 [==============================] - 0s 997us/step - loss: 4276.6294
Epoch 725/1000
6/6 [==============================] - 0s 997us/step - loss: 4923.4053
Epoch 726/1000
6/6 [==============================] - 0s 829us/step - loss: 4803.5601
Epoch 727/1000
6/6 [==============================] - 0s 997us/step - loss: 4757.1304
Epoch 728/1000
6/6 [==============================] - 0s 997us/step - loss: 4688.5210
Epoch 729/1000
6/6 [==============================] - 0s 1ms/step - loss: 4952.8647
Epoch 730/1000
6/6 [==============================] - 0s 1ms/step - loss: 5397.8960
Epoch 731/1000
6/6 [==============================] - 0s 1ms/step - loss: 6858.3320
Epoch 732/1000
6/6 [==============================] - 0s 1ms/step - loss: 7161.2407
Epoch 733/1000
6/6 [==============================] - 0s 997us/step - loss: 7580.8667
Epoch 734/1000
6/6 [==============================] - 0s 1ms/step - loss: 8580.0039
Epoch 735/1000
6/6 [==============================] - 0s 1ms/step - loss: 6170.1392
Epoch 736/1000
6/6 [==============================] - 0s 1ms/step - loss: 5482.0898
Epoch 737/1000
6/6 [==============================] - 0s 997us/step - loss: 6779.3643
Epoch 738/1000
6/6 [==============================] - 0s 1ms/step - loss: 7013.8198
Epoch 739/1000
6/6 [==============================] - 0s 1ms/step - loss: 6055.6597
Epoch 740/1000
6/6 [==============================] - 0s 1ms/step - loss: 4886.7896
Epoch 741/1000
6/6 [==============================] - 0s 1ms/step - loss: 4734.4580
```

```
Epoch 742/1000
6/6 [==============================] - 0s 997us/step - loss: 5168.4248
Epoch 743/1000
6/6 [==============================] - 0s 1ms/step - loss: 6514.3608
Epoch 744/1000
6/6 [==============================] - 0s 1ms/step - loss: 6051.2070
Epoch 745/1000
6/6 [==============================] - 0s 1ms/step - loss: 6671.3721
Epoch 746/1000
6/6 [==============================] - 0s 1ms/step - loss: 8920.5625
Epoch 747/1000
6/6 [==============================] - 0s 1ms/step - loss: 10742.9873
Epoch 748/1000
6/6 [==============================] - 0s 1ms/step - loss: 7759.6045
Epoch 749/1000
6/6 [==============================] - 0s 1ms/step - loss: 5419.2153
Epoch 750/1000
6/6 [==============================] - 0s 997us/step - loss: 5074.8374
Epoch 751/1000
6/6 [==============================] - 0s 997us/step - loss: 4456.4678
Epoch 752/1000
6/6 [==============================] - 0s 997us/step - loss: 4611.1255
Epoch 753/1000
6/6 [==============================] - 0s 1ms/step - loss: 4515.2827
Epoch 754/1000
6/6 [==============================] - 0s 1ms/step - loss: 4504.9741
Epoch 755/1000
6/6 [==============================] - 0s 1ms/step - loss: 5278.7461
Epoch 756/1000
6/6 [==============================] - 0s 1ms/step - loss: 5345.9438
Epoch 757/1000
6/6 [==============================] - 0s 997us/step - loss: 6948.5273
Epoch 758/1000
6/6 [==============================] - 0s 1ms/step - loss: 6007.5459
Epoch 759/1000
6/6 [==============================] - 0s 1ms/step - loss: 5286.7529
Epoch 760/1000
6/6 [==============================] - 0s 1ms/step - loss: 4190.5938
Epoch 761/1000
6/6 [==============================] - 0s 1ms/step - loss: 4186.5659
Epoch 762/1000
6/6 [==============================] - 0s 1ms/step - loss: 4473.8564
Epoch 763/1000
6/6 [==============================] - 0s 1ms/step - loss: 4381.4619
Epoch 764/1000
6/6 [==============================] - 0s 1ms/step - loss: 4887.6104
Epoch 765/1000
6/6 [==============================] - 0s 1ms/step - loss: 4695.5156
```

```
Epoch 766/1000
6/6 [==============================] - 0s 1ms/step - loss: 4951.2427
Epoch 767/1000
6/6 [==============================] - 0s 1ms/step - loss: 5806.5073
Epoch 768/1000
6/6 [==============================] - 0s 1ms/step - loss: 4453.9258
Epoch 769/1000
6/6 [==============================] - 0s 1ms/step - loss: 4411.0376
Epoch 770/1000
6/6 [==============================] - 0s 1ms/step - loss: 4832.7358
Epoch 771/1000
6/6 [==============================] - 0s 997us/step - loss: 4650.7065
Epoch 772/1000
6/6 [==============================] - 0s 1ms/step - loss: 4272.0186
Epoch 773/1000
6/6 [==============================] - 0s 1ms/step - loss: 4826.8843
Epoch 774/1000
6/6 [==============================] - 0s 1ms/step - loss: 4943.2803
Epoch 775/1000
6/6 [==============================] - 0s 1ms/step - loss: 4219.0269
Epoch 776/1000
6/6 [==============================] - 0s 1ms/step - loss: 6118.5186
Epoch 777/1000
6/6 [==============================] - 0s 1ms/step - loss: 5917.2158
Epoch 778/1000
6/6 [==============================] - 0s 1ms/step - loss: 5842.4941
Epoch 779/1000
6/6 [==============================] - 0s 997us/step - loss: 6457.1548
Epoch 780/1000
6/6 [==============================] - 0s 997us/step - loss: 6594.7197
Epoch 781/1000
6/6 [==============================] - 0s 997us/step - loss: 7492.8008
Epoch 782/1000
6/6 [==============================] - 0s 1ms/step - loss: 4710.5747
Epoch 783/1000
6/6 [==============================] - 0s 1ms/step - loss: 6511.7407
Epoch 784/1000
6/6 [==============================] - 0s 997us/step - loss: 5911.3828
Epoch 785/1000
6/6 [==============================] - 0s 997us/step - loss: 7539.6455
Epoch 786/1000
6/6 [==============================] - 0s 998us/step - loss: 11625.0400
Epoch 787/1000
6/6 [==============================] - 0s 997us/step - loss: 8741.5117
Epoch 788/1000
6/6 [==============================] - 0s 1ms/step - loss: 7067.6206
Epoch 789/1000
6/6 [==============================] - 0s 1ms/step - loss: 4622.6377
```

```
Epoch 790/1000
6/6 [==============================] - 0s 1ms/step - loss: 4462.8027
Epoch 791/1000
6/6 [==============================] - 0s 1ms/step - loss: 4610.3613
Epoch 792/1000
6/6 [==============================] - 0s 997us/step - loss: 4259.3433
Epoch 793/1000
6/6 [==============================] - 0s 1ms/step - loss: 4379.1143
Epoch 794/1000
6/6 [==============================] - 0s 995us/step - loss: 4311.2720
Epoch 795/1000
6/6 [==============================] - 0s 1ms/step - loss: 4485.9233
Epoch 796/1000
6/6 [==============================] - 0s 1ms/step - loss: 6860.6235
Epoch 797/1000
6/6 [==============================] - 0s 1ms/step - loss: 4956.7676
Epoch 798/1000
6/6 [==============================] - 0s 1ms/step - loss: 4755.9434
Epoch 799/1000
6/6 [==============================] - 0s 1ms/step - loss: 5952.7690
Epoch 800/1000
6/6 [==============================] - 0s 1ms/step - loss: 6361.3979
Epoch 801/1000
6/6 [==============================] - 0s 1ms/step - loss: 9486.4150
Epoch 802/1000
6/6 [==============================] - 0s 1ms/step - loss: 7405.6982
Epoch 803/1000
6/6 [==============================] - 0s 1ms/step - loss: 4589.4268
Epoch 804/1000
6/6 [==============================] - 0s 1ms/step - loss: 5578.6040
Epoch 805/1000
6/6 [==============================] - 0s 997us/step - loss: 5941.5498
Epoch 806/1000
6/6 [==============================] - 0s 1ms/step - loss: 6072.8164
Epoch 807/1000
6/6 [==============================] - 0s 1ms/step - loss: 5545.6963
Epoch 808/1000
6/6 [==============================] - 0s 1ms/step - loss: 4599.0659
Epoch 809/1000
6/6 [==============================] - 0s 1ms/step - loss: 4662.7656
Epoch 810/1000
6/6 [==============================] - 0s 1ms/step - loss: 5201.0708
Epoch 811/1000
6/6 [==============================] - 0s 1ms/step - loss: 6174.3652
Epoch 812/1000
6/6 [==============================] - 0s 1ms/step - loss: 5950.1621
Epoch 813/1000
6/6 [==============================] - 0s 997us/step - loss: 5928.7812
```

```
Epoch 814/1000
6/6 [==============================] - 0s 1ms/step - loss: 5162.1821
Epoch 815/1000
6/6 [==============================] - 0s 1ms/step - loss: 5062.5908
Epoch 816/1000
6/6 [==============================] - 0s 1ms/step - loss: 5895.3706
Epoch 817/1000
6/6 [==============================] - 0s 1ms/step - loss: 5763.7729
Epoch 818/1000
6/6 [==============================] - 0s 1ms/step - loss: 5845.7197
Epoch 819/1000
6/6 [==============================] - 0s 1ms/step - loss: 4939.8843
Epoch 820/1000
6/6 [==============================] - 0s 1ms/step - loss: 4756.6445
Epoch 821/1000
6/6 [==============================] - 0s 997us/step - loss: 5111.7437
Epoch 822/1000
6/6 [==============================] - 0s 1ms/step - loss: 4106.0596
Epoch 823/1000
6/6 [==============================] - 0s 1ms/step - loss: 4176.1777
Epoch 824/1000
6/6 [==============================] - 0s 1ms/step - loss: 4239.1372
Epoch 825/1000
6/6 [==============================] - 0s 1ms/step - loss: 4121.9165
Epoch 826/1000
6/6 [==============================] - 0s 1ms/step - loss: 4167.7305
Epoch 827/1000
6/6 [==============================] - 0s 1ms/step - loss: 4020.5583
Epoch 828/1000
6/6 [==============================] - 0s 997us/step - loss: 4467.5073
Epoch 829/1000
6/6 [==============================] - 0s 1ms/step - loss: 4325.3857
Epoch 830/1000
6/6 [==============================] - 0s 1ms/step - loss: 6011.6475
Epoch 831/1000
6/6 [==============================] - 0s 1ms/step - loss: 4259.4985
Epoch 832/1000
6/6 [==============================] - 0s 1ms/step - loss: 4455.6797
Epoch 833/1000
6/6 [==============================] - 0s 997us/step - loss: 4664.1772
Epoch 834/1000
6/6 [==============================] - 0s 997us/step - loss: 4391.8198
Epoch 835/1000
6/6 [==============================] - 0s 1ms/step - loss: 4529.1274
Epoch 836/1000
6/6 [==============================] - 0s 1ms/step - loss: 5966.1582
Epoch 837/1000
6/6 [==============================] - 0s 831us/step - loss: 4431.8125
```

```
Epoch 838/1000
6/6 [==============================] - 0s 1ms/step - loss: 4199.6006
Epoch 839/1000
6/6 [==============================] - 0s 1ms/step - loss: 4193.6519
Epoch 840/1000
6/6 [==============================] - 0s 1ms/step - loss: 4294.5757
Epoch 841/1000
6/6 [==============================] - 0s 1ms/step - loss: 4640.5078
Epoch 842/1000
6/6 [==============================] - 0s 1ms/step - loss: 7136.1899
Epoch 843/1000
6/6 [==============================] - 0s 1ms/step - loss: 4480.5718
Epoch 844/1000
6/6 [==============================] - 0s 1ms/step - loss: 4198.8413
Epoch 845/1000
6/6 [==============================] - 0s 997us/step - loss: 4244.6372
Epoch 846/1000
6/6 [==============================] - 0s 1ms/step - loss: 5236.9639
Epoch 847/1000
6/6 [==============================] - 0s 1ms/step - loss: 4375.5303
Epoch 848/1000
6/6 [==============================] - 0s 1ms/step - loss: 3871.9561
Epoch 849/1000
6/6 [==============================] - 0s 1ms/step - loss: 6026.1392
Epoch 850/1000
6/6 [==============================] - 0s 1ms/step - loss: 4670.1597
Epoch 851/1000
6/6 [==============================] - 0s 997us/step - loss: 4795.3594
Epoch 852/1000
6/6 [==============================] - 0s 1ms/step - loss: 4055.8564
Epoch 853/1000
6/6 [==============================] - 0s 1ms/step - loss: 4381.4956
Epoch 854/1000
6/6 [==============================] - 0s 997us/step - loss: 4281.2666
Epoch 855/1000
6/6 [==============================] - 0s 1ms/step - loss: 5836.2783
Epoch 856/1000
6/6 [==============================] - 0s 1ms/step - loss: 4898.4458
Epoch 857/1000
6/6 [==============================] - 0s 1ms/step - loss: 4189.0317
Epoch 858/1000
6/6 [==============================] - 0s 1ms/step - loss: 4229.8032
Epoch 859/1000
6/6 [==============================] - 0s 1ms/step - loss: 4057.0425
Epoch 860/1000
6/6 [==============================] - 0s 1ms/step - loss: 3968.3008
Epoch 861/1000
6/6 [==============================] - 0s 1ms/step - loss: 4191.9380
```

```
Epoch 862/1000
6/6 [==============================] - 0s 1ms/step - loss: 4017.0115
Epoch 863/1000
6/6 [==============================] - 0s 1ms/step - loss: 4338.2134
Epoch 864/1000
6/6 [==============================] - 0s 997us/step - loss: 4165.9482
Epoch 865/1000
6/6 [==============================] - 0s 1ms/step - loss: 4288.9517
Epoch 866/1000
6/6 [==============================] - 0s 1ms/step - loss: 5346.4932
Epoch 867/1000
6/6 [==============================] - 0s 1ms/step - loss: 5302.3892
Epoch 868/1000
6/6 [==============================] - 0s 1ms/step - loss: 4043.3682
Epoch 869/1000
6/6 [==============================] - 0s 1ms/step - loss: 4150.2920
Epoch 870/1000
6/6 [==============================] - 0s 1ms/step - loss: 4398.5107
Epoch 871/1000
6/6 [==============================] - 0s 1ms/step - loss: 5056.9316
Epoch 872/1000
6/6 [==============================] - 0s 1ms/step - loss: 9509.7822
Epoch 873/1000
6/6 [==============================] - 0s 997us/step - loss: 6484.1196
Epoch 874/1000
6/6 [==============================] - 0s 1ms/step - loss: 5225.3037
Epoch 875/1000
6/6 [==============================] - 0s 1ms/step - loss: 6415.3979
Epoch 876/1000
6/6 [==============================] - 0s 997us/step - loss: 5391.2856
Epoch 877/1000
6/6 [==============================] - 0s 1ms/step - loss: 5440.8369
Epoch 878/1000
6/6 [==============================] - 0s 831us/step - loss: 4051.1118
Epoch 879/1000
6/6 [==============================] - 0s 1ms/step - loss: 4424.7788
Epoch 880/1000
6/6 [==============================] - 0s 1ms/step - loss: 4174.9849
Epoch 881/1000
6/6 [==============================] - 0s 997us/step - loss: 3961.1870
Epoch 882/1000
6/6 [==============================] - 0s 1ms/step - loss: 4231.8042
Epoch 883/1000
6/6 [==============================] - 0s 997us/step - loss: 3939.9834
Epoch 884/1000
6/6 [==============================] - 0s 1ms/step - loss: 4487.2339
Epoch 885/1000
6/6 [==============================] - 0s 1ms/step - loss: 6776.1494
```

```
Epoch 886/1000
6/6 [==============================] - 0s 1ms/step - loss: 7623.6948
Epoch 887/1000
6/6 [==============================] - 0s 1ms/step - loss: 8828.3252
Epoch 888/1000
6/6 [==============================] - 0s 997us/step - loss: 7391.4971
Epoch 889/1000
6/6 [==============================] - 0s 997us/step - loss: 5556.2544
Epoch 890/1000
6/6 [==============================] - 0s 1ms/step - loss: 4266.0850
Epoch 891/1000
6/6 [==============================] - 0s 1ms/step - loss: 4578.7339
Epoch 892/1000
6/6 [==============================] - 0s 1ms/step - loss: 4730.8564
Epoch 893/1000
6/6 [==============================] - 0s 1ms/step - loss: 4030.5740
Epoch 894/1000
6/6 [==============================] - 0s 1ms/step - loss: 4469.2915
Epoch 895/1000
6/6 [==============================] - 0s 1ms/step - loss: 5141.6846
Epoch 896/1000
6/6 [==============================] - 0s 997us/step - loss: 5757.2051
Epoch 897/1000
6/6 [==============================] - 0s 1ms/step - loss: 4767.6782
Epoch 898/1000
6/6 [==============================] - 0s 1ms/step - loss: 3921.6245
Epoch 899/1000
6/6 [==============================] - 0s 1ms/step - loss: 4397.2031
Epoch 900/1000
6/6 [==============================] - 0s 1ms/step - loss: 4883.3389
Epoch 901/1000
6/6 [==============================] - 0s 1ms/step - loss: 4197.3149
Epoch 902/1000
6/6 [==============================] - 0s 1ms/step - loss: 4252.0190
Epoch 903/1000
6/6 [==============================] - 0s 1ms/step - loss: 3966.1772
Epoch 904/1000
6/6 [==============================] - 0s 1ms/step - loss: 4177.2437
Epoch 905/1000
6/6 [==============================] - 0s 1ms/step - loss: 4000.7993
Epoch 906/1000
6/6 [==============================] - 0s 997us/step - loss: 4739.2695
Epoch 907/1000
6/6 [==============================] - 0s 1ms/step - loss: 4461.6904
Epoch 908/1000
6/6 [==============================] - 0s 1ms/step - loss: 4044.1470
Epoch 909/1000
6/6 [==============================] - 0s 1ms/step - loss: 3943.0125
```

```
Epoch 910/1000
6/6 [==============================] - 0s 1ms/step - loss: 5530.7002
Epoch 911/1000
6/6 [==============================] - 0s 1ms/step - loss: 5445.9688
Epoch 912/1000
6/6 [==============================] - 0s 1ms/step - loss: 5814.0537
Epoch 913/1000
6/6 [==============================] - 0s 1ms/step - loss: 6839.5298
Epoch 914/1000
6/6 [==============================] - 0s 1ms/step - loss: 5893.9434
Epoch 915/1000
6/6 [==============================] - 0s 1ms/step - loss: 6079.9419
Epoch 916/1000
6/6 [==============================] - 0s 1ms/step - loss: 4138.8022
Epoch 917/1000
6/6 [==============================] - 0s 997us/step - loss: 4960.8555
Epoch 918/1000
6/6 [==============================] - ETA: 0s - loss: 11303.019 - 0s 1ms/step -
loss: 7841.9067
Epoch 919/1000
6/6 [==============================] - 0s 1ms/step - loss: 6337.3770
Epoch 920/1000
6/6 [==============================] - 0s 1ms/step - loss: 4501.6372
Epoch 921/1000
6/6 [==============================] - 0s 1ms/step - loss: 5010.3721
Epoch 922/1000
6/6 [==============================] - 0s 1ms/step - loss: 4327.9209
Epoch 923/1000
6/6 [==============================] - 0s 1ms/step - loss: 4189.9009
Epoch 924/1000
6/6 [==============================] - 0s 1ms/step - loss: 4011.8206
Epoch 925/1000
6/6 [==============================] - 0s 1ms/step - loss: 4565.1255
Epoch 926/1000
6/6 [==============================] - 0s 997us/step - loss: 4921.9351
Epoch 927/1000
6/6 [==============================] - 0s 1ms/step - loss: 4279.0869
Epoch 928/1000
6/6 [==============================] - 0s 1ms/step - loss: 6589.0312
Epoch 929/1000
6/6 [==============================] - 0s 1ms/step - loss: 6277.1040
Epoch 930/1000
6/6 [==============================] - 0s 1ms/step - loss: 7769.2979
Epoch 931/1000
6/6 [==============================] - 0s 1ms/step - loss: 5280.3242
Epoch 932/1000
6/6 [==============================] - 0s 1ms/step - loss: 4156.8398
Epoch 933/1000
```

```
6/6 [==============================] - 0s 1ms/step - loss: 4576.3530
Epoch 934/1000
6/6 [==============================] - 0s 1ms/step - loss: 4537.8804
Epoch 935/1000
6/6 [==============================] - 0s 1ms/step - loss: 4239.7769
Epoch 936/1000
6/6 [==============================] - 0s 1ms/step - loss: 4280.1963
Epoch 937/1000
6/6 [==============================] - 0s 1ms/step - loss: 4633.7607
Epoch 938/1000
6/6 [==============================] - 0s 1ms/step - loss: 4612.5010
Epoch 939/1000
6/6 [==============================] - 0s 1ms/step - loss: 4469.4043
Epoch 940/1000
6/6 [==============================] - 0s 1ms/step - loss: 4832.6353
Epoch 941/1000
6/6 [==============================] - 0s 1ms/step - loss: 4739.8413
Epoch 942/1000
6/6 [==============================] - 0s 1ms/step - loss: 5016.9678
Epoch 943/1000
6/6 [==============================] - 0s 1ms/step - loss: 4548.0220
Epoch 944/1000
6/6 [==============================] - 0s 1ms/step - loss: 7044.5767
Epoch 945/1000
6/6 [==============================] - 0s 1ms/step - loss: 4329.9844
Epoch 946/1000
6/6 [==============================] - 0s 1ms/step - loss: 3919.6667
Epoch 947/1000
6/6 [==============================] - 0s 1ms/step - loss: 4337.5195
Epoch 948/1000
6/6 [==============================] - 0s 1ms/step - loss: 4107.6035
Epoch 949/1000
6/6 [==============================] - 0s 1ms/step - loss: 4579.7456
Epoch 950/1000
6/6 [==============================] - 0s 1ms/step - loss: 4999.4072
Epoch 951/1000
6/6 [==============================] - 0s 997us/step - loss: 4132.0376
Epoch 952/1000
6/6 [==============================] - 0s 1ms/step - loss: 9238.9404
Epoch 953/1000
6/6 [==============================] - 0s 1ms/step - loss: 6997.3491
Epoch 954/1000
6/6 [==============================] - 0s 1ms/step - loss: 7776.0850
Epoch 955/1000
6/6 [==============================] - 0s 1ms/step - loss: 7772.9795
Epoch 956/1000
6/6 [==============================] - 0s 1ms/step - loss: 7113.3311
Epoch 957/1000
```

```
6/6 [==============================] - 0s 1ms/step - loss: 4303.5869
Epoch 958/1000
6/6 [==============================] - 0s 1ms/step - loss: 5631.0825
Epoch 959/1000
6/6 [==============================] - 0s 2ms/step - loss: 6748.0649
Epoch 960/1000
6/6 [==============================] - 0s 1ms/step - loss: 4687.3828
Epoch 961/1000
6/6 [==============================] - 0s 2ms/step - loss: 4206.9585
Epoch 962/1000
6/6 [==============================] - 0s 1ms/step - loss: 4002.3069
Epoch 963/1000
6/6 [==============================] - 0s 1ms/step - loss: 4833.5312
Epoch 964/1000
6/6 [==============================] - 0s 1ms/step - loss: 3797.7795
Epoch 965/1000
6/6 [==============================] - 0s 1ms/step - loss: 3790.0825
Epoch 966/1000
6/6 [==============================] - 0s 1ms/step - loss: 5192.3149
Epoch 967/1000
6/6 [==============================] - 0s 1ms/step - loss: 3890.4924
Epoch 968/1000
6/6 [==============================] - 0s 1ms/step - loss: 3847.0867
Epoch 969/1000
6/6 [==============================] - 0s 1ms/step - loss: 4687.7559
Epoch 970/1000
6/6 [==============================] - 0s 1ms/step - loss: 4499.1289
Epoch 971/1000
6/6 [==============================] - 0s 1ms/step - loss: 5978.2305
Epoch 972/1000
6/6 [==============================] - 0s 1ms/step - loss: 5319.4248
Epoch 973/1000
6/6 [==============================] - 0s 1ms/step - loss: 4750.1660
Epoch 974/1000
6/6 [==============================] - 0s 1ms/step - loss: 3966.2183
Epoch 975/1000
6/6 [==============================] - 0s 1ms/step - loss: 4606.7139
Epoch 976/1000
6/6 [==============================] - 0s 1ms/step - loss: 5989.9199
Epoch 977/1000
6/6 [==============================] - 0s 1ms/step - loss: 4251.1748
Epoch 978/1000
6/6 [==============================] - 0s 1ms/step - loss: 5039.9160
Epoch 979/1000
6/6 [==============================] - 0s 1ms/step - loss: 4506.6602
Epoch 980/1000
6/6 [==============================] - 0s 1ms/step - loss: 4775.5586
Epoch 981/1000
```

```
6/6 [==============================] - 0s 1ms/step - loss: 4505.6733
Epoch 982/1000
6/6 [==============================] - 0s 1ms/step - loss: 3898.7292
Epoch 983/1000
6/6 [==============================] - 0s 1ms/step - loss: 4346.6978
Epoch 984/1000
6/6 [==============================] - 0s 1ms/step - loss: 3849.0095
Epoch 985/1000
6/6 [==============================] - 0s 1ms/step - loss: 4330.3037
Epoch 986/1000
6/6 [==============================] - 0s 1ms/step - loss: 3815.9814
Epoch 987/1000
6/6 [==============================] - 0s 1ms/step - loss: 4015.6760
Epoch 988/1000
6/6 [==============================] - 0s 1ms/step - loss: 3853.8250
Epoch 989/1000
6/6 [==============================] - 0s 1ms/step - loss: 3786.4023
Epoch 990/1000
6/6 [==============================] - 0s 1ms/step - loss: 3701.3455
Epoch 991/1000
6/6 [==============================] - 0s 997us/step - loss: 3671.5850
Epoch 992/1000
6/6 [==============================] - 0s 1ms/step - loss: 3752.2451
Epoch 993/1000
6/6 [==============================] - 0s 1ms/step - loss: 3770.3982
Epoch 994/1000
6/6 [==============================] - 0s 1ms/step - loss: 3736.6614
Epoch 995/1000
6/6 [==============================] - 0s 1ms/step - loss: 4179.5352
Epoch 996/1000
6/6 [==============================] - 0s 1ms/step - loss: 3686.4458
Epoch 997/1000
6/6 [==============================] - 0s 1ms/step - loss: 3645.4326
Epoch 998/1000
6/6 [==============================] - 0s 997us/step - loss: 3952.5950
Epoch 999/1000
6/6 [==============================] - 0s 1ms/step - loss: 4207.4307
Epoch 1000/1000
6/6 [==============================] - 0s 1ms/step - loss: 5199.3423
```

[131]: `<tensorflow.python.keras.callbacks.History at 0x1aa30bdfbb0>`

sns.lineplot(x=range(len(loss)),y=loss) plt.title("Training Loss per Epoch");

6 Compare final evaluation (MSE) on training set and test set

[134]:
```
#test_predictions
```

[135]:
```
from sklearn.metrics import␣
↪mean_squared_error,mean_absolute_error,explained_variance_score
```

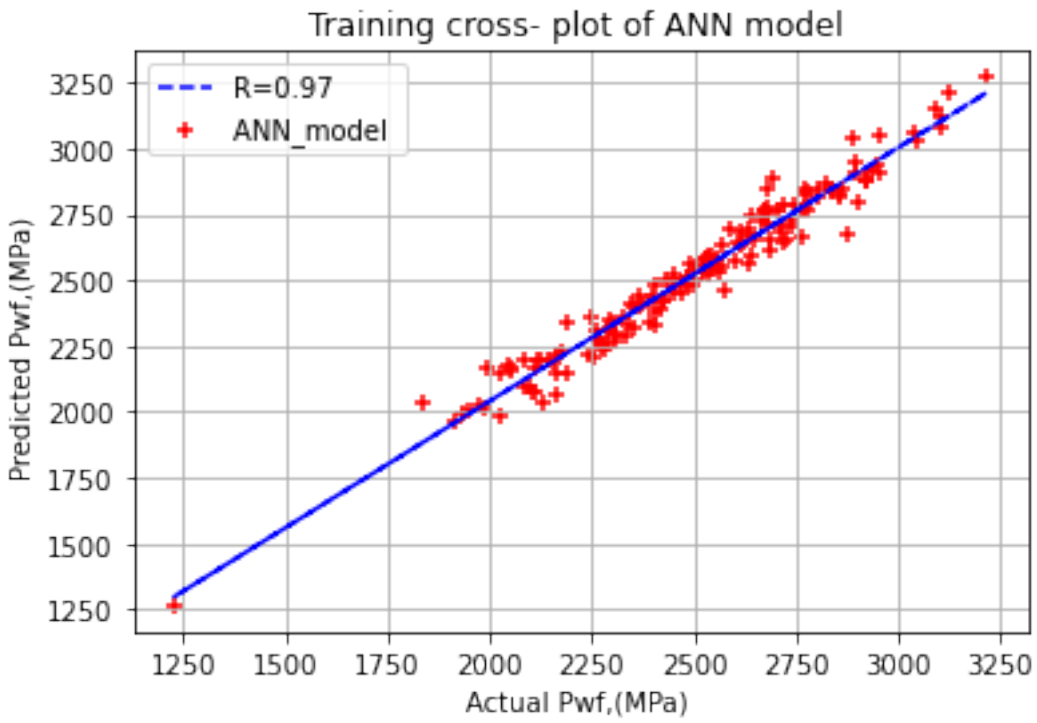
[136]:
```
predictions_test = model.predict(X_test)
```

[137]:
```
predictions_train = model.predict(X_train)
```

[138]:
```
# Create a scatterplot of the real test values versus the predicted values.
RFtest=plt.
↪scatter(y_train,predictions_train,color='red',marker='+',label='ANN_model ')

plt.xlabel(('Actual Pwf,(MPa) '))
plt.ylabel(('Predicted Pwf,(MPa) '))
R = r2_score(y_train, predictions_train)
plt.title('Training cross- plot of ANN model ')


plt.grid()
print(R)
m, b = np.polyfit(y_train, predictions_train, 1)
plt.plot(y_train, m*y_train+b,linestyle='--',c='blue',label='R=0.97')
plt.legend()
#plt.savefig('ANN-test')
```

```
0.9561095299937702
```

[138]:
```
<matplotlib.legend.Legend at 0x1aa2d276df0>
```

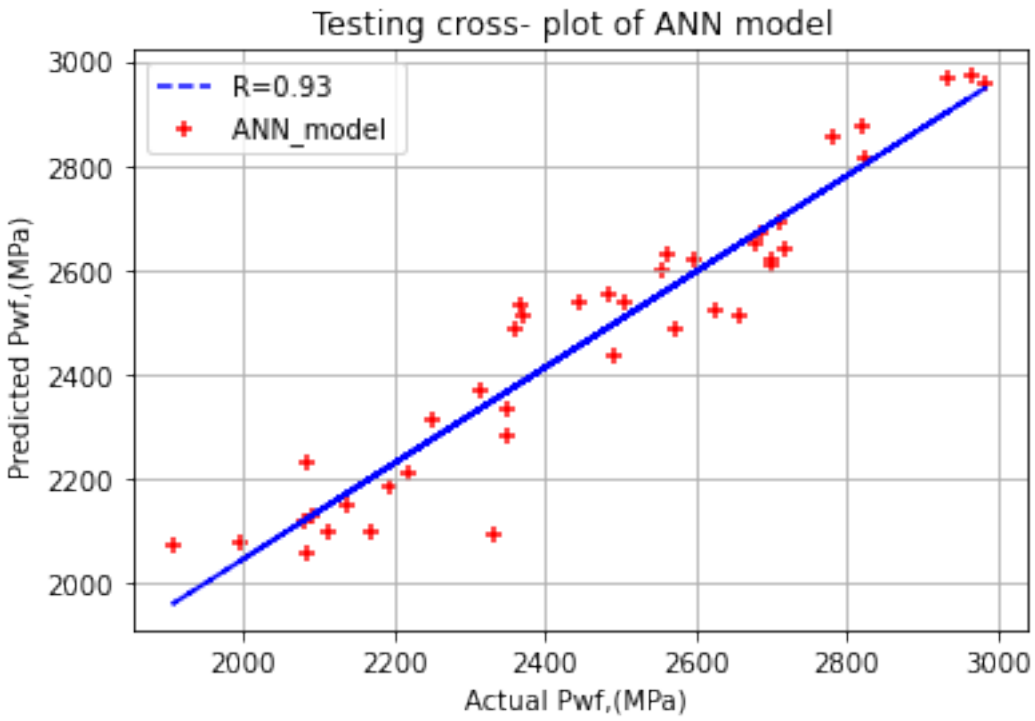


[160]:
```
predictions_test=pd.DataFrame(predictions_test)
predictions_train=pd.DataFrame(predictions_train)
test=pd.DataFrame(y_test)
train=pd.DataFrame(y_train)
```

[161]:
```
# Create a scatterplot of the real test values versus the predicted values.
RFtest=plt.
 ↪scatter(y_test,predictions_test,color='red',marker='+',label='ANN_model ')

plt.xlabel(('Actual Pwf,(MPa) '))
plt.ylabel(('Predicted Pwf,(MPa) '))
R = r2_score(y_test, predictions_test)
plt.title('Testing cross- plot of ANN model ')


plt.grid()
print(R)
m, b = np.polyfit(y_test, predictions_test, 1)
plt.plot(y_test, m*y_test+b,linestyle='--',c='blue',label='R=0.93')
plt.legend()
#plt.savefig('ANN-test')
```

```
0.9080054721196551
```

[161]: <matplotlib.legend.Legend at 0x1aa2eff8af0>



[162]:
```
from sklearn import metrics

print('MAE:', metrics.mean_absolute_error(y_test, predictions_test))

print('MSE:', metrics.mean_squared_error(y_test, predictions_test))
print('RMSE:', np.sqrt(metrics.mean_squared_error(y_test, predictions_test)))
y_test.mean()
```

```
MAE: 66.71120545922255
MSE: 7275.450008222243
RMSE: 85.29624850028425
```

[162]: 2456.9756097560976

[167]:
```
print('MAE:', metrics.mean_absolute_error(y_train, predictions_train))
print('MSE:', metrics.mean_squared_error(y_train, predictions_train))
print('RMSE:', np.sqrt(metrics.mean_squared_error(y_train, predictions_train)))
MAPE=np.mean((train - predictions_train) /train ) * 100
MAPE
```

```
MAE: 49.859710878314395
MSE: 4102.350726502411
RMSE: 64.04959583402858
```

[167]:
```
0           NaN
Pwf(psia)   NaN
dtype: float64
```

[44]:
```
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn.neighbors import KNeighborsRegressor
from sklearn.svm import SVC
```

[45]:
```
from sklearn.model_selection import GridSearchCV



k_range = list(range(1,40))
weight_options = ["uniform", "distance"]

param_grid = dict(n_neighbors = k_range, weights = weight_options)


knn = KNeighborsRegressor()

grid = GridSearchCV(knn, param_grid, cv = 10)
grid.fit(X,y)

print (grid.best_params_)
```

```
{'n_neighbors': 6, 'weights': 'distance'}
```

[ ]:
```

```

[46]:
```
 #first, initialize the classificators
#tree = DecisionTreeRegressor( splitter = 'random', max_leaf_nodes = 10,␣
 ↪min_samples_leaf = 5, max_depth= 5)
tree= DecisionTreeRegressor(random_state=24) # using the random state for␣
 ↪reproducibility
forest= RandomForestRegressor(random_state=48)
knn= KNeighborsRegressor(6,weights ="distance")
svm= SVC(random_state=24)
```

[59]:
```
models= [tree, forest, knn]
from sklearn import metrics
from sklearn.metrics import accuracy_score
from sklearn.metrics import r2_score
for model in models:
    model.fit(X_train, y_train) # fit the model
    y_pred= model.predict(X_test)# then predict on the test set
    y_pred_t=model.predict(X_train)
    MAE=metrics.mean_absolute_error(y_train, y_pred_t)
```

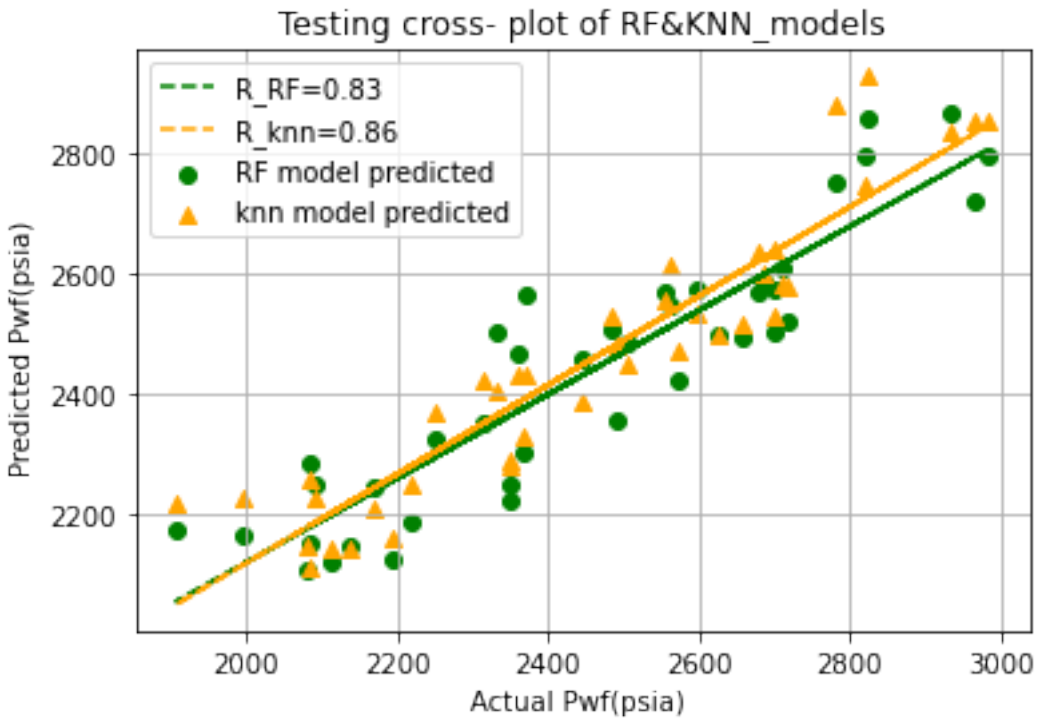
```
    MSE= metrics.mean_squared_error(y_test, y_pred)
    MAPE=np.mean(np.abs((y_train - y_pred_t) /y_train )) * 100
    R = r2_score(y_test, y_pred)
    RMSE= np.sqrt(metrics.mean_squared_error(y_test, y_pred))
    print(f"The MAE of model {type(model).__name__} is {MAE:.2f}")
    print(f"The MSE of model {type(model).__name__} is {MSE:.2f}")
    print(f"The RMSE of model {type(model).__name__} is {RMSE:.2f}")
    print(f"The MAPE of model {type(model).__name__} is {MAPE:.2f}")
    print(f"The R of model {type(model).__name__} is {R:.2f}")
    print("\n")
```

```
The MAE of model DecisionTreeRegressor is 0.00
The MSE of model DecisionTreeRegressor is 20260.34
The RMSE of model DecisionTreeRegressor is 142.34
The MAPE of model DecisionTreeRegressor is 0.00
The R of model DecisionTreeRegressor is 0.74


The MAE of model RandomForestRegressor is 39.43
The MSE of model RandomForestRegressor is 14893.91
The RMSE of model RandomForestRegressor is 122.04
The MAPE of model RandomForestRegressor is 1.69
The R of model RandomForestRegressor is 0.81


The MAE of model KNeighborsRegressor is 0.00
The MSE of model KNeighborsRegressor is 11307.00
The RMSE of model KNeighborsRegressor is 106.33
The MAPE of model KNeighborsRegressor is 0.00
The R of model KNeighborsRegressor is 0.86
```

[55]:
```
models= [tree, forest, knn]
from sklearn import metrics
from sklearn.metrics import r2_score
tree=tree.fit(X_train, y_train)
forest=forest.fit(X_train, y_train)
knn=knn.fit(X_train, y_train)
y_pred_DT= tree.predict(X_test)
y_pred_F= forest.predict(X_test)
y_pred_knn= knn.predict(X_test)
#plt.scatter(y_test,y_pred_DT,color='red',marker='*',label="DT model predicted")
plt.scatter(y_test,y_pred_F,color='green',marker='o',label="RF model predicted")
plt.scatter(y_test,y_pred_knn,color='orange',marker='^',label="knn model␣
 ↪predicted")
R = r2_score(y_test,y_pred_DT )
```

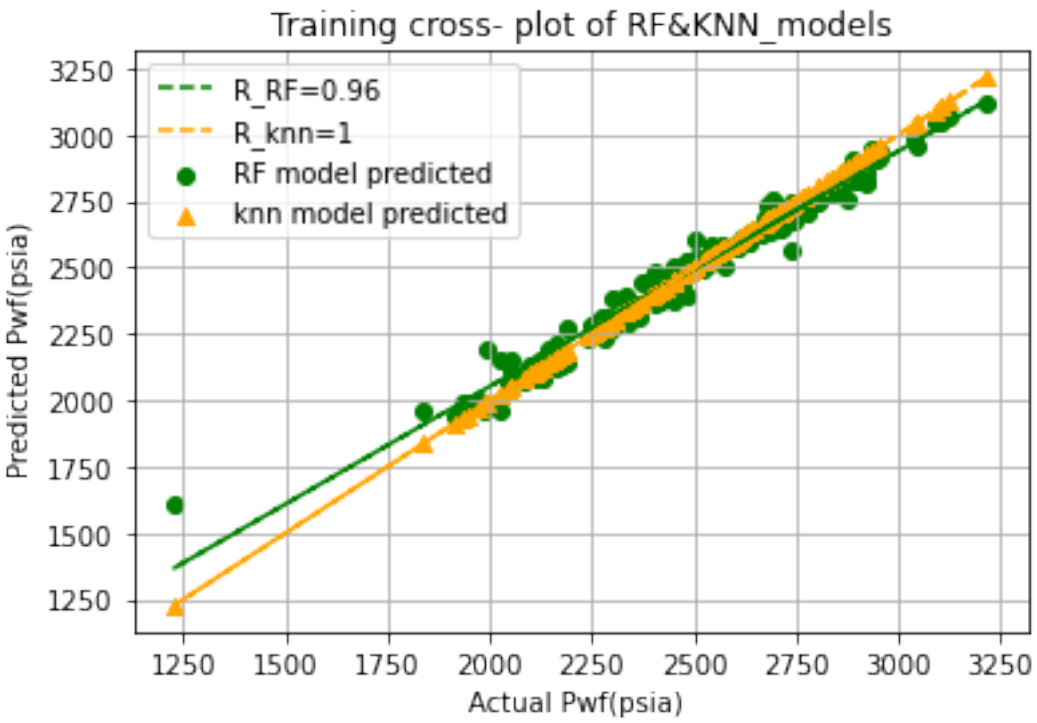
```
R2 = r2_score(y_test,y_pred_F )
R3 = r2_score(y_test,y_pred_knn )
plt.xlabel(('Actual Pwf(psia) '))
plt.ylabel(('Predicted Pwf(psia) '))

print(R)
print(R2)
print(R3)
m, b = np.polyfit(y_test, y_pred_DT, 1)
m2, b2 = np.polyfit(y_test, y_pred_F, 1)
m3, b3 = np.polyfit(y_test, y_pred_knn, 1)
#plt.plot(y_test, m*y_test+b,linestyle='--',c='red',label="R_DT=0.74")
plt.plot(y_test, m2*y_test+b2,linestyle='--',c='green',label="R_RF=0.83")
plt.plot(y_test, m3*y_test+b3,linestyle='--',c='orange',label="R_knn=0.86")
#plt.plot(y_test, m*y_test+b,linestyle='--',c='red',label="R_DT=0.74")
plt.legend()
plt.title('Testing cross- plot of RF&KNN_models')
plt.grid()
#plt.savefig('Machine-test')
```

```
0.7438178331903849
0.8116737438852756
0.8570285039387008
```



[49]:
```
models= [tree, forest, knn]
from sklearn import metrics
from sklearn.metrics import r2_score
tree_m=tree.fit(X_train, y_train)
forest_m=forest.fit(X_train, y_train)
knn_m=knn.fit(X_train, y_train)
y_pred_DT= tree_m.predict(X_train)
y_pred_F= forest_m.predict(X_train)
y_pred_knn= knn_m.predict(X_train)
#plt.scatter(y_test,y_pred_DT,color='red',marker='*',label="DT model predicted")
plt.scatter(y_train,y_pred_F,color='green',marker='o',label="RF model␣
 ↪predicted")
plt.scatter(y_train,y_pred_knn,color='orange',marker='^',label="knn model␣
 ↪predicted")
R = r2_score(y_train,y_pred_DT )
R2 = r2_score(y_train,y_pred_F )
R3 = r2_score(y_train,y_pred_knn )
plt.xlabel(('Actual Pwf(psia) '))
plt.ylabel(('Predicted Pwf(psia) '))
print(R)
print(R2)
print(R3)
m, b = np.polyfit(y_train, y_pred_DT, 1)
m2, b2 = np.polyfit(y_train, y_pred_F, 1)
m3, b3 = np.polyfit(y_train, y_pred_knn, 1)
#plt.plot(y_test, m*y_test+b,linestyle='--',c='red',label="R_DT=0.74")
plt.plot(y_train, m2*y_train+b2,linestyle='--',c='green',label="R_RF=0.96")
plt.plot(y_train, m3*y_train+b3,linestyle='--',c='orange',label="R_knn=1")
plt.legend()
plt.title('Training cross- plot of RF&KNN_models')
plt.grid()
#plt.savefig('machine_train')
```

```
1.0
0.9642425846470991
1.0
```


Training cross- plot of RF&KNN_models
R_RF=0.96
R_knn=1
RF model predicted
knn model predicted
Predicted Pwf(psia)
Actual Pwf(psia)
3250
3000
2750
2500
2250
2000
1750
1500
1250
1250
1500
1750
2000
2250
2500
2750
3000
3250

[ ]: